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Artikel: Humber Bridge (Great Britain)

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1. Humber Bridge (Great Britain)

Owner: Humber Bridge Board
Engineer: Freeman Fox & Partners
Principal Contractors:
Substructure: John Howard & Co. Ltd.; Tileman & Co. Ltd.
Superstructure: British Bridge Builders Ltd.
Approaches: Costain Civil Engineering Ltd.; A.F. Budge Ltd.
Construction Period: 1973-1981

General

There has been a local need for a fixed crossing of the Humber estuary for more than 100 years. When it is completed in 1981, the bridge will link areas on either side of the estuary, cutting road distances by as much as 50 miles. The bridge will thus provide the key to the future development of the new county of Humberside.

The main span of the bridge, 1410 m, is the longest in the world (exceeding the Verrazano Narrows Bridge, New York, by 112 m). Side spans of 280 m and 530 m bring the total length between anchorages to 2220 m. In general the design is similar to the Severn Bridge (UK) and the Bosporus Bridge (Turkey), completed in 1966 and 1973 respectively, although there are important differences.

Substructure

On the north bank, a hard well-jointed bed of chalk is close to the surface. This has provided good foundations for both the anchorage and the tower pier, which is on the land, close to the waters edge.

On the south side, in the areas where both the pier and the anchorage are located, soft alluvium is underlain by beds of boulder clay, sand and gravel. Below these beds, at a depth of 30 m, there is a deep bed of stiff heavily fissured Kimmeridge clay, on which the pier and the anchorage have been founded. The pier is in the river, about 500 m from the south bank, while the anchorage is on the land about 30 m behind the flood bund.

The anchorages are massive concrete structures within which the cables, after passing over steel saddles, splay out into separate strands which pass round the fixed strand shoes.

The north pier was constructed directly on hard chalk, while the south pier necessitated the sinking of two circular concrete cellular caissons, 24 m in diameter, down to the Kimmeridge clay 35 m below river bed level.

Towers

The towers are of concrete and the two tapered legs of each tower were built by slip-forming. After this, the four portal beams were constructed in situ between the legs, starting with the upper beam and working down. In this way the tower tops could be handed over to the superstructure contractor to allow preparations for footbridge erection to begin at the earliest possible time. Concrete was preferred to steel for the towers because of the saving in cost, not only of construction but also of maintenance.

