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Preliminary ground response of the Diezma landslide (Southern Spain)

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The reactivation of landslides is a major concern in regions of moderate to high seismicity, especially when it affects roads or villages. The Diezma landslide (Southern Spain), which had an estimated volume of 1.2 Mm3 and affected the main highway of Andalusia (A-92), it is located in a region of moderate seismicity and it has been active since 1998, but some local reactivations keep going after the general failure occurred in 2001, despite of the corrective measures built after the main failure. A heavy rain period was the triggering factor of the landslide, therefore future rains and mainly earthquakes may destabilize the whole slope again. An engineering-geological model of the landslide was developed from field surveys, laboratory tests, boreholes logs and geophysical investigations (MASW and seismic noise measurements). The landslide mass is constituted by silts and clays with heterometric blocks sliding on a metamorphic bedrock, and its mechanism was conditioned by structural constraints. The ground response o f the landslide was studied through experimental techniques including ambient noise and earthquake records. The ambient noise survey was designed for the use of the Nakamura′s HVSR technique. While the measurements done inside the landslide exhibit a sharp peak whose peak frequency varies depending of the site within the landslide mass, those made outside landslide mass are characterized by a flat response. A temporary seismic network (0-30 s broadband seismometers), set up inside the landslide and in rocky outcrops outside the landslide, has allowed to record up to 20 earthquakes with epicentral distances from local to distant earthquakes, and magnitudes ranging from 1.7 to 7.2, showing similar spectral response to that retrieved from noise measurements. An unconventional pseudostatic analysis was applied to the landslide under limit equilibrium conditions through several sine waves, which cause accelerations which values are in the range of the expected PGA values for a return period of 475 years in the area. The landslide stability varies depending on the frecuency values of seismic waves, so the earthquake-induced effects are related to the characteristic period of them and landslide geometry (thickness and length). The temporary seismic network installed in the landslide slope will allow constraining the co-seismic displacements in the landslide and the possible damages to the highway. The authors would like to thank the ERDF of European Union for financial support via project "Monitorización sísmica de deslizamientos. Criterios de reactivación y alerta temprana" of the "Programa Operativo FEDER de Andalucía 2007-2015". We also thank all Public Works Agency and Ministry of Public Works and Housing of the Regional Government of Andalusia.