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The Öresund Bridge, Erection of the Cable-Stayed Main Span

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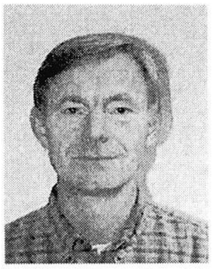
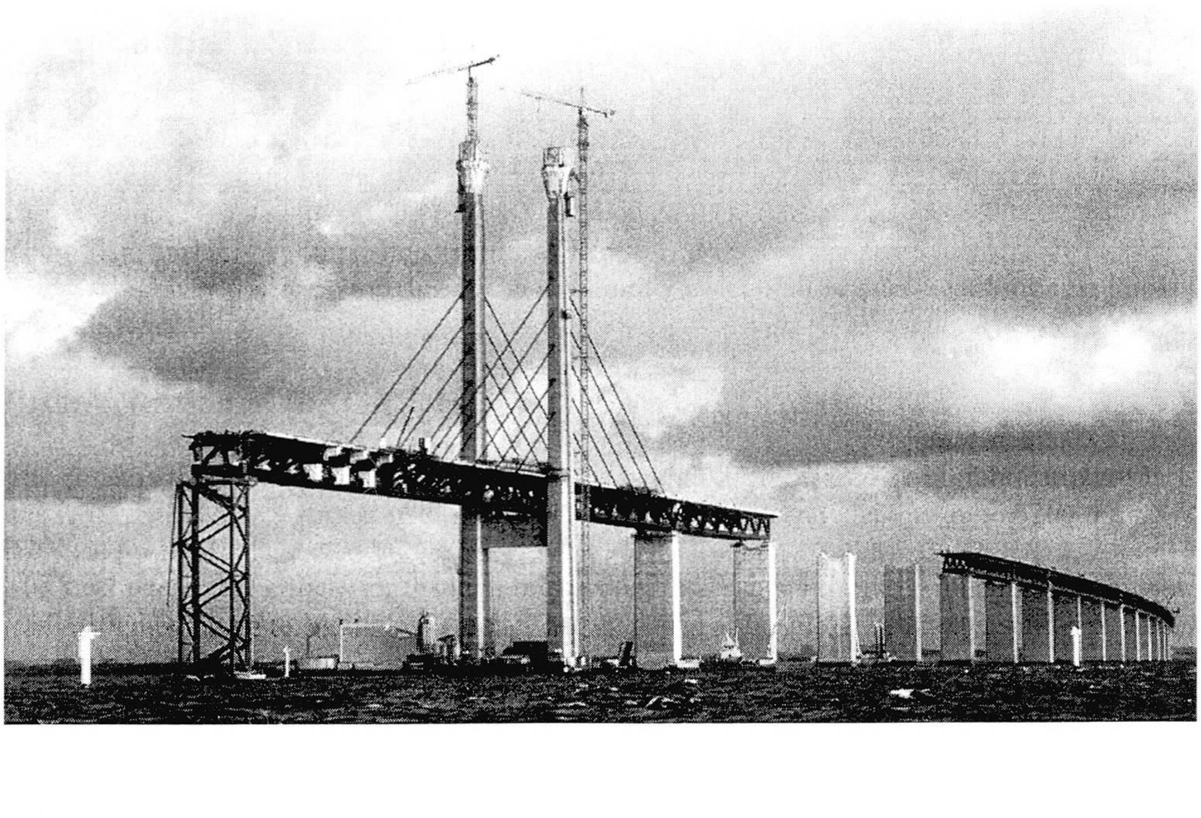


Abstract

The Öresund bridge consists of two approach bridges and a cable-stayed central bridge 1092 meters long. The main span is 490 meters which is a world record for cable-stayed bridges carrying both highway traffic and trains. The navigation clearance is 57 meters.
The bridge girder is a composite structure with a steel truss and a concrete deck carrying four lanes of highway traffic on top. Inside the truss girder a steel railway deck carrying two railway tracks is installed.

Prefabrication of the Girders

The construction of the Öresund bridge is to a very high degree based on prefabrication of large elements on-shore - 8 girders with lengths 120 or 140 meters and weights up to 6200 tonnes are used for the cable-stayed bridge.
The steel part of the girders for the high bridge are prefabricated in Karlskrona in Sweden and transported by barge to Malmö where they are unloaded at the girder reloading station and the concrete deck is cast.



Erection of the Girders

The main span of the bridge is erected using an innovative method. The girders are placed by the floating crane Svanen on temporary support towers placed on the seabed.
The joints are welded and the stay-cables are erected before the support towers are moved to a new position at the other pylon. The main advantage of this method is that the off-shore activities are cut down to a minimum which leads to time and cost savings compared to the normal cantilever method.
The girders for the high bridge are during erection connected to the previously erected girders. For this purpose a girder connection device has been developed. The girder connection device uses the short diagonal in the truss as a support element. The short diagonal is temporarily hinged at both ends to enable node rotations when the girder weight is transferred from the Svanen to the support arrangement. As the short diagonal is inclined a tension connection with hydraulic jacks is used in the upper chord to take the horizontal drift force.

Connection of the two cantilevers

When all the girders and the stays are erected the two cantilevers are joined at the centre of the main span. While the connection operation takes place the joint is exposed to environmental loads resulting in bending moments and forces at the joint. Therefore a cantilever connection arrangement has been developed to overcome these solicitations during the welding operation. The connection arrangement consist of two vertical and one horizontal lattice triangle which enable the transfer of shear forces and torsion at the joint. Bending moments from wind load on the bridge girder is taken by strong push pull connectors installed at the chords. The system is designed to enable rapid connection of the cantilevers to obtain a quick and safe transfer from the two free cantilevers to one main bridge span.

Erection of the Stay Cables

The main span of the bridge will be carried by stay-cables. 160 stays each consisting of approx. 70 strands will be used. The 7-wire strands are individually corrosion protected and anchored by wedges at the ends. A PEHD casing keeps the bundle of strands in position and reduces the drag coefficient of the stay-cable.
In order to prevent rain/wind induced vibration the casing is equipped with a double helical 2 mm thick spiral.
The stay-cables are erected strand by strand. The first strand to be erected in each stay is the reference strand which is stressed to the correct length. The first strand is equipped with a load cell and the following strands are all stressed until the load in the reference strand is reached.

Conclusions

The erection of the superstructure for the Öresund bridge is a challenging task involving development of erection techniques for girders weighing up to 6900 tonnes.
The erection of the superstructure for the cable-stayed bridge was commenced by the erection of the first girder in June 1998 and completion of the erection of girders and stays is scheduled for the summer 1999.