Unrenforced masonry structures'seismic improvement with F.R.C.M: the experience of the Vanvitellian Palazzo Murena of Perugia

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ABSTRACT

On the present days, thanks to the new technological means, the seismic improvement design criteria must look at the structural needs from a wide perspective, recognizing the quality of the Heritage buildings and acting accordingly. The aim of this contribution is to investigate the interactions among the historical knowledge, the seismic vulnerability assessment, the experimental investigations, the preservation of the architectural quality and the strengthening design in regard to the conservation of Palazzo Murena in Perugia, designed in the eighteenth century by the prominent Architect Luigi Vanvitelli and builded. In a previous contribution [1] the outcomes of the seismic assessment of the actual state of Palazzo Murena ranked the building in a rather safe state but highlighted that its "mezzanine floor" can be a vulnerable element of the masonry structure. Indeed the insights on such an iconic building revealed the presence of an asymmetrical structural-architectural system made up of a double volume by a composition of vaults and walls, built without a direct load path to the ground, aka *"in falso"* walls. The global seismic analysis, by macro-element [2], proved the good functioning of the existing masonry structure highlighting how its seismic behaviour is influenced by the peculiar structural shape. Later, more depth historical investigations and additional experimental tests were conducted on a selected portion of the building, which sums up all the aforementioned features, proved its coeval genesis to the rest of the architectural complex. Following the approach used [3], the increased level of knowledge combined with the structural observations, confirmed by the finite element modelling, permitted to conduct a preliminary local vulnerability analysis and to achieve a reinforcement intervention plan. In the present contribution is presented a design philosophy aimed at the tutelage of the building's architectural value by focusing the interventions'plan only on the elements of proved vulnerability so without involving stuccos, fine marble flooring, and other valuable elements that could not be restored if it were damaged during the implementation phase. Preserving the architectural characteristics, a local reinforcement intervention is proposed for the above-mentioned level; this consists of the application of plaster with FRCM (Fiber Reinforced Cementitious Matrix), assuring an adequate strength, without burden the masonry structure with additional weight, and therefore a decreasing of the seismic vulnerability. The scientific literature [4] reports that those plasters have multiple benefits compared to that reached with the welded wire ensuring anyway good mechanical properties: the reduced thickness compared to other traditional methods, the reversibility due to the employing of a mortar less aggressive than usual epoxy resins and lower environmental impact thanks to the use of natural origin of the nets'materials. The influence of such plan has been evaluated by means of an up-to-date numerical model and such outcomes, in terms of global seismic behaviour, has been finally evaluated versus the numerical results obtained for the Palace in its actual unreinforced state [1]. Subsequently the intervention plan has been designed according to the Italian Building Code and deeply considering, in addition, the role of the in-work implementation features. Eventually the technical drawings and the constructive details are proposed and described with respect to representative excerpts of the entire reinforcement plan. Contextually to this ongoing research the promising results encouraged the current plannig of laboratory experimental tests finalized at the assessing of the incidence of those next-gen composite materials'application regarding the prevention of the dangerous in plane wall's collapse.

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