Basic Emergency Shelter

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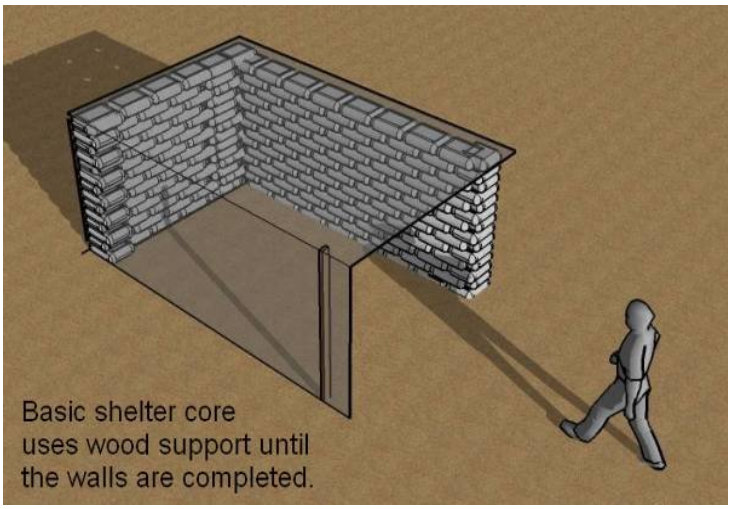
Many times tarps alone do not provide sufficient shelter for humanitarian relief operations, while tents may not be available or cost effective. What is often needed is a simple family shelter solution that is easy to transport and erect, less expensive than tents and uses standard materials that are globally available.

The building concept outlined here consists of sandbag (earthbag) walls filled with sand or soil from the site, and tarps for roofing. These emergency shelters would only be slightly more expensive than tarps by themselves, but provide superior protection against wind, rain, heat, cold, snow, bullets, fire, flooding, hurricanes and noise.



Above: Even partial height walls can provide shelter.

(Note: the terms sandbags and earthbags are used interchangeably to describe polypropylene or burlap bags filled with sand, soil, gravel or other material.)

Benefits of Earthbag Shelters:

Properly designed and constructed earthbag structures meet Shelter Standards: www.sheltercentre.org/library/Shelter+Standards

Economic Benefits:

- **Extremely low cost** (only slightly more than tarps alone)
- **Reduced inventories** and shorter shipping distances: earthbags are standard materials that are readily available almost anywhere in the world and can be purchased as needed regionally

Left: Standard bales of sandbags.

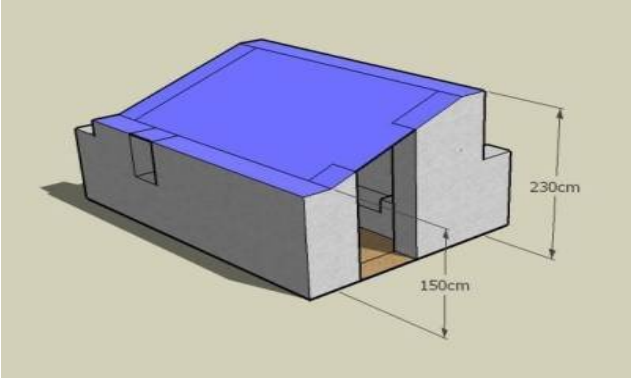
- **No special tools required**, although shovels would greatly speed construction (shovels could be reused for building other shelters, fire pits, etc.)
- **Adaptable to local materials** such as different tarp materials or dimensions

Emergency Response Benefits:

- **Ease of transport**: earthbags are light, compact and can be shipped by the pallet load
- **Highly scalable solution**: large numbers of shelter units could be shipped on little or no advanced notice, since sandbags are typically stockpiled for emergencies by suppliers accustomed to delivering large orders
- **Ease and speed of assembly**: two recipients could construct a basic shelter core of two walls in about two days by following one page of visual instructions
- **Individual shelters** can be incrementally improved and completed over time

Health Benefits:

- **Lower stress levels** due to enhanced security and improved privacy
- **Greatly enhanced comfort** and protection against the elements because of insulation value and thermal mass of earth, and options for roof and floor construction

