ESC2016-434, 2016
35th General Assembly of the European Seismological Commission

35th General Assembly of the European Seismological Commission
4–10 September 2016
Trieste

Rectangular Blocks vs Polygonal Walls in Archaeoseismology

Klaus-G. Hinzen (1) and Arnaud Montabert (2)

(1) Inst. Geologie und Mineralogie, Universität zu Köln, Germany (hinzen@uni-koeln.de), (2) Dep.s of Geosciences & Science and Antiquity, École Normale Supérieure Paris, France

Cracked or toppled walls are often considered strong evidence for a seismogenic cause of damage in archaeoseismology, and certain wall structures, like those with polygonal-shaped blocks, are regularly regarded as indicators of earthquake adapted building technique. The question arises as to what constitutes a quantifiable difference in vulnerability between e.g. Roman type walls of rectangular blocks, Inca type walls with irregular joint patterns, and Lycian or Roman walls with polygonal blocks. We used discrete element models of four differently structured walls of equal size to compare their dynamic behavior assuming simple gravity walls with perfect flat joints. A series of calculations with analytic signals resembling near fault ground motions shows a clear frequency and PGA dependence on the toppling behavior of all walls. In more than 600 tests we recorded the deformation or impact pattern of the walls and the distribution of the displacement of all blocks. The tests with controlled horizontal ground motions were supplemented by excitation of the models with a series of selected measured strong ground motions with PGAs from 0.1 to 1 g, applied in all three components of lateral ground displacement.
The observed deformations and toppling patterns provide a rough estimate of the main parameters of the driving motion. Effects known from archaeoseismic field studies such as corner expulsion and block rotation were observed. However, differences in vulnerability due to the wall block geometry are minor. Height to width ratio of the walls has a much stronger influence on their stability and toppling behavior than the block geometry.