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Long-Term Performance of PresLam Frames: Are Post-Tensioning Losses really an Issue?

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Abstract

Several post-tensioned timber buildings have been already constructed in New Zealand and overseas starting from 2010. The construction technology relies on unbonded post-tensioning tendons or bars passing through internal ducks in beams, frames or walls to create moment resisting connections. Supplemental energy dissipation can be obtained by introducing replaceable mild steel bars or other types of dissipation devices at the rocking interface generally called "dissipaters".

This paper resumes an up to date review on all the available information in terms of post-tensioning loss. Data coming from operative building under monitoring are presented and compared with respect to the beam-column joint detailing solution. Furthermore, the influence of different post-tensioning loss scenarios on the building seismic response is showed by analytical and numerical procedures.

Results show that interstorey drifts in case of earthquake might significantly increase with post-tensioning loss when dissipaters are not provided. However, floor displacements remain constant when additional damping devices are used even in case of extreme loss scenarios.

Keywords: PresLam, post-tensioning, timber, creep, long-term

1 Introduction

As a result of the Precast Seismic Structural System (PRESSS) program [1] the hybrid connection proved to be an efficient low-damage solution for precast concrete buildings. The innovative connection combines unbonded post-tensioning tendons and mild steel bars to accommodate the seismic demand through controlled rocking between structural elements. While tendons provide re-centering capability to the system, supplemental damping allows for hysteretic energy release as well as providing additional moment capacity.

In 2002 the concept was transferred to steel members [2] providing the hybrid system being material independent. After three years, the technology was extended to engineered timber products at the University of Canterbury [3] and referred to as the Pres-Lam system.

Since 2010, several PresLam buildings (Figure 1) have been built in New Zealand and overseas including different lateral load resisting systems: post-tensioned timber walls and post-tensioned timber frames.

While extensive research has been carried out regarding the system seismic response, few information is available concerning the long-term behaviour of PresLam Structures.

It is widely accepted in fact that post-tensioning loss deriving from creep phenomena in

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