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3. Water Tanks, Dodoma (Tanzania)

Owner:	*Capital Development Authority, Dodoma*
Engineers:	*Project Planning Assoc. Ltd, Toronto, Canada and VSL International, Berne, Switzerland*
Contractor:	*Saarberg Interplan GmbH, Saarbrücken, FR Germany*
Slipforming and Post-tensioning:	*VSL International, Berne, Switzerland*
Year of construction:	*1981*

Introduction

Dodoma, the future capital of Tanzania, lies approximately 400 km to the west of the present capital of Dar-Es-Salaam. Two circular water tanks, each of approximately 17 500 m³ capacity, have been built here and entirely covered with earth after completion. The stored water is used as drinking water.

Details of the structures

Each tank is 61 m in internal diameter and has a wall height of 6.92 m above the lower edge of the foundation. The wall thickness is 350 mm (Fig. 1). The wall is monolithically connected with the foundation, as this type of transition between wall and foundation has in general proved to be the best solution. The monolithic connection provides the optimum in respect of failure behaviour and watertightness. Constraints arising from post-tensioning are avoided by leaving a construction joint open in the bottom slab and concreting it after stressing.

Each tank has a flat roof, supported internally by individual columns. These columns are on a grid of 5.80 x 5.80 m. The distance between centres of the two tanks is 65 m.

Construction procedure

The walls of the tanks were constructed with the use of slipforming. This method proved to be economical in spite of the low height of the wall, since each wall could be divided into eight segments, thus making possible rational use of the formwork (Fig. 2). The total area constructed by slipforming was 5000 m². The rate of slipforming was 0.40 m/h, i.e. 15 hours were required for the construction of one segment. Erection of the formwork took 10 days, and 5 days were required for transferring it to the next section (Fig. 3).

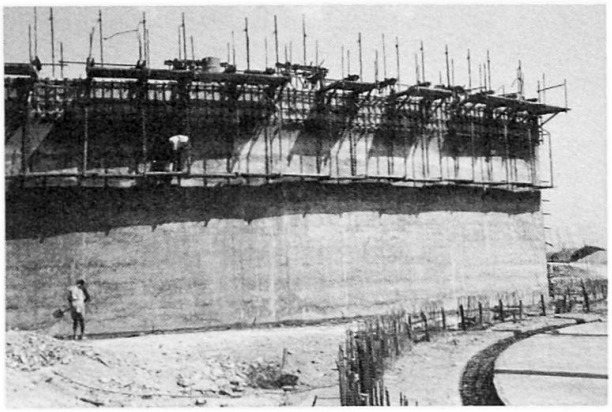

Fig. 2 Construction of a wall segment

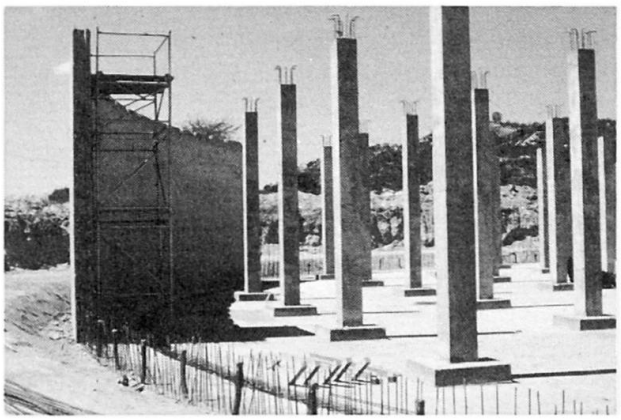

Fig. 3 First segment of a wall and columns completed

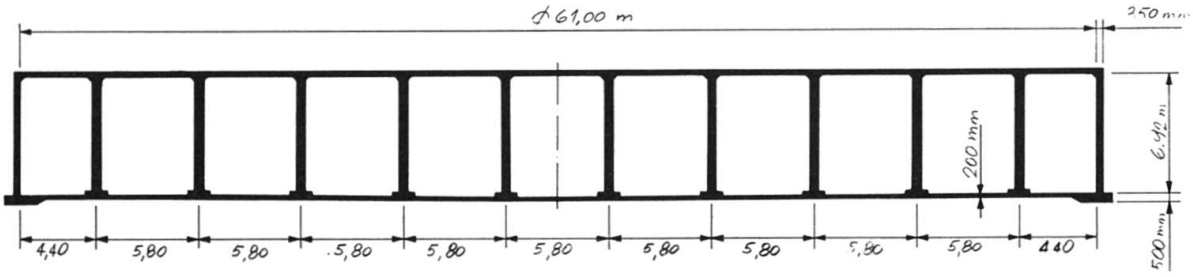

Fig. 1 Cross section of a tank

Post-tensioning

It had originally been intended to prestress the walls by the winding method. VLS International put forward an alternative solution, involving the use of annular cables ZZ 6-6 (ultimate force 1566 kN) and vertical tendons EC/L/EC 6-7, which proved more advantageous (Fig. 4). Two Z-anchorages per annular cable were chosen, on account of the large circumference of the wall.

