

Latrine lining and sanitation options in unstable ground

Summary

The emphasis of this technical brief is to present a range of options and examples on how to address or mitigate problems of collapsible formations using locally available skills and materials. The initial intention of the Emergency Sanitation Project was to identify or develop deployable kit for latrine liners, however further consultation with field engineers and humanitarian suppliers confirmed there was a low demand for imported liners – partly due to their high cost and partly because local solutions are available. Important in determining what is appropriate for the local context is to ensure local knowledge is utilised particularly related to behaviour of ground conditions and consultation takes place with local stakeholders and beneficiaries, particularly women to understand cultural, age and gender preferences which will influence which solutions are appropriate.

Introduction

Lining of pit latrines is necessary in unstable ground to keep workers safe during construction, beneficiaries safe during use and to enable emptying and re-use of latrines. However the need to line pits significantly increases the cost and time to building latrines.

In general, the top 0.5m of a pit should always be lined. The decision whether to line the rest of the pit will depend on the type of soil. When a pit is first excavated it may appear stable and it might not be possible to predict what will happen in the longer term. Soils with high clay content can change their stability as soil moisture content changes. Seeking out local knowledge and observing stability of existing excavations, e.g. presence of open wells, are good starting points and indicators to determine whether lining is needed. **If in doubt, pits should be lined.**

Soils that require lining	Soils that don't require lining
Soft sands and gravels	Soils with significant clay content
Unconsolidated soils	Most consolidated sedimentary rocks
Filled land	Laterite soils

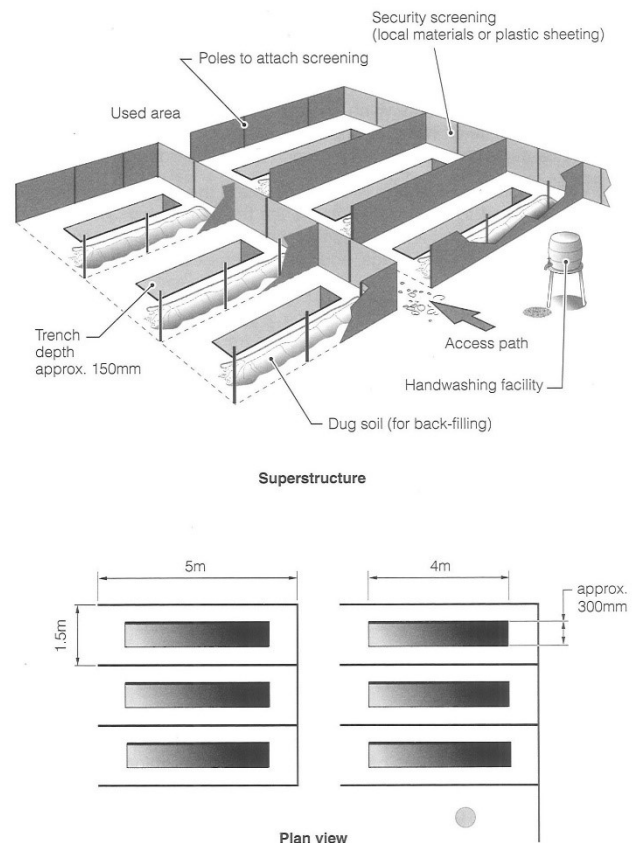
Compressed mudstones and shales

During excavation - Health and Safety of workers is of paramount and immediate concern. Where excavations are less than 1.5 metres depth it should be possible to fully excavate and then line from the base.

Risks can be reduced and costs minimised by reducing the depth of excavation and therefore lining. However the implications of pits filling quickly need to be considered including the cost and availability of equipment to desludge latrines once full. As an alternative to digging and lining a deep pit other options are available and these are discussed also here.

