

Structural Health Monitoring of the 9-Story Torre Central Building Using Recorded Data and Wave Method

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Abstract : The Torre Central building is a 9-story shear wall structure located in Santiago, Chile, and has been instrumented since 2009. Events of different intensity (ambient vibrations, weak and strong earthquake motions) have been recorded, and thus the building can serve as a full-scale benchmark to evaluate the structural health monitoring method developed. The first part of this article presents an analysis of inter-story drifts, and of changes in the first system frequencies (estimated from the relative displacement response of the 8th-floor with respect to the basement from recorded data) as baseline indicators of the occurrence of damage. During 2010 Chile earthquake the system frequencies were detected decreasing approximately 24% in the EW and 27% in NS motions. Near the end of shaking, an increase of about 17% in the EW motion was detected. The structural health monitoring (SHM) method based on changes in wave traveling time (wave method) within a layered shear beam model of structure is presented in the second part of this article. If structural damage occurs the velocity of wave propagated through the structure changes. The wave method measures the velocities of shear wave propagation from the impulse responses generated by recorded data at various locations inside the building. Our analysis and results show that the detected changes in wave velocities are consistent with the observed damages. On this basis, the wave method is proven for actual implementation in structural health monitoring systems.

Keywords : Chile earthquake, damage detection, earthquake response, impulse response, layered shear beam, structural health monitoring, Torre Central building, wave method, wave travel time

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