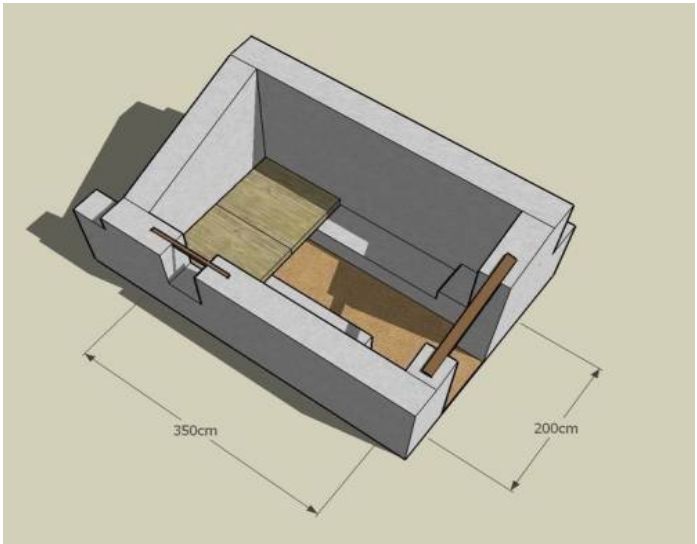


Above: Tarp roofs on gable walls drain well.

- **Adaptable layout configurations** to fit local climatic conditions and site
- **Less overheating** than tents with occupation throughout the day

Social Benefits:

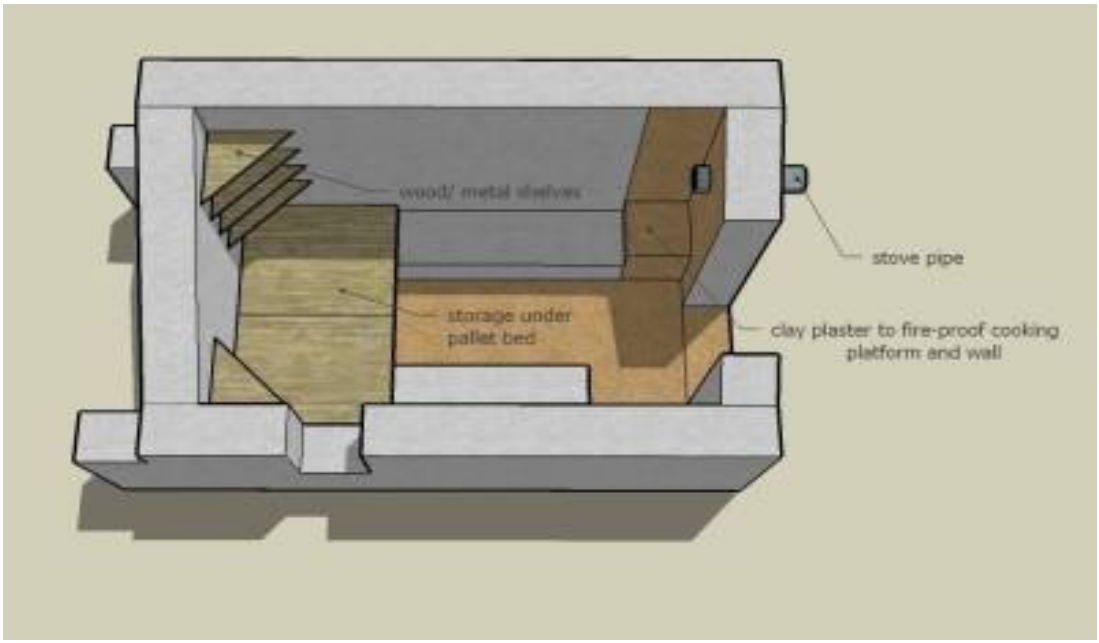
- **Dignified living space** : Each basic unit of 2 m by 3- 3.5 m is highly adaptable and repairable



- **Unskilled** women, men, children and the elderly can participate in the construction process and help determine their own living areas
- **Sturdier than tents** so is more easily accepted by affected communities
- **Recipients can modify** the design, including add space to it, based on family size and cultural requirements for privacy
- **Separate units** can each have their own tarp roof but share walls for ease of construction

- Above: A unit with sleeping platforms.

