HIGH RESOLUTION IDENTIFICATION OF SHEAR AND TORSIONAL WAVE VELOCITY PROFILES OF BUILDINGS – METHODOLOGY AND APPLICATION TO MILLIKAN LIBRARY

RAHMANI, M. T., U. So. California, Los Angeles, CA, rahmani@usc.edu; TODOROVSKA, M. I., U. So. California, Los Angeles, CA, mtodorov@usc.edu

Two new algorithms for structural system identification of buildings from recorded seismic response are presented, for use in structural health monitoring (SHM) systems, and their application to identification of NS, EW and torsional responses of Millikan Library in Pasadena [1]. Both are based on a wave propagation model of a building (layered shear beam or torsional shaft), and identify its velocity profile in a frequency band. One performs nonlinear LSQ fit of pulses in the impulse response functions, and the other one - iterative time shift matching. These algorithms reduce markedly the identification error of the direct algorithm [2], especially for high spatial resolution models (such that resolve the individual floors). Good accuracy of identification of high resolution models, which is most challenging, is necessary to be able to detect efficiently local damage and smaller damage. The main advantages of the wave travel time methods for SHM over the modal methods are their insensitivity to the effects of soil-structure interaction and local nature. The results for Millikan library show that the NS response is predominantly in shear and nondispersive for frequencies up to about 15 Hz. For the EW response, this is true for frequencies up to about 7.5 Hz, and dispersive behavior was detected for higher frequencies. The torsional response is nondispersive, for frequencies up to about 15-20 Hz. The structural fixed base frequencies are also identified from the transfer function of the fitted model. [1] Rahmani MT, Todorovska MI (2011) High resolution 1D system identification of buildings using impulse responses: methodology and application to Millikan Library, Soil Dynamics and Earthquake Engng, Jose Roësset Special Issue, submitted. [2] Todorovska MI, Rahmani MT (2011) System identification of buildings using wave travel time analysis and layered shear beam models - spatial resolution and accuracy, Struct. Control Health Monit., accepted.

Wednesday, April 18th / PM Poster / Golden Ballroom