

# **REINFORCED CONCRETE BEAMS RETROFITTED IN FLEXURE USING CFRP-NSM TECHNIQUE.**

Salam Al-Obaidi\*, and Franz N. Rad\*\*

\* University of Al-Qadisiyah – Roads and Transportations Engineering Department

\*\* Portland State University – Department of Civil and Environmental Engineering

**Biography:** **Salam Al-Obaidi** is a researcher at University of Al-Qadisiyah, college of Engineering, Roads and Transportations Engineering Department. He received his B.Sc. from University of Al-Qadisiyah college of Engineering, Civil Engineering Department and M.Sc from Portland State University, Maseeh College of Engineering and Computer Science, Civil and Environmental Engineering. His research interests include repairing of concrete structures.

**Franz N. Rad**, FACI, is a Professor of Civil Engineering and Arthur M. James Professor of Structural Engineering in the Fariborz Maseeh College of Engineering and Computer Science at Portland State University, Portland, OR. His research interests include developing earthquake damage and loss estimation models for buildings, mitigating earthquake damages, and forensic engineering.

## **ABSTRACT**

CFRP rods were inserted into grooves that were made in the bottom surface of the beams. Two sets, set A and set B of reinforced concrete beams were tested under flexural load. Each set contains four beams. One specimen was the control beam, and the others were additionally reinforced with two CFRP rods of #2, #3, and #4. Steel ratios of 0.7% and 0.4% were selected for set A and B respectively. The cross section of the beams was 10 in. (254 mm) x 6.5 in. (152 mm) with span length of 8 ft. (2.5 m). Loads, strains, and deflections are measured and theoretical and measured capacities are compared. The results indicate that NSM CFRP application increased the flexural capacity and the stiffness of tested specimens. However, retrofitting the specimens that had a low steel ratio appeared to be more effective than retrofitting specimens that had a high steel ratio.

**Keywords:** Near Surface Mounted Technique, NSM-CFRP application; strengthening concrete beams.

