



▲ *Three post-tensioned concrete sludge digesters*

Due to the rapid residential, commercial and industrial development in the north and north west region of Singapore, the Singapore Ministry of the Environment has expanded the Kranji Sewage Treatment Works. This will enable it to cope with the expected increase in waste water generated by these new developments.

VSL Singapore has been involved in the detail design and construction of Phase III of the expansion works, which has included the construction of three

sludge digesters, two gas holders and a sludge storage tank during the period January 1995 to July 1997.

Each of the three egg-shaped sludge digesters is supported on forty cast in-situ bored reinforced concrete piles. Each digester is approximately 36.5 m in height, however, upon completion it will only protrude 26 m above ground level and has a maximum diameter of 23.1 m. The digester walls vary in thickness from 700 mm near the base to 450 mm near the top of the digester and are constructed using a 35 grade concrete with a minimum cover to reinforcement of 40 mm. The wall thickness was not governed by static forces but rather by the aim to design a structure which can be easily built and in particular

where concrete can be properly placed and vibrated in order to achieve a watertight structure.

The post-tensioning system that has been adopted for the digesters is the VSL bonded multistrand system encased inside VSL PT-Plus plastic ducts.



▲ *Tank base reinforcement*

Scope of works performed

- Detail design and construction
- Post-tensioning system
- PT-Plus plastic duct

The PT-Plus plastic duct has been selected because it provides additional corrosion barrier for the prestressing strands. In addition, its lower friction characteristics have made it possible to reduce the number of horizontal tendons anchorages by 50%.

Due to its egg-like shape, hydrostatic pressure from sludge gives tensile membrane forces in the digester wall in both the horizontal direction and the median direction. These are both balanced by VSL post-tensioning cables. Whereas for the median cables normal Ec type



▲ Stressing blockouts ready for stressing

▼ Stressing blockout form and PT Plus plastic ducts



▼ Formwork in place of upper half of digester



CONSULTING ENGINEER
Binnie & Partners Singapore

MAIN CONTRACTOR
Hyundai Engineering &
Construction Co Ltd

DATE
1997

CLIENT
Singapore Ministry of Environment

SUB CONTRACTOR
VSL Singapore Pte Ltd.

anchorages have been used, the horizontal prestressing is achieved with cables running over 360° which are anchored and stressed in one Z-type anchorage per cable only.

This solution is well suited for egg-shaped digesters since no external blisters are required and the number of stressing pockets in the wall is minimised. Overall, approximately 60t of strands have been installed in each digester.



www.vsl.com