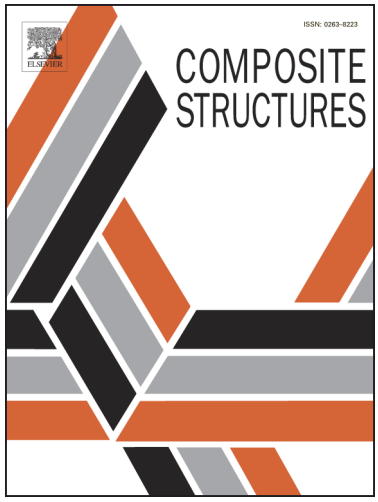

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Variation of the Vertical Stiffness of Strip-Shaped Fiber-Reinforced Elastomeric Isolators under Lateral Loading

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Abstract

A fiber-reinforced elastomeric isolator (FREI) is a relatively new type of isolator that utilizes fiber material for the reinforcing layers. FREIs can be installed in a bonded or unbonded application. In this study, finite element analysis (FEA) is carried out on bonded and unbonded strip-shaped FREIs to investigate the variation in vertical stiffness as the isolator undergoes lateral displacement. The vertical stiffness of the isolators under pure compression obtained by FEA was in good agreement with the predictions of two available closed-form solutions. As the lateral displacement increases, it was observed that for bonded FREIs the vertical stiffness decreases monotonically; whereas, for unbonded FREIs, the vertical stiffness decreased up to 175% shear deformation, where an increase in vertical stiffness was observed. FEA results confirmed that the effective overlap area method provides reasonable estimates for the vertical stiffness of bonded FREIs. It is observed that as the applied vertical stress increases, the vertical stiffness of bonded and unbonded FREIs increases. Finally, the paper shows that under large lateral displacements, bonded FREIs develop large tensile stresses in the regions outside the overlapping areas, while the tensile stresses that develop in unbonded FREIs are very low and confined in a small region.

Keywords: fiber-reinforced elastomeric isolators; laminated rubber bearings; seismic isolation; combined lateral and vertical loading; vertical response; finite element analysis

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