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Featured Project

Electro-Osmotic Pulse to Reverse Concrete Corrosion at Kentucky Army Air Field

Fort Campbell Parking Ramps Affected by Alkali Silica Reaction

By Dana Finney

Pictured is an overview of alkali silica reaction damage common to colliding slabs, which took place at Fort Campbell, Kentucky Army Airfield. Photo courtesy of the Army's Engineer Research and Development Center (ERDC) Construction Engineering Research Laboratory (CERL).

The Army Corps of Engineers' Engineer Research and Development Center (ERDC) is investigating yet another use for electro-osmotic pulse (EOP) technology. The current initiative aims to stop the slow deterioration of concrete caused by an alkali silica reaction (ASR) in the transient parking ramp concrete at Fort Campbell, Kentucky Army Airfield. The ongoing project is being funded under the DoD Corrosion Prevention and Control Program managed by the Corrosion Policy and Oversight Office. (See *Army Innovation to Halt Water Seepage at Historic Hirohito Bunker*.)

The affected parking ramp sections at Campbell Army Air Field were built in the early 1940s, and the ASR was discovered five to 10 years later. The parking ramp is composed of 20-foot by 20-foot concrete slabs that are 17 inches thick. "At Ft. Campbell, the ASR-induced expansion of the concrete causes the slabs to grow and move adjacent slabs, which becomes a major issue," said Orange Marshall, senior research project manager at ERDC's Construction Engineering Research Laboratory (CERL). The concrete expansion quickly closes expansion joints in the pavement, and the compressive forces begin to crush adjacent concrete surfaces or move entire slab sections. "This particular expansion moved the fire house off of its foundation a few years ago," said Marshall.

Marshall explained that the alkali-silica reaction (ASR) is a form of concrete corrosion that slowly deteriorates concrete from the inside by forming highly expansive gels that cause the concrete to expand or swell. It is a chemical process in which alkalis, mostly from the Portland cement and pozzolans used in the concrete mix, react with certain types of silica, such as chert, quartzite, opal, and strained quartz crystals, within the aggregate when moisture from the soil, snow, and rain infiltrates the concrete.

"This reaction produces an alkali-silica gel that expands, generally causing cracking, heaving, and pop-outs of the concrete," he said. As a retrofit solution, CERL is demonstrating and evaluating a design for installing EOP technology into the pavement that will seek to stop the ASR by transporting moisture away from the concrete's interior.

The EOP system was installed in two sections near the edge of the parking ramp. One section is 60 feet wide and 95 feet long and the other, 80 feet wide and 95 feet long.

One slab tore another after the cumulative effects of alkali silica reaction at Fort Campbell, Kentucky. Photo courtesy of ERDC-CERL.

Buckling occurred at Fort Campbell after one slab compressed against another. Photo courtesy of ERDC-CERL.

According to the test design, Electro Tech Cathodic Protection installed anodes at half the thickness of the pavement to be treated, and they placed cathodes in the soil below and around the pavement as well as near the top surface.

“To be successful, this configuration will need to reduce the moisture content of the cross-section of concrete to less than 70 percent relative moisture,” Marshall explained.

The EOP system installation was completed in December 2009 and activated in March 2010. Marshall noted: “We are collecting internal concrete moisture and temperature data at two-inch, five-inch, and eight-inch depths at 32 locations. We are also collecting data related to the slab expansion and movement at 21 locations both in and adjacent to the treated sections.”

“We plan to monitor the system’s performance through March 2012,” Marshall said. “The next step is to gather the data from one year of operation and analyze it to determine the system’s effectiveness at achieving the 70 percent internal moisture level, while also determining the slab expansion and movement. These conclusions will be included in a CERL technical report.”

Cynthia Greenwood contributed to this report.