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Artikel: Bridges on the Mecca-Halban Freeway (Saudi-Arabia)
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14 Bridges on the Mecca-Halban Freeway (Saudi Arabia)

Client: *Ministry of Communication, Riyadh, Kingdom of Saudi Arabia*

Design and Supervision: *Zacoconsult, Consulting Engineers, Riyadh A Joint Venture between Cowiconsult Copenhagen and the local firm Zahret al Riyadh*

Introduction

The 760 km Mecca-Halban Freeway is part of a cross-country freeway linking the capital, Riyadh, with Dhahran by the Arabian Gulf and Jeddah by the Red Sea (Fig. 1).

More than 100 bridges with a total length of 21,800 m will cross the numerous wadis. A total of 60 bridges is required in connection with road crossings and interchanges. Subways along the freeway will allow nomades and livestock to safely cross the freeway.

The freeway passes through extremely varied terrain. The most spectacular section is the approximately 1,000 m high ascent of the Heyaz mountain range, where the roads wind through wadis and narrow valleys from the coastal plain to the Najd plateau.

All wadi bridges are designed to provide for the passing of floods with a fifty-year recurrence interval and a free height between water surface and the underside of the bridge deck which varies from a minimum of 0.75 m for wide shallow wadis to 1.50 m for narrow, deep wadis.

Fig. 1

Piers in reinforced concrete are 1 m to 1.25 m dia. columns to minimize forces in any direction from the rapidly flowing water. The piers are either fixed or hinged to the superstructure and fixed to the bases.

The foundations are spread directly on the sandy wadi formations. The bases are generally founded 4 m into the riverbed, i.e. well below the maximum scour depth. A loose stone riprap protection has been provided above the bases to provide additional safety against detrimental scour.

Furthermore, gabions have been used for embankment protection at the bridge ends.

In cases where the rock formation is encountered less than 4 m below riverbed a direct base in mass concrete is specified.

Interchange Bridges

All interchange bridges (Fig. 4) have been designed as single or double hollow box girders in prestressed concrete. The overall width of the deck confirms Several hundred kilometres of the road passes through desert areas, at some locations where there are moving sand dunes (Fig. 2).

Field work including soil investigation and topographical survey was started in January 1977 and the final design was completed in May 1978. This tight time schedule could only be met by extensive use of integrated computer methods based on central data base systems.

Design Standards

The loadings on bridge structures conform to the current AASHTO "Standard Specification for Highway Bridges". Live loads are, however, increased by approximately 20 per cent, and a single truck of 60 tons has been taken into consideration in the design to compensate for the large number of heavily loaded trucks.

Wadi Bridges

The superstructure for each carriageway consists of two reinforced longitudinal beams (18 m spans) (Fig. 3), or prestressed double box girders (40 m spans), both types continuous at the supports, cast in situ, and transversely connected by a reinforced concrete slab cantilevering beyond the beams or box girders. The overall width of the decks conforms to the full shoulder-to-shoulder width of the carriageways, allows 3 lanes and shoulders on both sides of the carriageway resulting in a total width of each deck of approximately 17 m including kerbs.

to the full shoulder-to-shoulder width of the overpassing highway.

2-span bridges with end piers concealed in the embankments are generally preferred to allow for the possibility of widening the underpassing freeway and to provide an unobstructed view in the interchange area. Spans ranging from 30 m to 50 m have been employed.

A minimum vertical clearance of 5.50 m under bridges has been provided in accordance with Saudi Arabian standards.

Where the overpassing road has two carriageways separated by a median, two separate bridges are provided for reasons of economy.

For aesthetical reasons the piers are tapered contributing to a light impression of the bridge structure. The superstructure is cantilevered behind the end piers in order to balance dead load bending moments in the spans. Therefore, the end piers have been positioned as optimally as possible in order to obtain an economical ratio between the span length of the cantilevered portion of bridge as well as an aesthetically light impression of the entire bridge structure.

The construction of reinforced concrete bases and piers has been carried out by conventional cast in situ methods.

The superstructures are cast in situ and the prestressing cables have been jacked in one single operation.

Design Schedule

The tight design schedule could only be met by extensive use of modern design methods comprising automatic collecting of field data and computerized design and drafting based on central data base systems.

Maps as well as road and bridge drawings have been traced by a plotter connected with a PRIME computer. This eases quality assurance and gives complete uniformity of the design documents.

Duration of Works

Construction works have been staggered and the first part started in January 1979. The 125 km eastern section of the freeway was completed in 1981 as a single carriageway. The Mecca-Taif section (127 km) was constructed in full width from 1981 to 1983. The section from Taif and 400 km eastwards is presently under construction new and is schedulded to be completed as a single carriageway in 1984. The total cost will be 7,500 million Saudi Riyals.

Field work including soil investigations and topographical survey was started in January 1977. Photogrammetry commenced in June 1977. The design and tender documents for the first 70 km of the freeway was submitted in October 1977. Final design of the total freeway project was completed in May 1978.

(A. Borregaard Sørensen)

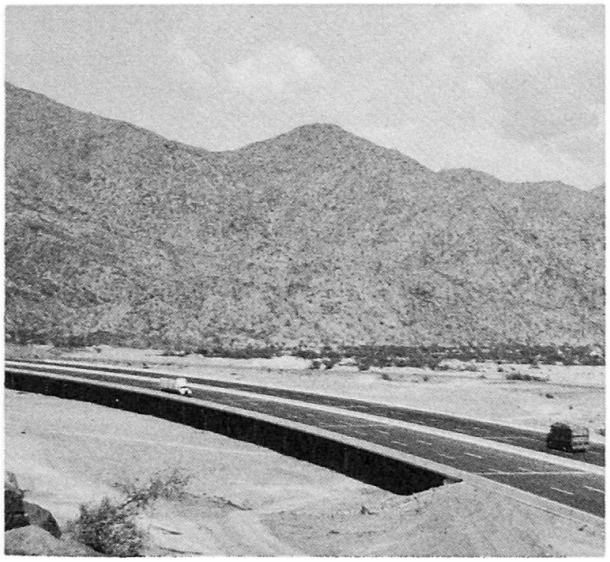

Fig. 2

Fig. 3

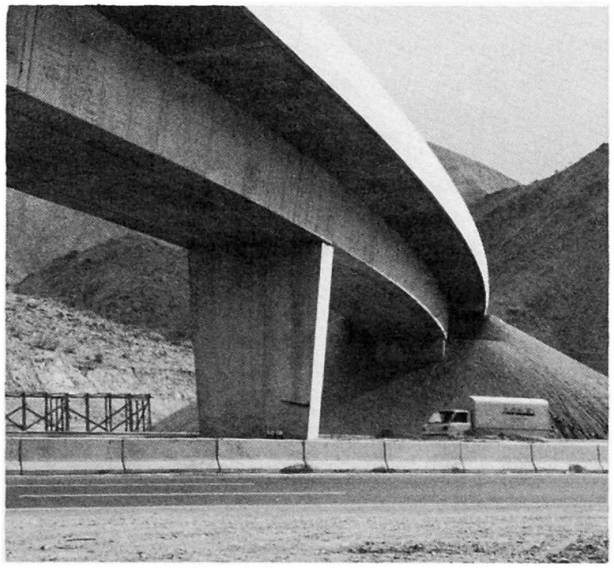

Fig. 4