home.cd3wd.ar.cn.de.en.es.fr.id.it.ph.po.ru.sw

Case study 8
Factory made tanks, 1 to 25m cubic metre capacity, New Zealand

This example has been taken from Ferrocement water tanks and their construction by S. B. Watt and published by Intermediate Technology Publications - found at http:/../www.oneworld.org/itdg/publications.html

Introduction

Ferrocement tanks have been made commercially in New Zealand for many years and have now largely replaced the traditional corrugated galvanised iron tanks. They are used mainly to store water for domestic and dairy purposes on the farm but they are also winning acceptance for industrial liquid storage. The cost of the smaller tanks is comparable with that of tanks made from other materials such as galvanised iron; the cost per unit volume decreases rapidly with increase in size.

Tank sizes

The tanks are constructed in various sizes, with capacities from $1m^3$ to $25m^3$, diameters from 1m to 3.6m, and heights from 1.3m to 2.9m. With specially built formwork and machine mortar mixers each tank takes 2 5 person days to build. There are several manufacturers producing such tanks in New Zealand. The high wage costs in New Zealand are reflected in the prices of the tanks.

Design

The water pressure in a tank full of water generates stresses in a tank that are difficult to calculate structurally. The tanks have been designed to resist only hoop stresses and a layer of woven netting is included as nominal reinforcement; this netting in fact provides the only reinforcement at the base of the wall where it joins with the floor the point of greatest stress. This section is thickened during construction and from information given by the manufacturers there is no evidence that cracks appear under normal loads. The only causes of failure have resulted from damage during delivery.

All the tanks are built with an integral roof and a covered access hatch.

Capacity (m3)	Diameter (m)	Height (m)	Weight (tonne)
0.9	1.2	1.3	0.25
1.8	1.55	1.3	0.3
2.7	1.85	1.3	0.45
3.6	2.0	1.45	0.8
4.5	2.0	1.95	1.25

