A time-domain covariance-based parameter estimation method for torsional shear buildings

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Abstract

A time-domain parameter estimation algorithm for direct estimation of stiffness properties of a torsional shear building has been developed. The algorithm decouples the banded global stiffness matrix into story stiffness matrices, and therefore is capable of identifying the lateral stiffness parameters of each story independent of others. Covariance matrices of the structural response to unknown source of excitation is used in formulating the equations of motion in order to eliminate the external force from the equations of motion based on the NExT method (James et al., 1993). The method can be applied to ambient vibration data gathered before and after a severe event for damage identification and localization up to the story level. A subsequent least-squares problem can be solved in order to further localize damage by smearing out the components of the story stiffness matrix to the lateral stiffness of two separate lateral load resisting systems in each direction. The algorithm is verified using the IASC-ASCE benchmark problem, and applied to data gathered from the Factor building located at the UCLA campus.

References:

James GH, Carne TG, Lauffer JP 1993. The natural excitation technique for modal parameters extraction from operating wind turbines. SAND92-1666, UC-261, Sandia National Laboratories, Sandia, New Mexico.