Lining Trench Latrines

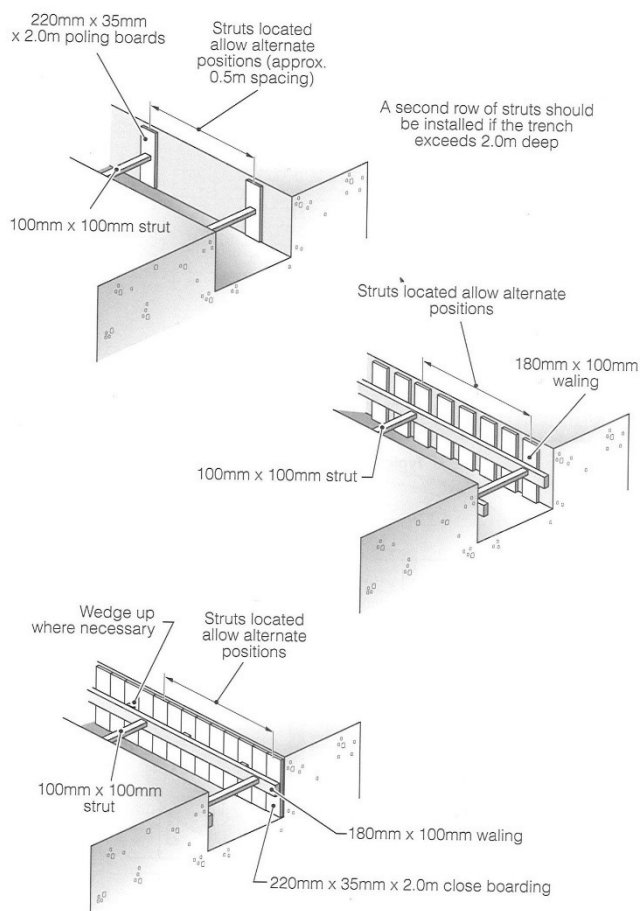
Trench latrines are commonly constructed to meet first phase emergency sanitation needs. As a short term solution, shallow trenches – 20-30cm wide and 15cm deep, provide a rapid solution, avoid the need for lining. These provide a rapid solution but afford users limited privacy, have a very short lifespan and require considerable space.



Where there are sufficient tools, materials and human resources available, deep trench latrines

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provide a longer lasting solution. Commonly used pit lining materials include timber, concrete blocks, bricks, stone, mud blocks or corrugated iron sheets. Pit lining is most cost effective where pits are to be emptied regularly. In circumstances where it is not planned to rapidly transition to household latrines and it may be necessary to de-sludge and re-use trench latrines, lining pits in formations that are not prone to collapse may also be necessary to protect the pit and avoid having to rebuild totally new latrines. The following sketch illustrates timber support systems. Depending on available materials plastic sheeting and/or iron sheets can combine or reduce the need for timber struts.



(taken from *Excreta Disposal in Emergencies* (2007))

Several options for latrine lining have been documented by the [South Sudan WASH Cluster*](#) in 2014 where collapsible formations and expandable black cotton soils present particular challenges to digging and stable pits.

Commercially available liners



Oxfam tested out a number of liners within the scope of the Emergency Sanitation Project (Dunster House, Oxford Plastics, Evenproducts). No perfect solution was found and all liners were prone to warping dependant on the amount and location of bracing usedⁱ. Further discussions with suppliers confirmed some reluctance to invest resources in development of commercial liners as there is no perceived market. Cost and shipment time are both prohibitive factors discouraging use of commercial liners. The cost of a single [Evenproducts liner*](#) as illustrated (dimensions 150x100x63cm) is \$70. The cost of liner for a 3m x 1m x 3 m deep pit suitable for a 4 cubicle latrine is \$700 (without considering shipping & clearance costs).

Improvised liners for single pit

Circular pits are naturally more stable than square or rectangular pits and for single pits these should be considered. This alone may reduce the need for a liner. The compromise of a circular pit (used with a rectangular slab) is that the volume of the pit will be smaller so unless dug deeper, it will fill quicker. Common lining materials include: local stone, burnt bricks, concrete culverts, soil/cement blocks, timber, corrugated iron sheet, oil drums.

Thin liners such as oils drums, CGI sheet, and bamboo/cane are not strong enough to take the weight of a floor slab or superstructure and therefore require strengthening at the top by a ring beam.

Typically, liners require a foundation to stop them sinking into the ground below. In firm soils a simple pad foundation is sufficient. In softer formations, it may be necessary to lay a foundation of stones on the base of the excavation. If only partially lining a pit, leave a step in the pit wall on which to build the foundation. The attached [link*](#) provides instructions for constructing a ferro-cement liner and ring beam using meshwire*. In Dadaab Kenya Oxfam sourced a

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local supplier to crimp corrugated iron sheets as the most cost effective means of scaling up shared household latrines rapidly.

