Single-skin, externally reinforced, brick tank

Instructions for manufacture

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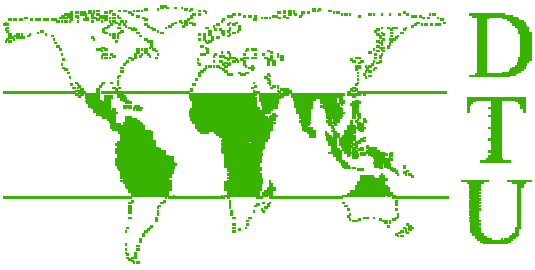

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Introduction
The single-skin, externally-reinforced brick tank is designed to minimise material input. The single-skin brick wall, normally having insufficient hoop strength to withstand the stresses imposed by the internal water pressure, is externally reinforced with packaging strap to give adequate hoop strength to the tank. This reduces the quantity of brick required to build such a tank, with brick only, by more than half. The capacity of the tank is approximately 6 cubic metres, with an internal diameter of 2.0m and a height of 2.0m.

These instructions are based on the procedures used to manufacture a tank at the Vipassana Meditation Centre in Herefordshire, UK, during the summer of 1999. Figure 1 shows the main components of the tank (the external render is not shown in order that the strapping and brickwork configuration can be seen clearly). These instructions go through the construction procedure step by step, but it should be remembered that where identical materials are not available (e.g. using different brick sizes) then allowances may have to made to compensate for this.

Tools required for the construction process

Tool	**Number needed**
Shovel	2
Bucket	2
Trowel (large)	1
Trowel (small)	1
Float	1
Spirit level	1
Hammer	1
Tape measure	1
Ladder (trestle type)	1
Wheel barrow	1

Total time required for tank construction:

Skilled - approx 4 days
Unskilled - approx 4 days

Also needed

- Clean area for mixing mortar (preferably hard surfaced)
- Plastic sheeting for curing (5m x 5m)

