Geophysical Research Abstracts
Vol. 19, EGU2017-14260, 2017
EGU General Assembly 2017

Seismic response monitoring of the Arno river masonry embankment during the conservation works after the Lungarno Torrigiani riverbank landslide (Florence – May 25, 2016)

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Geohazards are the most relevant processes that can damage or increase the risk of human beings, properties, critical and transport infrastructures, and environment itself. They also could involve the interruption of human activities. The concepts of disaster risk reduction and disaster risk management involve the development, improvement, and application of policies, strategies, and practices to minimize disaster risks throughout society. Since 1972 (UNESCO Convention) the identification, protection, and preservation of cultural and natural heritage has been recognized to be of outstanding value to humanity, and a key resource to build resilient societies. Nevertheless, world architectural wealth is accumulating damages and heavy losses because of both materials deterioration and exceptional natural or man-made events. The "health" of buildings/structures/infrastructures may be evaluate by its deterioration or damage level. Thus, structure dynamic characterization and microtremor analysis are considered powerful techniques, even thought seismic noise techniques in densely populated area are hardly to carry out because of the background noise due to the human activities. A wide bibliography about buildings/structures/infrastructures seismic dynamic characterization is counterposed to a missing one about their seismic response during conservation/safety works, even thought the seismic vibration monitoring (SVM) is widely used. On May 25, 2016 a riverbank landslide seriously damaged a portion roughly 100 m long of the Lungarno Torrigiani historical masonry embankment wall (left river bank of the Florence urban stretch of the Arno river, between Ponte alle Grazie e Ponte Vecchio). The street next to the embankment wall collapsed, and the earth fill material was fully retained by the embankment wall that did not collapse but seriously deformed towards the Arno river, fracturing itself in three main areas (a cusp roughly in the middle of the damaged wall, where is also concentrated the maximum landslide pressure, and two hinges). In this work we present the results of the SVM carried out during the conservation works. The SVM (sampling frequency 200 Hz) was carried out from August 14 to October 10, 2016 by means of three high gain triaxle velocimeters SS45 (own frequency 4.5 Hz), each one coupled with a SL06 24-bit digitiser, located onto the masonry embankment wall, in the three main fractured areas. The H/V results of the traces acquired to evaluate the resonance frequency of the masonry embankment wall showed that its main resonance frequency was between 4 Hz and 15 Hz, in agreement with the frequency range of roughly 10-meters-high, squat and monolithic structure. Moreover, the maximum peak component particle velocities substantially increased during the roto-percussion piling works, and clearly showed the works advancement. The spectra analysis showed that the NS component, perpendicular to the wall, was the most stressed until the end of the piling works. The SMV indicated that the piling works stressed more the embankment wall section between Ponte alle Grazie hinge and the cusp. Finally, the hinge zones seem to be more sensitive to the vibrations characterized by low-frequency content, while the cusp section (the most damaged one) was more sensitive to vibrations associated with on site works.