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## **The Øresund Bridge: Project Development from Competition to Construction**

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### **Abstract**

Øresundskonsortiet is owned jointly by the two states Denmark and Sweden and is the Owner of the Øresund Link, responsible for planning, designing, financing, constructing, and after completion of the road and rail Link of its operation and maintenance. ASO Group was formed by Ove Arup & Partners of the UK with SETEC of France and Gimsing & Madsen and ISC of Denmark. Georg Rotne of Denmark is architect to the group. ASO Group, engaged by Øresundskonsortiet in 1993 after an international design competition, is responsible for the bridge concept and is presently integrated in the Owner organisation with particular responsibility for monitoring the construction works of the bridge. The paper describes the project development that took place for the bridge from the design competition to the construction. Also described are the Owner's construction contract strategy, the quality management policy and the Owner's active role through cooperation with the Contractor in achieving the earliest possible opening of the Link.

The design competition took place in the early part of 1993 and the result was that two proposals were chosen. They included two very different bridge designs: ASO Group's two-level concept and ØLC's proposal for a single-level bridge. Øresundskonsortiet decided to develop both designs further in parallel before choosing between them. Only the two-level solution is described in any detail as that in the end proved the successful concept.



*The two-level bridge*

A number of alternatives for the layout of the whole Link were prepared and evaluated. The main issues were the environmental impact of the Link and the economic consequences of alleviating the impact. The critical factor was the blocking of the water flow through Øresund due to the physical obstruction of the Link. The environmental investigations carried out by Øresundskonsortiet and their consultants proved that a 'zero solution' could be achieved without serious economic consequences, and on this basis the two governments gave their approval in the summer of 1994 to constructing the Link. However, the Swedish environmental legislation requires that the Swedish Water Court, which is independent of the Swedish government, had to rule on the effect on the water regime of constructing the Link as a prerequisite of giving the permission to construct the Swedish part of the Link.

In July 1995 the Water Court gave its ruling on the construction of the Swedish part of the Link and this cleared the main legal obstacles for the construction of the Link. The timing and content of the ruling was critical considering that the tender documents for the bridge had been issued to the prequalified bidders in December 1994 and their bids received in June 1995 i.e. before the ruling of the Water Court.

The bridge was issued to the bidders in two packages, the High Bridge and the Approach Bridges. Both bridge concepts were offered. The evaluation of the bids led to the award of one combined contract for the whole bridge to Sundlink Contractors HB in November 1995. Sundlink consists of Skanska of Sweden, Hochtief of Germany and Monberg & Thorsen and Højgaard & Schultz of Denmark. The Contractor's designer is a Joint Venture of COWI of Denmark and VBB of Sweden. Sundlink's bid was based on ASO's two-level concept.

At an early stage Øresundskonsortiet had decided to base the construction contracts for the Link on the design & build concept. It means that the Contract specifies a number of requirements on function, aesthetics, safety and environmental protection that the finished product shall fulfil. The Contractor has undertaken to design and construct works that fulfil the requirements, while the Owner has undertaken to pay the contract price. The undertaking of the Contractor includes everything required for the total completion of the "Portion of the Link" to a state in which it is "fit for its intended purpose". Excluded from the Contractor's undertaking are only those items that are expressly excluded by the Contract. This runs contrary to the principles of a traditional construction contract. Basically the Owner has specified what the Contractor shall achieve, and the Contractor determines how to achieve it. As a logical consequence of the design & build concept the Owner has adopted the basic quality assurance principle of self-control. The Owner is monitoring the Contractor's compliance with his Quality System and the requirements of the Contract.

In general the Owner does not need to nor does he want to approve materials, which are to be incorporated in the works. The Owner does not get involved in the day-to-day inspection and approval of construction work. The Owner is of course present at the sites and may from time to time test materials or inspect the works. However, it is vitally important that the Contractor sees the Owner's monitoring as a supplement to and not a replacement of his own supervision and QC function.

Areas requiring approval by the Owner are limited in order to maintain a clear division of responsibility. The most important approval by the Owner is the approval of the Contractor's Project Quality Programme, which forms the basis for the Owner's monitoring. The Quality Plans are crucial for the planning, execution and control of the works and are therefore subject to scrutiny by the Owner. No work activity is allowed to commence until the Quality Plan covering that particular activity has been approved by the Owner. The Quality Plans are the proof that the Contractor has understood the specified requirements and knows how he will achieve them.

Several simultaneously running contracts make up the Link and in order to coordinate the activities the Owner has taken an active role in optimising the planning of the so-called Parallel Works. The clear objective is to have the Link completed and inaugurated as early as possible and within budget. Close cooperation between the Owner and the various contractors has led to the success of this combined effort.

The Owner's strategy of cooperation, trust and openness has been a success. The bridge Contract is on time and on budget and the quality of the permanent works is to the Owner's satisfaction. There have been no disputes so far and therefore no significant claims against the Owner. This is not usual for a project of this size and complexity and can to a large degree be attributed to the spirit of partnership between Contractor and Owner, which has been allowed to develop throughout this truly international project soon to connect the two countries Denmark and Sweden.



*The cable-stayed bridge nearing completion*