Great Belt

East Bridge

Storebæltforbindelsen is the road and railway link between the Danish Islands Funen and Zealand. It connects Copenhagen with the mainland of central Europe. An important part of this link is the Great Belt East Bridge, one of the longest suspension bridges in the world, for which the Joint Venture, Great Belt Contractors, had been awarded the concrete and substructure works.

HOCHTIEF
CONSTRUCTION AG

The Project

The pylons from which the main span is suspended will rise to a height of 254 m. They are constructed of in-situ reinforced concrete, but are founded on prefabricated reinforced concrete caissons.

The cable forces (55,000 tonnes per block) will be transferred to the subsoil by means of the two reinforced concrete anchor blocks, which are positioned on the viaduct side of each of the pylons and will rise to a height of 68 m.

19 piers support the approach span viaducts, with spans of 193 m. Eighteen piers are prefabricated and one pier is cast in-situ. The prefabricated piers comprise a caisson, a lower and an upper pier shaft.

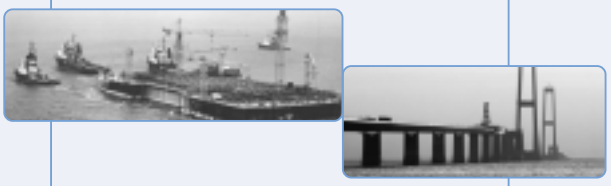
The bridge abutments are constructed of in-situ reinforced concrete.

Works in the Prefabrication Dock

The caissons for the pylons, anchor blocks and seven of the piers were constructed in two purpose built dry docks in Kalundborg. Kalundborg is 45 km to the north of the bridge on the island of Zealand. The dry docks were excavated to depths of –13 m and –10 m. When the caissons were complete the docks were flooded and the dock walls were breached to enable the caissons to be transported.

The extremely large caissons for the pylons and the anchor blocks were floated up, and then towed to the bridge site by powerful seagoing tugs. They were the sunk into their final position onto the previously prepared stone foundation beds.

Apart from the seven heaviest caissons, all of the approach span caissons and shafts are prefabricated at the quayside at a specially constructed load-out quay. The elements are lifted by heavy capacity sheerleg crane barges and transported to the bridge line.



The Pylons

Each Pylon is constructed as a single mass up to level +21 m. Above this point the construction splits into two inclined legs which are connected by cross beams at levels + 125 m and + 240 m.

The legs are formed in 58 lifts each of 4 m height using “self climbing” formwork. The formwork has seven working levels for fixing reinforcement, concreting, operating and finishing.

In order to compensate for the influence of gravity during the construction of the inclined legs, “overshooting” of each lift position can be accommodated in the surveying.

The Anchor Block

On plan, each Anchor Block is the size of a soccer pitch. The Anchor Blocks form the transition between the suspension bridge and the approach span viaducts and are very complicated structures. The lower part is formed by a cellular caisson type box, with each of the cells being filled with ballast. There are a number of different types of ballast material. The upper part comprises inclined legs and a pier shaft. The 45° inclined legs are constructed using a technique known as “free-cantilevering”.

Within the Anchor Blocks there are two 9,000 m^3 reinforced concrete massifs through which the main span forces are transferred. The reinforcement in the massifs is a 3-dimensional grid comprising Ø 35 mm reinforcement bars, diagonally intersected by Ø 200 mm ducts accommodating 3 Macalloy post-tensioning bars.

Bridge Works Offshore

The foundations were formed by the excavation of pits in the seabed using a bucket dredger. The deepest pits were dredged in up to 25 m depth of water with the lowest point of the foundation at level -32 m. The pits were backfilled with crushed stone which was sub- sequently compacted. The foundation was then topped off with an uncompacted screeding layer of crushed stone, placed to a tolerance of 20 mm. The skirts of the caissons were designed to penetrate into the screeding layer during placing.

The towing of the caissons and subsequent positioning on the seabed required great accuracy. Model tests had been undertaken beforehand to determine their behaviour during this critical operation. The Pylon and Anchor Block caissons which measure respectively 78 m x 35 m and 122 m x 55 m on plan were positioned within the required tolerances of 200 mm. The void between the caisson bottom and the screeded layer was grouted within 72 hours of the caisson being placed.

The placing of the prefabricated elements for the Approach Span viaducts took place in single or dual lifts using sheering crane barges.

Project data

Client:	A/S Storebæltforbindelsen, Denmark.
Contractor:	Joint Venture Great Belt Contractors consisting of 5 companies, HOCHTIEF as lead partner with a share of 38%
Total length of bridge:	6790 m
Length of suspension bridge:	2694 m
Midspan of suspension bridge:	1624 m
Eastern approach bridge:	2529 m
Western approach bridge:	1567 m
Height of pylons:	254 m
Navigation clearance:	65 m
Order value:	397 mill. EURO
Construction period:	October 1991 to October 1995

Overall quantities:

In-situ concrete	170,000 m^2
Prefabricated concrete	100,000 m^2
Reinforcing steel	42,000 tons
Post-tensioning steel	1,955 tons

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