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Design and Construction of a CFRP Cable Stayed Footbridge

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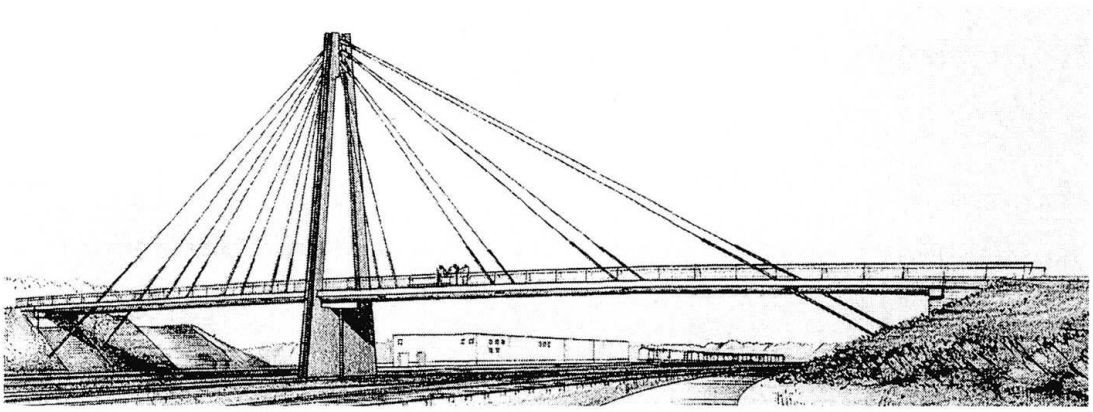

Fig 1. Artist's impression of Herning footbridge, courtesy Møller & Grønborg Architects and Planners

Abstract

The first bridge in Denmark, and one of the first in the world, to be built with extensive use of Carbon Fibre Reinforced Polymer (CFRP) materials is in the final stages of construction in the Danish town of Herning. The cable stayed bridge has one central pylon, dual cable planes and a total length of 80 m. The bridge will facilitate pedestrians and emergency vehicles crossing a railway switchyard.

The bridge will be the longest so far to be constructed with exclusive use of CFRP stay cables. The bridge deck will be post tensioned with 6 CFRP tendons, and a 40 meter section of the bridge deck will be reinforced with CFRP bars and stirrups. The opposite 40 meter section will be reinforced with a combination of conventional reinforcement and stainless steel reinforcement.

The immediate goal of the project is to gain experience within the use of new non-corrosive materials in exposed structural components. In a longer perspective, the limit of cable supported bridge's main span may be increased significantly by substituting traditional steel cables and girders with advanced composite components. A bridge across the Strait of Gibraltar with a main span significantly above the 5 km mark is one exciting possibility for the future.

The Danish Road Directorate has an intensive interest in non-corrosive materials, being responsible for the operation and maintenance of the Danish main road network which includes more than two thousand bridges. The heavy use of de-icing salts in the winter periods combined with frequent freeze-thaw cycles have rendered traditional reinforced concrete bridges prone to damage, initiated by reinforcement corrosion.

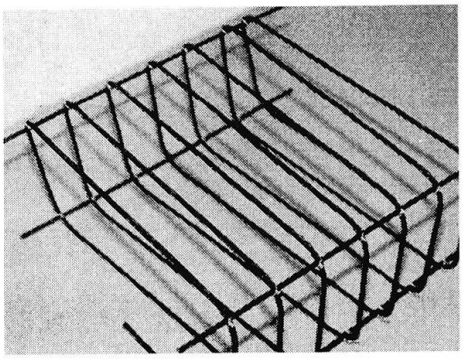

Fig 2. CFRP bars and stirrups, Tokyo Rope Mfg. Co.

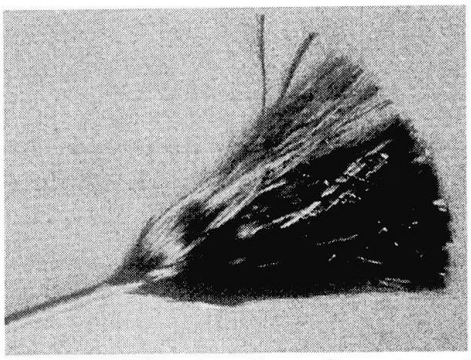

Fig 3. CFRP wire, 5mm diameter, with ca. 400.000 fibres, courtesy BBR

The performance of the CFRP cables and reinforcement will be monitored during the service life of the bridge. Especially the environmental resistance will be followed. As a consequence of the use of non-corrosive reinforcement, the bridge deck is without the traditional bituminous waterproofing membrane. If the trial is successful, it may be possible to omit the water proofing membranes in the future. This would mean a considerable reduction in maintenance costs and limit traffic disruption during maintenance operations.

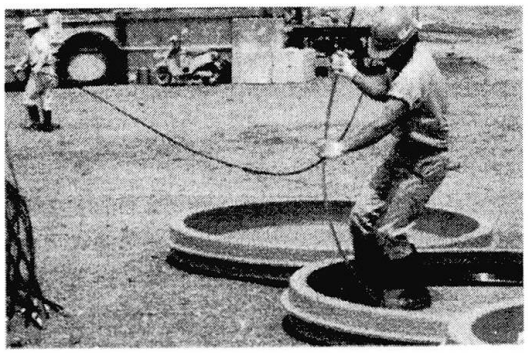

Fig 4. Handling of CFRP 7-wire tendons, courtesy Tokyo Rope Mfg. Co.

The bridge is part of a development project for the Danish Road Directorate. COWI has been the leading partner in a group of international companies and research institutes with the aim to study the use of advanced composites, particularly carbon fibre materials, in construction. The bridge was designed by COWI with Møller & Grønborg as architects. Skanska A/S has been the main contractor.