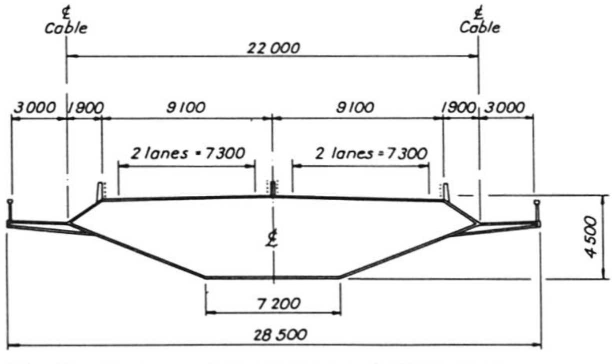

Fig. 2 Cross section of suspended structure

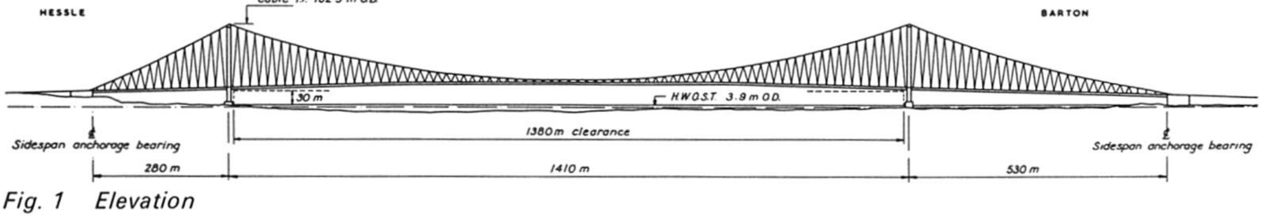

Fig. 1 Elevation

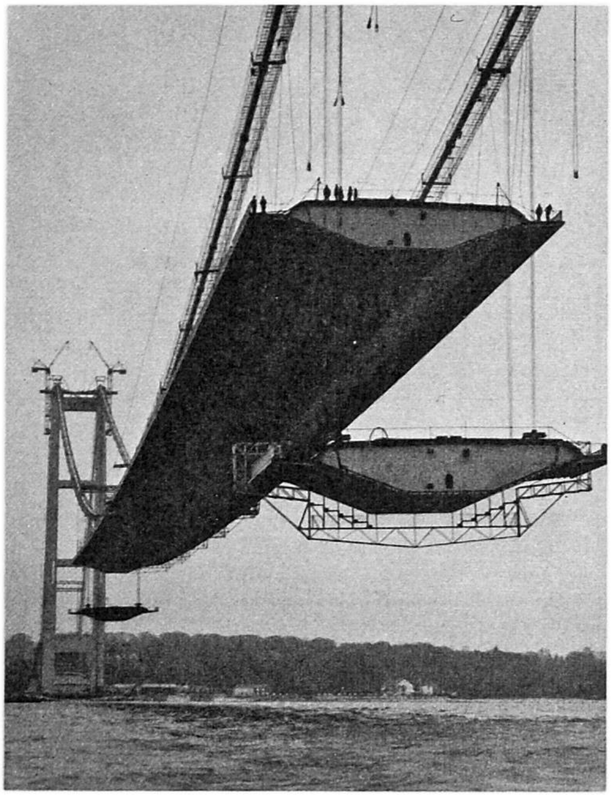

Fig. 3 Box erection. Two boxes being lifted simultaneously. The nearer box carries a temporary welding gantry

Cables and hanger ropes

Each cable contains just under 15,000 galvanised 5 mm parallel wires, the breaking load of each being about 3 t. In the shorter side span the cable tension is increased due to the relatively steep inclination of the cables, and additional wires are provided, anchored at the tower top. The wires were placed by the aerial spinning method, each trip of the wheel carrying two bights of wire.

The cast steel cable bands are clamped to the cable at 18.1 m horizontal spacing, and the spiral strand hanger ropes are pinned to lugs on the underside. As the hangers are inclined (see Fig. 1), they resist relative longitudinal movement between the cables and the deck; the lay length of the strand of which they are made is relatively short and this gives them a capacity to absorb energy which assists the structural damping.

Suspended structure

The suspended deck is of the streamlined box form similar to that used at Severn and Bosporus. This gives good aerodynamic stability at the same time as minimising wind drag. The clean external surface makes it simpler and cheaper to maintain than an equivalent stiffening truss type of suspended structure. In order to give adequate torsional stiffness the depth of the box has been increased to 4.5 m (as compared with 3 m at Severn and Bosporus). (See Fig. 2).

The stiffened plate panels were assembled at site into box units 18.1 m long (see Fig. 3) which were then floated out on pontoons and lifted by carriages supported by the cables (see Fig. 4). Once in position, the permanent hangers were connected and the boxes temporarily joined together until the increasing load in the cable, and consequent change of profile, allowed accurate alignment of the boxes and final welding. There are rocker bearings at the end of each span to provide lateral and torsional restraint.

The surfacing consists of 38 mm of mastic asphalt, generally to BS 1447, which is being laid by machine for the first time. This will bring advantages of increased speed of laying, and improved riding quality of the finished surface.

(B. P. Wex)

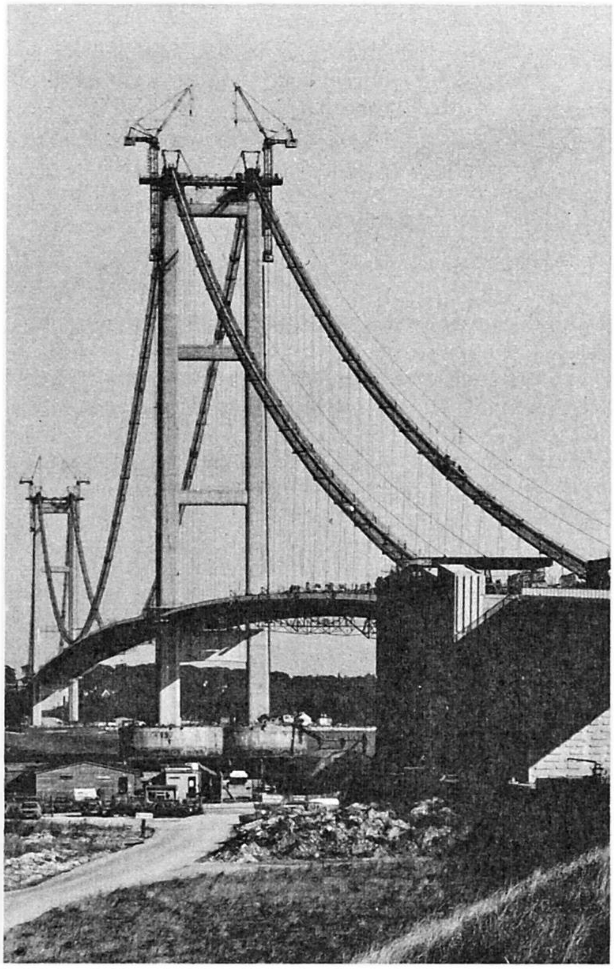

Fig. 4 General view of the structure, October 1980. (Note the effect of lack of asphalt dead load on the continuity of the profile at the tower.)