

Numerical modelling of masonry vaults with different brick pattern

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Abstract

Masonry vaults represent one of the most widespread types of horizontal structural elements in historical constructions. Therefore understanding their behaviour is a crucial precondition for the accurate assessment of the global safety of historical buildings. Vaults can be built according to different brick patterns, which, in historical building practices, were generally chosen for technical reasons [1].

Brick pattern is expected to play an important role in the global behaviour of vaulted structures. The way stones and bricks are jointed together is a key to understand what equilibrium path stresses would take. In spite of the importance of this topic, the role of brick pattern on the mechanical behaviour of vaults has been investigated by few authors (e.g. [2]) which observe that the same vault arranged with different masonry apparatus behaves differently. To our knowledge, almost all studies consider barrel vaults only, subjected to concentrated and distributed loads.

The objective of this study is to evaluate the influence of the masonry apparatus in barrel and cross vaults subjected to static vertical loads and imposed displacements. The study is carried out through a numerical approach, considering a simplified micro modeling approach [3]. The direction of the bed joints is the parameter of the analyses. Two directions are considered: parallel and orthogonal to the arch ring plane. Isotropic elastic behavior is considered for bricks and non-linear behavior for mortar joints. The displacement field is evaluated for each pattern and load condition and is monitored in specific control nodes. Comparison of results allows evaluating which of the two considered geometries is more sensitive to different configurations of the masonry apparatus.

References

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