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Rigid body spring model for the structural assessment of old masonry dams

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ABSTRACT

In this paper, a Rigid Body Spring Model (RBSM) for the structural assessment of old masonry dams is presented. Old masonry dams are massive structures, which their stability depends on the gravity loads applied in the structure. Mainly, the structural assessment of old masonry dams is performed by means of a static approach, where the resultant of all forces acting on the dam must lie in the third middle of the base of the dam. However, this approach is too conservative and mostly does not reflect the real structural behavior of the dam. In this context, there is the need of models that are simplified enough to allow a simple and fast parametric analyses, but they should also account the peculiar behavior of the masonry.

The RBSM proposed idealizes the masonry structure as a set of rigid elements. These elements are quadrilateral and have the kinematics of rigid bodies with two linear displacements and one rotation. Three springs connect the common side between two rigid elements or the restrained sides. These connections are two axial springs, separated by a distance that take into account a flexural moment, and one shear spring at the middle of the side. The springs represent the mechanical characteristics of the material, and the strains and stresses of each spring represent the average strain and stresses inside each element, according to a tributary volume.

The RBSM is a semi–continuous model. Initial contacts do not change during the analysis and a relative continuity among elements exists. Overlapping, separation or sliding between two adjacent elements can exist; numerically, these mean compression, tension or shear and sliding on the connecting sides. The effective performance of the proposed model is demonstrated by numerical validation and by comparisons with some numerical models presented in the literature.