Each wall thus comprises 12 annular cables, each possessing two anchorages VSL type Z, situated opposite to each other. The anchorages of two successive cables are displaced by 90°. The cable spacing increases from 350 mm at the bottom to 1000 mm at the top. The block-outs in which the anchorages are situated are 1400 mm long, 250 mm wide and of maximum depth 198 mm. They are on the external face of the wall. The axes of the annular cables are 100 mm from the external wall face.

The vertical post-tensioning consists, as mentioned above, of cables of type EC/L/EC 6-7. The EC anchorages are 1.50 m apart, this dimension corresponding to twice the radius of the loop. In total, 64 of these cables are provided in each tank.

The cables could be stressed when a concrete strength of 25 N/mm² had been reached. First of all, each alternate vertical cable was stressed, then the remaining vertical cables. Each alternate annular cable was then stressed, starting from the bottom and then, also from the bottom upwards, the remaining horizontal cables were stressed.

(H. U. Aeberhard)

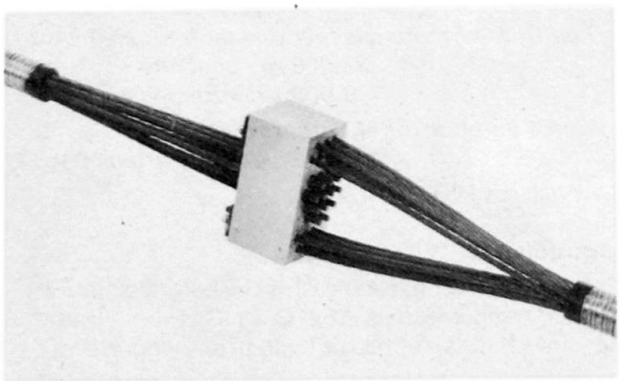

Fig. 5 VSL centre stressing anchorage type Z

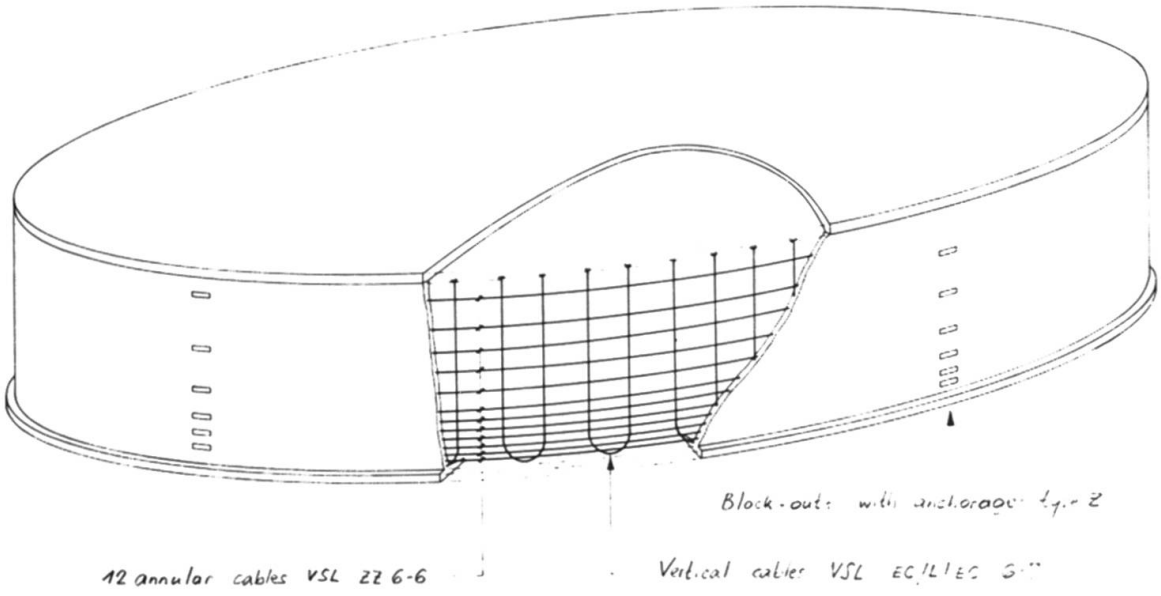

Fig. 4 Diagrammatic representation of post-tensioning