Dumbarton Bridge (California, USA)

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Owner: *Department of Transportation, State of California*
Engineer: *Department of Transportation, State of California*
Contractor: *Guy F. Atkinson Constr. Co.*
Construction Period: *38 months*
Service Date: *1982*

Introduction

The new Dumbarton Bridge replaces an antiquated 2-lane crossing of the southern arm of the San Francisco Bay. The new bridge provides a congestion-free link from the East Bay to the lower San Francisco Peninsula. The new structure is 2,600 m long, 2,195 m of which is over water. The main navigation span of 104 m provides 26 m vertical clearance. The 26 m deck contains two traffic lanes and a breakdown lane for each direction of traffic separated by a concrete safety barrier, plus a pedestrian and bicycle path, also separated from traffic by a concrete safety barrier.

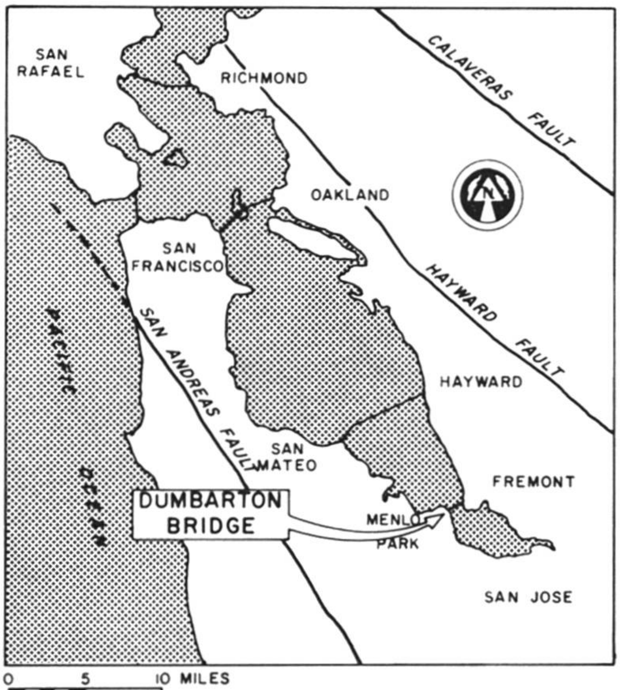

Fig. 1 Site location

Structure Description

The new Dumbarton Bridge consists of three types of structures:

1) At each end of the bridge is a 198 m reinforced concrete slab trestle supported by 0.51 m^2 prestressed concrete piles driven into the approach fill.

2) The portion over deep water is 960 m long and consists of 15 spans of twin, two-cell, trapezoidal steel box girders. Most of the span lengths are 61 m. The girders were erected by two cranes and field bolted together into a continuous 5-span unit. A reinforced lightweight concrete deck acts compositely to form the superstructure.

   Piles for the deep-water portion are 227 t, 1.4 m diameter hollow prestressed concrete, filled with tremie concrete, and extending through approximately 12 m of water. The piles act in bending to resist lateral wind and seismic loads.

3) The shallow-water portions adjacent to the trestles consist of prestressed concrete girder spans 680 m long on the west side and 594 m long on the east side. Most girders are 46 m long and were cast in two segments in a remote casting yard, posttensioned together at the bridge site, hauled a short distance on a temporary timber work trestle and placed in position by a specially fabricated lifting truss. The girders are shaped like an inverted delta to harmonize with the steel trapezoidal shaped box girder, and are made of lightweight concrete. Three to four spans are connected together for continuity for vehicle loads with a reinforced lightweight concrete deck.

   The piles for these portions of the bridge are 82 t, 0.51 m^2 round concrete filled steel pipe piles. This type of pile was selected to provide the ductility required to resist the deformations induced in the thick mud by seismic activity.

Seismic Considerations

The new structure lies midway between the San Andreas Fault to the west and the Hayward Fault to the east. Special criteria for equivalent static force design were developed from soil and structure dynamic analysis. Both actual and synthetic earthquakes were used in the spectral and time-history dynamic analysis to check the static-force design. Large out-of-phase movements were provided for at piers and abutments by extra-large bearing seats and tying the structure together at joints by heavy cable restrainers.

Aesthetic Considerations

The overall appearance of the bridge was given special attention to produce a flowing superstructure, supported by rugged-looking rigid-frame concrete piers, with inclined columns.

The sloping webs of the trapezoidal and delta girders match well with the sloping lines of the concrete piers, producing an overall harmonious motif.

