CASE STUDY
SOUTH CAROLINA DEPARTMENT OF NATURE RESOURCES

Owner: South Carolina Department of Natural Resources, Columbia, South Carolina
Project Engineer/Designer: Davis & Floyd, Inc., Charleston, South Carolina
Repair Contractor: Trident Construction Company, Inc., North Charleston, South Carolina
Material Suppliers/Manufacturers: Sika Corporation, Lyndhurst, New Jersey and Guaranteed Supply Company, North Charleston, South Carolina

INTERNATIONAL CONCRETE REPAIR INSTITUTE

ICRI Award Winner
Award of Excellence
Special Projects Category

BUILDING TRUST

Background

The South Carolina Department of Marine Resources Research Institute was constructed in 1974 with an addition completed in 1977. The institute is located along the banks of the Charleston Harbor with a spectacular view of the Arthur. The building contains administrative offices, classrooms, a library, an auditorium, "wet labs" for saltwater marine life research, and other research labs. The total building is 50,000 sf; wet lab Area A is approximately 5,600 sf and wet lab Area B is about 2,700 sf. The floor of the building consists of a raised, cast-in-place, concrete structure to elevate it above the flood elevation. Reinforced concrete elements include columns, joists, girders, and floor slab. The roof framing above the concrete floor level consists of steel columns and beams supporting bar joists and a metal deck. The exterior walls are architectural precast concrete. Most of the interior walls are non-loadbearing concrete masonry units.

The Problem

Living next to the ocean, corrosion is a serious concern. The State of South Carolina Department of Natural Resources (SCDNR) determined that the large amounts of corrosion observed throughout their building needed to be addressed. Visual investigations in 2006 found several degraded structural conditions, including deteriorated reinforcement, spalled concrete, cracked concrete, and rust stained concrete. In 2008, a destructive investigation uncovered many areas in which 25-50% section loss of the reinforcing steel had occurred. Some areas had complete section loss of the reinforcing steel. Approximately 20% of the 50,000 sf building required concrete repair. The top surface of the floor slab in the "wet labs" was coated with an epoxy floor coating that had failed, allowing saturation from the saltwater tanks and routine washing of the lab area. The root cause of the steel corrosion and resulting spalling stemmed from high chloride content and insufficient cover.

Top side spalling and steel corrosion.

Underside spalling and steel corrosion.

The Sika Solution

Multiple measures of concrete repair and protection to restore structural integrity included full slab removal in some areas as well as partial depth removal in both wet lab areas A and B. The previous floor coating was removed and replaced while cracks were gravity fed with Sikadur® epoxy resins. Local and general corrosion mitigation and protection was implemented using Sika® Galvashield® CC 65 and Sika® Armatec® 110. Other improvements included: repair of the floor systems within the wet labs wet labs using SikaTop® Seal 107 waterproofing to protect the slabs, removal and replacement of all support clips for the exterior precast wall panels, removal and replacement of exterior concrete stairs and supports, and installation of new, insulated window and doors throughout.

Demolition at Lab A

Completing lab finishes.

The new ready-mix concrete design included a corrosion inhibiting admixture to provide additional protection for reducing the same incipient anode effect throughout the entire slab placement areas. Due to the high level of chlorides found in the concrete in Lab B, 634 anodes were installed by laying out the steel reinforcement grid. A surface applied penetrating corrosion inhibitor, Sika® FerroGard® 903, was applied to the beams and underside of the slabs to provide protection of the entire exposed concrete underside. The underside spall repairs included large, deep repair areas that required forming and pumping the repair mortar, Sika® Monotop® 611. The structural strengthening of different beam locations was accomplished using Sikawrap® Hex 103C carbon fiber fabric saturated in Sikadur® 300 epoxy wrapped around the sides and undersides of four beams. Wet lab Area B received SikaQuick® 1000, a cementitious overlay, to provide better pitch to drains and improve the floor finish. Finally, all wet lab floor slabs were coated with a high-build epoxy floor coating system, Sikagard® 62.

Sika® Monotop® 611 - one component, polymer-modified, silica fume enhanced, cementitious pump and pour mortar

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

Sika® Armatec® 110 Epo-Cem - protects the steel from corrosion in areas of inadequate cover. Improves bond of repair mortar to both the substrate and steel.

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.

Sika® FerroGard® 901 - is a liquid concrete admixture formulated to protect embedded reinforcing steel from corrosion.

Sika® Control 40 - is an admixture used to produce high performance concrete with greatly reduced drying shrinkage.

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

Sikadur® - epoxy resins help restore structural integrity by injection into cracks and voids. The most comprehensive range of epoxy products for structural bonding and grouting.

Sika® Galvashield® CC 65 - embedded galvanic anodes used to control on-going corrosion and to prevent the initiation of new corrosion.

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.

SikaQuick® 1000 - One-component, rapid hardening repair mortar with extended working time and early strength gain.

SikaGrout® 212 - non-shrink, nonmetallic, cementitious grout with a unique 2-stage shrinkage compensating mechanism.

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