EXPERIMENT 7 (SIMULATION)

Corrosion Assessment in Rebars of RC Structures Using PZT patches

OBJECTIVE

This simulation experiment, based on experimental data measured during actual accelerated corrosion tests carried out on reinforced concrete (RC) structures.

OVERVIEW

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

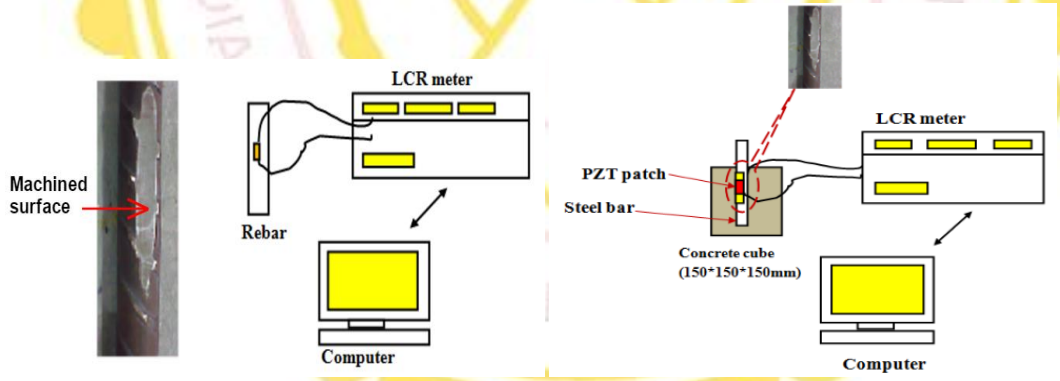


Figure 1: Data acquisition setup for accelerated corrosion in (a) bare rebar (b) embedded rebar

EXPERIMENTAL DETAILS

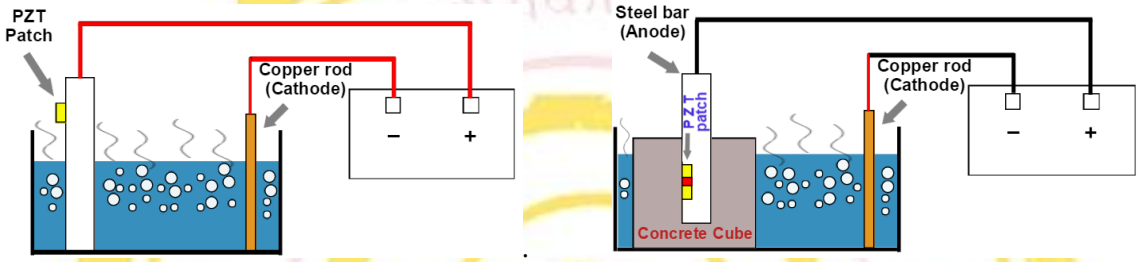
In the accelerated corrosion experiments of bare rebar, following components are used:

- Copper rod acting as Cathode.
- Bare rebar acting as Anode.
- PZT bonded to rebar which is further connected to LCR meter by electrodes.
- Beaker containing brine solution whose salinity is 35 parts per thousand.

For accelerated corrosion experiments in embedded rebars, the components are same except that a 150 × 150 × 150 mm concrete cube with an embedded bar replaces the bare rebar the setup for accelerating corrosion for bare rebar and reinforced concrete is shown in Figure 2(a) and (b) respectively.

EXPERIMENTAL PROCEDURE

The setup for accelerating corrosion for bare rebar and reinforced concrete is shown in Figure 2(a) and (b) respectively. Through this animation, the user can visualize the process of accelerated corrosion and can obtain signatures of the PZT patch bonded to rebar during various stages. Figure 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.



(a) (b)

Figure 2: Setup for accelerating corrosion (a) Bare rebar (b) Reinforced Concrete

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

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

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 plot a histogram of RMSD for the various damaged states. Note your observations and draw conclusions.

REFERENCES

1. Talakokula, V. and Bhalla, S. (2015), "Reinforcement Corrosion Assessment Capability of Surface Bonded and Embedded Piezo Sensors for RC Structures", Journal of Intelligent Material Systems and Structures, Vol. 26, No. 17 (Nov), pp. 2304-2313. DOI: 10.1177/1045389X14554133

2. 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", Sensors and Actuators A; Physical, Vol. 241 (May), pp. 79-91, DOI: 10.1016/j.sna.2016.02.033

3. Talakokula, V., Bhalla, S., and Gupta, A. (2014) "Corrosion Assessment of RC Structures Based on Equivalent Structural Parameters Using EMI Technique", Journal of Intelligent Material Systems and Structures, Vol. 25, No. 4 (Mar), pp. 484-500

4. Literature on piezoelectric sensors.

