A BRIDGE TO THE FUTURE

Mapei products were selected for the East Bridge segment of this grandiose transportation project linking the islands of Denmark with the continent

by Natasha Calandrino and Pasquale Zaffaroni

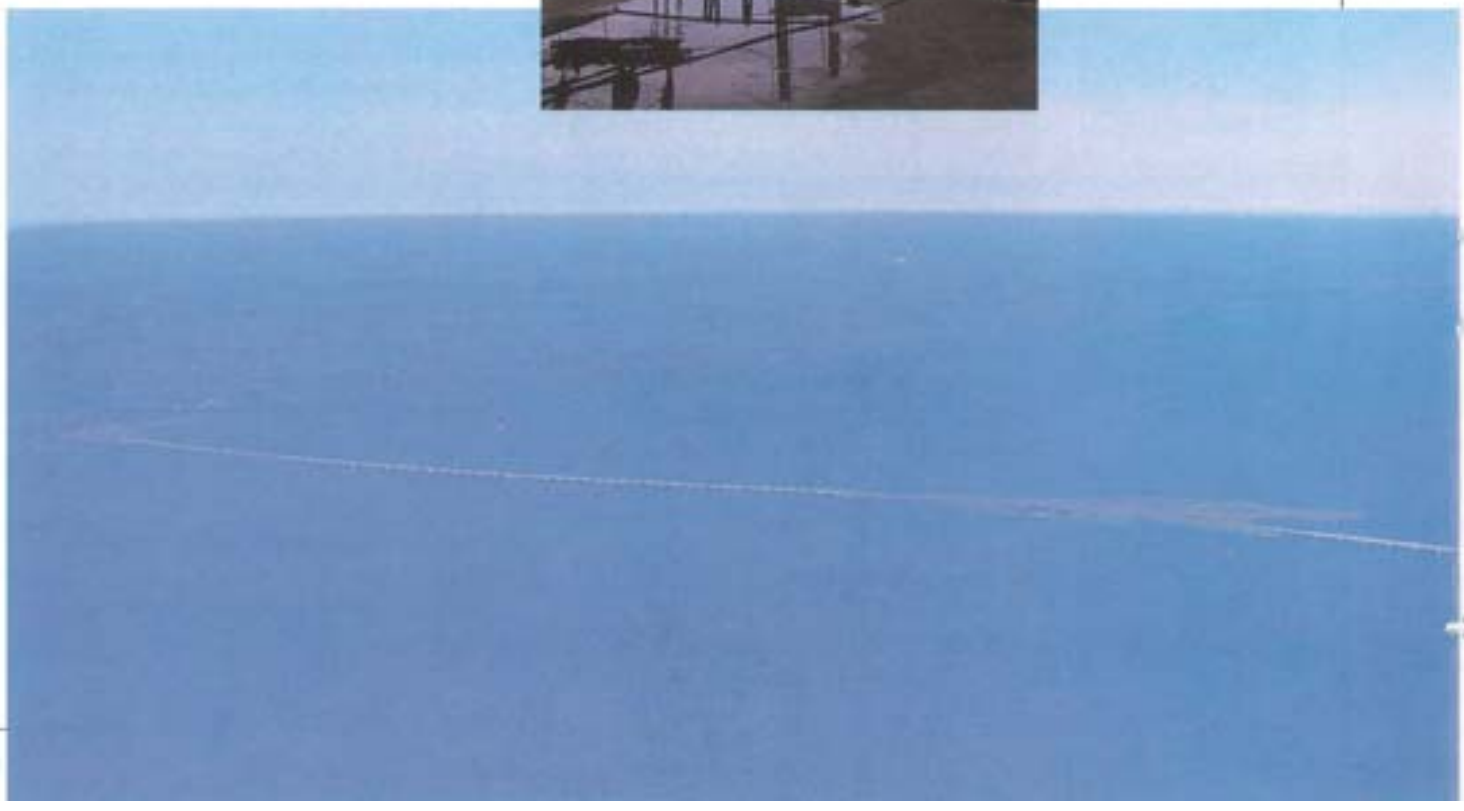
The Great Belt Link connecting the islands of Denmark to the rest of the continent is without a doubt one of the most significant infrastructure projects to be completed in Europe in recent years. The project called for the construction of two bridges carrying three lanes of automobile traffic in each direction (with an estimated 16,000 cars a day!), and an undersea tunnel exclusively for trains: a colossal network 6,790 meters long crossing the Storaebelt Strait between the Danish mainland and the island of Zealand. The two bridges were designed to perform the same function but with different characteristics. The West Bridge covers the first portion of the project between the Danish peninsula and the little island of Sprogo, located approximately at the halfway point of the Great Belt Link. The East Bridge connects Sprogo with the island of Zealand and was inaugurated June 14th of this year. With a central span 1,624 meters long between its two concrete towers, it is the world's second longest suspension bridge.

