Introduction

The Øresund Tunnel forms part of the Øresund Link that will connect the cities of Copenhagen in Denmark and Malmö in Sweden across the Øresund.

The Link, which will comprise a motorway and a railway, consists of three different construction elements:

- A man-made peninsula adjacent to Copenhagen airport (Kastrup) and a 4 km long man-made island (called Peberholm) located roughly in the middle of the Øresund;
- The world’s longest immersed tunnel of 3,520 metres, positioned between the peninsula and Peberholm;
- A bridge of 7.8 km length between the artificial island and the Swedish coast near Malmö.

The decision to construct the Link was taken by the Danish and Swedish governments after lengthy discussions, mainly about the environmental aspects of the works. The Link is being built under design & construct contracts, and will be operated by Øresundkonsortiet who will charge a toll. The opening of the Link is scheduled for 2000.

The tunnel project

In mid-1995 Øresundkonsortiet signed a contract with the Øresund Tunnel Contractors for the design and construction of the tunnel.

The partners in Øresund Tunnel Contractors (ØTC) Joint Venture are:

- NCC AB from Sweden,
- E. Phil & Søn A.S. from Denmark,
- Dumez-GTM S.A. from France,
- John Laing Construction Ltd. from Great Britain
- Boskalis Westminster Dredging BV from Holland.

Special aspects of tunnel construction

In response to the limited available construction time ØTC developed an innovative way of construction which, in particular, was designed to minimise risks resulting from the Scandinavian weather conditions.
Typical design features:

- Simultaneous construction of two tunnel segments on two covered production lines, in a casting yard at land level
- Casting of a 2,500 m³ segment in one continuous 24 hour cast
- Sluicing the completed elements down from land to sea level by use of a lock
- Preparation of a gravel bed foundation for tunnel elements in the dredged trench, using the Boskalis scrading® method
- Use of satellite navigation for transport and for tunnel element immersion

On behalf of ØTC, Hydronamic executed various engineering tasks during the design phase of the project:

- Design of the gravel bed foundation, including construction method
- Design of the survey system to verify acceptability of the gravel bed
- Design of the stone protection layer on top of the tunnel, including required filter construction
- Supervision of model tests in the local hydraulic laboratories (DHI)
- Development of immersion equipment
- Development of the QA (work-) procedures for the marine works
- Development of the Multi Purpose Pontoon (MPP) for ØTC.

The design

The tunnel cross-section consists of two dual-carriage motorway bores, with a service annex escape gallery in between, and two single-track railway bores. The total width of the tunnel is 38.65 m, with a height of 8.55 m. Twenty 176 m long elements will form a straight tunnel of 3,520 m.

The maximum construction depth is approx. 22 m below water, while the future navigation depth over the tunnel will be dredged to -10 m.

A complicating factor at this site is the behaviour of the current. There is hardly any tidal variation but a very complex current system exists in the Little Belt, Great Belt and the Øresund.

The most accurate current prediction system available can only predict up to 12 hrs. ahead. This limits the flexibility of operations, necessitating strict management based on step-by-step, ‘go or no go’ decision-making.

Multi Purpose Pontoon

The purpose designed and built Multi Purpose Pontoon has the following tasks:

- Cleaning the dredged trench
- Construction of the gravel bed
- Survey of the gravel bed for acceptance
- Repair and maintenance of the gravel bed, when required
- Backfill of trench with sand and stone material
- Construction of filter and armour layers

Multi Purpose Pontoon MPP.