Cyclic tests on masonry vaults strengthened through composite reinforced mortar

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ABSTRACT

The coupling of non-corrosive reinforcements (glass or carbon fibers, PBO, stainless steel) with inorganic matrices is gradually becoming a common practice for the strengthening of historical masonry vaults, overcoming most of the typical durability drawbacks of traditional techniques, based on steel and concrete, and of modern strategies based on organic resins.

The authors already investigated on the effectiveness of a strengthening technique based on the application, at the vault extrados or intrados, of a 30 mm thick mortar coating with GFRP (Glass Fiber-Reinforced Polymer) meshes embedded [1,2]. The cyclic tests performed on full-scale, isolated vaults evidenced significant improvements in both resistance and displacement capacities, due to the presence of the GFRP mesh, which effectively enhanced the masonry flexural response, contrasting the opening of cracks. However, the results clearly evidenced that the reinforced vaults can fail prematurely if the sliding and/or uplift at the spring sections is not adequately prevented.

Thus, further experimental investigations were performed on reinforced vaults built on masonry abutments, proposing and testing a solution to effectively connect the vaults with the walls. In particular, the connection is based on ductile bars injected in the masonry and embedded in the mortar coating; the bars are adequately spaced, so as to allow their plasticization, providing thus to the vault end sections the rotation capability, but with resistance against sliding and uplift.

The results are presented and discussed in the paper and are compared with the previous ones; both reinforcement applied at the extrados and at the intrados are considered. The specific setup designed for the cyclic tests, based on a uniform horizontal load, permitted to clearly evidence and investigate of this detail aspect, differently from the simplified schemes typically adopted in the literature (based on concentrated vertical loads).

The importance of an effective connection of the vault with the abutments resulted of fundamental importance for exploiting the whole benefits of the reinforcement; useful results and design indication are thus provided.

REFERENCES

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