San Francisco – Oakland Bay Bridge Second Crossing

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Summary

Built 1932-1936, the San Francisco-Oakland Bay Bridge reached its traffic capacity in the 1980's. Today, even with the seismic reinforcement of its West crossing and the replacement of its East crossing (to be completed in 2013), the traffic capacity of the bridge remains the same as when it was built, which is clearly inadequate for the current state of Bay Area traffic demand. Once the new East crossing is in use, the old East crossing structures are slated for demolition. The authors discuss the viability and advantages of reusing the East crossing's abandoned steel structures as part of an entirely new bridge, nearly doubling traffic capacity.

Keywords: bridge, steel, retrofitting, reuse, traffic, Oakland, San Francisco, Loma Prieta.

1. Introduction

When the San Francisco-Oakland Bay Bridge (SFO Bay Bridge) opened to traffic in 1936, it was one of the greatest engineering achievements of the 20th century. It was built in just 3 ½ years during the Great Depression, at a cost then estimated at $78 million.

Figs. 1 & 2. West Crossing (left) and East Crossing (right)

The SFO Bay Bridge actually consists of several bridges with different structural systems, forming a 13,7 km cross-bay roadway (7,1 km over water). The main parts are a suspension bridge West crossing (Fig.1) structure (3140 m) from San Francisco to Yerba Buena Island (YBI), a tunnel and short concrete viaduct segment on YBI (549 m), and an East crossing , from YBI to Oakland (3417 m), consisting of several steel truss systems (Fig. 2).

Fig. 3. Bay Bridge with New East crossing under construction

The entire bridge (Fig.3) was built with 151 593 tons of structural steel. [1]

2. History

When the Bay Bridge was completed in 1936, it was the longest bridge in the world. The bridge, with its three major segments, is listed on the National Register of Historic Places. The Register's comment is: "One of the largest and most important historic bridges in the country." The bridge and its neighbor, the Golden Gate Bridge (completed at about the same time),

https://doi.org/10.2749/222137813806548613

represented the culmination of more than 100 years of development of bridge engineering and construction in the United States.

The bridge's East crossing was locally damaged during the Loma Prieta earthquake of 1989. Subsequently, the West crossing underwent structural improvements, completed in 2009. The entire East crossing is being replaced, and is scheduled for completion in October, 2013.

3. Traffic capacity and population demographics

The bridge is the busiest vehicular link in Northern California. Demand has increased at least 6-fold over the past 75 years. Moreover, the population projection for the Bay Area is 8 880 000 by 2025, a 47% increase from 1990. Yet even after renovation, traffic on the bridge will remain restricted to the same capacity it had when originally built 76 years ago - five vehicular traffic lanes in each direction. Obviously this problem will need to be resolved soon.

4. Proposed Solution

The solution is to add a second bridge, parallel to the existing Bay Bridge, and reuse the abandoned East Crossing structures for the new East portion of this second bridge (Fig. 4). In contrast to past unsuccessful studies this proposal differs in that it takes advantage of the "abandoned" structures – some 55,000 t of fabricated steel that served very well for decades – valued at perhaps $340 million. That coupled with eliminating the need to pay to demolish the old structures – another $280 million, yields a potential savings of $620 million.

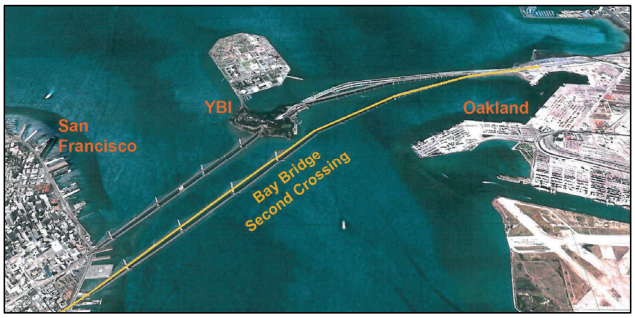

Fig 4. Concept for the second crossing South-East of the existing Bay Bridge

The idea of salvaging the 55 000 tons of already fabricated structures is a worthy one. The best option for building this part of a new crossing is to reuse the existing steel structures, build new foundations and piers alongside the current ones, barge and lift or slide the existing superstructure on to the new substructure and reinforcing them as needed. There are several options to creating more structural capacity of the existing structures.

5. Discussions, Final Comments and Conclusions

Because of the relentless population increase of in the San Francisco Bay Area, and the resulting pressure on traffic crossing the Bay, it is inevitable that a new bridge will be needed to relieve that congestion. The abandonment of the old East Crossing offers an opportunity to double, or nearly double, the capacity of the renovated SFO Bay Bridge. This paper lays the ground work for doing that cost effectively, by realigning and retrofitting the 55 000 t of structural steel destined for abandonment and demolition. But decision making and planning must begin very soon—especially the decision not to demolish the steel of the old East Crossing.

Advantages of the proposed new Crossing, as well as structural concepts to increase the structural capacity of the salvaged structures, are discussed further in the full paper.

6. References

[1] UNITED STATES STEEL, "The San Francisco – Oakland Bay Bridge", 1936