INVESTIGATION OF THE STRENGTH AND DUCTILITY OF REINFORCED CONCRETE BEAMS STRENGTHENED WITH CFRP LAMINATES

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(Abstract)

The use of fiber reinforced plastics (FRP) in repairing and strengthening bridges has been researched in recent years. In particular, attaching unidirectional FRP to the tension face of reinforced concrete beams has provided an increase in stiffness and load capacity of the structure. However, due to the brittle nature of the unidirectional FRP, the ductility of the beam decreases. One possible solution to this problem is the use of cross-ply or off-axis FRP laminates. This thesis focuses on the investigation of the flexural behavior of reinforced concrete beams strengthened with one of two different FRP orientations (0°/90° and ±45°). More particularly, the change in strength and ductility of the beams as the number of FRP layers are altered is investigated. Seven under-reinforced concrete beams were constructed and tested to failure. With the exception of the control beam, each specimen was applied with two, three, or four layers of either 0°/90° or ±45° FRP orientations. To predict the flexural behavior of the specimens, a theoretical model was derived using basic concepts, past research, and the tested properties of the concrete, steel reinforcement, and FRP. Also, two methods were used to analyze the ductility of the tested beams. Along with the test details of each specimen; the moment, deflection, CFRP strain, crack patterns, and mode of failure are discussed. The results included an increase in load capacity with respect for the number of CFRP layers applied for both orientations. Also, the ductility of the beams were reduced by adding CFRP orientations.

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Table of Contents

List of Figures

List of Tables