Response of Reinforced Concrete Panels Retrofitted with Elastomeric Polyurethane Coatings Under Blast Loads

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Abstract

Recent deterioration and damage to buildings and infrastructures caused by the extreme loading events have emphasized the necessity of adequate dynamic resistivity of those structures against such impulsive loadings. This innovation is on the use of palm oil-based polyurethane (PU) as a retrofitting material to enhance the structural capacity and resistance of reinforced concrete (RC) structural elements against impulsive effects. A numerical study was conducted using non-linear Finite Element (FE) code, LS-DYNA to study the dynamic resistance of bio-based PU coated RC slab elements subjected to blast load impact. FE models were developed based on an experimental investigation conducted by Tanapornraweekit et al. (2010). The material models were verified with the experimental outcomes of the varying strain-rate properties of materials which were investigated by the authors in the subsequent studies. Developed FE models were verified and validated using the experimental outcomes of the Tanapornraweekit's study. The contribution of coating thickness on the overall efficiency of the retrofitting scheme was assessed by four different coating thickness. The coating thicknesses were selected as the proportion to the total panel thickness, which are 2.5%, 5%, 10% and 20%. In addition, three concurrent studies on the coating thickness were undertaken, which are the influence of the coating thickness on impact face, rear face (with respect to blast) and, on both faces (with equal coating thickness). Findings indicated that the overall effectiveness of the proposed technique has shown great potential in terms of reduction in the panel deformations, support rotation and fragmentation effect in enhancing the blast resistance of RC elements.

Keywords: Bio-based polyurethane; Retrofitting; Reinforced concrete; Impulsive loading