ADVANCED DAMAGE DETECTION IN REINFORCED CONCRETE APPLYING ACOUSTIC EMISSION, WAVELET TRANSFORM AND SHANNON ENTROPY

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Received: July 08, 2024; Revised: October 16, 2024; Accepted: October 28, 2024

Abstract

Concrete structures are extensively used in infrastructure but are susceptible to deterioration due to external loads, fatigue, and environmental factors. Early damage detection is vital for effective monitoring and failure prevention. Continuous sensor-based health monitoring can extend the design life of these structures. Acoustic Emission (AE) is a promising non-destructive testing technique for assessing damage in concrete, as it captures signals generated by microcrack formation and propagation. AE sensors detect these signals, which can be analyzed using wavelet transform (WT) in the time-frequency domain. Additionally, changes in the Shannon entropy of AE signals can indicate the presence and severity of damage in concrete. This study explores the effectiveness of combining WT and Shannon entropy for detecting damage in concrete structures using AE signals. Concrete specimens were subjected to simulated damage using pencil-lead break (PLB) tests, and the resulting AE signals were recorded. The WT was applied to decompose the AE signals into time-frequency components, facilitating the identification of damage-induced frequency bands. Shannon entropy was then calculated for each decomposed frequency band to measure the randomness or disorder within the signal. The results are expected to show that damage initiation and progression are reflected in changes in the frequency content and entropy of AE signals. An increase in entropy in specific WT frequency bands is anticipated to correlate with the presence and severity of damage in the concrete. This study aims to establish a different method for the localization of damage in concrete using a combination of WT and Shannon entropy analysis of AE signals.

Keywords: **Concrete Structure; Health Monitoring; Acoustic Emission; Damage Detection; Wavelet Transform; Shannon Entropy**

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DOI: https://doi.org/10.55766/sujst-2024-05-e05716

Suranaree J. Sci. Technol. 31(5):010334(1-11)