The East Bridge

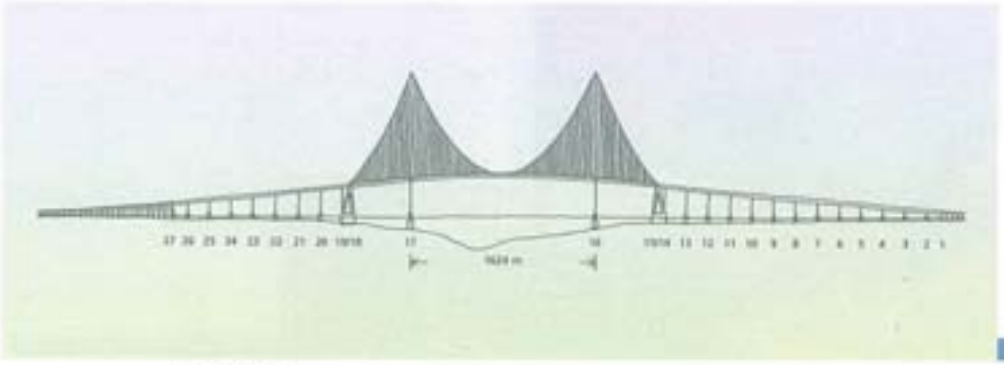
Mapei products were selected to be used

PHOTO 1

Photo 1
"The Great Belt Link" between the North Sea and the Baltic, with two bridges (East Bridge and West Bridge) and a tunnel linking the Danish islands with the continent



DRAWING 1



Drawing 1
The drawing shows the East Bridge, a suspension bridge 65 meters high with its two lateral access bridges whose steel - supported roadways rest on concrete pylons.

PHOTO 2

Photo 2
Details of the formwork used in the full scale test for casting the bearings, with the tip of the pylon and the base of the bearing reproduced in the Mapei plant in Mediglia

Photo 3
One of the first trials of the full scale test

in building the East Bridge. The project turned out to be especially complex because it had to integrate a transportation system moving cars, trains and ships without having a negative impact on the environment. Each year 20,000 ships pass from the North Sea to the Baltic through the channel separating the islands of Sprogo and Zealand. Having to keep the channel open to heavily trafficked shipping lanes necessitated the building of a suspension bridge 65 m. above the waterline with a long central span. The towers had also to be able to withstand the potential impact of a large ship accidentally colliding into them without the bridge's suffering irreparable damage. The East Bridge is

PHOTO 3

PHOTO 4

Photo 4
The slab produced for the full scale test model to check the performance of the MAPEFILL against the project specifications

PHOTO 5

Photo 5
MAPEFILL mixed with gravel was used to reduce the heat of hydration caused by the remarkably thick casting

Photo 6
Detail of the reinforcing bars inside the bearings

divided into three separate structural elements, the central suspension span and the two bridges approaching it on either side. Although the latter were not suspension bridges, they presented a considerable challenge to the project's architectural and construction firms. For both the central span and the two lateral spans the architects opted for a roadway with a longitudinal center reinforcing beam and with trusses forged entirely in high strength Fe 420 steel.
The roadway rests on concrete pylons 193 m. apart. Its main requirement was resistance to horizontal vibrations caused by wind and vertical vibrations caused by automobile traffic. Most importantly, the mortar used for anchoring the rods connecting the reinforced concrete pylons with the steel bearings supporting the roadway had to possess high flexural and compressive strength.

