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Air-Coupled Ultrasonic Application for Civil Infrastructure

Speaker: Hajin Choi

Dep.of Architectural Eng., Soongsil Univ.

Quality control and quality assurance (QC/QA) of infrastructure elements have become an important issue to our nation. In particular, the evaluation of civil infrastructures immediately after an earthquake to determine extent of internal, non-visible damage can play an important role in the effort to ensure public safety. Thus, to fully characterize damage progression within full-scale structures, advanced non-destructive evaluation (NDE) technology is required. In non-destructive evaluation, advanced sensing technology has become important gateway to assess full-scale civil infrastructures within limited time. The Impact-Echo (IE) method has been one of the promising NDE techniques in civil engineering application, providing thickness mode frequency of delamination as S1-ZGV (zero group velocity) emerged from guided waves in plates. In this study, we proposed the improvement of IE method using multi-channel air-coupled sensing and guided wave analysis, and its practical application in a full-scale bridge deck. The developed array system utilizes air-coupled MEMS arrays to receive leaky portion of Lamb waves without coupling process on the surface of concrete. Numerical stress wave analysis is performed to verify the system and simulate the feasibility and accuracy of the proposed method in discerning local delamination. For experimental validation, the system is applied to full-scale concrete slab with artificially embedded delamination. From a dense and fast measurement, guided wave analysis is performed using two-dimensional fast Fourier transform (2-D FFT). In the frequency-wave number domain (f-k domain), guided wave modes can be separated into the order of symmetric and anti-symmetric wave modes. The theoretical and experimental results demonstrate that the thickness mode frequency and apparent velocity in concrete are clearly obtained from f-k and Vcp-f domains respectively. The proposed method has a great potential to the application of air-coupled IE in the field.

School of Urban & Environmental Engineering

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- **Where: Bldg.110(EB4), Room.N101**
- **Host : Prof. Shin, Myoungsu**
  ext. 2814, msshin@unist.ac.kr