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Practical construction advice for developing countries

A permeable lining for seepage pits (pit latrines, soakaways and shallow wells)

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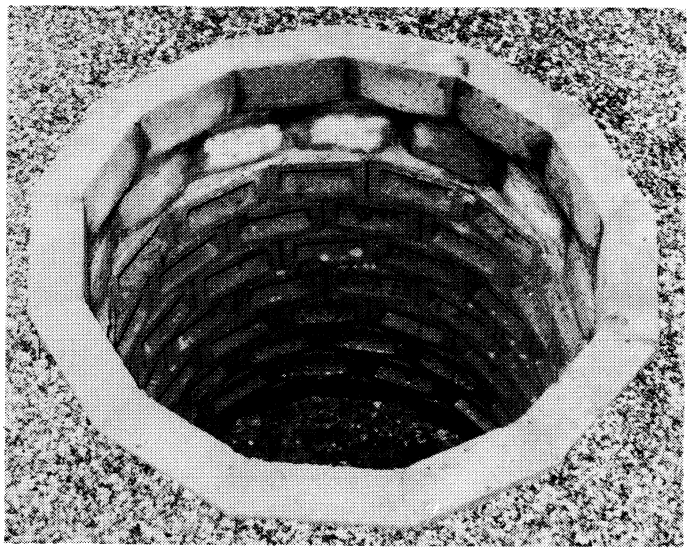
Lining of pit latrines is of growing interest in many developing countries where improved and permanent non-sewered sanitation is being installed. In particular, where mechanised emptying by powerful suction tanker is intended, an effective permeable lining is necessary to prevent ground erosion under the latrine and eventual collapse of the floor and superstructure.

In furthering latrine improvements the Building Research Establishment has developed a moulded concrete lining block which, although originally designed to line pit latrines, could also be used to line soakaways and shallow wells.



A lined percolating pit, using purpose-made concrete blocks.

INTRODUCTION

Collapse of pit latrines is not uncommon in housing areas where basic unlined pits are installed. Often a latrine has a toilet compartment (superstructure) built over an unlined pit. Ground subsidence, and hence superstructure collapse, can occur due to erosion caused by the rise and fall of groundwater or by the powerful suction action of periodic mechanised emptying.

An effective foundation for the latrine floor and superstructure can be provided by a pit lining that also allows seepage to the surrounding ground of water and liquids resulting from decomposition of excreta.

Materials commonly used for lining pit latrines and soakaways are fired clay bricks, concrete blocks, large stones or preformed concrete rings. 10 to 15 mm wide

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gaps in the lining, usually achieved by leaving vertical joints unfilled, or by the use of perforated blocks or rings, should be provided for seepage. The top 0.5 metre of a lining should be mortared in to form a ring beam on which the floor is located. Backfilling the excavation with gravel around a pit lining, can improve the seepage capacity of a soakage system installed in ground of low permeability, eg clayey loam soil. This provision can increase the pervious area available for the passage of liquids to the ground.

The BRE lining system is based on a purpose-made concrete lining block that is easy to make on site in a simple hand mould, is easy to install because the blocks are laid without mortar (except the top courses), is self-supporting because of the surrounding soil pressure, and is likely to be cheaper than systems using building blocks or naturally occurring stones that require mortar.

THE BRE LINING SYSTEM

A pit lining consists of:

- a course of blocks laid directly on an undisturbed but sound and level floor of a pit, without a separate foundation;
- successive courses of blocks, laid without mortar, each made up of 13 blocks laid end to end to form a circular course of 1 metre internal diameter (cover picture);
- a top 0.5 metre of lining using solid blocks mortared in to form a ring beam foundation for a floor or cover slab.

