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Experimental and Numerical Evaluation of Concentrically Loaded RC Columns Strengthening by Textile Reinforced Concrete Jacketing

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Abstract

Nowadays, Textile Reinforced Concrete (TRC) has become a very popular strengthening technique for concrete structures. This paper presents an investigation on the applicability of TRC for strengthening reinforced concrete column. Both experimental and numerical studies are conducted to evaluate the confinement effects of various TRC strengthening schemes. The experimental study is performed on a series of six reinforced concrete square columns tested to failure. Two of them were un-strengthened as references, the other four were strengthened by one or two layers of Carbon Textile Reinforced Concrete (CTRC). The results indicated that the application of carbon TRC enhanced the ductility and ultimate strength of the specimens. Failure of all strengthened columns was together with tensile rupture of textile reinforcements at the corners of column. Finite element models of the CTRC strengthened columns based on ATENA software package were developed and verified with the experimental results. The analytical results show that in the specimen corner areas, textile reinforcements are subjected to a 3D complicated stress state and this may be the cause of their premature failure.

Keywords: Textile Reinforced Concrete; Strengthen; Column; Confinement; Carbon Textile; ATENA.

1. Introduction

Reinforced Concrete (RC) columns as important structural members that transmit gravity and lateral loads to foundation in building structures and brittle failure of RC column may result in the entire collapse of building. Existing RC columns may require strengthening for a variety of reasons, for example: load increases due to higher live loads; change in the facility use; damage to structural parts due to fire damage, corrosion of steel reinforcement, etc. There are numerous methods available to retrofit RC columns, each with relative performance and practical strengths as well as weaknesses. Currently, the most preferable, efficient and practiced methods are RC jacketing and FRP wrapping. RC jacketing aims at increasing capacity of the structure by increasing its axial load capacity, shear strength, flexural strength and ductility. However, it requires a large jacket thickness, in normal cases higher than 70-100 mm, leading to decrease architectural area while increasing total mass of structure. This method is also not very suitable for structures in corrosive environments. On the other hand, FRP wrapping has advantages over concrete jacketing method such as much less thickness, lower weight and better constructability. However, strengthening performances are only limited to shear strength and deformation capacity. Axial load capacity can be increased by confinement effect, but is limited in extent. Besides, durability matters like fire, ultraviolet radiation, thermal cycles, and humidity should come into consideration when applying these methods.

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