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Ductility of Reinforced Concrete Frame Buildings Subjected to the Recent New Zealand Earthquakes

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Abstract

The city of Christchurch in New Zealand suffered from a series of earthquakes between September 2010 and December 2011 that led to significant structural damage mainly in the RC buildings where most of them were demolished later. This paper presents the analysis results of two RC frame buildings when they were subjected to earthquake sequences from New Zealand earthquakes. The buildings are four and six story buildings that were designed to provide ductile response during earthquake loading. Nonlinear time history analyses were conducted on the numerical models for these buildings using PERFORM-3D to evaluate their behavior. The ductility demands and the hysteretic behavior at plastic hinges were investigated. The results showed increases in the ductility demands and the hysteretic behavior at plastic hinges was significantly affected which led to changes in the stiffness of the RC components.

Keywords: Reinforced concrete frames, ductility, plastic hinges, earthquake Sequence.

1 Introduction

The current design practice relies on the ductile flexural response at plastic hinges as the primary source of energy dissipation during earthquake loading cycles. This requires proper care in detailing the locations where plastic hinges are expected to occur. According to the seismic design provisions in modern building codes, buildings are supposed to resist minor earthquakes without damage, moderate earthquakes without significant structural damage, and in the case of a major earthquake, some structural and non-structural damage is allowed but without collapse. This is achieved when buildings are designed for ductile response during the maximum credible earthquake (MCE) through implementing several concepts such as capacity design, strong column-weak beam mechanism and preventing anchorage failure.

This paper studies the seismic behavior of ductile RC frame buildings in order to make sure that they can withstand a sequence of ground-motions and provide better ductility.

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