The blocks—

- are moulded in a simple turn over mould (Figure 3);
- are solid for the upper courses, but perforated for below (Figures 1 and 2), both having angled end faces;
- should have a compressive strength, at 28 days, of about 10 N/mm^2;
- are made from a concrete mix (by volume) of approximately
  1 part Portland cement
  8 parts aggregate (graded from 10 mm to sand);
  or, if sand only,
  1 part Portland cement
  6 parts clean sand

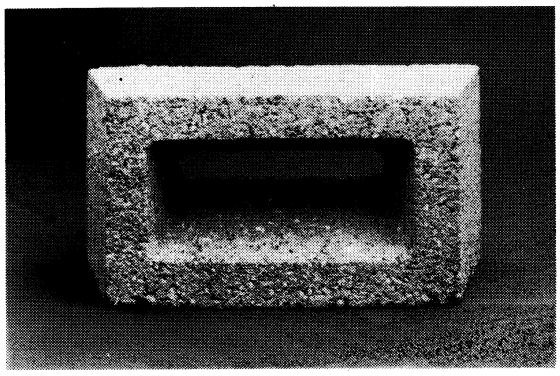


Figure 1 Concrete lining block

both mixes should use only sufficient water to allow a handful to be compressed and just stick together.
Experimentation is advisable with local materials, adjusting the cement content if necessary, to give blocks of adequate strength and durability.

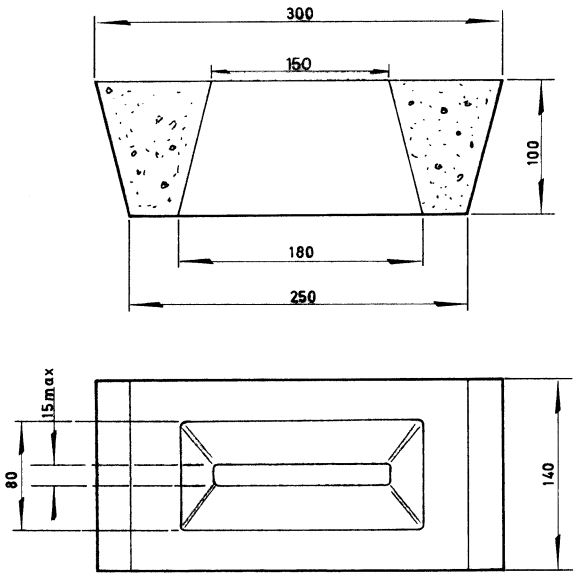


Figure 2 Block dimensions (mm)

BLOCK MOULD

The block mould is fabricated from 1 mm mild steel sheet; top edges beaded for stiffness; corners welded. Side stiffeners, of 25 x 25 mm angle, extend beyond the body and are welded to both the body and 20 mm diameter handles (Figure 3).

The core of the mould is either fabricated from 1 mm steel sheet or it can be an oiled hardwood block. If the core is detachable, ie secured by screws through the base of the body, the same mould may be used for both solid and perforated blocks. Alternatively, separate moulds could be used to make either form of block.

The loose top plate is 350 $\times$150 $\times$ 1 mm steel sheet, with 10 mm turned down lips on three sides.

