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Shear Strength of Reinforced Concrete Columns Retrofitted by Glass Fiber Reinforced Polyurea

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Abstract

Aged structures and structures constructed based on outdated non-seismic design codes should be retrofitted to enhance their strength, ductility, and durability. This study evaluates the structural performance of Reinforced Concrete (RC) columns enhanced via polyurea or Glass Fiber Reinforced Polyurea (GFRPU) strengthening. Four RC column specimens, including a reference specimen (an unstrengthened column), were tested to evaluate the parameters of the strengthening materials and the strengthened area. The tests were carried out under a combined constant axial compressive load and quasi-static cyclic loading. The experimental results show that the composite strengthening provides lateral confinement to the columns and leads to enhanced ductility, shear-resistance capacity, and dissipated energy. The shear strength provided by the composites depends on the degree of lateral confinement achieved by the composite coating. The specimens finally failed through the development of diagonal tension cracks within the potential plastic hinge regions. The specimen treated with GFRPU strengthening showed greater strength and dissipated more energy than the specimen treated with polyurea strengthening. Furthermore, by modifying ATC-40, this study proposed an equation to estimate the shear capacity provided by the composites.

Keywords: Retrofit; Coating; Polyurea; Strengthening; Reinforced Concrete Column; Shear Crack.

1. Introduction

Deteriorated or aged Reinforced Concrete (RC) members should be rehabilitated or strengthened using appropriate methods to recover their structural performance. The seismic design code in Korea was published in 1988; hence, a number of older structures were constructed based on non-seismic design codes. Consequently, it has become necessary to enhance the structural performance of such structures without their demolition and reconstruction owing to concerns regarding environmental pollution, wasted resources, and natural disasters such as earthquakes.

The structural performance of structural members deteriorates because of reasons such as the aging of construction materials, fire damage, changes in use, deficiencies in the design, or construction errors. Thus, members should be strengthened to improve their structural performance, increase their load-carrying capacity, and enhance their seismic performance.

There are two approaches to the seismic retrofitting of concrete structures: global and local. Global methods involve strengthening the entire structure at the structural level using methods such as cross bracing, shear walls, and base

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