SEISMIC ENHANCEMENT OF EXISTING BUILDINGS BY MEANS OF FIBRE REINFORCED CONCRETE DIAPHRAGMS

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Restoration of historical buildings often involves the structure earthquake hazard reduction. To this purpose, the strengthening of wooden floors is often proposed, in order to form roof and floor diaphragms transferring the horizontal loads to the shear resistant masonry walls. The resistance of the floors with respect to the seismic actions can be attained with different strengthening techniques, such as the addition of thin ordinary or high performance concrete slabs, the use of very thin steel plates, or wooden diaphragms, alternatively obtained with plywood panels or new thick planks.

The adoption of an overlaying thin concrete slab allows to upgrade both the in-plane stiffness and strength of the floor. As a drawback however, the dead load and therefore the seismic actions can be significantly increased. On the other hand, because of construction issues related to the correct setting of the steel mesh, the adopted actual thickness of the R\C slabs is often higher than the thickness resulting by the structural analysis.

A new strengthening technique is proposed and discussed in this paper. The strengthening solution consists in adopting a thin fibre reinforced concrete slab overlaying the existing wooden floor. The substitution of the ordinary steel mesh with fibres may allow the minimization of the slab thickness. As a consequence, both the dead load and the seismic action might be significantly reduced. When the thickness of the slab is reduced, the amount of steel reinforcement can be kept constant by increasing the fibre volume fraction in the mix.

Aim of the present study is to evaluate both the feasibility and the efficiency of the proposed technique. Fibres, as well as the ordinary steel mesh, should be able to prevent the slab in-plane brittle shear failure. This way, the structural ductility is governed by the flexural failure following the steel rebars yielding. Therefore, the robustness of the structure with respect to the seismic actions might be ensured.

The efficiency of the technique is evaluated by means of experimental full-scale tests on panels undergoing in-plane shear actions as well as nonlinear finite element analyses. The influence of different parameters (such as the thickness of the slab, the fibre content, and the amount of steel ties) on the diaphragm performance is evaluated.

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