9.0	2.9	1.95	2.1
13.5	2.9	2.6	3.0
18.0	3.65	2.6	4.0
22.5	3.65	2.9	5.0

Table 1 Size and weight of New Zealand tanks

Cement	740 kg
Sand	1.0m3
Plain wire 4mm diameter	330m
Wire mesh 1m	28m

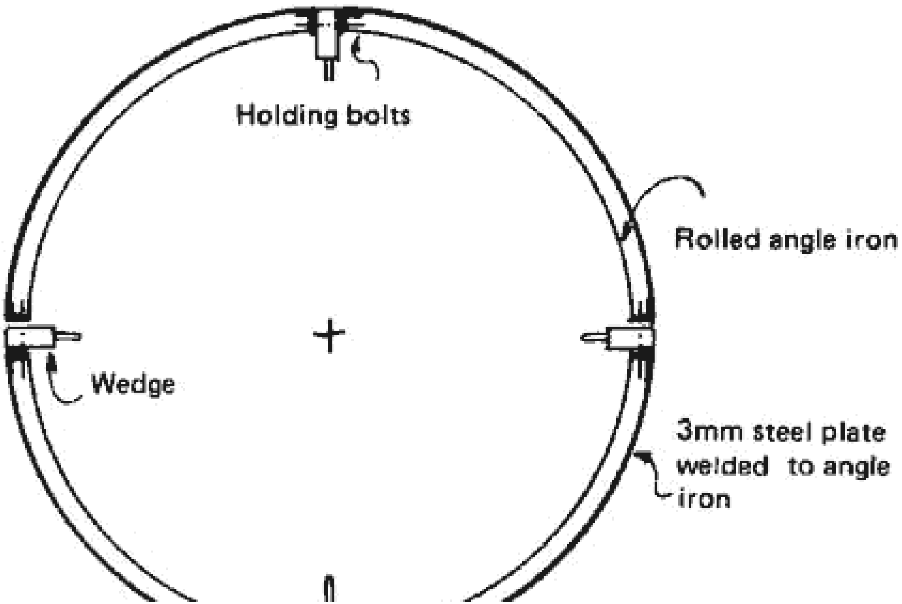
wide	
Weld mesh for slab	7m2

Table 2 Materials needed to make a $9m^3$ tank

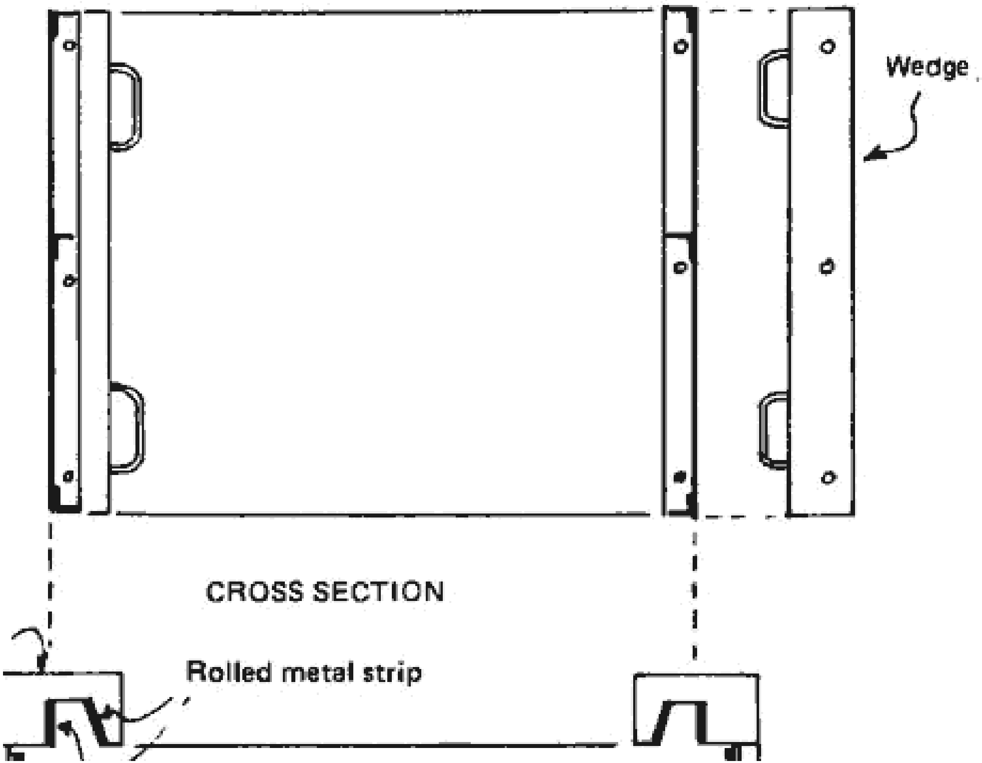
The quantities shown in Table 2 are higher than a comparable tank, which would be built in situ. The tanks described here have to be stronger than the self-help tanks to be able to withstand the extra stresses during transportation

Construction

The tanks are constructed on special fabricated steel formwork which is quickly erected (see Figure 1), or on a temporary timber formwork. Usually, the floor of the tank is cast first; this is reinforced with welded steel mesh made from 8mm diameter rods at 20cm centres with a floor thickness between 6cm and 10cm, depending on the size of the tank. Loops of 8mm steel are allowed to project from the base to allow for easy handling; this also reduces the stresses that will be set up in the tanks as they are being lifted or winched. A strip of chicken wire is also cast into the sides of the floor and is bent up into the walls.



PLAN



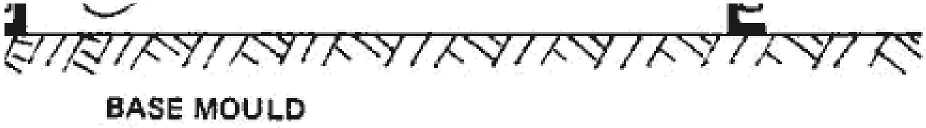


Figure 1 - Commercial tank formwork

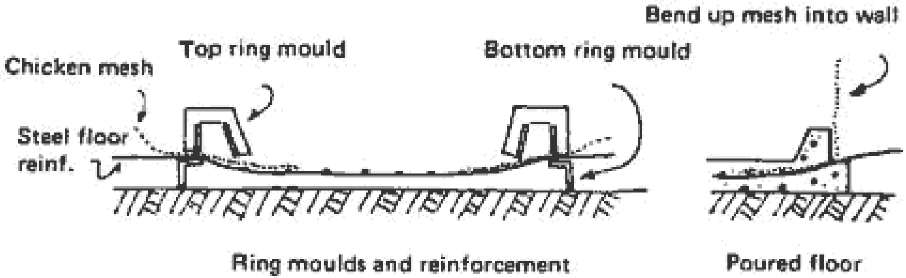


Figure 2 Casting the base slab

When the floor slab has been cast, the formwork is erected and the chicken wire folded up against the shuttering. A layer of chicken wire or weld mesh made from 2mm wire at 5cm centres is wrapped around the tank to cover the shuttering from top to bottom (see Figure 3).

