

Moisture-Induced Effects on Diffuse Ultrasound in Concrete

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This study examines how internal moisture migration and the subsequent phenomena due to drying in concrete affect diffuse ultrasound parameters. An experimental test series involves multiple long-term drying and rewetting cycles to simulate change of environmental conditions in concrete structures. A predefined protocol traces these phenomena by monitoring mass changes in cylindrical specimens. Diffuse wave tests are performed using a pair of piezo-ceramic (PZT) patches attached to the concrete, functioning as a ultrasonic transmitter and receiver in the frequency range between 250 and 550 kHz, which is enough to monitor diffusion of ultrasound in concrete. The experimental results indicate that moisture evaporation and subsequent drying-induced micro-cracking in concrete notably impact the measured diffuse ultrasonic parameters. These parameters exhibit distinct variations and cyclic behavior in accordance with drying and re-wetting processes, not fully returning to their original saturated values. The difference between original values at same moisture levels implies the possibility of drying-induced damage in concrete due to repetitive drying and re-wetting cycles. The results demonstrate that the clear and significant sensitivity of diffuse wave parameters to both moisture movements and their subsequent effects on concrete, which should be understood for enhancing the reliability of diffuse ultrasound measurements in concrete exposed to environmental fluctuations.