IMPRESSED CURRENT CORROSION CHARACTERISTICS OF PRESTRESSED CONCRETE BEAMS SUBMERGED IN SEAWATER

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Steel in prestressed concrete may be subject to electrochemical corrosion through interaction with electrical potential fields set up by adjacent cathodically protected structures, or by high voltage direct current transmission grounding. Whatever the origin of the potential field, current flow in the prestressing steel results in corrosion of steel at the point of current discharge. If this discharge is highly localized, failure of the wire could be the result; whereas if the discharge is evenly distributed over the surface of the wire, the overall strength reduction may be small. The resulting corrosion products, when exposed to sufficient free oxygen, form the familiar red rust, $Fe(OH)_3$. The corrosion products, which have a greater specific volume than the steel, cause cracks to form in the concrete cover when resulting internal pressures exceed the tensile strength of the concrete.

In the present effort, impressed current corrosion tests were performed on 12 prestressed concrete 2.5 x 2.5 x 48 inch specimens submerged in seawater. Two constant currents, 20 and 60 milliamperes per square foot of surface of the steel, were used with two cathode designs. One cathode was designed to distribute the current discharge evenly over the entire prestressing wire surface, while the second cathode configuration was designed to concentrate the current discharge within a very small section of the prestressing wire. In addition to the electrified specimens, several control beams were placed in seawater and in tap water but without impressed current.

During the seawater exposure period, electrical potential was monitored and visual inspections were made on a weekly basis to observe the presence of surface rust stains and cracks. Surface rust stains appeared on the beams

after eight to fifteen weeks. Surface cracks generally followed these stains by one or two weeks. Total exposures ranged from twelve to twenty weeks, after which the prestressing wires were tested to failure in tension to determine the strength reduction due to corrosion.

The reduction in strength ranged from 21 to 48 percent, with seemingly no relation to the corresponding cathode configuration. Following testing, the beams were disassembled to inspect visually the areas of corrosion along the wires. From the test results and the lack of definite corrosion patterns corresponding to the cathode design, it appears that the relative cathode-anode geometry had little effect on the results. In general, the potential and resistance exhibited sharp drops within a week prior to surface cracks becoming visible. This was probably due to the crack propagating outward from the corroding wire. None of the control beams, in seawater or in tapwater, showed any signs of corrosion.

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