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6. Egg-Shaped Digester Tanks in Matsumoto City (Japan)

Owner: Municipality of Matsumoto City
Engineer: Japan Sewage Works Agency
Contractor: Joint Venture of Tobishima Construction Co., Ltd. and Matsumoto Doken Co., Ltd.
Post-tensioning: Taisei Corporation, Tokyo
Construction period: October 1987 – October 1988

Introduction

At the Miyabuchi Sewage Disposal Centre in Matsumoto City (approx. 200 km north-west of Tokyo), two egg-shaped digester tanks, each of 2000 m³ volume, have been constructed as part of the extension of the plant. The egg-shape for digester tanks becomes more and more popular since it has various advantages over a cylindrical tank. Probably the most important advantage is that the curved surface causes the deposits to sink to the bottom of the cone, where they can be easily and continuously removed. The light particles that are produced during the digestion process ascend to the surface of the sludge, where they form a crust. Since the surface area in an egg-shaped tank is smaller than in a cylindrical tank, the removal of the crust is less demanding. For the same reason, the heat losses are smaller. Finally, the egg-shape also contributes to a more efficient digestion process.

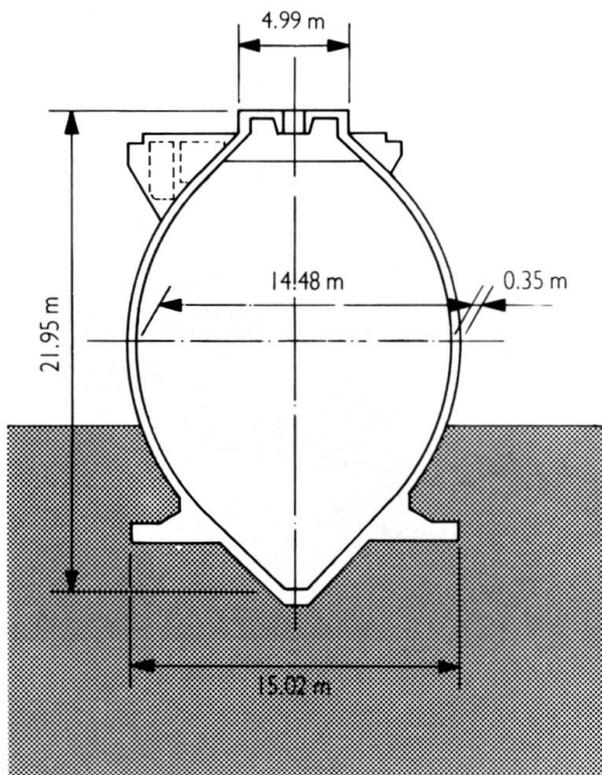


Fig. 1 Cross-section of the tanks

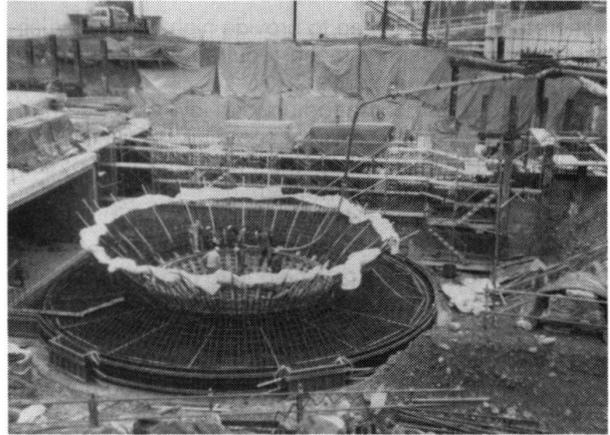


Fig. 2 Construction of the bottom cone, the foundation ring and the lower part of the shell



Fig. 3 View of the formwork; note the block-out forms for the horizontal post-tensioning

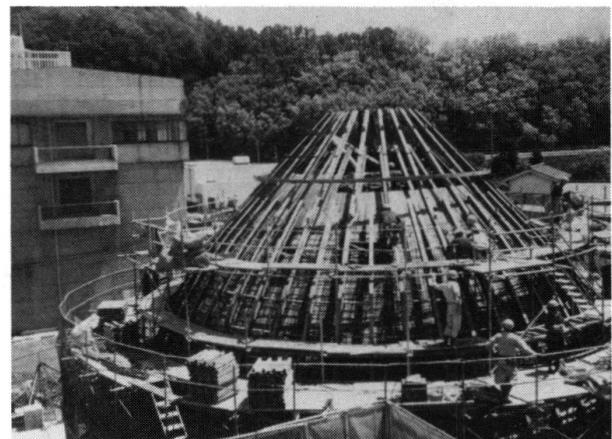


Fig. 4 Construction of the top part of the shell

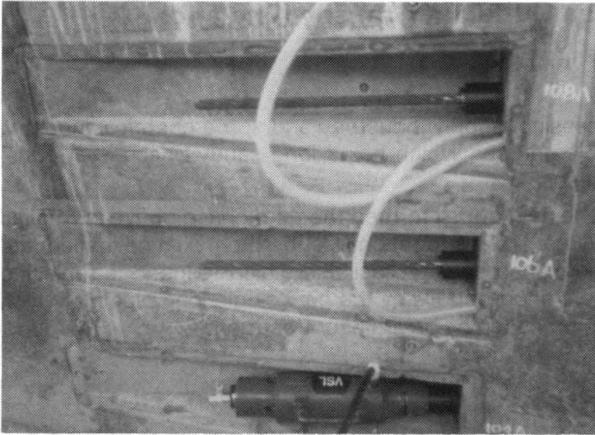


Fig. 5 Anchorages and stressing of horizontal shell tendons

Details of the tanks

These are approx. 22 m high, with a maximum inside diameter of 14.48 m and a shell thickness of 350 mm at the level of the maximum diameter. This thickness is the same throughout the upper part of the tank shell while it increases continuously towards the foundation ring where it reaches 500 mm. This value also applies to the bottom cone. The flange-shaped footing, which bears directly on stable gravel, has an outside diameter of 15.02 m.

