The 2022 World Congress on
The 2022 Structures Congress (Structures22)
16-19, August, 2022, GECE, Seoul, Korea

Characterization of Freeze-Thaw Damage in Concrete Using Contactless Ultrasonic Measurements

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ABSTRACT

We present work to characterize distributed cracking damage in concrete caused by freeze-thaw (F-T) cycles. Rayleigh wave scattering behaviors are investigated using numerical simulations to understand the interaction between incident ultrasonic Raleigh waves and F-T damage. A contactless ultrasonic scanning measurement system that utilizes a multi-channel MEMS microphone array is used to collect ultrasonic scanning data from concrete specimens subjected to F-T cycles. Then, a data processing approach that extracts damage-sensitive scattering components from the collected ultrasonic scanning data is employed to characterize the extent of F-T damage in the tested concrete samples. The proposed approach is evaluated using other nondestructive and destructive test methods including ultrasonic pulse velocity (UPV) measurements, dynamic modulus testing, and petrographic analysis. The results confirm the effectiveness of the approach to characterize F-T damage in concrete. The fully contactless ultrasonic scanning measurement system can potentially characterize F-T damage within concrete structures *in situ* without preparing separate samples.

REFERENCES

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