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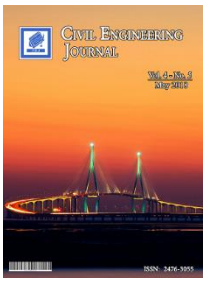

A Numerical Analysis of T-Shaped Reinforced Concrete Beams Strengthened with Polymeric Strap of CFRP and GFRP by Finite Element Method

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Abstract

In recent decades, researchers and structural engineers have shown great interest in the use of Fiber Reinforced Polymer (FRP) plates/sheets for maintaining strength and durability in the utilization of concrete structures. In this study, reinforced-concrete beam with T-shaped cross-section is reinforced with Carbon Fiber Reinforced Plastic (CFRP) plates and Glass Fiber Reinforced Plastic (GFRP) plates under 4-points inflections by finite element method. In order to analyze the performance of the polymer plates used in the reinforcement of the considered concrete beams, some sheets with 5cm and 10 cm width having different formation patterns are joined to the concrete area. For this purpose, the angle between the lines of the plates and the longitudinal axis of the beam is varied based on four different degrees of gradations, from 30 to 90°. In addition, the role of these sheets in limiting the deformation of the beam in its U-shaped and full-wrapping conditions is studied. The transversal distance between the plates is also considered as equal to the width of plates. Seventy-two samples of concrete beams with C30 and C50 grades which were strengthened with polymer plates are compared with non-polymeric concrete beams. The numerical analysis results illustrate that the use of the different formation patterns and deflection angle of plates cause differences in the process of beam settlement. Further, the results show that C50 grade concrete samples are most effective in the reduction of concrete deformation when carbon fibers of 5cm width are used at an angle of 30 degrees with beam linear axis and traversal formation pattern. On the other hand, among the C30 grade samples, the best performance is related to the use of 5 cm carbon fibers which were utilized as full-wrapping. Under both aforementioned circumstances, the possible amount of the polymeric beam settlement over non-polymeric beam will decrease by about 50%.

Keywords: CFRP; GFRP; T-shaped Concrete Beam; Polymer Plates; Reinforced Concrete (RC).

1. Introduction

In recent years, the reinforcement of existing concrete buildings is regarded as the most important issue in civil engineering. An overview of the damages caused by loading shows that until now, a high percentage of reinforced concrete (RC) buildings do not have enough or acceptable strength to confront static or dynamic loads, because these constructions are designed on the basis of old rules and regulations, and most of them do not comply with the new bylaw. Moreover, operational insufficiencies and weaknesses have also increased the vulnerability of these concrete structures to the applied loads. Accordingly, the importance of strengthening these buildings with authentic, plain and economical reinforcement methods is now widely recognized. In other words, each concrete structure needs a considerable

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