



Circularization Technique for Strengthening of Plain Concrete Short Square Columns Subjected to a Uniaxial Compression Compressive Pressure

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Abstract

This paper presents an experimental **study** for strengthening existing columns against axial compressive loads. The objective of this work is to study the behavior of concrete square columns strengthening with circularization technique. In Iraq, there are significantly more reinforced rectangular and square columns than reinforced circular columns in reinforced concrete buildings. Moreover, early research studies indicated that strengthening of rectangular or square columns using wraps of CFRP (Carbon Fiber Reinforced Polymer) provided rather little enhancement to their load-carrying capacity. In this paper, shape modification technique was performed to modify the shape (cross section) of the columns from square columns into circular columns. Shape modification technique is also called circularization technique because the cross section is modified from square into circular cross section. Then, the circularized columns were wrapped with CFRP wraps. Shape modification is the strengthening method adopted in this paper as a mean to strengthen existing square columns. Columns studied in this paper are short columns with square sections as a special case of rectangular columns. Columns in this study are plain concrete columns (having concrete strength of $f'_c = 24.41$ MPa) with no internal steel reinforcement. The aim of this research is to study experimentally the behavior of circularized concrete square columns confined with CFRP wraps. Then, for better understanding, the results were compared with another, more widely used, strengthening technique which is the direct wrapping of square columns with CFRP wraps. Thus, investigating experimentally the effectiveness of the two aforementioned strengthening techniques in increasing the load-carrying capacity and ductility of the existing concrete columns. The methodology of this research is that six plain concrete short square columns were casted. These six columns were exerted to compressive pressure using concrete testing machine. These six columns were divided into three groups, each group consisted of 2 columns. The three groups were classified as follows: first group (titled L0) consisted of two square columns which were not strengthened by any method, second group (titled L1) consisted of two square columns confined by one layer of CFRP wraps, finally, the third group (titled LC1) consisted of two circularized square columns confined by one layer of CFRP wraps.

Experimental results showed that load bearing capacity and ductility of square columns have been significantly enhanced. Test results showed that shape modification technique (columns LC1) produced enhancement in load carrying capacity about 167.8 % of the original non-strengthened columns (columns L0). Furthermore, square columns wrapped by one layer of CFRP wraps (columns L1) produced enhancement in load carrying capacity about 56.1% of the original non-strengthened columns (columns L0). As such, it was evident that circularization technique resulted in enhancement in load carrying capacity far more than the enhancement obtained from wrapping the square columns with CFRP wraps.

Keywords: Circularization; Plane Concrete Columns; Confinement; Stress Concentration; Load Bearing Capacity; Uniaxial Compressive Pressure; CFRP (Carbon Fiber Reinforced Polymer).

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