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The Lifting, Transport and Placing of the Øresund Pylon Caissons

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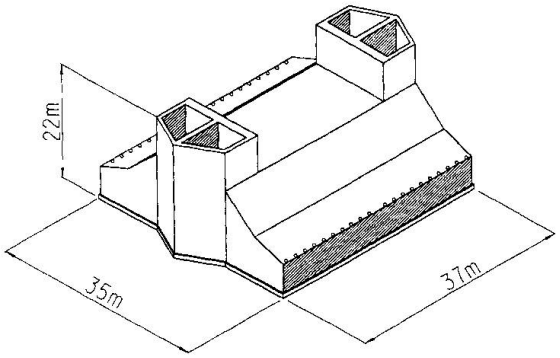
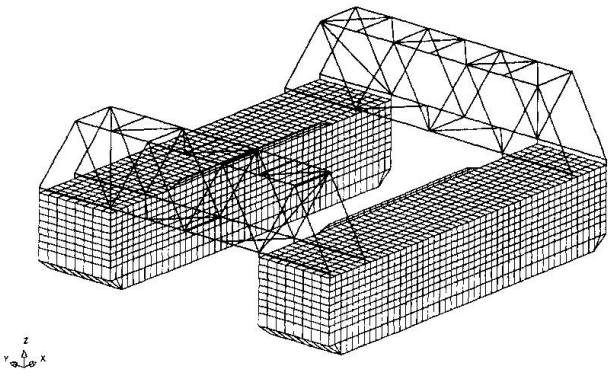
Abstract

The two 204 metre tall main pylons of the cable stayed, central part of the Øresund bridge rest on concrete caisson foundations. Each caisson has plan dimensions of 35 by 37 metres, is 22.5/21 metres high and has a dry weight of about 20'000 tonnes. The two caissons were prefabricated in the Kockums dry dock in Malmö. They were prestressed in all three directions. The anchor heads of the vertical prestressing cables were used as attachment points for the lifting tendons.





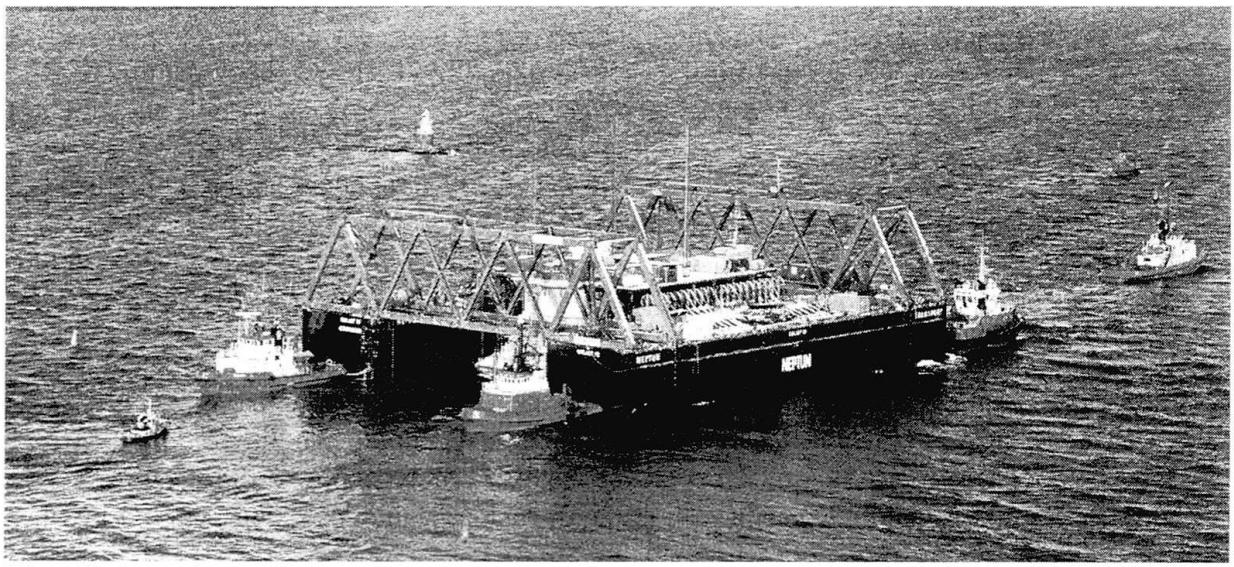
The transportation of the caissons from the dry dock to their permanen t location in Øresund was achieved by means of a purpose built and equipped catamaran. The same consisted of the two existing Neptun barges Goliat 18 and Goliat 19, suitably strengthened, connected with two space truss structures (one fore and one aft), and equipped with VSL hydraulic strand lifting/lowering equipment. The design lifting weight of the partly submerged caisson was 12'200 tonnes.

Following were the main steps of the two LTP (Lifting-Transport-Placing) operations:

- After flooding the dock, entering the catamaran into the dock and positioning with the first caisson between the two barges

- Connection of the strand tendons of the lifting equipment to the post-tensioning anchor heads of the caisson by means of screw type couplers
- Lifting of the caisson until achieving the same draught of both catamaran and caisson (6.4 m)
- 110% load test by temporary lifting the caisson a further 1 metre out of water (reduced buoyancy)
- Seafastening of the caisson in horizontal direction by means of shimming towards surge and sway stoppers attached to the barge side shells
- Mechanical locking of the lifting tendons for the sea transportation
- Manoeuvring of the loaded catamaran out of the dock and out of the Malmö harbour
- Towing to installation site using 5 tugs, three in front and two aft, navigating the extraordinary load over the 12 kilometres distance using satellite based system (GPS)
- At the installation site coupling of the catamaran to a pre-laid and pre-tested 8-legged mooring system consisting of anchors and chains
- Positioning of the catamaran with winches and mooring cables
- Using the satellite navigation system (GPS) to satisfy the tight placement tolerances (± 75 mm)
- Lowering of the caisson by 12 meters onto pre-installed foundation pads on rock, 10 meters below sea bed, while simultaneously filling the catamaran with ballast water. Touch-down weight about 3.000 tonnes
- After touch-down, immediately slackening of the lifting tendons by combination of pay-out several strokes of the hydraulic jacks and ballasting of catamaran
- Uncoupling of the lifting tendons by divers
- Return of the catamaran to the dry dock to repeat the same operational steps for the second caisson

The LTP operations as described were successfully completed during April 1997. The achieved placement accuracy was 42 mm for the first (west) and 24 mm for the second (east) caisson.



West Caisson during Towing