Indian Journal of Science and Technology, Vol 9(42), DOI: 10.17485/ijst/2016/v9i42/101824, November 2016
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Flexural Response of Fibre Reinforced Polymer Laminated Pre-stressed Concrete Beams

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Abstract

Objectives: To examine the effect of Glass Fiber Reinforced Plastic (GFRP) laminated on strength and deformation capacity of pre-stressed concrete beams under static loading condition. **Methods/Statistical Analysis:** In this study, 7 Pre-Stressed Concrete (PSC) beams were cast and laminated with GFRP. The beams were tested under monotonically increasing loading and manual readings were recorded. Sufficient data was obtained on the strength, deformation and failure characteristics of pre-stressed beams with and without GFRP laminates for beams tested under static loading. **Findings:** In all the pre-stressed concrete beams, 5mm UDCGFRP strengthened PSC beams showed an improved flexural strength. The test results inferred that strengthened pre-stressed concrete beams showed 93.15% increase in load carrying capacity than that of control specimens. All GFRP laminated pre-stressed concrete beams experience flexural failure. **Application/Improvements:** The pre-stressed concrete beams laminated with glass fibre reinforced polymer were found to be very effective in load carrying capacity, deflection and ductility. It can be also be suitably adopted for rehabilitation and restoration of corrosion damaged, old infrastructures and seismic affected concrete structures.

Keywords: Fibre Reinforced Polymer, Flexural, Glass Fiber Reinforced Plastic (GFRP), Post-Tensioned, Pre-Stressed Concrete, Strengthening

1. Introduction

A structure plays an important role in the development of an individual or state or country. Without high rise strong and aesthetic structures, development of human race is unimaginable. A structure comprises of three major elements namely beam, column and slab. All these elements have importance of their own. Beams are one the most important structural member for any structures; it may be bridge, Industrial building, roadways etc. Beams must be designed in such a way that it can withstand any type of loads without producing any deformation or cracking to the structures. But at times the beams may experience sudden static loads for which they are not designed. Due to these sudden loads the beams tends to crack[1,2]. This is mainly due to the tension or compression in beam. The pre-stressed concrete beams were used in buildings which has to withstand heavy loads like bridges, industrial buildings etc. The pre-stressed beams are designed to withstand heavy loads. These beams have lesser beam depths, posses improved resistance to shearing. These beams are mostly used where the span is more. In order to protect the beam from the cracking produced due to fatigue load strengthening to be induced. Strengthening of beams resulted in decreased number of cracks. The crack width and its sizes are considerably reduced.

The traditional techniques like steel plate bonding, concrete jacketing and external post-tensioning are common in practice. Exceptional characteristics of Fibre Reinforced Polymer (FRP) composites hold major advantages over the traditional techniques of strengthening. This type of composites have some unique characteristics such as high strength to weight ratio, easy installation, high resistance to corrosion and low installation cost which makes an effective solution.

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