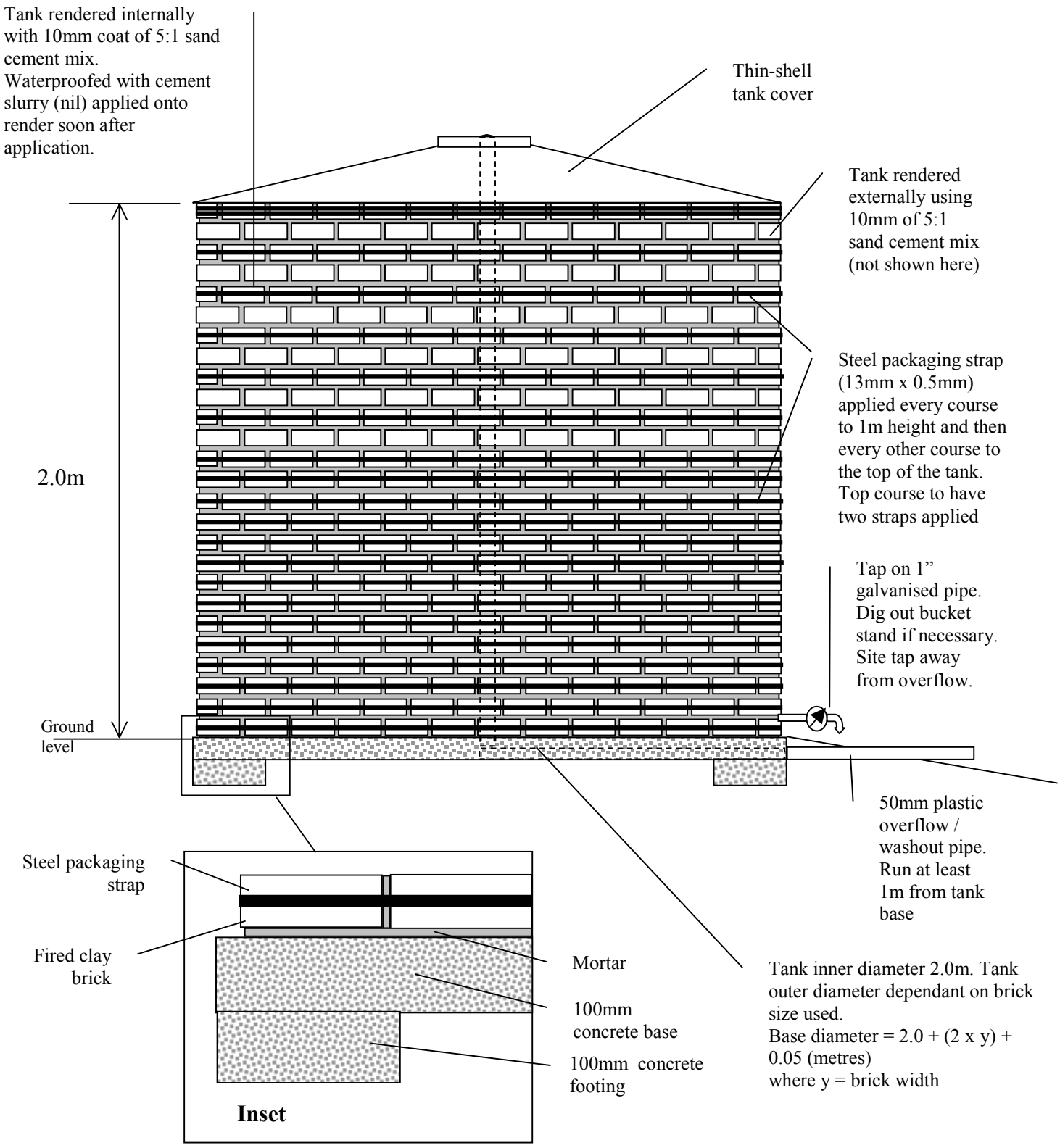


Figure 1. Sketch (not to scale) of the SSER tank, showing the main components

Laying the foundations

Material requirement (approximate)

- hardcore (for base) 1.5 tonnes
- sand 0.5 tonnes
- aggregate 1.0 tonnes
- cement 5 x 50 kg bags
- 75 mm plastic pipe 2m
  1 x 90^{o} elbow

(we used 63mm solvent weld rainwater downpipe, but any similar pipe will do – it has to be of sufficient diameter to act as overflow)

Time required: skilled 0.5 days
unskilled 0.5 days

Find a suitable location for the tank i.e. close enough to the catchment area to conveniently transport the water, an area with suitably firm ground with no risk of subsidence, etc. If the ground is sloping slightly take advantage of this to site overflow pipe later. If the ground is flat the base may have to be laid above ground level to allow overflow water to run off. If the latter is the case, some form of shuttering will be required (bricks can be used and reclaimed for use in the wall later).

Assuming there is sufficient slope to take the overflow pipe out as required, dig a circular hole to a depth of 250mm and to a diameter that is two metres plus twice the width of the brick being used and then add 50mm (0.05m) (see note below).

Diameter of base = 2.0 + (2 x y) + 0.05 metres
where 2.0m is the internal diameter of the tank
y is the width of the brick being used
0.05m gives a 25mm border around the base

