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The Oeresund Bridge on the Link between Denmark and Sweden

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Summary

The Øresund Link being established between Denmark and Sweden is a 16 km toll-funded road and railway crossing. It consists of a 4 km immersed concrete tunnel, a 4 km artificial island and a 8 km long bridge. The bridge includes a 1.1 km cable-stayed high bridge with a navigation span of 490 m and approach bridges each side with typical 140 m spans. The cross section is composite with the upper road deck in concrete and the lower railway deck in concrete on the approach bridges and in steel on the high bridge. The two decks are separated by two parallel steel trusses.

1. Introduction

Øresundskonsortiet (ØSK), a company owned jointly and equally by the Danish and Swedish governments, is responsible for the project design and construction of the fixed link. The Link will after its scheduled completion in year 2000, be owned and operated by ØSK.

ASO Group is house consultant to ØSK, responsible for technical services and aesthetics of the bridge. The group consists of Ove Arup & Partners (UK), SETEC (F), Gimsing & Madsen (DK) and ISC (DK). Georg Rotne (DK) is the group's architect.

The contract for the construction of the bridge was signed with Sundlink Contractors HB in November 1995. Sundlink consists of Skanska (S), Hochtief (D), Monberg & Thorsen (DK) and Højgaard & Schultz (DK). The detailed design is carried out for the contractor by a joint venture consisting of COWI (DK) and VBB-VIAK (S). The design of the bridge is based on ASO Group's conceptual and illustrative design for a two-level bridge. The conceptual design is included in the contract in the form of Definition Drawings, which must be followed by the contractor in his detailed design.

2. The Bridge

The cable-stayed high bridge (Fig 1) consists of a central navigation span with two side spans each side. Minimum headroom in the main span is 57 m. The high bridge is connected to the artificial island and the Swedish coast at Lernacken via a number of 140 m approach spans. The bridge deck is in two levels with a dual two-lane motorway at the top and a two-track railway at the bottom. The two levels are separated by two parallel Warren type steel trusses.

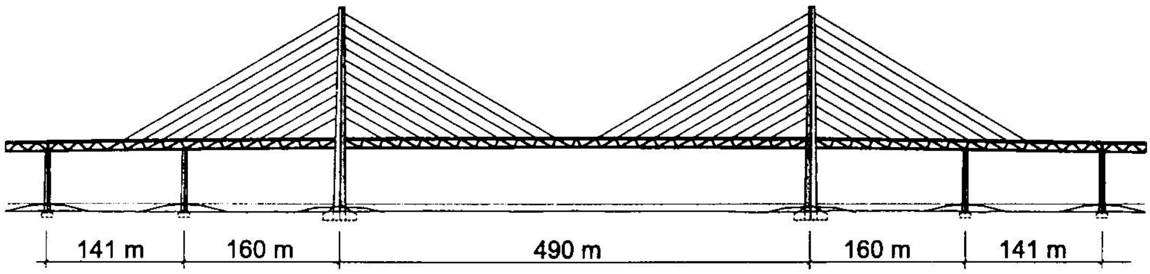
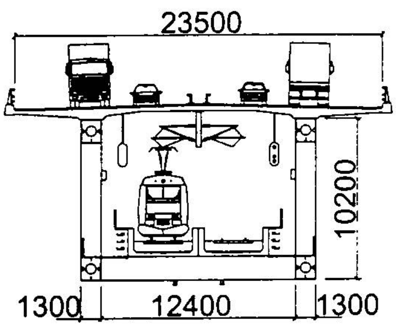


Fig. 1 The cable-stayed high bridge

The steel trusses have a more open bracing (45°) than generally used in truss bridges, and vertical members are only installed at truss ends at expansion joints. The 20 m bay length of the truss is constant along the bridge, but the configuration is modified at the cable-stayed spans so that every other diagonal has the same direction as the stay cables. The 490 m main span will at completion be the longest cable-stay supported span in the world carrying both road and heavy rail traffic.



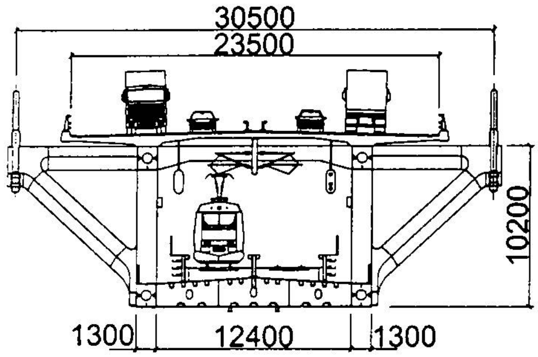


Fig. 2 Cross sections

2.1 Details

The trusses are placed 12.4 m apart and are in composite action with the concrete top flange. The transversely prestressed concrete slab has an average thickness of only 0.30 m. Hogging moments in the slab over the supports are transferred to the torsionally stiff upper steel chords. The transfer of tension at the top of the deck to the steel is secured by normal reinforcement anchored to long studs over the webs of the chords. The transfer of normal forces from the truss to the upper deck is concentrated at the nodal points, where 150 mm Nelson studs are provided closely spaced over the 7 m length of the nodes.

On the approach spans, the railway at the lower deck is carried in two concrete trough sections supported on 2.6 m wide transverse steel box beams spanning between the lower nodes. The troughs are in composite action with the chords. The width of the cross beams is determined by the large horizontal forces to be transferred from the truss diagonals to the concrete. The connection between cross beam and concrete is similar to the one described for the upper deck: long studs concentrated at the webs of the troughs to transfer tension from the local hogging moments in the troughs, and short studs concentrated at the outer trough webs to transfer horizontal shear from the steel to the concrete. The troughs are in reinforced concrete. As for the upper deck it was found uneconomic to apply longitudinal prestressing after the shear connection to the steel is made, as a major part of the prestress force would be transferred to the steel. In the cable-stayed spans the concrete troughs are substituted by a shallow steel box between the lower chords, as the advantages of the lighter deck prevailed over the extra cost of the steel.