# Experimental Studies on a Novel Structural Detailing of RC Frames to Resist Earthquake and Progressive Collapse

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## Abstract

Conventional structural design methods mainly concern the demands of individual hazards, while a multi-hazard oriented design method is in great need in the ever-complex multi-hazard building environment. Earthquake and progressive collapse, which are the two most critical encountered threats of reinforced concrete (RC) frames, are considered in this study. Previous study indicates that the newly added reinforcement in progressive collapse design may weaken the structural seismic resistance due to "strong-beam-weak-column" failure mode. To resolve such confliction, a novel structural detailing is proposed. Both cyclic and progressive collapse tests are conducted to validate the performance of the newly proposed reinforcement arrangement. The experimental results showed that the proposed RC frame structural detailing can maintain satisfying progressive collapse resistance and efficiently mitigate the column and joint damage under cyclic load.

**Keywords:** Experimental tests, RC frame, Structural detailing, Earthquake, Progressive collapse

## 1 Introduction

Recent years have witnessed growing attention being paid to the structural safety under ever-complex multi-hazard environment. RC frame, being highly efficient in construction material use and flexible in space arrangement, is the most commonly used structural system. Various hazards need to be considered over the lifespan of RC frames, among which earthquake and progressive collapse are thought to be the most critical encountered threats [1-2]. Progressive collapse refers to the disproportional chain collapse action of a structure initiated by a local failure which may be caused by fire, explosion or overloading [3]. Conventional structural design of RC frames mainly concerns the demand of individual hazard, which consequently results in single hazard oriented design such as the commonly used seismic design and progressive collapse design. Existing studies have proven that a specific design method will not only determine the structural performance subjected to the oriented hazard, but also have impact on the resistance against other hazards [4-6]. Such impacts could be either positive or negative. However, existing design codes barely investigate the interactions between different design methods, which is undoubtedly unsuitable and even unsafe for the future development of multi-hazard oriented design.

It has been proofed that improving the seismic design intensity of an RC frame will have a

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