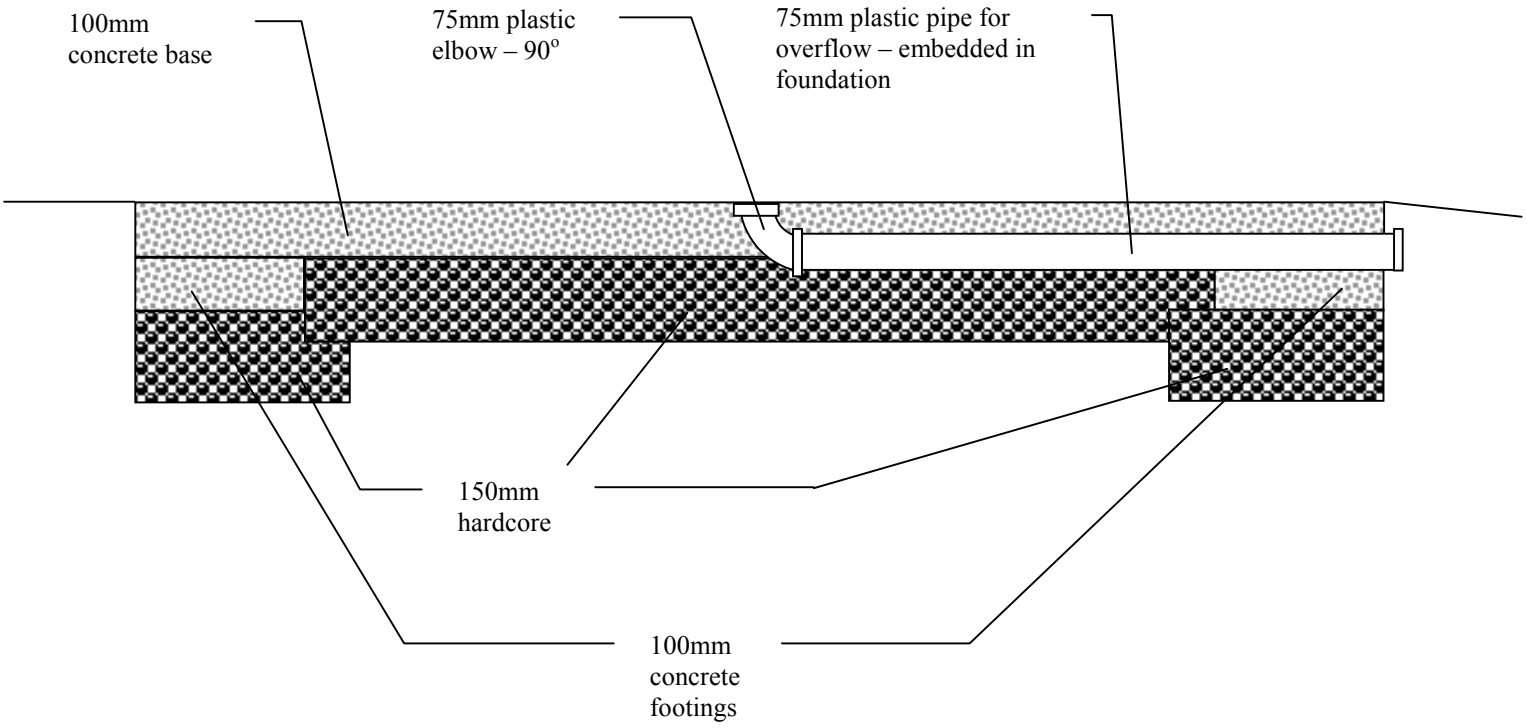


Figure 2 – details of the tank base

The footings are then dug to a further 100mm depth. The width of the footings again depends upon the width of the brick being used – allow for the 25mm border around the tank, add 50mm inside the tank wall and also make an allowance for the stone that will make up the under-base. Lay the stone to a depth of 150mm.

The overflow pipe is now placed such that it will sit partially in the stone (one third of its depth) and partly buried in the concrete (two thirds of its depth). There should be a very slight gradient on the pipe. The elbow is at the centre of the tank. Make a good seal between the elbow and the pipe.

Then peg out the area ready for the concrete. A peg is placed at the centre of the tank, next to the elbow. Pegs are then placed at regular intervals around the perimeter of the tank at the same level.

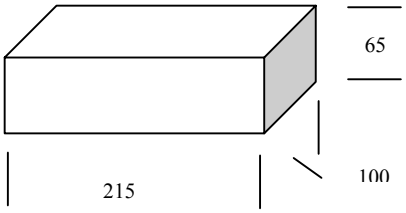
Make the base in one session. Use concrete of mix 4:2:1 (aggregate: sand: cement). Level using a tamping board using the pegs as a guide.

Building the tank wall

Material requirement:

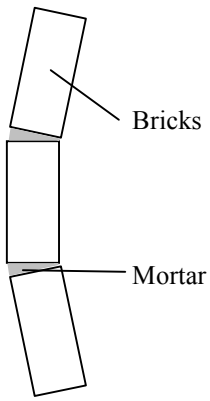
- bricks 800 (using brick dimensions shown)
- Cement 3 x 50 kg bags
- Sand 1 tonne

Time required: skilled 1.5 days
unskilled 1.5 days



Brick dimensions used on prototype

The tank wall is built simply by forming whole bricks into a circle. The bricks are not cut to shape. This leaves a slight angle between bricks but this causes no problems and is compensated for when rendering. The verticality and cylindricality of the wall can be maintained in one of two ways:



1. By using a spirit level – if the wall is set up at the base to be round and the walls are kept vertical then the tank will be perfectly cylindrical.

2. By placing a length of pipe in the elbow and bracing it in the vertical position. A length of is then loosely tied around the pipe and measured to give the desired length. This is then used as a guide for the tank construction.

Note: if the first method is used the elbow should be protected to prevent mortar falling in during construction.

The wall is built up to the required height i.e. 2 metres and a trestle ladder is used to pass mortar into the tank for building. Working from the inside is easiest – stock up enough bricks inside to finish the wall at an early stage.

The wall should then be properly cured by covering the whole with polythene sheet for 7 days and wetting the walls daily.

