Affordable Solutions to Pit Latrine Collapse

Affordable Sanitation Team

Rachel Aukamp

Background

The issue of open defecation has become a universal problem in sanitation. Although pit latrines provide a low-cost remedy in rural areas such as Northern Ghana, their performance proves unpredictable in conditions of soil collapse.

Definition of the Problem:

- Sandy soil collapses when saturated if the pit is not lined
- People are deterred from using pit latrines because they are afraid the hole will collapse
- Because people are afraid of the latrines, they resort to open defecation which leads to health hazards

Project Objective

The objective of the Affordable Sanitation team is to develop a liner that will be resistant to the forces of the soil and the structure above as well as affordable to local people. The team has been allotted 150 GHC for this project, or approximately 40 USD.

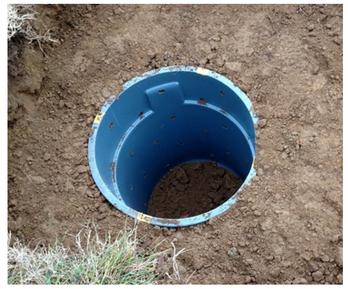
Sand Bag Liner

This image shows the sand bag liner constructed of small sandbags prior to a permeability test.

The decision has been made to accept this liner design as a potential solution.

Plastic Tub Liner

This image shows the plastic tub liner in the ground. Holes drilled in liner are to ensure permeability of the liner.



The decision has been made to discontinue development of this liner as it does not meet the necessary criteria.

Solution

Four liner designs were evaluated based on the criteria outlined in the table below. This table served as a guide and reference for the team when considering and testing each liner design.

Liner Design	Requirements (5 points)			Perceived Criteria (3 Points)				Preferred Qualities (1 point)					Rating**
	Inexpensive	Locally Available Materials	Resistant to Soil Pressures	Accommodates Slab and Superstructure	Permeability	Quality of Materials/Longevity	Environmentally Friendly	Minimal Exposure to Waste	Removability	Ease of Fabrication/Assembly	Ease of Installation	Familiarity to materials	
Rebar Reinforced	✓	✓	✓*	?	✓*	✓*	✓	✓	X	✓	✓	✓	28
Sand Bags	✓	✓*	✓	✓	✓	✓*	?	✓	X	✓	X	✓	27
Ferro-cement	✓*	✓	?	?	✓*	✓	✓	✓	X	✓*	✓*	✓	23
Plastic Tub	X	X	?	✓*	X*	✓	?	✓	X	✓	✓	X	9

✓ Meets Criterion X Does Not Meet Criterion ? Unknown

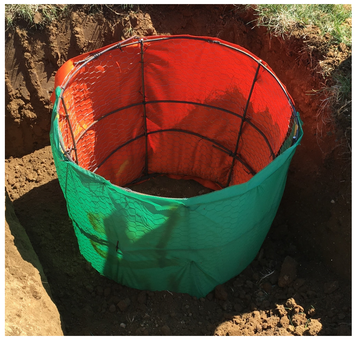
Ferro-Cement

Mold Application Method

Direct Application Method

A decision has not yet been made on this liner. The team is in the process of conducting research and tests to determine the status of the liner.

Rebar-Reinforced Fabric Liner



This rebar-reinforced fabric liner was constructed in 2016. The team is currently in the process of modifying this design to reduce its cost.

A decision has not yet been made on this liner. The team is in the process of conducting research and tests to determine the status of the liner.

2016 Site Visit

In the summer of 2016, the Affordable Sanitation team travelled to Ghana to implement a rebar-reinforced liner design. The adjacent picture was taken eight months after the liner was implemented, showing that the liner has withstood soil pressures, even during the rainy season when the soil was completely saturated.

Future Work

- Make decisions on the Ferro-Cement and Rebar-Reinforced Liners
- Finalize development of liner designs which meet the criteria
- Prepare for a site team trip to Ghana in January of 2018
- Travel to Ghana and implement potential liner designs

Partner and Funding

World Vision

World Vision is a Christian humanitarian organization dedicated to helping children, families, and their communities worldwide reach their full potential by tackling the causes of poverty and injustice. The team's primary contact with World Vision is Mr. Bismark Norgbe.

Acknowledgements

Project Manager: Dr. Tesfa Yacob, tyacob@messiah.edu

MVP Panelists: Dr. Michelle Lockwood, Dr. Thomas Soerens, Mr. Bob Hentz, Mr. Murray Fisher, Mr. Doug Flemmens, Mr. Dereck Plante

Additional Project Team Members: Kenton Grossnickle, Duane Troyer, Sydney Schandel, Connor McGovern, Adam Barley, Isaac Underhill, Cheylee Smith

Messiah College

Department of Engineering

the Collaboratory for strategic partnerships and applied research