Structural evaluation of typical historical masonry vaults of Cagliari: sensitivity to bricks arrangements

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ABSTRACT

Masonry vaults have a great diffusion in the historical architectural heritage: in this work, their structural behaviour is investigated [1]. Attention is focused on a typical typology of masonry vaults built during the nineteenth-century in the city of Cagliari. They are lowered sail vaults, obtained from the intersection of a spherical cap with a prism with a square base carved on its base, i.e. with four vertical planes. These vaults are built with different brick arrangements. Several wedges, each one with its bricks pattern compose the vault: starting from the corners, bricks rows are initially perpendicular to the diagonals till to form a square with the vertexes in the crown of each lateral arch, where bricks rows change orientation.

Some hypothesis about the constructive techniques that might have been used by masons are investigated. The role plaid by bricks arrangement is considered. The purpose is twofold: evaluate the role plaid by bricks arrangement in their mechanical behaviour and in relation to the techniques adopted for their construction.

A series of rigorous laser scanner surveys have been performed on some of these vaults in the Cagliari area, in order to obtain the effective geometry both at macro-level – the vault shape – and at micro-level – brick patterns.

A NURBS (Non-Uniform Rational B-Spline) representation of the geometry is adopted and adaptive upper bound limit analyses are performed. NURBS entities, which are common in commercial CAD packages, have the great advantage to describe complex geometries such as curved elements, with very few elements. An upper bound limit analysis formulation is adopted, in which the NURBS elements forming the mesh are idealized as rigid bodies with dissipation allowed only along interfaces. The mesh constituted by few NURBS elements is progressively adjusted through a genetic algorithm in order to minimize the live load multiplier [2, 3]. A comparison with incremental nonlinear analyses is finally carried out in order to evaluate the speedy limit analysis computations carried out with the aforementioned adaptive limit analysis technique.

REFERENCES

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