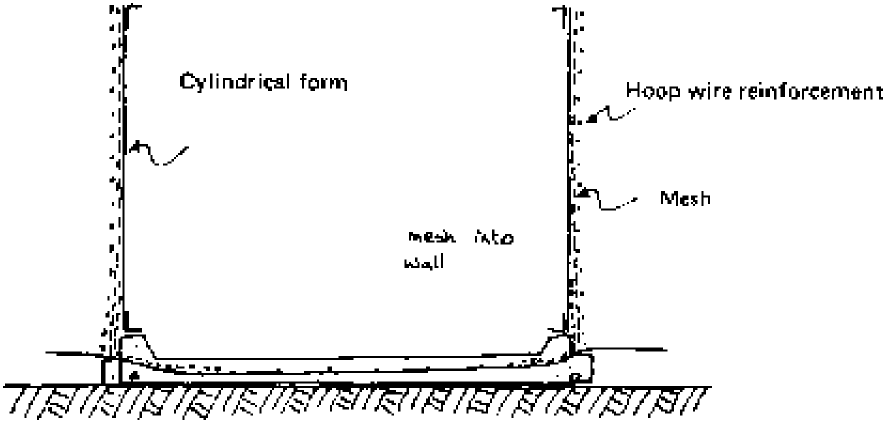


Figure 3 Assembling the formwork and reinforcement

The main reinforcement, 4mm diameter straight wire, is wrapped tightly around the tank in a spiral with a 5cm gap between the wires. Theoretically this gap should be much smaller at the bottom of the tank than at the top to take the extra stresses, but in practice the spacing is left constant. This prevents mistakes during construction and does not add appreciably to the overall cost. The same spacing is often used on all of the tanks, both small and large.

The first mortar layer (1:3 cement:sand by volume)is trowelled onto the tank

1cm thick and given 24hrs to harden. A second layer of mortar is then trowelled on and finished smooth with a plasterers float; this is also given 24hrs to harden.

The formwork is now carefully stripped and removed from inside the tank and a third layer of mortar is trowelled onto the inside of the tank to completely cover up the reinforcement. A thick un-reinforced coving is added to strengthen the joint between the floor and the tank.

Finally, the roof is built onto the tank y laying mortar onto shaped formwork which is propped from underneath. the roof is reinforced with two layers of wire mesh, which is tied onto the mesh protruding up from the walls (see Figure 4).

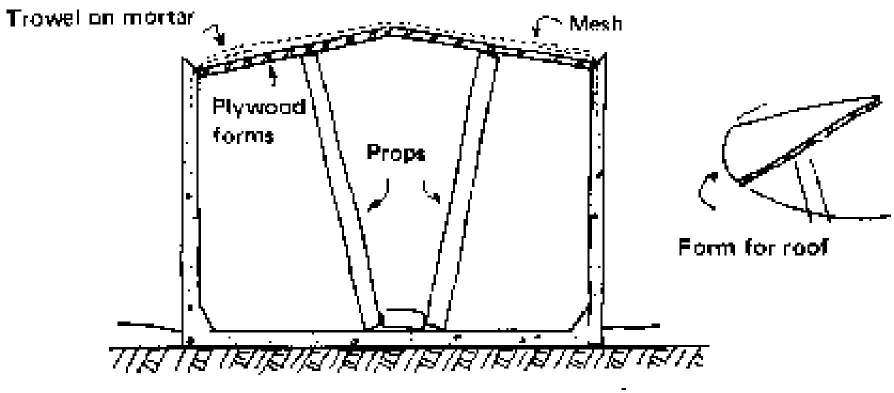


Figure 4 Constructing the roof

A prefabricated angle iron frame is set into the wire mesh to provide formwork for an access hatch into the finished tank. This is removed after the mortar has set. Mortar is trowelled on in a 3cm layer and allowed to cue for 3 days. When it is strong enough the roof and access hatch formwork is stripped and a layer of mortar trowelled onto the inside of tank roof.

The tank is finally painted on the inside with a coat of cement and water slurry, a small volume of water is allowed to sit in the bottom of the tank and the tank is covered and cured for at least 7 days.

Transporting the tanks

The factory tanks of less than 25m^3 capacity are light enough to be carried by lorry. They are taken to the prepared site and joined directly to the necessary pipe connections; tanks of larger capacity are usually built on site.

The smaller, lighter tanks are lifted onto and off of the lorry with a truck-mounted hoist. The larger tanks are winched onto the truck with a sling. The first step is to jack one edge of the tank clear of the ground. The truck is then so positioned so that a pair of steel runners resting on its carrying platform can be placed under the tank to form a ramp. A wire rope sling is fitted around the tank, which is then drawn up the ramp by a winch mounted on the truck. Steel pipes are used as rollers when moving the tank.

For unloading the platform of the truck is raised slightly and the tank slides down the ramp. The steel pipes are again used as rollers and the downward movement is controlled by the winch.

Return to top of page

Return to index page

home.cd3wd.ar.cn.de.en.es.fr.id.it.ph.po.ru.sw