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Self-Sensing Fiber Reinforced Cement Mortars for the Monitoring Of Critical and Transport Infrastructures

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The critical infrastructures such as bridges, highways, mass transit systems, airports are very significant in human life today. As these infrastructures are subjected to damage and deformations due to mechanical and environmental factors, it is very critical to assess structural performance in order to sustain public safety. Although current techniques are applied by taking advantage of strain-gauges, fiber optic sensors or acoustic sensors whose local sensing capability transmit the data about the health of the structure, practices exhibit that there is a need for developing reliable, easily implantable, cost-efficient and durable methods to allow continuous assessment. At this juncture, monitoring of structures by addition of carbon products instead of using extra sensor can be a better solution thanks to the piezo-resistive response of carbon-based materials. In addition to the structural performance, non-structural properties can be easily provided without being in need of any integrated systems by equipping cementitious composites with carbon-based materials. Among carbon-based materials, carbon nanotubes (CNTs) draw attention with regard to superior mechanical and electrical properties. In this study, the piezo-resistive properties and the sensing ability of the cement mortars are investigated by utilization of CNTs and measuring the changes in resistivity under the application of 3-point flexural loading. Beside flexural tests, compression tests were also applied on the same specimens to ensure the mechanical property. Results confirmed that carbon nano tube-cement mortars exhibited an increased change in resistivity, which is indicative of the improved sensitivity of the material in strain sensing. Furthermore, both flexural and compression strengths of the specimens are improved by CNTs with the inclusion of only 0.5% of total cement weight. Within this scope, it is believed that incorporating the self-sensing attribute into cementitious composites can enable implementation of non-destructive monitoring and quick assessment of the civil infrastructures.

Keywords: Structural health monitoring, cement mortars, carbon nanotubes (CNTs), self-sensing.