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Energy Absorption Evaluation of CFRP-Strengthened Two-Spans Reinforced Concrete Beams under Pure Torsion

Ammar N. Hanoon [a], Ali A. Abdulhameed [a*], Haider A. Abdulhameed [b], Saad K. Mohaisen [c]

[a] *Department of Reconstruction and Projects, University of Baghdad, Baghdad, Iraq.*

[b] *Civil Engineering Department, University of Technology, Baghdad, Iraq.*

[c] *Civil Engineering Department, College of Engineering, Al-Mustansiriyah University, Iraq.*

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Abstract

For more than a decade, externally bonded carbon fiber reinforced polymer (CFRP) composites successfully utilized in retrofitting reinforced concrete structural elements. The function of CFRP reinforcement in increasing the ductility of reinforced concrete (RC) beam is essential in such members. Flexural and shear behaviors, ductility, and confinement were the main studied properties that used the CFRP as a strengthening material. However, limited attention has been paid to investigate the energy absorption of torsion strengthening of concrete members, especially two-span concrete beams. Hence, the target of this work is to investigate the effectiveness of CFRP-strengthening technique with regard to energy absorption of two-span RC beams subjected to pure torsion. The experimental program comprises the investigation of two groups; the first group comprises eight un-strengthened beam specimens, while the second group consists of eight strengthened beam specimens tested under torsional forces. The energy absorption capacity measured from the area under the curve of torque-angle of twist for tested beams. Two parameters were studied, the influence of concrete compressive strength and the angle of a twist. Experimental results indicated that all beams wrapped with CFRP sheet display superior torsional energy absorption capacity compared to the control specimens. The energy absorption may consider as a safety index for the torsional capacity of two-span RC beams under service loadings. Therefore, it is possible to avoid structural as well as material damages by understanding the concept of energy absorption that is one of the important experimental findings presented in this study.

Keywords: Two-span Beams; Reinforced Concrete; Torsional Strengthening; CFRP Fabrics; Energy Absorption; Ductility.

1. Introduction

Torsional moments can be developed in many RC members significantly. Bridge elements, horizontally curved members, eccentrically loaded beams and spandrel beams are subjected to torque. Therefore, there is a need for increasing the torsional capacity of such structural members to carry additional load, as well as, avoid structural damage [1].

The ductility of RC members can be described as the ability to withstand plastic deformation without loss in load carrying capacity before failure. In principles, the mechanical energy of the RC element transformed into potential energy. However, this is an indication of inherent ductility acts together with energy absorption of such structures [2,

* Corresponding author: aliadel@uobaghdad.edu.iq

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