- **Storage** can be easily incorporated into shelters with scrap pieces of wood, bamboo, or metal inserted between bags across corners to provide shelving



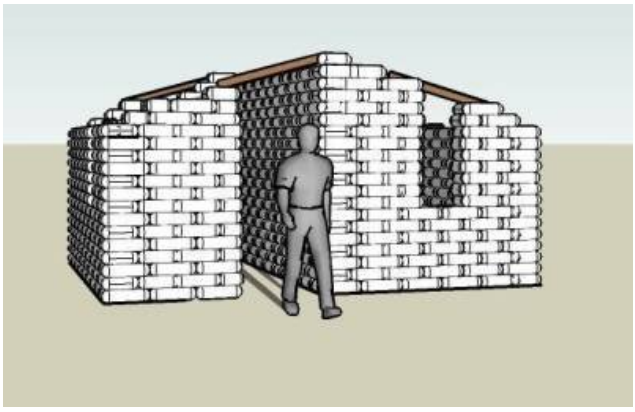
Above: Basic unit with storage and cooking area.

Transitional Benefits:

- **More durable than tents** : UV protected earthbags last for 1-2 years; covered with mud, earthbags can last for many years
- **Can become permanent** shelter if desired as part of a transitional shelter strategy (unlike tents that cannot)
- **Other structures** can be built of the same building system: staff quarters, administrative facilities, clinics, kitchens, social spaces, storage sheds, sanitation facilities, schools, play areas, etc., all with the same benefits as the shelters
- **Can be dismantled** and the materials reused

Environmental Benefits

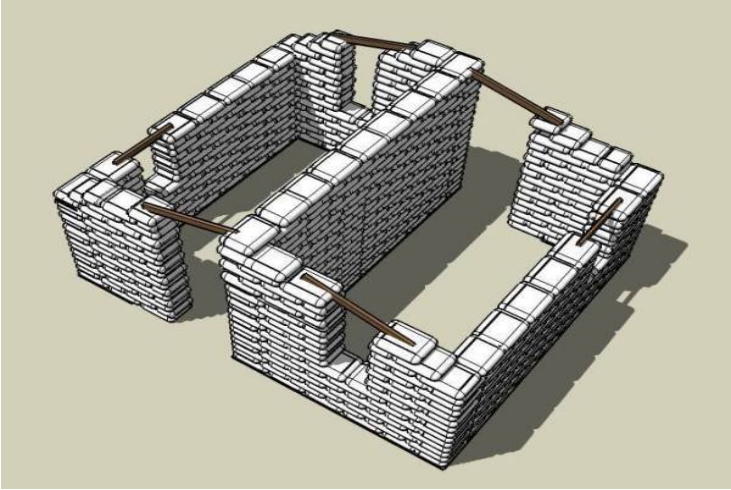
- **Minimizes impact** on local resources (minimal use of wood saves cutting of trees)
- **Allows use of debris** generated by shelter users including grain or food bags and shipping pallets



Above: Doubled units with doors on opposite ends have some privacy.

Shelter Flexibility:

Flexibility of design is a key aspect of building with earthbags. For example, the same materials (earthbags and tarps) can be used for hot and cold climates. Locations and sizes of window and door openings can be adjusted for lighting, ventilation and security. Wall heights can be easily adjusted for climate (higher walls for hot climates, lower walls for cold climates), along with layout and overall shelter sizes. Large families could occupy two or more shelters. Extended families could be grouped in adjoining units. Salvaged materials (wood poles, doors, windows, curtains, pallets) could be safely utilized to extend shelters that have a structurally sound core.

