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CFRP Sheets for Retrofitting Prestressed Concrete Bridge Girders

Herish Hussein[1], Hardi Hussein[2]
[1]Old Dominion University
Norfolk, Virginia 23529, USA
hhuss001@odu.edu,
[2]University of Koya
Koya, Erbil, Iraq
hardyhusseinkurdish@gmail.com

Extended Abstract

This study presents a theoretical investigation on retrofitting AASHTO prestressed bridge-girder, type PCB-5, using Carbon Fiber Reinforced Polymer (CFRP) to increase flexural strength. CFRP has been mainly used to strengthen the tension regions only [1-3]. Herish and Razzaq showed that installing CFRP in both tension and compression regions of building prestressed concrete inverted tee beams [4] and bridge box girders [5] increases flexural strength and decreases mid-span deflection.

In this study, CFRP is installed in the tension bottom fiber in the first case and the compression region in the bottom of top-flange wings in the second case. The cross-sectional dimensions of the studied girder (PCB-5) are slightly changed for the sake of simplicity. In this study, 24 ASTM Grade 270 seven-wire strands each having a ½-in.-diameter are installed in three rows at the bottom flange of the girder, and the compressive strength of the concrete used is 7000 psi. Ultimate tension and compression strength of the CFRP is 260 ksi with Young`s Modulus of Elasticity of 22000 ksi. Non-linear moment-curvature relations are predicted using an iterative algorithm for both retrofitted and non-retrofitted beam sections to show the difference between the change in strength from the reference girder (non-retrofitted girder) and the two different proposed retrofitting schemes. The studied prestressed concrete girder was first retrofitted only in the tension region (Case I) using three laminar sheets of 24 in. x 1/16 in CFRP. In the second retrofitting scheme (Case II), three laminar sheets of CFRP are used in both tension and compression regions simultaneously.

The results show that retrofitting only the tension region (Case I) gives a 84% increase in flexural strength. Retrofitting both tension and compression regions simultaneously (Case II) increases flexural strength by up to 112%. Increasing strength was at the cost of decreasing ductility in the reference beam.

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