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Strengthening of RCC Column Using CFRP

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Abstract

In some buildings, when quality control is poor, the columns have a weak compressive strength, particularly in floor zone. Low compressive strength of the column member will lead to reduction in bearing capacity of column. This project is carried out to investigate the overall actions of P.C.C cylinder, strengthened with wrapped CFRP. From the literature study One or two of them will be a control specimen and the other six specimens were strengthened with CFRP. The main parameters studied from the literature research were the compressive strength, and the height of CFRP wrapped part of column. The results include mode of failure, ultimate load. All the test specimens were loaded to failure in axial compression and the behaviour of the specimens in the axial directions was investigated. Test results exposed that the CFRP wrap increases the strength and ductility of plain and RC cylinders expressively. The main conclusion of this project was, strengthening of column using CFRP and which may give good results of the column load carrying capacity.

INTRODUCTION

The construction industry is undergoing a significant trans- formation as it grapples with the dual challenges of en- vironmental sustainability and resource management. With traditional building materials like clay and cement contributing extensively to greenhouse gas emissions and resource deple- tion, there is a growing demand for alternative materials that are both environmentally friendly and economically viable. Eco-friendly bricks represent a promising solution in this re- gard. These bricks are made from sustainable materials, often incorporating waste products from agricultural and animal husbandry processes. By utilizing materials such as bone meal, cow dung ash, and wood ash, manufacturers can reduce the environmental impact associated with conventional brick pro- duction while simultaneously addressing waste management issues.

BACKGROUND

Retrofitting of existing civil engineering structures has been undergoing intense study in recent times. Time induced deterioration of existing structures, degradation due to environmental impacts, poor initial design and construction, lack of maintenance, and sudden events like earthquake indicates structural strengthening as a viable necessity. With the recent developments in material science, methods and techniques for structural strengthening have been diverse. One of today's state- ofthe-art techniques are the use of Fibre Reinforced Polymer (FRP)

composites, which are currently being viewed by as highly promising materials in the construction. The durability of concrete structures has always been an issue of great concern especially related to the corrosion of steel reinforcement. Coastal structures, ports, chemical industry facilities, and bridges are examples of critical structures subjected to reinforcement corrosion. Using Carbon Fibre Reinforced Polymer (CFRP) as supplemental reinforcement could be an option.

In some buildings, when quality control is poor, the columns have a weak compressive strength, particularly in floor zone. Low compressive strength of the column member will lead to reduction in bearing capacity of column. This paper is carried out to investigate the overall actions of R.C columns, strengthened with wrapped CFRP. From the literature study One or two of them will be a control specimen and the other six specimens were strengthened with CFRP. The parameters considered are the number of composite layers and the compressive strength of unconfined concrete. Fiber-Reinforced polymer (FRP), also is a composite material made of a polymer matrix reinforced with fibers. The fibers are usually glass, carbon, or aramid, although other fibers such as paper or wood or asbestos have been sometimes used sometimes used.

RELATED WORK

Experimental Program

The experimental work performed for this study is described in this section. This section declares also the study parameters that have been used to understand the behavior of confined R.C column with the new strengthening technique method of CFRP jacket. The details of each tested specimen (the dimensions and reinforcement details) are also presented. The properties of used materials are determined and compared with the Egyptian code and specification requirements. Also, the test procedure, test setup, and measurement devices are illustrated.

Study Parameters

The experimental program is studying the behavior of thirteen R.C columns strengthened by carbon fiber polymers (CFRP). Test specimens are RC columns of cross-sections; 150 x150 mm for square columns, 150 x200 and 150 x300 mm for rectangular columns, and 150 mm diameter for circular columns. All columns are 1200 mm in height. The tested specimens were classified into five groups to study the effect of using CFRP wraps on the load-carrying capacity of circular RC columns. While Group (2) is to study the effect of load-carrying capacity and behavior of square and rectangular RC columns. Group (3) is to study the effect of using CFRP wraps on the load-carrying capacity and behavior of square and rectangular RC columns. Group (4) is used to study the radius effect of curvature, R, of the ellipsoidal profile by using CFRP wraps on the load-carrying capacity and behavior of the square RC columns. Finally, Group (5) is to study the optimum radius effect of curvature, R, of the ellipsoidal profile by using CFRP wraps on the load-carrying capacity and behavior of the rectangular RC columns.

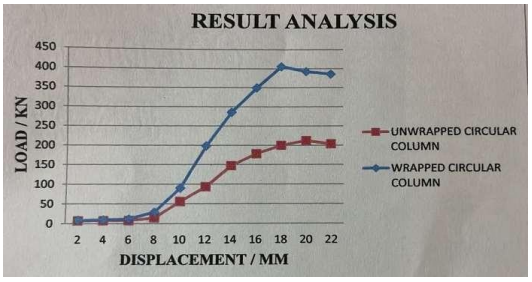
Literature Based Findings

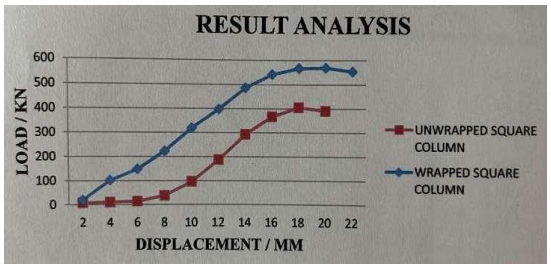
D. Vigneshkumar (IJRET, 2018): This paper is carried out to investigate the overall actions of R.C columns, strengthened with wrapped CFRP. The overall response of the wrapped concrete
cylinders was superior to that of the unwrapped cylinders subjected to the same environmental conditions. The CFRP wrapped specimen showed significant improvement in terms of strength, stiffness. and ductility in comparison to a similar unwrapped cylinder.

K. Olivova, J. Bilcik (SJCE,2008): In this paper the author uses fiber reinforced polymer (FRP) materials for structural repair and strengthening has continuously increased in recent years, due to several advantages associated with these composites when compared to conventional materials like steel. This paper presents the results of an experiment at study on the structural behavior of Reinforced concrete columns strengthened with carbon fibre sheets.

K. P. Jaya, Jessy Mathai (WCEE, 2012): This paper includes a study on Seismic retrofitting of constructions vulnerable to earthquakes is a current problem of great political and social relevance. Most of the Indian building stock is vulnerable to seismic action even if
located in areas that have long been considered of high seismic hazard. Hence, experiments were conducted on Reinforced concrete columns with and without FRP wrapping.

GRAPHICAL REPRESENTATION OF RESULTS





Graph -Result Analysis of CFRP Wrapped and Unwrapped Square RCC Columns

DISCUSSION

Test results shows that the increase in strength of RCC member is more than 50% of conventional method. For retrofitting of structures this is an useful and successive technique we achieved. Increase in strength of Square, Rectangular and Circular specimens are 40.40%, 51.27% and 91.39% respectively.

CONCLUSION

We can increase the strength of RCC structures successfully by using CFRP. Our test results shows that the increase in strength of RCC member is more than 50% of conventional method. For retrofitting of structures this is an useful and successive technique we achieved. Increase in strength of Square, Rectangular and Circular specimens are 40.40%, 51.27% and 91.39% respectively.

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