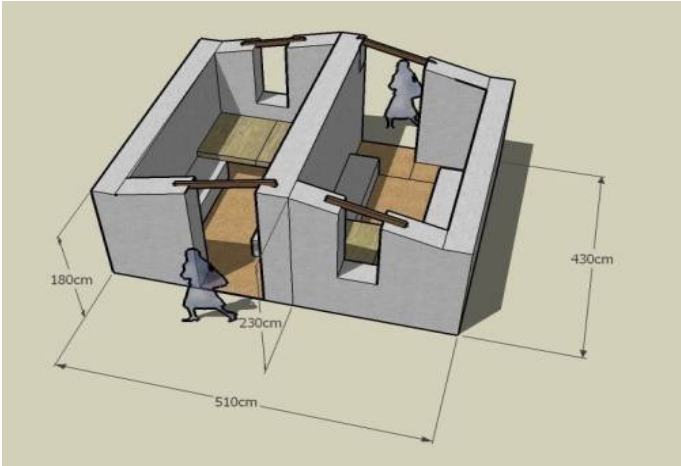


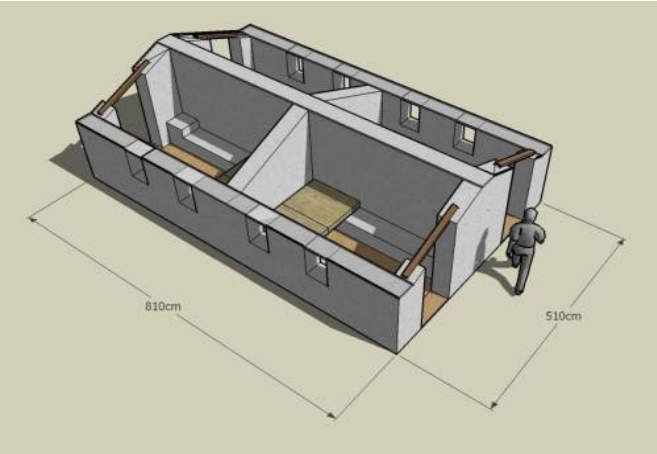
Above: Adjoining shelters require less work per unit.

Earthbag shelters can be joined together into buildings of culturally acceptable shapes. Sloping walls allow headroom for standing with some lower ceilings above sleeping platforms.

Right: Double units can allow cross-ventilation in humid tropical and subtropical regions.

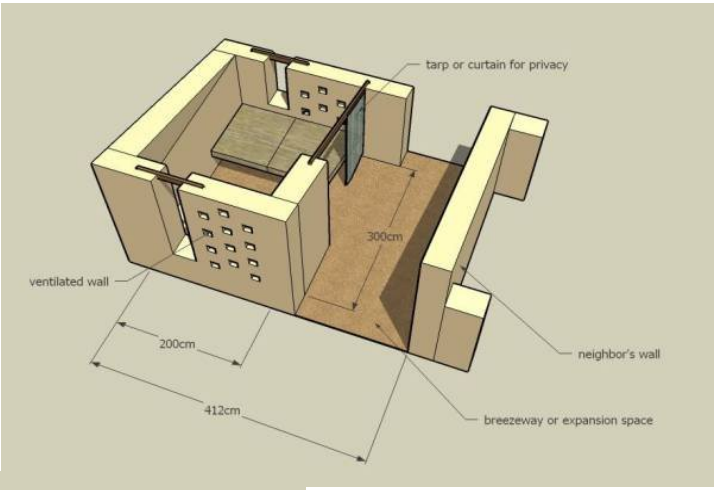
Below: Clusters of four units with less ventilation may be more appropriate for dry tropical or temperate regions.

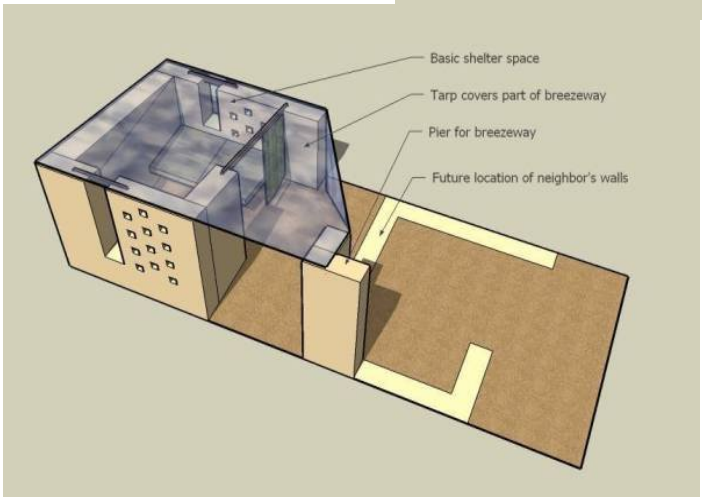




Building with earthbags also lends itself to participatory design, which typically leads to dwellings that better reflect cultural preferences as to appropriate layouts, orientation, cooking preferences, and enhanced privacy and protection for women and children.