Full scale test

The detailed planning for such a large scale project made it necessary to test the materials to be used. Mapei was able to satisfy this requirement because of the high quality of its products and its very accommodating technical assistance team. A full scale test was conducted at the Mapei plant in Mediglia to guarantee

PHOTO 6

PHOTO 7

PHOTO 8

Photo 7
Checking the porosity on the surface of the MAPEFILL after removing the slab. The photo shows limited porosity

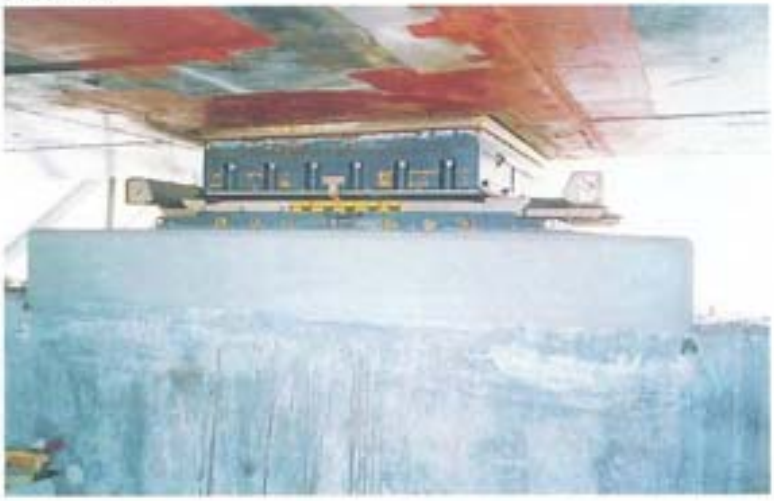
Photo 8
The MAPEFILL bearings are coated with MAPELASTIC to increase protection against atmospheric agents

Photo 9
Another step in applying the MAPELASTIC

Photo 10
The finished bearing coated with MAPELASTIC

PHOTO 9

PHOTO 10



optimum product performance and proper installation on site. Following the pattern of the reinforcing bars, the top of a pylon was reproduced to simulate actual conditions. A slab was then prepared to represent one of the bearings, containing the exact number of the same size Nelson rivets used in the real bearings. An extremely fluid mortar was needed so it could be poured around the thick network of rebars. The ideal product for the task was MAPEFILL mixed with fine gravel to reduce the heat of hydration generated by such thick casting. Once the slab was removed, the surface was examined to check porosity, i.e. the exact number and size of pores. This last test was very important because it ensures that the weight of the beams is evenly distributed over the entire area.

After checking that the modulus of elasticity was in keeping with the requirements of the bearings' manufacturer, tests were made to measure mechanical strength both at normal temperatures and at 5°C over various amounts of time. With the data gathered during the series of full-scale tests at Mediglia, Mapei was able to co-operate actively on site, following casting closely and checking up on the pumpability of the product.

For increased protection from atmospheric agents the MAPEFILL bearings were coated with MAPELASTIC, a mortar that is permanently flexible even at sub-freezing temperatures and

PHOTO 11

Photo 11
The impressive silhouette of the East Bridge under construction. The span was inaugurated June 14, 1998

impermeable to sulphates and chlorides. A light-colored MAPELASTIC similar to the color of the concrete was requested. Here, too, Mapei was happy to comply. Special importance was placed on maintenance from the very first conceptual analysis of the project. Periodic safety checks will be made to guarantee that the products installed will last for over 100 years, even at gusts of wind up to 25 m/s. ❑

The technical sheets of the products mentioned in this article are contained in Mapei binder N° 3 "Building specialty line".

TECHNICAL DATA

Project: "The Great Belt Link"

Year of Execution: 1991-1998

Architects: Dissing + Weitling Arkitektfirma A/S and Jørgen Vesterholts Tegnestue ApS

EAST BRIDGE:
Construction firm: Iritecna-CMF Sud, Italia in cooperation with Steinman Boynton Gronquist & Birdsall, USA

Technical consultants: Joint Venture CBR:
- COWIconsult A/S, Denmark
- Ramboll, Hannemann & Højlund A/S, Denmark

Specialists associated with Joint Venture CBR: Chodai, Japan

Mapei products used:
MAPEFILL
MAPELASTIC

The Mapei products mentioned are part of Mapei's European product lines