Construction procedure

The tanks were constructed one after the other. After excavation, a thin concrete layer was sprayed onto the soil in the area of the bottom cone and the foundation ring which were subsequently constructed. Then followed the execution of the lower hemisphere and stressing of the tendons of this part. The next stage was the construction and cable stressing of the upper hemisphere; finally the crown was added. Once completed the tanks were provided with a vertically structured cladding. Construction of the second tank followed that of the first one four months behind. Concrete cube strength required after 28 days was 35 N/mm².

Post-tensioning

The tanks are horizontally and vertically post-tensioned. Whereas bars were used for the vertical tendons, the shells are horizontally post-tensioned with VSL Ø 21.8 mm monostrand tendons. This type of monostrand, which consists of 19 wires as opposed to the 7 wires normal prestressing strand is made of, is a Japanese particularity and exclusively applied in Japan. These tendons, which are located at the outside of the vertical post-tensioning and which are spaced by 100 to 650 mm, were installed prior to concreting. Each tendon covers half the circumference and was anchored in block-outs which were subsequently filled with concrete. The block-outs of subsequent bands of tendons were staggered. Each foundation contains 4 hoops of VSL tendons EE 6-7 anchored in 4 buttresses. The tendons were prefabricated and placed into the formwork before concreting.

(H. U. Aeberhard)

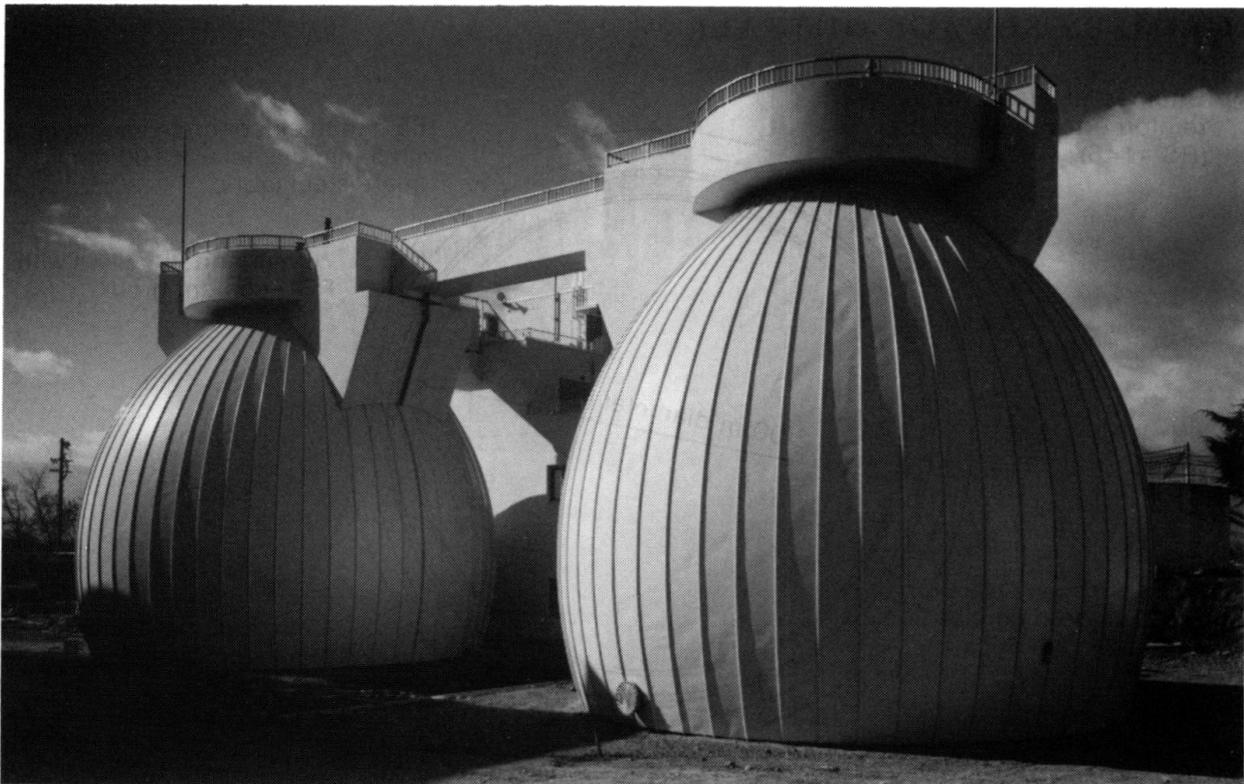


Fig. 6 View of the completed tanks