



A novel HVSR approach on structural health monitoring for structural vulnerability assessment

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This work suggests a novel approach for vulnerability assessment in structural health monitoring (SHM) through Horizontal to Vertical Spectral Ratio (HVSR) method. Acceleration recordings of different age concrete buildings [1] are analyzed using the conventional method for estimation of fundamental frequency in SHM (Fast Fourier Transform-FFT method). The results of frequency spectrum are verified theoretically (mass and stiffness matrices models) but also by practical techniques applied in real structure data, for the estimation of structural resonance frequencies [2-4]. The same recordings are analyzed by HVSR method and study the differences and the similarities of both methods (FFT and HVSR) under earthquake excitation. Both methods can reveal resonance frequencies and amplitude of buildings under study, with great detail and efficiency in terms of ease of deployment, computation, cost and time. Furthermore HVSR recordings of strong seismic motion are compared with HVSR recordings of ambient noise for the case study buildings. The similarities of HVSR recordings (between earthquake and ambient noise) reveal the same analogy in HVSR spectrum. This enables a simple HVSR noise recording in a building to present the same information with an earthquake HVSR recording that are much rarer. This study presents a novel index which compute the increase of HVSR between floors and correlates the increasing rate with the structural vulnerability of the specific building. The main idea is that this HVSR rate index is strongly related with the differential acceleration (between floors), a determinant measurement for SHM assessment in concrete buildings. Experimental data verify the above HVSR rise index by presentation of higher HVSR rise in older buildings (with visible cracks in beams, damage and stress in their structure) than other younger buildings without any visible damage.

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