Units with more cross-ventilation may be appropriate in warm areas with very heavy rainfall. Bags can be arranged for some screen-type openings. Shed roofs can more efficiently separate entrances from stormwater runoff.





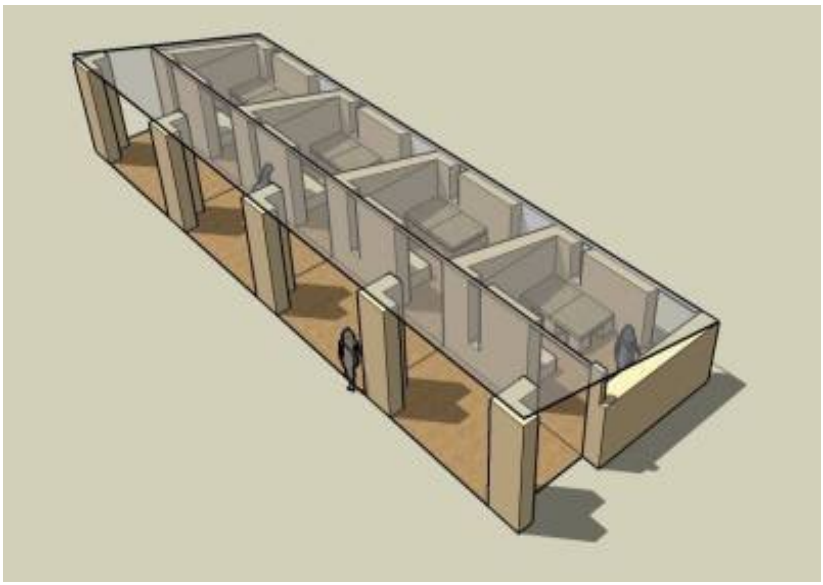
Above: Ventilated units.

Left: Breezeways can provide additional covered space, even before neighboring units are complete.

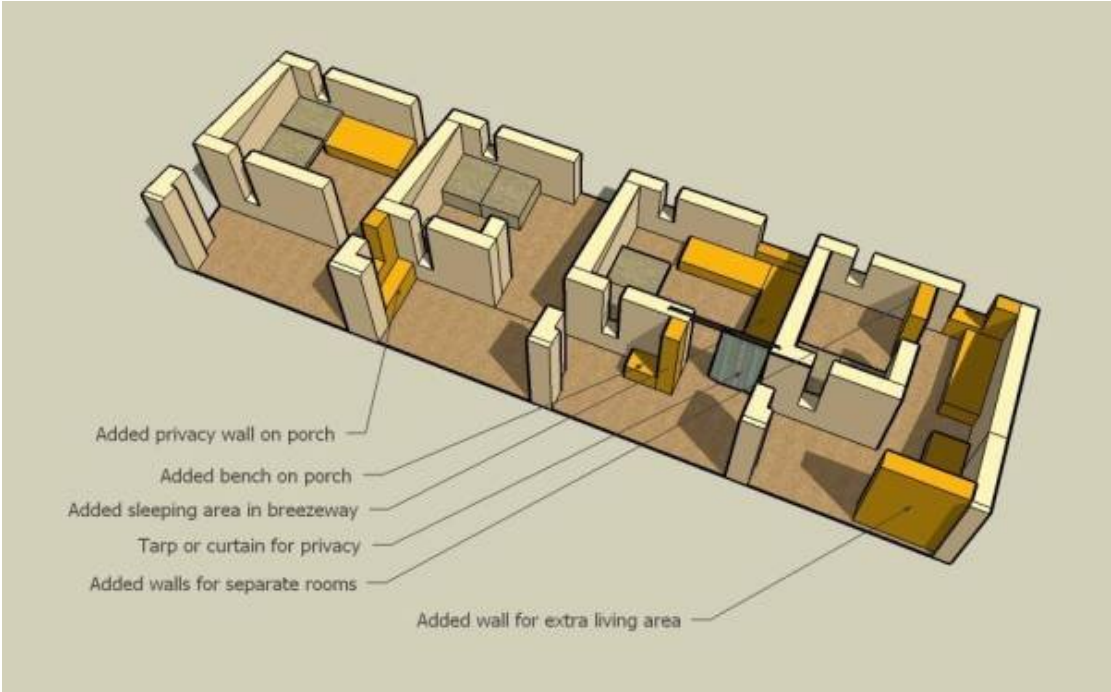
Transitional Shelter Possibilities:

