VIRTUAL SMART STRUCTURES AND DYNAMICS LAB



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EXPERIMENT 11 CORROSION ASSESSMENT IN REBARS OF RC STRUCTURES USING PZT PATCHES

OBJECTIVES

This simulation experiment, a measurement cum simulation experiment, aims to employ electromechanical impedance (EMI) signatures to detect and quantify the severity of rebar corrosion in reinforced concrete (RC) structural components.

EXPERIMENTAL METHODOLOGY

Corrosion of steel reinforcement is one of the main causes of damage and premature failure of RC structures, and at the same time responsible for high costs for inspection, maintenance, restoration and replacement of the infrastructure. Recently, Talakokula and Bhalla (2015) proposed a new corrosion assessment approach based on the mechanical impedance EMI technique Figs. 1(a) and (b) present the experimental setup for the rebar corrosion related laboratory experiments for bare rebar and embedded rebar respectively. User may go through the thesis of Dr. Vislalakshi Talakokula for more information: http://web.iitd.ac.in/~sbhalla/thesispdf/visalakshi.pdf.



Fig. 1 Accelerated corrosion tests in (a) bare rebar (b) embedded rebar

EXPERIMENTAL DETAILS

In the accelerated corrosion experiments of bare rebar, following components are used:

- Copper rod acting as Cathode.
- Bare rebar acting as Anode.
- Piezoelectric ceramic (PZT) patch bonded to rebar, further connected to LCR meter
- Beaker containing brine solution whose salinity is 35 parts per thousand, where specimen is inserted and accelerated corrosion induced using impressed current.

For accelerated corrosion experiments in embedded rebars, the components are same except that $150 \times 150 \times 150$ mm concrete cube with an embedded bar replaces the bare rebar as shown in Figs. 2(a) and (b) respectively. By means of animation, the user can visualize the process of accelerated corrosion and can acquire the signatures of the PZT patch bonded to the rebar during various stages. Fig. 2 shows a screenshot of the animation. The user can visualize the data in by plotting in excel and study the changes in signature with increasing corrosion.



To statistically quantify damage, compute root mean square deviation (RMSD) in conductance by following equation directly in MS excel:

$$RMSD(\%) = \sqrt{\frac{\sum_{i=1}^{n} (G_i^1 - G_i^0)^2}{\sum_{i=1}^{n} (G_i^0)^2}} \times 100$$
(1)

where

- G_i^0 = Baseline conductance value at *i*th frequency
- G_i^1 = Conductance value after damage at *i*th frequency
- n = No. of frequency data points

As an exercise, the user may plot a histogram of RMSD for the various damaged states, note observations and draw conclusions.

REFERENCES

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- Talakokula, V., Bhalla, S., Ball, R J., Bowen, C. R., Pesce, G. L., Kurchania, R., Bhattacharjee, B., Gupta, A. and Paine, K. (2016), "Diagnosis of Carbonation Induced Corrosion Initiation and Progression in Reinforced Concrete Structures using PiezoImpedance Transducers", <u>Sensors and Actuators A</u>; Physical, Vol. 241 (May), pp. 79-91, DOI: 10.1016/j.sna.2016.02.033
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