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Autor: Kalhauge, E. / Jessen, J.J. / Haas, G.

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Client
The Road Directorate

Design and Supervision
COWIconsult

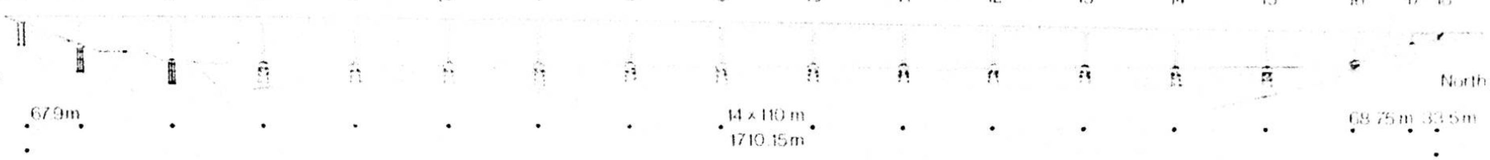
Architects
Hvidt & Mølgaard-Nielsen

Contractors
The Vejle Fjord Consortium
Monberg & Thorsen Ltd
Dyckerhoff & Widmann AG
A. Jespersen & Søn Ltd

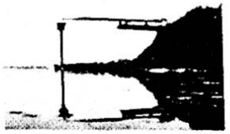
Vejle Fjord Bridge, Denmark

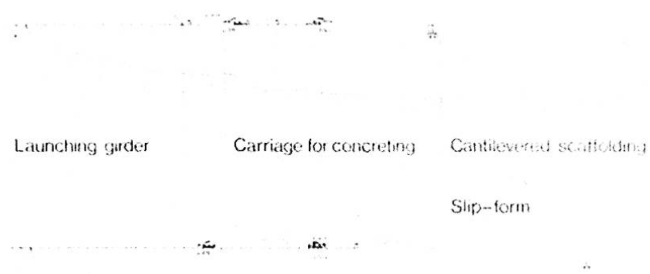
Erik Kalhauge
Jens Jonas Jessen
Georg Haas

Cowiconsult



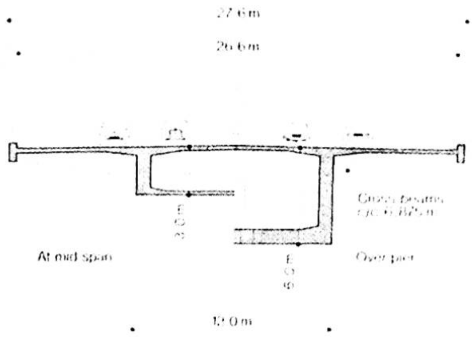
Elevation



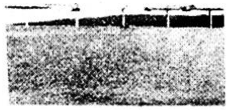


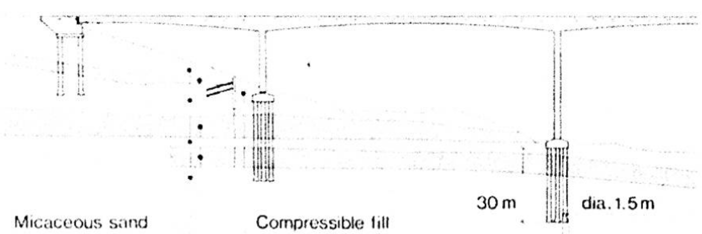
Principle of execution

When open to traffic in 1980 the motorway bridge across Vejle Fjord will be the second longest bridge in Denmark with a total length of 1710 m. The superstructure is constructed in post-tensioned cast in-situ concrete using the balanced free cantilever method. The cross section is designed as a central box-type girder with cross beams. The effective width is 26.6 m. The foundation is mainly on piles. Bored piles are used as well as driven piles.

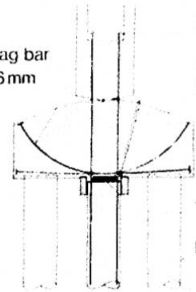


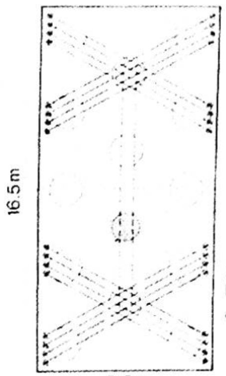
Cross section





Section in southern bank





Test loading of bored piles
Prestressing of pilecap (pier no. 2 and 3)

VEJLE FJORD BRIDGE - E. KALHAUGE, J.J. JESSEN, G. HAAS, COWICONSULT, DENMARK.

During the design phase and in the course of the erection of the bridge a number of special problems arose and were solved by somewhat unconventional means.

Two of these problems aroused special interest at the poster session and will be treated in detail in later publications: The Pier Foundations in the South Slope and the Temperature Gradient Problem of the Superstructure.

A decisive improvement of the stability of the potentially dangerous south slope was achieved by means of several stabilizing measures. In view of the difficult soil conditions it was decided to employ large bored piles, ϕ1.50 m, for the foundations of the three southernmost piers. The piles were up to 30 m long and were carried through alternating layers of tertiary clay and water-bearing sand. Their bearing capacity was established by testloading 3 piles with vertical loads of 11-17 MN each. The load-settlement relationships of the pile groups have been followed from the time of construction, also studying the influence of artesian pressure variations in the soil layers.

A close control of the temperature conditions of the superstructure concrete was necessitated, partly because an early striking of formwork was desirable in order to obtain a reasonable flow of work for the cantilever construction.

After a series of model calculations and correlating tests during the construction of the first segments, it was realized that temperature differences might lead to excessive tensile stresses - and ensuing cracks - in certain sections of the structure, especially during times of the year with adverse climatic conditions.

The temperature problems may be divided into the types as shown in the table below.

In order to avoid adverse affects from these temperature gradients, a special enveloping insulation carriage was developed covering 1½ section behind the form. The carriage is supported on the bridge deck and is connected to the construction carriage.

The envelope is constructed from 16 mm plywood boards, provided with 10-50 mm foam insulation. The distance between concrete surface and the envelope ranges from 0.6 to 2.0 m. Depending on ambient temperature, hot air is blown into the space. On the deck, however, the insulation is placed directly on the concrete.

Measurements have been made during the construction by means of Nickel-Chromium thermoelements embedded in the concrete. In the table is shown a comparison between maximum temperature differences measured.

Difference in temperature. Influence of Insulation.

Problem type	No Insulation $\Delta T_{max.}$	Insulation $\Delta T_{max.}$
Local gradients in massive elements	65°C	12°C
Temperature differences between adjacent elements of the cross section	40°C	15°C
Temperature differences across construction joints	60°C	30°C