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Seismic Response of Precast Concrete Frames with Hybrid Connections

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Abstract

Hybrid frames contain precast concrete elements (beams and columns) that are connected by unbonded post-tensioning steel and partially debonded mild steel reinforcing bars, where both types of steel contribute to the overall moment resistance of the connection. In this research, effect of contribution of post-tensioning tendons on the nonlinear response of hybrid frame has been studied and a new distribution of post-tensioning in the height of structures proposed. With this distribution of post-tensioning, hybrid frames had less interstory drifts and so, design of precast pre-stressed frames would be better based on earthquake demands. Considering the combination of two different conceptual systems, namely Non Linear Elastic (NLE) and the Tension Compression Yielding (TCY), the cyclic moment-rotation behavior of the hybrid connection can be analyzed by individually modeling the behavior of unbonded tendons and mild steel. For performance base evaluation, hybrid frames were modeled and analyzed under earthquake input motions corresponding to three intensity levels. At each intensity level, the damage state in the buildings was quantified using the maximum transient interstory drift. The seismic performance of hybrid frames satisfied the performance limits under earthquake input motions with intensities similar to or below that of the design-level earthquake.

Key words: Precast concrete, Hybrid moment frames, Performance base evaluation.

1. Introduction

The precasting of concrete offers a wide variety of fabrication and assembly options. From a design perspective, the frame beam options can be placed in two categories: those that emulate cast-in-place concrete construction and those that provide connections between components that are capable of sustaining post yield deformations. The term “jointed precast” is also used to identify precast concrete elements designed to yield at the precast interface. In post yielding connections, the precast joint is located at the maximum demand moment and hinging area. Systems with this type of connections may be designed in two methods, first to design a system similar to monolithic concrete systems, so in this type, design must be based on concepts of strength and control capacity and second is based on