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Composite Structures in the Øresund Bridge

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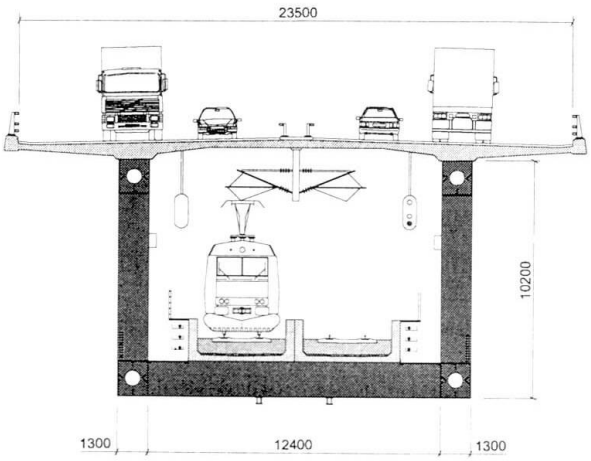
Abstract

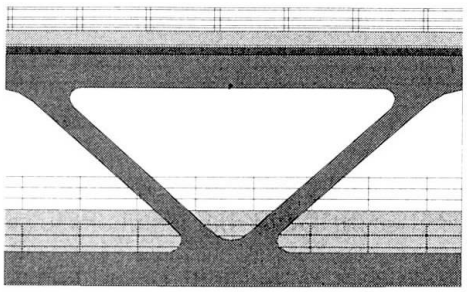
The conceptual design by ASO Group for the two-level Øresund Bridge included both an upper road deck in concrete and a lower railway deck in concrete. Both concrete decks acted in combination with the two longitudinal chords as part of the upper and lower truss flanges.

The 7.8 km long bridge was tendered in 1995 as a so-called 'detailed design and construct' contract, where the main dimensions were fixed by contractual definition drawings while the Contractor was made responsible for the detailed design. The definition drawings defined the geometry and materials to be used for the bridge, however the drawings also defined the few cases where the tenderer had a choice and the limits of his choice.

For the upper and lower decks the tenderers were free to choose between having steel decks or concrete decks. The successful tenderer, Sundlink Contractors HB selected concrete for both upper and lower decks of the 6.4 km long Approach Bridges.

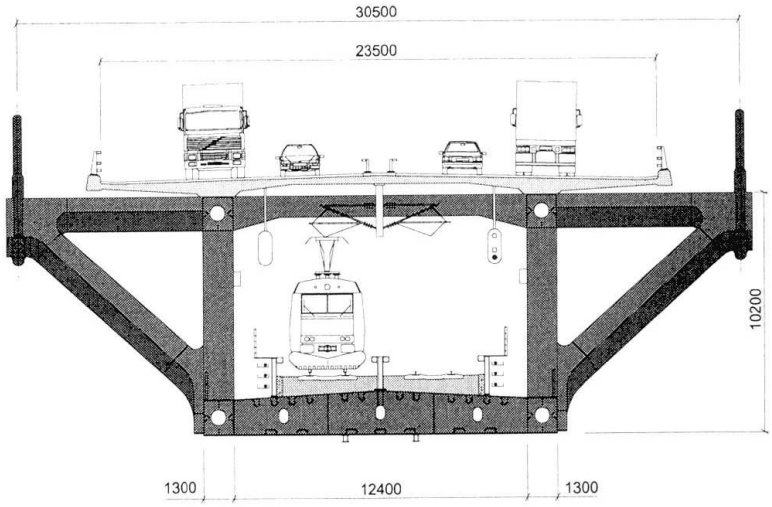


Cross section approach spans



20m truss module

For the 1.1 km long cable-stayed High Bridge concrete was also chosen for the upper deck but a lower steel deck was chosen as the weight saving was found important in the 490 m main span.



Cross section cable-stayed spans

The ASO Group (Ove Arup & Partners, SETEC TPI, Gimsing & Madsen and ISC) developed the bridge design for a design competition in 1993 and was appointed as the Owner's bridge consultant to develop the concept into tender documents. A number of detailed studies and investigations in particular for the composite solution were carried out at pre-tender stage as this solution was expected to be chosen by most tenderers.

The basic codes of practice for the design of the Øresund Bridge are the Eurocodes, which at the time of tender were only available in preliminary editions valid for building structures. ASO Group therefore carried out a comprehensive study of shear connections between steel and concrete, partly to assess the viability of alternatives to headed studs and partly to determine the fatigue characteristics of shear connections.

At the upper deck concentrated normal forces are introduced in the concrete at the nodal points. This leads to a high concentration of shear studs in these regions but does not give rise to particular problems. At the lower deck the transfer of the normal force from steel to concrete is more complicated, as the forces from the truss nodes pass through a steel crossbeam to the concrete troughs. The contractor's designer carried out the detailed design of the connections, while ASO Group carried out parallel analyses including investigations of alternative solutions, among others a separation of the concrete troughs from the steel structure.