Emergency earthbag shelters could be incrementally upgraded to make permanent shelters. For example, four shelter units grouped together could initially serve as emergency shelter for four families, but be later upgraded to one permanent home with each living space greater than 3.5 sq. meters. (This meets Sphere Transitional Shelter Standards that call for 3.5 sq. meters per occupant for long-term habitation.)

Right: Linear groups of shelter units and breezeways.



Tents rapidly depreciate in value and in a disaster/survival situation have a lifespan of about 1-2 years. It is more efficient and cost effective to invest upfront in earthbag shelters that are then improved as part of a transitional shelter strategy.



Above: Shelters customized over time.

Shelter Options:

- **Earthquake- or tsunami-resistant** design is possible
- **Additional shading**/ shelter from precipitation can be added with wood poles to support tarps in front of shelter
- **Greater insulation:** Roofs with insulation between 2 tarps (grass, straw, leaves, bags of rice hulls, etc.); Floors: layers of straw, grass, etc. covered with a tarp, or volcanic gravel such as scoria or pumice covered with earth; Walls: insulation material can be packed around walls and held in place with wattle and daub, scrap wood or metal, or extra tarps as available.
- **More durable roofing** can be supported with roof poles or rafters of wood, bamboo or pipe
- **Rope, twine or cord** can facilitate attaching tarps and poles, although earthbags could hold tarps in place
- **Enhanced fire resistance** can be provided by earth plaster on exposed bags
- **UV protective coatings** are available for added cost
- **Different types of stoves** can be accommodated inside or outside the shelter

Features to Enhance Livability:

- **Sunken floors** in dry climates help moderate temperature extremes
- **Pallet benches or beds** resting on earthbag ledges will allow storage below
- **Wider earthbag benches** can be created with larger bag sizes or added loose soil
- **Simple shelves** or niches can be built into walls

- **Tamped earth floor** reduces dust: made by digging down to mineral soil, moistening slightly and tamping repeatedly
- **Curtains** can seal off sleeping areas
- **Mosquito nets** can be easily fastened to walls to hang at door and window openings as needed

Barriers to Earthbag Shelter Use:

- Initial lack of familiarity of building with earthbags may be present, although untrained volunteers readily take to using earthbags in emergency flood control
- Hard or frozen soil will limit use of earthbags unless there is a mechanical means of providing sand or loose soil using tractors, excavators and/or trucks
- Shelter Standards require pre-packaging of individual shelters, along with necessary tools, instructions and repair kits. Although pre-packaged earthbag shelters are not yet available, this requirement could be met by NGOs, sandbag suppliers or other entities unless aid agencies agree to simply dispense earthbags and tarps on an as need basis. For example, aid staff could distribute one 500-count bundle of sandbags (a quantity commonly available from suppliers) and one tarp to each family, and then share a shovel with other families

Emergency earthbag shelters do not need to meet the same standards as permanent earthbag houses that typically use barbed wire, reinforced bond beams, etc. Simplifying the design offers significant cost reductions as well as reduced labor and speed of construction. Earthbags alone form stable walls when built in short segments that include corners.

We welcome any feedback to improve these preliminary designs and suggestions for how to utilize them for humanitarian relief projects.

The Authors

Owen Geiger and Patti Stouter are both available for consultation, shelter design and training.

Dr. Owen Geiger: Ph.D. in Social and Economic Development, engineer and author, is the former Director of Builders Without Borders and current Director of Geiger Research Institute of Sustainable Building, www.grisb.org, is devoted to finding solutions to the world's housing problems through sustainable building. We believe the answer lies in education - helping others help themselves. He is co-author of www.EarthbagBuilding.com.

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Bibliography

Earthbag Building website, www.earthbagbuilding.com

Geiger Research Institute of Sustainable Building, www.grisb.org