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Torsional Strengthening of Reinforced Concrete Beams with Externally-Bonded Fibre Reinforced Polymer: An Energy Absorption Evaluation

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Abstract

The impacts of numerous important factors on the Energy Absorption (EA) of torsional Reinforced Concrete (RC) beams strengthened with external FRP is the main purpose and innovation of the current research. A total of 81 datasets were collected from previous studies, focused on the investigation of EA behaviour. The impact of nine different parameters on the Torsional EA of RC-beams was examined and evaluated, namely the concrete compressive strength (f'_c), steel yield strength (fy), FRP thickness (t_{FRP}), width-to-depth of the beam section (b/h), horizontal (ρ_h) and vertical (ρ_v) steel ratio, angle of twist (θu), ultimate torque (Tu), and FRP ultimate strength (fy_{-FRP}). For the evaluation of the energy absorption capacity at different levels, Response Surface Methodology (RSM) was implemented in this study. Also, to fit the measured results, Quadratic and Line models were created. The results show that the RSM technique is a highly significant tool that can be applied not only to energy absorption-related problems examined in this research, but also to other engineering problems. An agreement is observed between Pareto and standardized charts with the literature showing that the EA capacity of the torsional FRP-RC beams is mostly affected by the concrete compressive strength, followed by the vertical reinforcement ratio. The newly suggested model in this article exhibits a satisfactory correlation co-efficient (R), of about 80%, with an adequate level of accuracy. The obtained results also reveal that the EA acts as a safety index for the FRP-strengthened RC beams exposed to torsional loadings to avoid sudden structural damage.

Keywords: Energy Absorption; Reinforced Concrete Beams; Torsional Strengthening; FRP, Response Surface Method (RSM).

1. Introduction

Generally, in buildings, bridges, and other such structures, Reinforced Concrete (RC) members are exposed to a sequence of significant actions such as flexural, shear, and torsional moment, which may result in structural failure [1-3]. In comparison with shear and flexural impacts, torsion is typically taken into consideration as a secondary effect. As a result, the available literature consists of limited research into the torsional behaviour of RC structural members [4]. Note that in cases like curved girders in bridges, spandrels, and curved beams in buildings, the torsional effects

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