Effect of geometrical imperfections on the response of dry-joint masonry arches to support settlements

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ABSTRACT

Movements of the abutments are one of the main sources of damage for masonry arches. These movements may be induced by various causes such as differential settlements, subsidence, landslides, instability of the supporting walls/pillars and many others. Although support movements are generally limited in their instantaneous magnitudes, they may lead to serious damage and even collapse over time [1]. Several research works have recently investigated the response of arched structures on moving supports. Analytical and numerical predictions have often been validated by comparison with the results from experimental tests performed on small-scale models (e.g. [2, 3, 4]). Major results report that the analytical and numerical methods generally overpredict the displacement capacity obtained experimentally due to the imperfections and inaccuracies that characterize the physical models compared to the "perfect" numerical ones. In this work, the effect of imperfections on the response of scaled dry-joint masonry arches to the settlement of one support was investigated. Experimental tests were performed on 1:10 small-scale models built as dry-joint assemblages of bi-component composite voussoirs. Two sets of voussoirs with different geometrical accuracies were produced by using different manufacturing techniques. Numerical simulations of the experimental tests were performed adopting a FE micro-modelling approach, where each voussoir was modelled as a distinct block and dry-joints were represented as no-tension friction interfaces. Experimental and numerical results were compared in terms of collapse mechanism, hinge configuration and ultimate displacement capacity. The imperfections of the physical models, and, in particular, the roughness of the contact surfaces between adjacent voussoirs, were found to play a fundamental role on the arch response. These imperfections were taken into account in the numerical models by properly setting the stiffness of the interface elements.

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