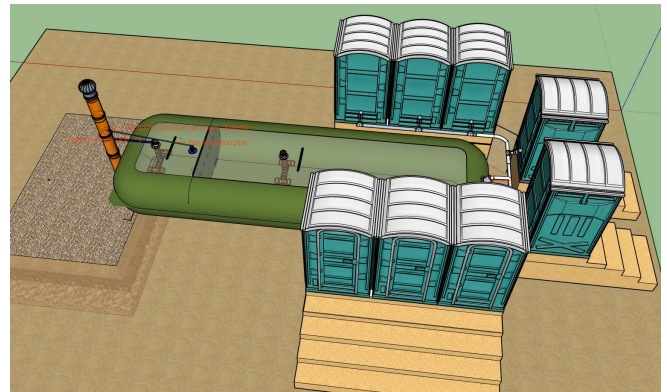


Sand bags are a simple technique to line a pit. Considerations to be aware of i) sand bags take up a large volume themselves so a large diameter excavation is required, ii) food sacks can easily rip and do perish with time which can undermine the strength of the liner. This can be overcome by mixing cement with the sand fill to make a weak dry mortar mix. A step by step guide on construction of a sandbag liner is included [here*](#).

Alternative toilet technologies

In areas of loose soil or unstable ground the cost involved and skills required to build a pit latrine may make it preferable to look for an alternative toilet solution than does not require underground excavations at all. Factors to weigh up include analysis of longer term maintenance and replacement costs as well as short term upfront costs, acceptability - confirmed through community consultation and required minimum/likely lifespan.

Septic tank: Oxfam in partnership with BORDA has developed a septic tank kit. Each one is capable of handling waste from upto 500 people with retention of 3-6 months between exhausting.



The anticipated cost of the septic tank once commercialised is \$2,000.

Raised Latrines –



The cost of a double cubicle raised latrine is £450 and supplied through the [Oxfam procurement centre](#) in multiples of 6. Each twin latrine has a holding tank of 2m³.

Urine diversion dry toilets – (UDDTs) have been successfully trialed and scaled in Ethiopia and expanded into multiple responses.



They are proven as cost effective in the transition towards household latrines and as a result of Oxfam's work, UNHCR now endorse UDDTs as a

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preferred solution in areas of difficult ground conditions. The longevity of UDDTs and ease of emptying more than offsets the higher initial capital costs (see [UDDT SOPs](#)). Oxfam is in the process of developing emergency UDDT kit which will enable urine diversion toilets to be deployed in the earlier stages of an emergency. A plastic insert (prototype below) transforms a standard (Nagmagic/Dunster) keyhole squatplate into a urine diversion toilet. Oxfam has also produced a mould to facilitate production of high quality concrete UD squatting slabs. The intention is that both items will become available through the Oxfam Supply Centre.

Tiger worm toilets – contain composting worms that live inside the toilet vault to digest faeces, reducing the accumulation rate and significantly extending the lifetime of the toilet. The toilet vault or collection chamber is shallow or can be above ground negating the need for excavating in unstable ground. Tiger worms are sensitive to their environment so are not suited to all contexts ([see SOPs](#)).

Container based sanitation (CBS) – currently considered as a niche product, operating on a small scale in densely populated urban areas (SOIL, Sanergy, X-runner, LooWatt, Sanivation).

Not widely used in humanitarian response to date (small scale pilot in Kakuma, Kenya). Oxfam in partnership with Sanergy has produced a low cost household toilet which is being used within informal settlements in Nairobi. The biggest constraint for container based toilets is the servicing model required. These costs can be partly offset by “waste to value” initiatives which turn human waste into a commodity. The complexity of such a model and the

absence of full cost recovery models limits such an approach for a humanitarian context. The most basic form of containment that has been more widely used in emergency response is containment through bags, e.g. [“Pee-poo” type solutions](#).

Container based toilet designed by Oxfam &



Sanergy. Production planned for 2019

References

WEDC: Latrine pit excavation and lining (Guide 24) <https://wedc-knowledge.lboro.ac.uk/resources/booklets/G024-Latrine-pit-excavation-on-line.pdf>

[Excreta Disposal in Emergencies: A field Manual, Inter-Agency Publication, Peter Harvey, 2007.](#)