Ain Shams University
Faculty of Engineering
Department of Structural Engineering

Strengthening of Steel I-Section Beam-Column using Pre-Stressed CFRP Laminate

A THESIS
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MASTER OF SCIENCE IN CIVIL ENGINEERING (STRUCTURAL)

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Statement

This dissertation is submitted to Ain Shams University for the degree of Master of Science in Civil Engineering (Structural Eng.)

The work included in this thesis was carried out by the author in the Department of Structural Engineering, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this thesis has been submitted for a degree or qualification at any other university or institution.

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Abstract of M.Sc. Thesis

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Using Carbon Fibers Reinforced Polymers CFRP in strengthening steel structures' members (beams and columns) is a good method because of its significant effect on the strength. In addition, CFRP laminates can be easily connected to such members without affecting the workspace. Most of researchers, who considered this field of strengthening, concentrated their research on beams or columns and very few researches are on beam-columns. The strengthened structural members represent an extremely complex and highly indeterminate analytical problem with a large number of parameters affecting their structural behavior. Many failure modes must be taken into consideration during analysis. Not only tensile failure in either steel or laminate governs the strength but also interfacial failure probably controls the strength of such structure. Pre-tensioning the CFRP panel laminate used for strengthening increases the overall strength of the member. Present research focuses on the behaviour of steel I-section beam-columns subjected to both flexure and compression force and strengthened using pre-stressed CFRP laminate. Two failure modes are investigated in this research; the first failure mode is the steel

yielding failure criteria (mature failure), the second failure mode is the de-bonding of the CFRP laminate from the steel beam-column (pre-mature failure). Analytical model and finite element analysis are developed to investigate the strength of CFRP bonded steel beam-columns.

Keywords: steel; beam-column; I-section; strengthening; CFRP laminate; pre-stressed.

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