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The Effectiveness Investigation of New Retrofitting Techniques for RC Frame against Progressive Collapse

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Abstract

Progressive collapse in a building has caused local and subsequent damage throughout the system to spread and large-scale causes the collapse of the entire building. Progressive collapse is usually due to fire, gas explosion, terrorist attack, vehicle collisions, misplaced design and construction. Therefore, it is necessary to study the iMPact of this phenomenon and rebuild the building against it. Based on this, in this research, we will examine and evaluate practical solutions for reinforcing reinforced concrete frames against progressive collapse. The proposed solutions in this study were the use of reinforcing bars at the top and bottom of the beam, the effect of the layout of the cross section reinforcement for the participation in the chain performance, the use of Carbon Fiber Reinforced Polymer (CFRP) sheet at the bottom and three sides of the beam and the effect of the additional layer of CFRP sheet in the section performance of the beam against progressive collapse. In this study, a 2-story frame is modeled using OpenSees software and retrofitted with the above techniques, and the effectiveness of each of these techniques is evaluated in the final performance. The results show that the best approach to reinforcing the beam is by rebar and CFRP, which has resulted in improved chain performance and the greatest reduction of vertical displacement in the beam.

Keywords: Progressive Collapse; RC Frame; Chain Performance; Retrofitting Frame; OpenSees.

1. Introduction

The progressive collapse is basically a small, localized structural failure that results in the collapse of a part of the structure or even the entire structure. One of the structural failure mechanisms that has received considerable attention in recent decades is the progressive collapse. In this phenomenon, one or more structural members deteriorate suddenly due to the explosion, and each re-distribution of load disrupts other structural elements and the building is progressively destroyed. The progressive collapse in the code is referred to as a state of destruction, in which the local fracture of the main structural member leads to the destruction of adjacent members one after another and ultimately causes additional damage [1]. Since the failure of the Forefront, improvements in the integrity and flexibility of structures to resist progressive collapse are included in various regulations. [2-4]. After the terrorist attacks, especially in the Twin Towers of the World Trade Organization, the issue of evaluating and evaluating the potential for progressive collapse in critical structures has become one of the research axes. This phenomenon can also create problems for structures constructed according to the current regulations, during severe earthquakes, and even lead to the destruction of the entire structure.

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