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**Autor:** Falbe-Hansen, Klaus / Larsson, Örjan  
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## **The Øresund Bridge: Monitoring Construction Quality**

### **Klaus FALBE-HANSEN**

Director  
Ove Arup & Partners DK  
Copenhagen, Denmark

### **Örjan LARSSON**

Contract Director  
Øresundskonsortiet  
Malmö, Sweden

Klaus Falbe-Hansen received his MSc degree in civil and structural engineering from the Technical University of Denmark, 1967. He joined Ove Arup & Partners UK in 1968 and is a Director of Ove Arup & Partners Denmark and Project Director of ASO Group

Örjan Larsson received his MSc degree in civil engineering from the Technical University of Lund, 1969. He worked for NCC as a Contractor until he joined Øresundskonsortiet in 1993. He is Contract Director responsible for the Øresund Bridge Contract.

### **Abstract**

The Øresund Bridge is part of the fixed link under construction between Denmark and Sweden. Øresundskonsortiet is the Owner of the Link and responsible for its implementation, operation and maintenance. ASO Group, consisting of Ove Arup & Partners (GB), SETEC (F) and Gimsing & Madsen and ISC (DK), is the Owner's Consultant responsible for bridge concept and for monitoring the quality of the construction works. The Contractor is Sundlink Contractors HB consisting of Skanska (S), Hochtief (D) and Monberg & Thorsen and Højgaard & Schultz (DK). COWI (DK) and VBB (S) have carried out the detailed design for the Contractor. The paper describes the Owner's Quality Management Policy, first as defined in the contract documents and later as executed during the construction phase. The same principles as described here for the bridge contract have been applied to all major contracts for the Link. Opening of the Link is scheduled for July 2000.

The US\$1bn construction contract for the 8km two-level road and rail bridge was awarded in November 1995. The principles behind the Owner's contract strategy were:

- 'design and build',
- 100 years service life,
- application of well-known technology and
- control and documentation of quality.

The Owner's approach to achieve his objectives is one of cooperation, which necessarily must be based on mutual confidence and trust between the Owner and the Contractor.

The Owner's requirements regarding function, aesthetics, safety and environmental protection are defined in the contract documents. Everything required to fulfil those requirements is included in the Contractor's scope of work with only specified duties on the Owner. The Contractor has been given considerable freedom regarding the means and methods. Basically the Owner specifies what the Contractor shall achieve, and the Contractor determines how to achieve it. The Contractor is responsible for supervising his own work and for providing documentation to prove that he is doing so and that as a result the work he is doing is of the quality required by the Contract. This means that the Contractor shall approve his own work. However, the Owner is monitoring the Contractor's performance.

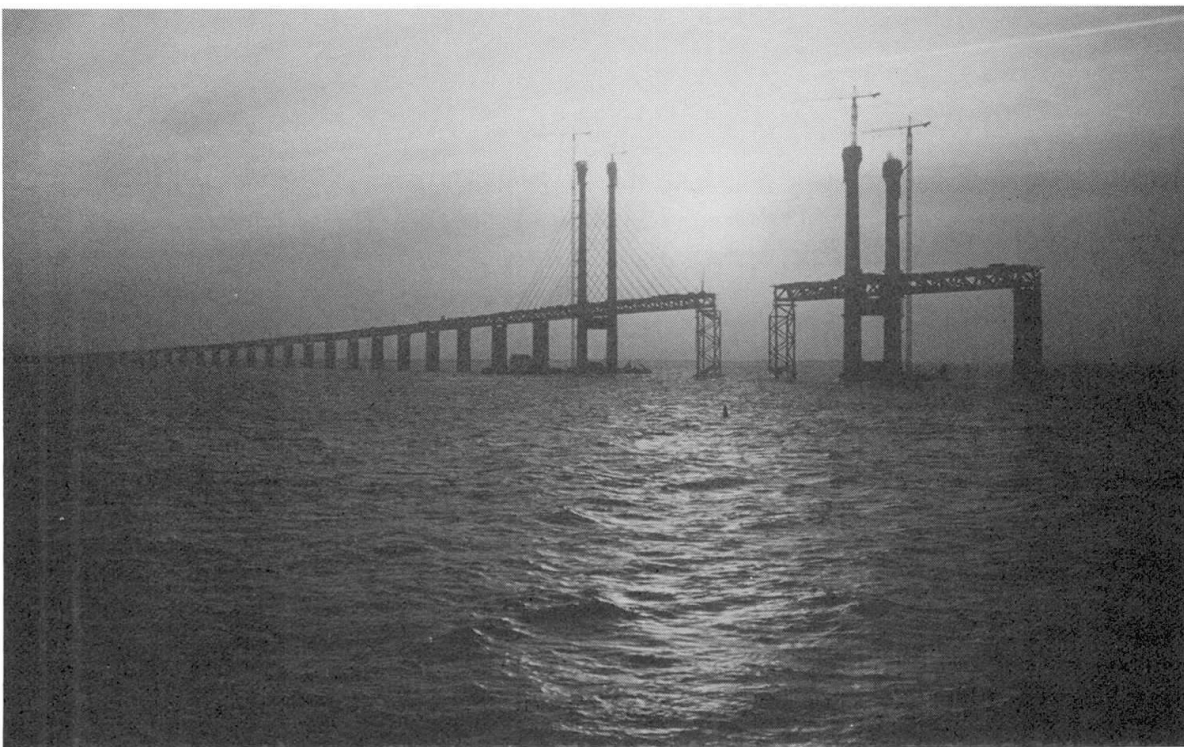
The Contractor shall establish maintain and adhere to a Project Quality Programme specifically adapted to the Contract. The PQP shall be based on the contract document, Quality System

Requirements, which in turn is based on the EN ISO 9001 standard, 1<sup>st</sup> edition. The PQP shall be documented by a Quality Manual and a number of Quality Plans (QP), which are subject to approval by the Owner.

The Contractor is responsible for the detailed design, however, his so-called basic design is subject to approval by the Owner and shall follow the contract document, Definition Drawings, which defines the visible geometry of the bridge.

The Owner's monitoring consists among others of review and approval of the Contractor's documentation, quality system audits, construction monitoring, review and approval of remedial action on non-conforming work and checking and signing off of Payment Validation Reports.

Most procedures covering the Owner's monitoring were produced before the construction contract was awarded. However, a number of the procedures concerning site queries and non-conforming work have been revised in line with the Owner's increasing confidence in the Contractor.



*The 490m main span is nearing completion*

There can be many reasons for developing revised and apparently relaxed procedures for the processing of site queries and of works not conforming to the Owner's requirements. One of course being the Owner's limited resources, in fact a total of only 12 to 15 people has been engaged in the Owner's monitoring of the construction work. However, more important reasons are:

- to demonstrate the Owner's confidence in the Contractor's self-control and
- to create a use-friendly system that keeps control.

The bridge is not yet complete but it is not too early to conclude that the Owner's strategy of cooperation, trust and openness has been a success. The Contract is almost 80% complete, is on time and on budget. The quality of the permanent works is to the owner's satisfactory. There have been no disputes so far and therefore no significant claims against the Owner, and none are expected either. 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, which has been allowed to develop on this truly international project linking the two countries Denmark and Sweden.