Humanitarian Engineering:  
Transitional Refugee Shelter
Mountaintop Pilot Project: Summer 2013
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Our Solution:
Earthbag construction uses abundantly available soil as the main structural material

The Problem:
To develop housing for under-resourced parts of the world

Our Objective:
To develop a transitional shelter for refugees that can be simply built using local materials

Key Design Points:
- Simple construction process
- Relatively inexpensive
- Reduced impact on host environment
- Easily acquired materials
- Use of local materials
- Sturdy structure
- Personalizable design
- Security
- Modular potential

Earthbag Wall: Construction Process

Test #1, Wall #1 (7/8 - 7/9)
Purpose: Determine how to create an earthbag wall
Results:
- Process is labor intensive
- Earthbag sizes inconsistent
- Difficult to create high walls without scaffolding
- Process goes faster with more workers
Questions Generated:
- How do you reduce amount of labor per home?
- How do you connect walls?
- Ideal soil amount to fill bags?

Test #2, Wall #2 (7/15)
Purpose: Determine the stability of a single-row stacking pattern and how to construct corners
Results:
- “Single” row steps are stable
- Slope = 23°/53” = 0.434
- Height does not increase fast enough to stay within limited footprint
- Corner is very stable
Questions Generated:
- How do you increase slope of steps?

Test #3, Wall #3 (7/17)
Purpose: Determine the stability of a double-row stacking pattern and the resulting corner
Results:
- “Double” row steps are stable
- Slope = 31°/33” = 0.94
- Height does increase fast enough to stay within limited footprint
- Corner is less stable than single-row stacking
- Bags can be carried up earthbag steps
Questions Generated:
- What overall design best implements this technique?

Test #4, Wall #4 (7/18)
Purpose: Determine a method of allowing light through the earthbag wall
Results:
- Unsuccessful
- Plastic bottles deformed easily
- Limited light allowed through
- Bottles not easily secured through wall
- Staggering method didn’t work with bottles
Questions Generated:
- How do you allow adequate light to enter the structure?

Possible Future Direction:
- Determine more possible building iterations
- Discuss feasibility of project with NGO’s and camp administrators
- Design and test different roofing structures
- Put together simple step-by-step construction pamphlet
- Design and implement rainwater collection system
- Design a socially conscientious site plan for the refugee camp
- Test how to apply a protective earthen plaster

Supplementary Wall Transition Test (7/25)
Purpose: Determine how to attach other structural material to earthbag wall
Materials:
- Branches
- Bags
Results:
- Natural bond beam required for top two rows of earth bags

Supplementary Shear Test (7/23)
Purpose: Determine lateral stability of top bags
Parameter 1:
- 20 ‘tamps’ spread over 2 bags
Results:
- Less than 0.5” movement
Parameter 2:
- 20 ‘tamps’ spread over 1 bag
Results:
- 23” lateral movement

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