CASE STUDY
LAKE MERRITT

Owner: City of Oakland: Oakland, California
Project Engineer/Designer: Degenkolb Engineers, Oakland, California
Repair Contractors: Alpha Restoration & Waterproofing, South San Francisco, California
Material Supplier/Manufacturer: , Sika Corporation, Lyndhurst, New Jersey; Vector Corrosion Technologies, Tampa, Florida

INTERNATIONAL CONCRETE REPAIR INSTITUTE

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BUILDING TRUST

The Problem

The Lake Merritt Boathouse is located on the saltwater Lake Merritt within the city of Oakland, California. It was built in 1909 as part of a city movement to enhance the city of Oakland. The building is U-shaped and has two stories, each of approximately 8,500 sf. The two wings were used to store canoes and sailboats for recreational purposes and the midsection was used to house a pumping station for firefighters. The foundation piers, girders, beams and slabs are all constructed of cast-in-place, reinforced concrete. The exterior façade consists of cement plaster over reinforced concrete. In 2002, voters approved a plan to return the dormant historic Boathouse to near its original design. They desired the lower level be upgraded to enhance the boating facilities and upper level renovated as a restaurant. The new design required installation of micro-piles for seismic upgrade of the building. Consequently, the general contractor installed a coffer dam, dewatered the area and began excavation to expose the foundation. Once exposed, cracking, spalls and signs of corrosion problems were observed throughout the building's substructure. A materials and engineering firm determined that most of the beams, girders, piles and slabs had cracking, spalls and signs of corrosion. The chloride content was very high, ranging from 0.4-0.9% by weight of concrete (theoretical threshold for corrosion is 0.02 – 0.03%). Heavy corrosion was noted in many areas and several areas had complete loss of the stirrups and/or the longitudinal steel. The firm concluded the spalling was caused by corrosion of the reinforcing steel from insufficient cover and chloride ingress.

Extensive spalling of the beams, girders and slabs caused by severe corrosion of the reinforc-

Girder after application of CFRP. Slab after application of epoxy coating. Note areas of shoring required comeback and touchup.

The Sika Solution

The Owner and Engineer set a goal to properly repair the damaged concrete, protect from future steel corrosion, protect from moisture penetration, structurally upgrade deficient members, and minimal impact on the overall project schedule. The concrete removal and surface preparation was completed in accordance with ICRI Guidelines. Sika® Armatec® 110 was applied to reinforce the steel coating and act as bonding agent to repairs. Pre-bagged Sikacrete® 211 repair materials repaired the slabs, beams and girders. Sacrificial anodes, Sika® Galvashield® XP+, were installed within the repairs around the perimeter and core drilled. In areas where the concrete was otherwise sound, the sacrificial anodes were installed in a grid pattern. Galvashield® CC anodes were installed on piers with monitoring kits to monitor current output. These anodes were patched with SikaRepair® 223 and SikaGrout® 212. SikaWrap® Hex 103C carbon fiber fabric was fixed to the underside of the beams and slabs with damaged reinforcing steel for structural strengthening. For added protection, a layer of Sikagard® 62 epoxy coating covered all exposed concrete surfaces below the high-tide waterline and the underside of slabs.

Close up of a completed area (before and after).

SikaWrap® - Carbon and Glass Fiber Fabrics wrap around concrete and masonry structures for repair and strengthening.

Sikadur® 22 Lo-Mod - an epoxy resin that provides a hard wearing, slip resistant wearing surface. This overlay system seals the concrete and provides waterproofing protection.

Sika® FerroGard® 903 - as a dual action corrosion inhibitor, will reduce corrosion currents by penetrating through the concrete and forming a protective coating on the embedded steel bars.

Sikagard® 550W Elastocolor and 670W - protect concrete facades from the damaging effects of carbon dioxide (carbonation), water and pollutants. Either crack-bridging (550W) or rigid (670W), both are high-performance protection coatings, available in a variety of decorative colors.

Sika® Armatec® 110 EpoCem® - protects rebar in areas of inadequate cover.

SikaTop® Plus Mortars - two component polymer modified materials containing Sika® FerroGard® 901 corrosion inhibiting admixture.

Sikagard® 62 - a 100% solid, high-build protective coating used successfully on water projects for decades. It offers long-term protection to the concrete and easy maintenance.

Sikacrete® 211 - a single-component portland cement based concrete which contains factory blended aggregate. This product is available in 80 lb. bags and 2000 lb. supersacks.

Sikarepair® 223 - is a one-component, early strength gaining, cementitious, patching material for vertical and overhead repair of concrete.

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