

**Department of Civil Engineering and Engineering Mechanics
Columbia University**



**Investigation of Microstructure Evolution in Cementitious
Materials through Setting using Poroelastic Parameters obtained
from Ultrasonic Wave Reflection**

Prof. Kolluru V. Subramaniam

Civil Engineering Department, City College of the City University of New York

Host: Prof. C. Meyer

The response of hydrating cement paste through setting and early strength gain, are monitored using rheological and ultrasonic reflection measurements. The rheological measurements comprised of measuring the increase in elastic modulus and yield stress. Ultrasonic measurements were performed using horizontally polarized shear waves (SH) reflected off of the hydrating cement paste. By combining the information from rheological and ultrasonic measurements, it is found that the evolution of a continuously connected network of cement particles within the paste, when all cement particles are bonded to all the neighboring particles by the products of hydration, is coincident with a rapid increase in the shear modulus of the porous skeleton. Changes in the ultrasonic signal through setting are related with changes in the porosity and stiffness of an equivalent water-filled poroelastic material, which provides identical acoustic impedance. A theoretical framework based on the poro-elastic idealization of the hydrating cement paste is developed for interpreting the ultrasonic reflection data. The poro-elastic representation of hydrating cement paste is shown to provide simultaneous, realistic estimates of capillary porosity and shear modulus for hydrating cement paste. A predictive approach for strength gain based on microstructural variables assessed non-destructively from the ultrasonic measurements is presented. Finally, some practical applications of the ultrasonic measurements are discussed.

October 16, 2009 (Friday)

**2:00 - 3:00 p.m.
Room 327, Mudd**

<http://www.civil.columbia.edu/~ling/seminar>