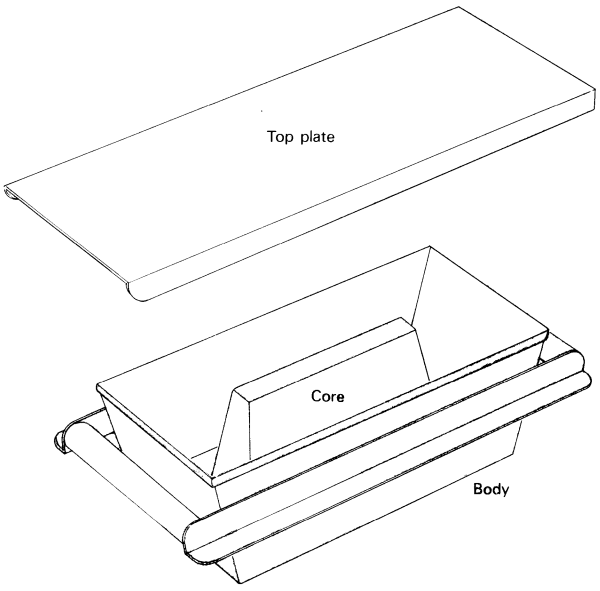
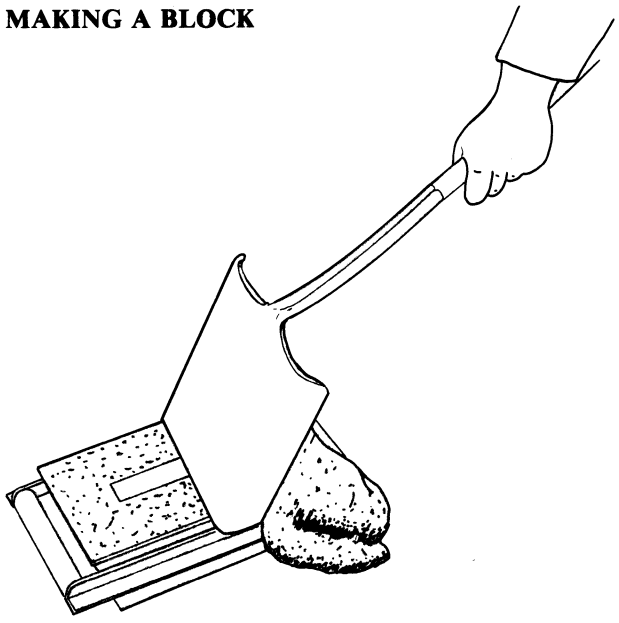
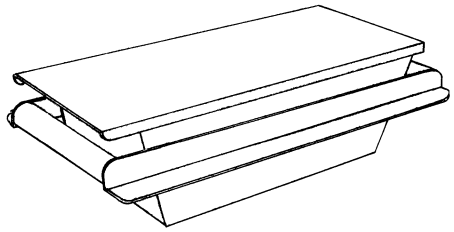


Figure 3 Steel turn-over mould

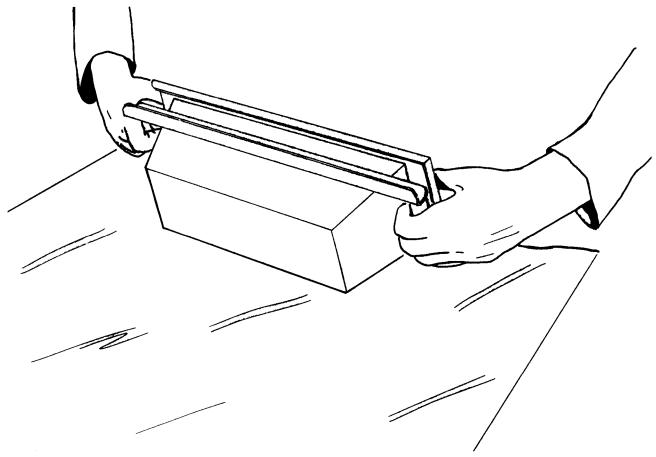
MAKING A BLOCK



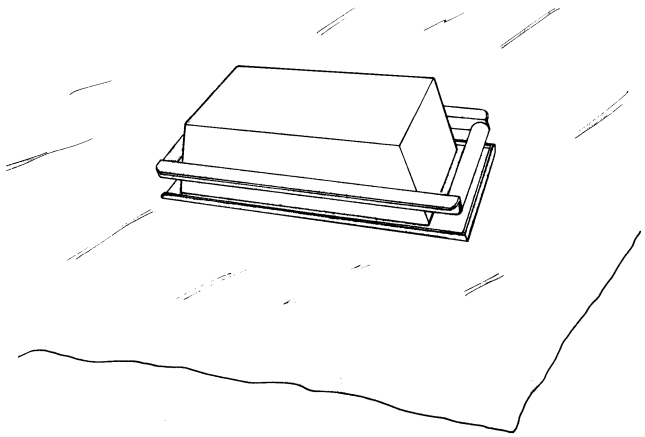
1 Fill mould with concrete, compact with back of shovel and finish level with top edges of mould 'Body'.



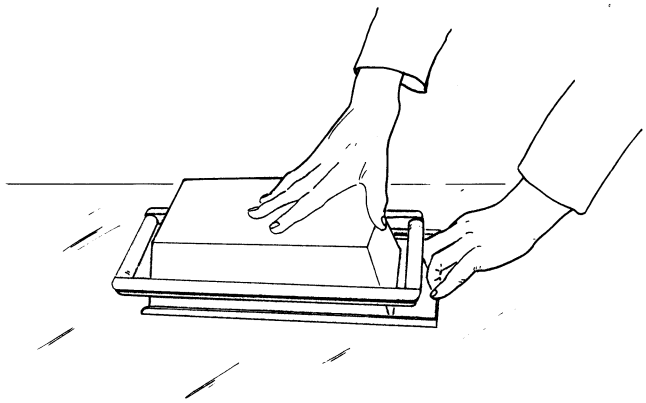
2 Place 'Top plate' in position over mould 'Body', side lips down.



