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Advanced materials for seismic retrofit of existing reinforced concrete buildings with poor quality concrete

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Recent devastating earthquake outlined the high vulnerability of existing reinforced concrete (RC) buildings to seismic actions. The lack of seismic detailing often led to the shear failure of unconfined beam-column joints or of short columns limiting the entire structural performances. Significant research effort promoted the use of composite materials as an efficient, cost-effective and easy to install retrofit solution. This led to a massive use of Fiber Reinforced Polymer (FRP) systems in the reconstruction processes following recent Italian seismic events (L'Aquila, 2009; Emilia, 2012 and Central Italy 2016). Nowadays, these strengthening solutions are common in the design practice and simple and reliable design formulations are available. Although the FRP strengthening and other retrofit techniques allowed to significantly increase the seismic capacity of most of the damaged RC buildings by L'Aquila earthquake, a significant portion of buildings were demolished due to the economic inconvenience of the retrofit solution, poor quality concrete or high residual drift. Thus the proper solution for the seismic retrofit of beam-column joints or columns with poor quality concrete using innovative solutions based on advanced materials is nowadays under investigation. The most recently developed design formulation for the FRP strengthening of beam-column joints are herein illustrated and the limits of this technique when applied to a poor concrete substrate are discussed. The effectiveness of an alternative retrofit solution consisting on the use of Fiber Reinforced Cementitious Composites (FRCC) is analyzed by experimental tests on two beam-column joints extracted from a real building damaged and demolished after the 2009 L'Aquila earthquake. The use of advanced materials to define an innovative solution for the strengthening of columns affected by a quasi-brittle failure governed by the flexure-shear interaction is also discussed.

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