Applying the steel packaging strap

Kimarakwija – you will have to source a supply of packaging strap and purchase a tensioning tool and crimping tool from Kampala. Quote for the cost of the trip to Kampala, as well as the tool and crimps, in your tender. The full kit for this includes:
- steel strapping (comes in rolls of several hundred metres)
- tensioning tool (for pulling the strap tight around the tank)
- crimping tool (for crimping the strapping once in place)
- dispenser (optional tool for easily dispensing the strap – makes this job a lot easier)
- crimps (usually in a box of 1000 – for crimping the strap)

Time requirement:
- skilled 0.5 days
- unskilled 0.5 days

The strap is applied to the brick masonry specimen using a manually operated tensioning tool. Once fully tensioned the strap is crimped using specially designed crimps and crimping tool and then the tensioning tool is removed. It can be seen from Figure 8 below that the tensioning tool holds the strap away from the wall in order to allow access for the jaws of the crimping tool. When the tensioning tool is removed there is some loss of tension in the strap and so packing is placed under the strapping (pieces of broken stone can be used) before the tool is removed to prevent this loss of tension.

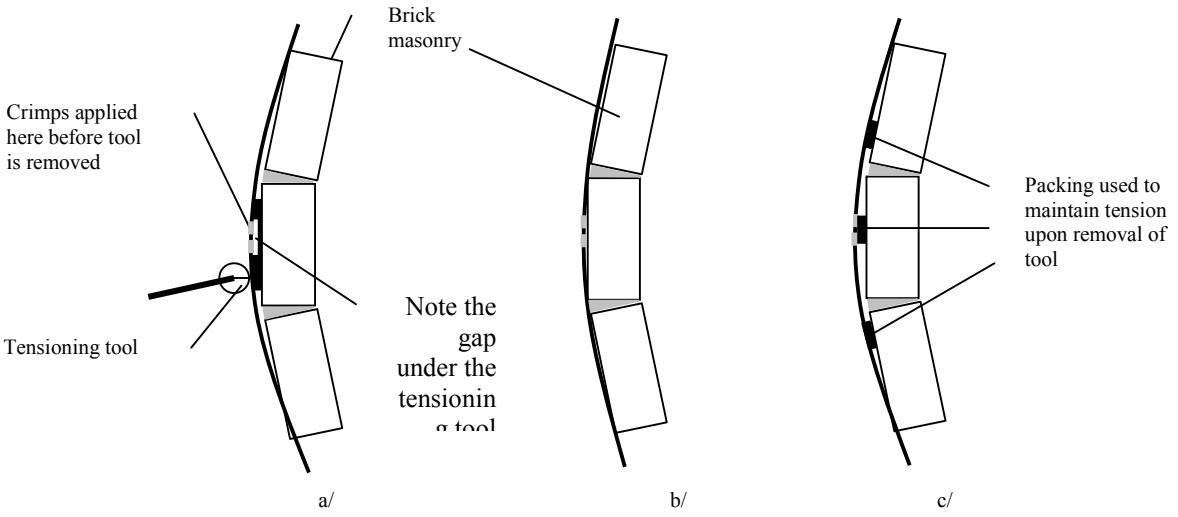


Figure 8 – showing tensioning and crimping arrangement for steel strapping a/ during the tensioning and crimping process b/ when crimping is complete and the tensioning tool has been removed and tension reduced c/ maintaining tension by using packing

The strapping is placed on every course of bricks for the lower one metre of the tank and then every other course for the upper metre. There can be some difficulty in applying the strapping on the lower two courses because of the difficulty of access for the tool. This can be overcome by digging a small hole in the ground where the tool access is required. This can be filled later.

Covering the tank
The tank is covered with a thin shell ferrocement cover. This is mortared into place. (this has been quoted for separately)

Rendering the tank
Material requirement:

- Cement 2 x 50 kg bags
- Sand 400kg (mix 4:1)
- Mortar plasticiser 1 litre (where available)
- Water as required

Time:

- Skilled 1.5 days
- Unskilled 1.5 days

The tank is rendered both internally and externally to a thickness of 10mm (which varies due to the uneven surface caused by the angled bricks). A 5cm fillet is built up between the wall / base junction. The mix is 4:1 (sand:cement). The internal surface is then painted with a cement slurry.

Other (with detail to follow)

- A filter can be placed in the tank cover. This can be the usual bucket of gravel.
- A 2.5 metre length of pipe is required to run from the elbow in the base to the cover. This is slotted at 2m height to act as the the overflow (more detail to follow).
- Tap and galvanised pipe – I haven't yet given any information about the siting of the tap and the dugout for tap stand. Please make an estimate for this in the quotation. More information will follow

Strap dispenser

Strap showing crimps

Tank with straps in place (note the double thickness at the bottom – we do not want this any longer). The straps are painted with red oxide paint in this photo to prevent rusting as the tank will sit without render for some time during the testing phase.