COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

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for the degree of Doctor of Philosophy (Ph.D.)

"Initiation and Propagation of Corrosion in Dry-Cast Reinforced Concrete Pipes with Environmental Effects"

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ABSTRACT OF DISSERTATION

Initiation and Propagation of Corrosion in Dry-Cast Reinforced Concrete Pipes with Environmental Effects

This research was conducted to better understand the corrosion propagation stage on dry-cast reinforced concrete pipes (DCRCPs) while exposed to high moisture conditions and chlorides. Corrosion initiation and propagation was studied in instrumented specimens obtained from segments of Dry-cast reinforced concrete pipes. All specimens were subjected to accelerated chloride transport by the application of an electric field. Corrosion of the steel wire mesh initiated after a few days to a few months rather than several years. The specimens were then transferred to high moisture environments (immersed in water, high humidity and/or covered with wet sand) during the corrosion propagation stage. Potentials, linear polarization resistance (LPR) and Electrochemical Impedance Spectroscopy (EIS) measurements were carried out periodically. During the propagation stage in different exposures, reinforcement eventually reached negative potentials values (< -0.55 Vsce), which suggest mass transfer limitations. These specimens showed no visual signs of corrosion such as cracks or corrosion products except the ones exposed to high humidity and laboratory environments; where in some corrosion products have reached the concrete surface. Moreover, the apparent corrosion rate values obtained suggest high corrosion rates. No crack appearance on specimens exposed to other conditions, could be explained by the porosity of the specimens; the corrosion products moved into saturated pores. It is speculated that although, there might be mass transfer limitations present, the current demanded by the anode is being balanced by a larger cathode area due to macrocell effects, since the high moisture conditions likely reduced the concrete resistivity and increased the throwing power. The corrected polarization resistance (Rc) was calculated by subtracting the solution resistance from the apparent polarization resistance measured. The Rc values measured over time were used to obtain the calculated mass loss (using Farady's Law). Most specimens were forensically analyzed and the measured mass loss compared to the calculated mass loss. The forensic examination includes the measurement of the actual corroding areas. The measured corroding areas were used to obtain the corrosion current density (i_{corr}). A comparison was made of the calculated corrosion current densities obtained using the linear polarization resistance method (LPR) and the extrapolation methods. It was evident that most of the specimens' corrosion rates were significantly high. The corrosion products filled the wet-pores inside the concrete and provides an explanation for no cracks or corrosion bleed outs visually observed on the specimens.

BIOGRAPHICAL SKETCH
Born in Kumbakonam, India
B.S., Madurai Kamaraj University, Tamil Nadu, India, 2003
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CONCERNING PERIOD OF PREPARATION & QUALIFYING EXAMINATION

Time in Preparation: 2013 – 2018

Qualifying Examination Passed: Fall 2013

Published Papers:

F. Presuel-Moreno, H. Balasubramanian, Y. Y. Wu, "Corrosion propagation of dry-cast reinforced concrete pipes exposed to simulated field environments", paper C2014-4371 CORROSION/2014, San Antonio, TX March 9-14 (2014) (Proceedings published on CD)