

## The effect of torsional and bending vibration on shear-wave velocity extracting from building response by seismic interf

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Because shear-wave velocity correlates with the shear rigidity of buildings, the decrease of it is a indicator of the loss of stiffness, which is possibly caused by structural damage or degradation. Therefore, shear-wave velocity identification is intended for use in health monitoring of upper structures excluding the effect of soil-structure interaction. Shear-wave velocity can be extracted from tracing the propagation of a pulse from normalized cross-correlation of the motion between two points based on the view of response as the wave vertical propagation process. In this study, the reference point is the top of the building (virtual source) instead of the base (physical source) which results in the transfer function including the effect of rigid-body rocking. However, for high-rise and eccentric structures torsional motion and bending motion is inevitable. In practical measurement of horizontal motions with single sensors located on the side not the core of the building plane, it is unavoidable to record the torsional response which mixed with the shear-mode motions. Therefore, the effect of torsional response to shear-wave velocity extraction should be deliberated on to avoid erroneous use of the travel time of torsional wave instead of that of shear wave. Furthermore, the extraction of shear-wave propagation from building vibration generally in bending mode is valid or not should be examined.

In this study, firstly a 3D model with eccentricity is used to calculate the horizontal and vertical impulse response to analyze the effect of torsional and bending response to shear-wave velocity extraction. And the method to eliminate the effects of torsional and bending vibrations to obtain the shear-wave propagation with high resolution is presented. Secondly, a practical use of earthquake records measured in a high-rise building to examine the effect of torsional and bending vibration to shear-wave velocity extraction. Thirdly, velocities of shear wave, torsional wave, and bending wave are extracted separately to evaluate the changes of stiffness before and after the Tohoku earthquake for health monitoring.

Keywords: shear-wave velocity of buildings, deconvolution method, torsional response, seismic interferometry, system identification, Tohoku earthquake