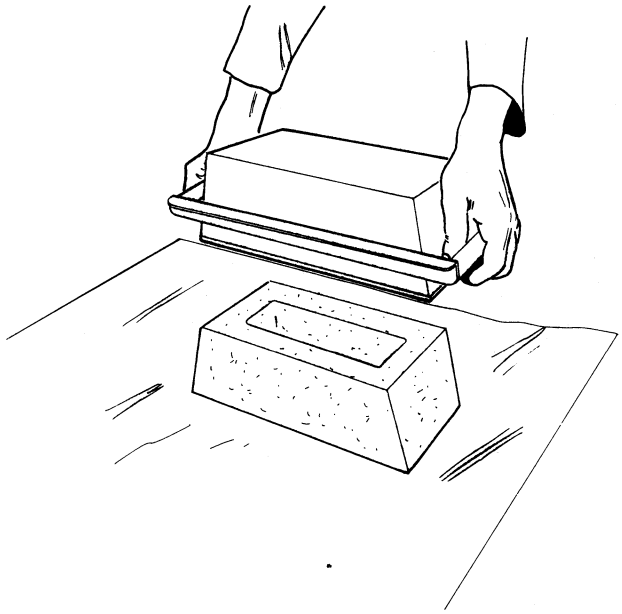
3 Lift up filled mould, holding 'Top plate' securely, and turn mould over.



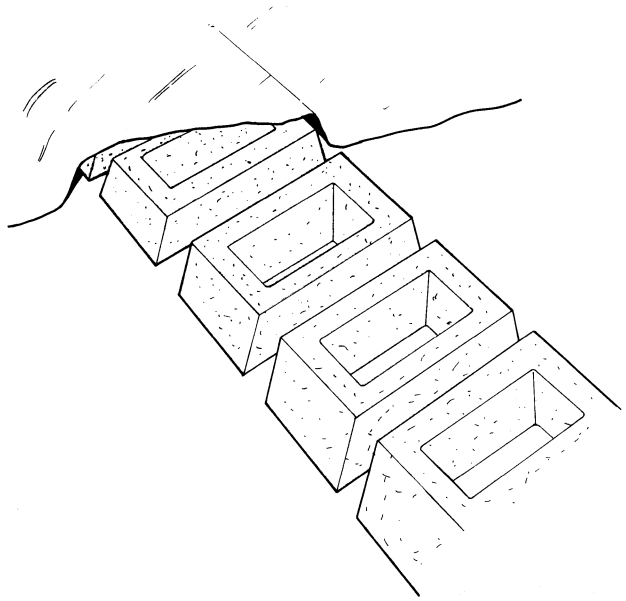
4 Placed filled mould upside down on a plastic sheet on flat ground. 'Top plate' will now be underneath.



5 Hold mould stationery with one hand and withdraw ' Top plate' from under 'Body', using end lip as finger hold.



6 Lift mould 'Body' vertically, clear of concrete block.



7 Blocks laid in rows, covered and kept damp. Leave to cure for at least seven days before handling.

APPLICATION OF THE LINING SYSTEM

This concrete block lining system is being installed in a large low-income housing scheme in northern Botswana. Further experience of the production and use of this type of block is sought by BRE Overseas Division, with information on costs relative to alternative local lining options for pit latrines and soakaways.

Another application of this type of block lining system is envisaged for lining shallow wells. Care is necessary with the design of well head and apron to protect the water source from contamination by well users and animals (see general information on well design and construction; Reference 5).

ACKNOWLEDGEMENTS

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ASSOCIATED READING AND REFERENCES

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5 **Watts S B and Wood W E.** Hand dug wells and their construction. Intermediate Technology Publications Limited, London 1976.

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