(C. Seim)

Fig. 2 Lifting of a trapezoidal steel box girder

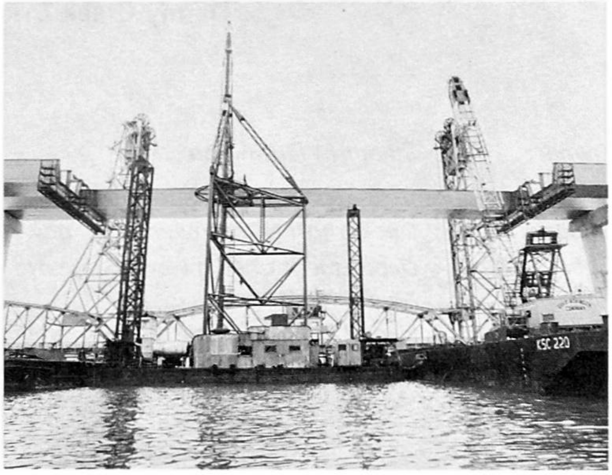

Fig. 3 Girder erected and field bolted

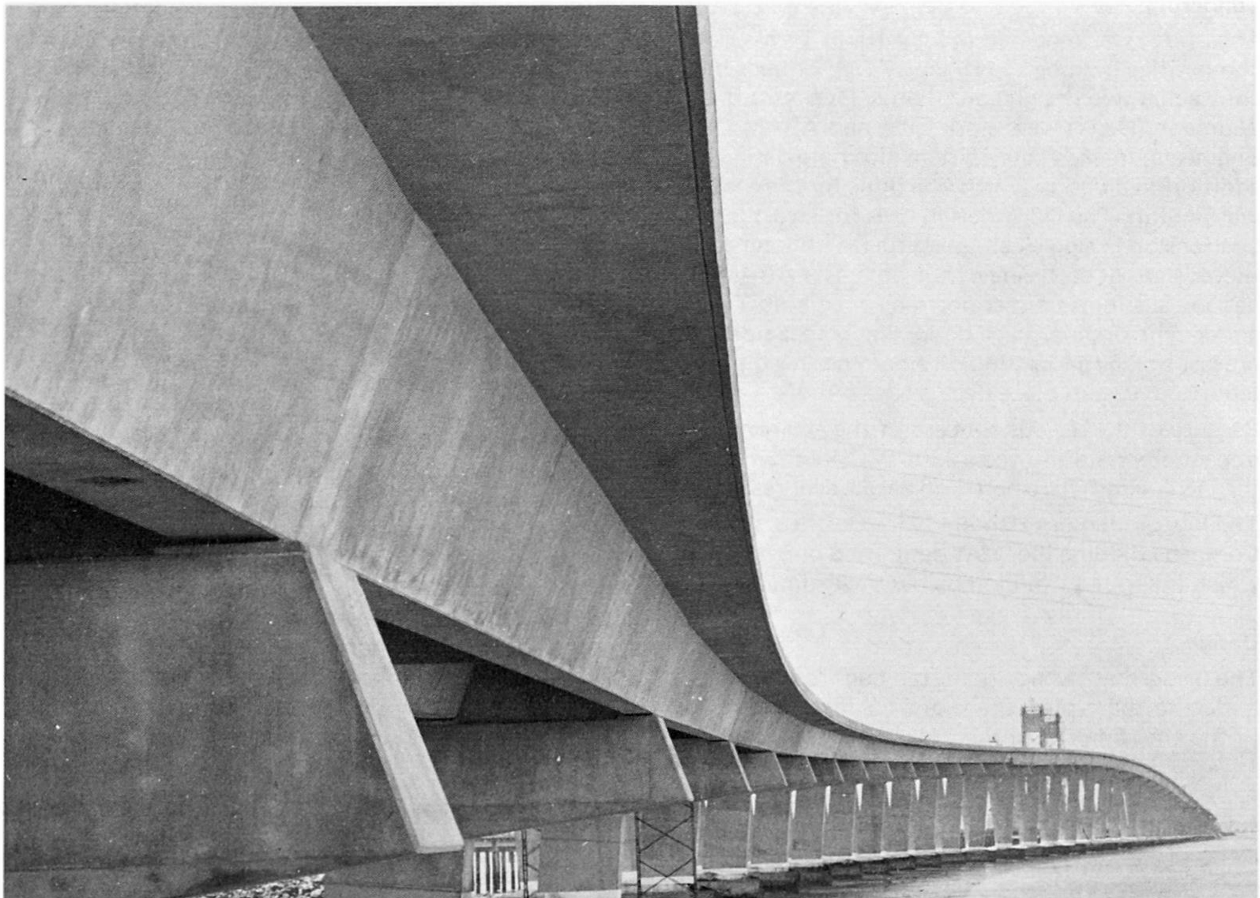

Fig. 4 Prestressed lightweight concrete girders