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William D Finn
The University of British Columbia, Canada

Finite element model updating of a super tall building with ambient vibration data

The Shanghai tower is the tallest structure in China and one of the super tall buildings in the world. The 128 storey building stands approximately 632 meters high. On May 8th, 2015, an ambient vibration test was performed on this building in its final stages of construction. Nine modes of vibration and associated damping ratios were identified below 1 Hz using the Frequency Domain Decomposition (FDD) and Enhanced Frequency Domain Decomposition (EFDD) techniques. To get a quick and direct insight into the overall dynamic behavior of this complex structure, a simple and efficient lumped-mass stick model based on macro beam theory was developed in SAP2000 as the baseline model. This model was first calibrated with a sophisticated Finite Element (FE) model developed using ABAQUS. By performing the sensitivity analysis, several sets of parameters were selected and then modified with an automated updating procedure. After model updating, the average difference between the model and measured first nine frequencies was reduced from 28% to 4% and the average Modal Assurance Criterion (MAC) value was improved from 73% to 87%. The process of model updating for super tall buildings described in this study can lead an efficient and accurate prediction of their seismic response and the outputs are reliable for wide range of applications in the area of seismic performance, long term heath monitoring and risk assessment.

Biography

W D Liam Finn was a Professor of Civil Engineering at UBC from 1961-1999, Anabuki Research Professor of Foundation Geodynamics, Kagawa University, Japan and Seismic Consultant to Anabuki Construction Company, Japan (2000-2005). He is an International Consultant in Geotechnical Earthquake Engineering and has published over 350 papers. He has carried out seismic safety evaluations on 20 major dams and seismic studies on offshore platforms and pipelines. He is an Honorary International Member of the Japanese Geotechnical Society, the Chinese Soil Dynamics Society, EERI, IAEE, ASCE and is honorary Professor of the Institute of Building Construction in Beijing. He is a Fellow of Churchill College, Cambridge and a Fellow of the Engineering Institute of Canada. He was Editor in Chief at International Journal of Soil Dynamics and Earthquake Engineering. Since 1980, he has been a member of the committee responsible for the seismic provisions of the national building code of Canada.

finn@civil.ubc.ca

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