

Seismic stability analysis of Peruvian historical earthen walls

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ABSTRACT

In many places around the world there still exist statues, walls and columns which, despite being located in areas of high seismicity, are still standing and in good conditions after several hundred years. Although Peru is located on a zone of high seismicity, some pre-Columbian walls are still standing after having withstood many intense earthquakes. The remarkably stable dynamic response of these structures when rocking freely due to horizontal ground motions has been extensively studied (Housner, 1963; Hogan, 1989; Makris & Zhang, 1999). The aim of the project presented in this article is to evaluate the probability of seismic overturning of Inca monuments (XVth century CE) during future strong earthquakes.

The Wiracocha temple walls located near Cusco and the Inca trail walls that cross the PUCP campus in Lima were selected for this study. Both earthen walls were modelled as free-standing rigid blocks which could rotate around the corners at their base. A set of synthetic ground acceleration signals were then generated according to the seismicity and ground conditions of both sites. The artificial ground acceleration records were scaled to the uniform hazard spectrum of Peru for return periods of 500, 1000 and 2500 years and different moment magnitudes (Tavera, 2014; Roncal, 2017). The rocking time history response of each wall due to these ground motions was then numerically computed and plotted in order to assess the seismic risk due to overturning of these important earthen monuments.

The main conclusion is that these walls will most probably remain standing for many more centuries.

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