Global Vibration Modes of a Four-Story Wood Building

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A four-story wood office building was equipped with a purpose-built measurement system for measuring temperature, moisture, and vibration data. Five bi-directional geophone sensors were included for long term monitoring. Vibration data from days with high wind were used to estimate the first three modes (eigenfrequencies, damping factors and mode shapes) of the building by use of operational modal analysis (OMA). Although the vibration levels of the building were very low, the first three modes were possible to extract with reasonable confidence. The eigenfrequencies were found to be approximately 3.3, 3.6, and 4.0 Hz, with relative (viscous) damping factors in the range of 2 to 3%. The mode shapes were shown to agree with those of a finite element model. An attempt to scale the modal model was made by installing a small electrodynamic shaker with a 1 kg moving mass, and excite the building with harmonic vibration close to the eigenfrequencies, and using the OMAH method. Although the results were inconclusive, the small shaker was shown to be sufficient to detect harmonic response around the building. More work is needed to increase the confidence in the scaling results.

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