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Effect of Fibrous Jacket on Behavior of RC Columns

Wathiq Jassim Mhuder [a*], Samir M. Chassib [a]

[a] *Civil Engineering Department, Collage of Engineering, Misan University, Maysan, 62001, Iraq.*

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Abstract

This paper presented an extensive study about the strengthening of RC square short columns with high strength concrete jackets reinforced with steel fiber. The aim of this study is to investigate the effect of confinement by fibrous jacket on the behavior of RC column. A comparative study is performed on 23 square columns (six of them were unconfined columns where the remaining seventeen were confined columns) with varied parameters such as steel fibers ratio and type, jacket thickness, partial and full strengthening, type of confining jacket (hoop and composite), use of epoxy as bond material between the concrete column and strengthening jacket, and length parameter. The test results showed that the strengthened columns showed a significant improvement in the ultimate stress, load-carrying capacity, maximum strain, ductility, and energy absorption. Increase the steel fibers ratio (1, 1.5 and 2%) increased the ultimate stress by (22.5, 12.3 and 12.5%) respectively. The use of epoxy as bond material enhanced the ultimate stress by an average improvement by (55%). Composite case in the strengthening enhanced the load-carrying capacity larger than hoop case by (28.7 and 42%) for FRC jackets with hooked and straight fibers respectively but in case of stress capacity, hoop jacket carries stresses more than composite according to the stressed cross-sectional area. Increase jacket thickness (25 and 35 mm) enhanced the ultimate stress by (28.7 and 15.5%) respectively. Partial strengthening has a good enhancement in the ultimate load but was less than full strengthening. Increase the length by (25 cm) decreased the enhancement in load capacity of the column with hoop jacket by (45.3%). Concrete jackets enhanced Energy absorption and ductility which improved the deformation capacity. The compressive behavior of stub concrete columns was also modeled, simulated, and analyzed numerically by a 3D nonlinear finite element model. The verification process was performed against the reported data of the experimental test which proved the results of experimental results and showed a good agreement between experimental and numerical outcomes.

Keywords: Square Columns; Concrete Jackets; Steel Fibers; Jacket Thickness; Ductility; Finite Element.

1. Introduction

Strengthening of the columns may be urgent need for some structures and find the most effective ways to retrofitting these columns is the challenge. Rehabilitation of some parts of the structures or the enhancement of the structural capacity of them may be necessary at some times, especially when damage occurs as a result of the deterioration due to environmental conditions, excessive loading, design errors, or significant damage caused by explosions or earthquakes [1]. In recent years, structures have become unable to meet the necessary design standards for many reasons, the most important of which are design errors or perhaps the low quality of engineering implementation of the facilities, as well as changing the purpose of buildings for another use that requires a high strength of the structure. Among the other reasons that weaken the structures is the corrosion of steel inside the concrete, which leads to cracking concrete because of its great importance in preserving the tensile strength of the concrete. As an action, these structures are strengthened by designing armor to support the designed load, or to

* Corresponding author: alobaidi_ali@uomustansiriyah.edu.iq

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