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Evaluating Integrity of Concrete Structures Using Electromagnetic Waves: A New Approach

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ABSTRACT

Various structural health monitoring techniques for concrete structures have been developed to maintain the safety of infrastructure (Sakiyama et al., 2021). The objective of this study is to propose a new analytical method to evaluate the integrity of concrete structures using electromagnetic waves. For the experimental study, two concrete walls, one with defect and one without, are prepared. To simulate various defect locations, four types of electrical wires with artificial joints (0, 1, 2, or 3) are installed in each wall. Electromagnetic signals obtained from the electrical wires are analyzed by two different methods. Both the velocity and the reflection coefficient of the electromagnetic waves are calculated and compared according to the defect conditions. The experimental results show that the velocity of the electromagnetic waves increases in defective areas because the dielectric constant of air is lower than that of sound concrete. In addition, the area under the signal, representing the integration of the reflection coefficient, is higher in the defect condition compared to the sound concrete. This study demonstrates that using a combination of these two analytical methods can more efficiently estimate the integrity of concrete structures.

REFERENCES

Sakiyama, F.I.H., Lehmann, F., Garrecht, H. (2021), “Structural health monitoring of concrete structures using fibre-optic-based sensors: A review.” Magazine of concrete research 73, 174-194.

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