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Performance-based and damage assessment of SFRP retrofitted multi-storey timber buildings

Abbas Vahedian*, Seyed Saeed Mahini and Rex Glencross-Grant

Discipline of Civil and Environmental Engineering, University of New England, Armidale, NSW, Australia

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Abstract. Civil structures should be designed with the lowest cost and longest lifetime possible and without service failure. The efficient and sustainable use of materials in building design and construction has always been at the forefront for civil engineers and environmentalists. Timber is one of the best contenders for these purposes particularly in terms of aesthetics; fire protection; strength-to-weight ratio; acoustic properties and seismic resistance. In recent years, timber has been used in commercial and taller buildings due to these significant advantages. It should be noted that, since the launch of the modern building standards and codes, a number of different structural systems have been developed to stabilise steel or concrete multistorey buildings, however, structural analysis of high-rise and multi-storey timber frame buildings subjected to lateral loads has not yet been fully understood. Additionally, timber degradation can occur as a result of biological decay of the elements and overloading that can result in structural damage. In such structures, the deficient members and joints require strengthening in order to satisfy new code requirements; determine acceptable level of safety; and avoid brittle failure following earthquake actions. This paper investigates performance assessment and damage assessment of older multi-storey timber buildings. One approach is to retrofit the beams in order to increase the ductility of the frame. Experimental studies indicate that Sprayed Fibre Reinforced Polymer (SFRP) repairing/retrofitting not only updates the integrity of the joint, but also increases its strength; stiffness; and ductility in such a way that the joint remains elastic. Non-linear finite element analysis ('pushover') is carried out to study the behaviour of the structure subjected to simulated gravity and lateral loads. A new global index is re-assessed for damage assessment of the plain and SFRP-retrofitted frames using capacity curves obtained from pushover analysis. This study shows that the proposed method is suitable for structural damage assessment of aged timber buildings. Also SFRP retrofitting can potentially improve the performance and load carrying capacity of the structure.

Keywords: timber buildings; performance-based assessment; damage detection; pushover analysis and Sprayed Fibre Reinforced Polymer (SFRP)

1. Introduction

The requirement for lightweight, resistant, sustainable and cost-effective structures has been increasingly in demand worldwide due to reduced supply of raw materials and energy sources. The efficient and sustainable use of materials in building design and construction has received

*Corresponding author, Mr., E-mail: a.vahedian.61@gmail.com

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