

# Investigation and Remediation of Pile Foundation, Ford Island Bridge, Hawaii



Ford Island Bridge.

The Ford Island Bridge is located between the eastern tip of Ford Island and the northeast shore of Pearl Harbor, Hawaii. The bridge is 4,673 ft long by 46 ft wide with a movable floating draw span in the middle in the middle. The floating bridge section includes a 930-foot long retractable floating concrete pontoon and two steel transition spans. The fixed spans of the bridge consist of 32 concrete piers on 420 prestressed concrete piles.



Deck inspection and core sampling.

Construction of the bridge started in January 1996 and was completed in April 1998. Routine inspections in 2000 found severe deterioration of several concrete piles in the tidal zone. Those damaged piles were repaired with concrete jackets or pile replacement. However, a follow-up investigation revealed the potential for further deterioration of the piles due to alkali-silica reactions and corrosion of reinforcing steel.

Ben C. Gerwick, Inc. has been retained as an expert to conduct an independent investigation of the cause(s) of the pile deterioration and to identify remediation options for mitigation of further pile deterioration. The experts conducted site inspections and extensive sampling/testing of the concrete piles, including petrographic analysis, optical and scanning electron microscopy, energy dispersive spectroscopy, chloride and sulfate analysis. The detailed investigation concludes that the pile deterioration was primarily caused by a synergistic combination of seawater attack and alkali-silica reaction. The seawater attack on the concrete was mostly due to sulfate attack from sea-

water. The alkali-silica reaction was caused by the alkalinity of concrete and silica fume agglomerates from poorly dispersed, densified silica fume in the concrete. Furthermore, corrosion of reinforcing steel also imposes a potential threat to the pile condition due to high permeability of the concrete.

Based upon extensive site investigation and laboratory testing, we assessed the risk for further deterioration of the piles in accordance with the existing pile conditions and exposures (i.e., splash/tidal zone, submerged zone, atmospheric zone). We evaluated the effectiveness of many remediation methods for marine piles and recommend implementation of the most effective protection measures now. We also developed the plans and specifications for the remediation. The protection measures for the piles are currently under consideration for implementation in the bridge.

## Services Performed:

- Site Inspection
- Concrete Technology
- Condition Assessment
- Prestressed Concrete Piles
- Concrete Repair and Protection



Epoxy coated steel reinforcement.

Year of Completion: 2004

Client: Manson Construction Company