Surface Wave Velocity-Stress Relationship in Uniaxially Loaded Concrete

The sonic surface wave (or Rayleigh wave) velocity measured on prismatic concrete specimens under uniaxial compression was found to be highly stress-dependent. At low stress levels, the acoustoelastic effect and the closure of existing microcracks results in a gradual increase in surface wave velocities. At higher stress levels, concrete suffers irrecoverable damage: the existing microcracks widen and coalesce and new microcracks form. This progressive damage process leads first to the flattening and eventually the drop in the velocity-stress curves. Measurements on specimens undergoing several loading cycles revealed that the velocities show a stress-memory effect in good agreement with the Kaiser effect. Comparing the velocities measured during loading and unloading, the effects of stress and damage on the measured velocities could be differentiated. Moreover, the stress dependency of surface wave velocity proved to be direction-dependent. The velocity increases and decreases the most when measured parallel and perpendicular to the loading axis, respectively.

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