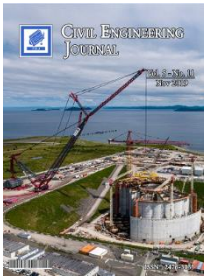
Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 5, No. 11, November, 2019



Numerical Investigation of the Behavior of Reinforced Concrete Beam Reinforced with FRP Bars

Rania Salih [a, b*], Zhou Fangyuan [a]

[a] *Huazhong University of Science and Technology, School of Civil Engineering and Mechanics, Wuhan, Hubei 430074, China.*

[b] *Red Sea University, School of Civil Engineering ,Portsudan, Sudan.*

Received 16 July 2019; Accepted 28 September 2019

Abstract

In this study, the behavior of reinforced concrete beams reinforced with FRP bars was investigated. A total of seventeen models were carried out based on the finite element software (ABAQUS). The concrete damage plasticity modeling was considered. Two types of fiber polymer bars, CFRP and GFRP as longitudinal reinforcement for concrete beam were used. The validation of numerical results was confirmed by experimental results, then the parametric study was conducted to evaluate the effect of change in different parameters, such as (diameter size, number of bars), type of FRP bars, longitudinal arrangement for FRP bars. All results were analyzed and discussed through, load-deflection diagram, according, to the difference parameter considered. The results showed that the use of FRP bars in rebar concrete beam improves the beam stiffness and enhance the cracking load. The load capacity enhanced in the range of (7.88-64.82%) when used CFRP bars. The load-carrying capacity of beams strengthened with CFRP is higher than that of strengthened with GFRP. Furthermore, the use of FRP bars in bottom and steel in top reinforcement is useful to overcome the large deflection, and improving the beam ductility. Finally, the results of finite element models were compared with the prediction equation, according to ACI440.1R-15.

Keywords: Reinforced Concrete Beam; FRP Reinforcement; Finite Element Analysis; Load-deflection Curve.

1. Introduction

The use of modern Fiber Reinforced Polymer (FRP) bars for reinforcing and repair structural member (columns, beams, deep beams, and slabs), has been rapidly increased within the past few years. The durability of the reinforced concrete element is a major concern due to the corrosion of steel reinforcement in concrete structures exposed to de-icing salts and marine environments [1, 2]. However, Deficit of mechanical strength of reinforced concrete structures and poor bond behavior between steel and concrete are often caused by the corrosion of steel reinforcement. In addition to a high level of durability and fatigue durability, FRP reinforcing bars have a high strength-to-weight ratio, which creates an attractive choice as reinforcement for concrete structures [3]. The most commonly used in infrastructure and commercially available FRP bars types are included, Carbon fiber reinforced polymer (CFRP), Aramid fiber reinforced polymer (AFRP), Glass fiber reinforced polymer (GFRP) and Basalt fiber reinforced polymer (BFRP). Every type of bars has been different in mechanical properties, physical appearance, and surface configuration. Moreover, FRPs can be produced as bars, ropes, tendons, and grids [4].

* Corresponding author: rania_salih@hotmail.com

http://dx.doi.org/10.28991/cej-2019-03091412