

Determining the Optimal Traffic Opening Time Using Piezoelectric Sensors

Adlan Amran¹, Yen-Fang Su¹, Na (Luna) Lu^{1,2,3}

¹Lyles School of Civil Engineering, Sustainable Materials and Renewable Technology (SMART) Lab, Purdue University

²School of Materials Engineering, Purdue University

³Birck Nanotechnology Center, Purdue University

ABSTRACT

The Indiana Department of Transportation (INDOT) requires a reliable method of determining the early age quality of concrete to improve traffic opening time. We propose to develop an in-situ method that enables an accurate, efficient, and non-destructive health monitoring of concrete using the electromechanical impedance (EMI) technique coupled with a piezoelectric sensor named Lead Zirconate Titanate (PZT). The test was conducted by mounting a PZT sensor on mortar samples. The PZT sensor was then excited by a voltage to track the strengthening of samples. The data obtained from the EMI technique was refined using the Root Mean Square Deviation (RMSD) model. Simultaneously, identical mortar samples underwent a compressive test to measure sample strength in a destructive manner. Both tests were repeated by varying the mortar sample's cement type and water-to-cement ratio. Finally, both tests were compared to one another via regression analysis. The outcome has shown a significant correlation between the compressive strength and the EMI data. This indicates that the PZT based EMI technique can potentially be used to non-destructively measure the early age concrete strength for optimizing traffic opening time.

KEYWORDS

Piezoelectric Sensor, Electromechanical impedance (EMI), Non-destructive testing (NDT), Early age strength