Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 181 (2017) 257 – 264

Procedia Engineering

www.elsevier.com/locate/procedia

10th International Conference Interdisciplinarity in Engineering, INTER-ENG 2016

Experimental Research in Flexural Behavior of Carbon Fiber Polymer Strengthened Beams

Christiana Cazacu[a]*, Teofil Galatanu[a], Paraschiva Mizgan[a], Radu Muntean[a], Florin Tamas[a]

[a]*Transilvania University of Brasov, Turnului 5, Brasov, Romania*

Abstract

This experimental research has studied the flexural behavior of CFRP strengthened beams. Four simply supported beams, reinforced using CFRP laminates where subjected to different sustaining loads and tested in flexure. The main of the test is to examine the effects of initial load and load history on the ultimate strength of reinforced concrete beams by externally bonded CFRP materials. The theoretical moment-curvature relationship and the load-displacement response of the tested beams were predicted by using software CATIAV6. Comparison has been made between numerical and experimental results. The test results showed that the strengthened patterns had influence on the beams structural performance, improving load capacity, increased flexural strength, enhanced flexural stiffness, modifying structural behavior and changing failure mode.
© 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of the organizing committee of INTER-ENG 2016

Keywords: concrete structures; Numerical (CATIA V6); beam; externally bonded; reinforcement.

1. Introduction

Structure Fiber reinforced polymer (FRP) composite materials encompass a wide variety of engineered materials that are designed to add strength where needed and reduce the weight of the structures. Advantages of FRP composites include high strength to weight ratios, corrosion resistance, electrical insulation, radio and magnetic transparency and ease of installation and construction [1]. High strength composites made of carbon fiber and organic polymers are being successfully used for various types of repair applications [2].The repair of structurally

* Cazacu Christiana. Tel.: +40-747-075947.
*E-mail address:*cazacuchristiana@yahoo.com

1877-7058 © 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of the organizing committee of INTER-ENG 2016
doi:10.1016/j.proeng.2017.02.387

deteriorated concrete structures becomes necessary as the structural element ceases to provide satisfactory over loading, strength, and serviceability. In recent years, the development of fibre reinforced polymer (FRP) material, with a high-strength-to-weight ratio and excellent resistance to corrosion, makes it particularly suited to structural applications. Because of the good performance, field application of repair by epoxy-bonded FRP laminates is now recognized to be an effective and convenient method, [3], [4]. The earliest reported examples of plate bonding were those carried out in South Africa and France (Fleming and King 1967; Bresson 1971). Since then the plate bonding technique has received a lot of attention and today it is used in all types of structures for repair and rehabilitation. [5]

The traditionally, steel plates were used as external reinforcement for existing concrete structures but there are some problems associated with them, including the need for careful surface preparation of the steel prior to bonding and potential corrosion at the steel/ adhesive interface. Another issue is awkward manipulation of heavy steel plates, necessitating restrictions on plate length and the need for many lapped joints, the need for anchor bolts, and maintenance painting. Fiber-reinforced plastic (FRP) materials do not suffer from corrosion problems, and most of their mechanical and physical properties are better than those of steel [6],[7].

2. Experimental Program

2.1. Concrete test beams

A total of seven beams were tested. All beams have identical rectangular cross-sections and the same size: 150 mm × 200 mm × 1000 mm. All beams were tested in three-point bending over a simple span (Fig. 1). The 7 heavy concrete beams type of regular class C16/20 were obtained in laboratory under CP012-2008, with compressive strength of about 17 N/mm^2 after 28 days. Calculation recipe that was prepared after concrete complies with EN 206-1: 2000 to 1 mc using the following amounts: Dry aggregate 0-4 mm 770kg (46%); Dry aggregate 4-8 mm 335kg (20%); Dry aggregate 8-16 mm 570kg (34%); Ordinary portland cement CEM II/A-S 42, 5R 355 kg; Water 230 kg; Additive type BV3M 2.84 l.

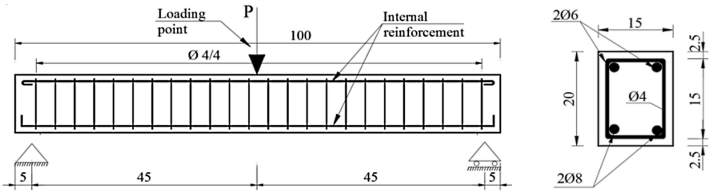

Fig. 1. Details of RC Test Beams[8]

2.2. External reinforcing materials

The purpose of the experiment was tracking changes in bending and final tensile based on the application of CFRP materials, the appearance of elastic and plastic deformations with crack opening, and the influence of CFRP materials on damaged reinforced concrete. So 7 simply supported beams with different externally bonded reinforcement and different damage as listed in Table 1 and Fig. 2. Three replicate beams (of Type G2, G3, G4), named G2A, G3A, G4A were incrementally loaded to 23kN, 27kN, 28kN then unloaded, to cause cracking in the concrete and yielding of the tensile rebars. After that these beams were externally strengthened with CFRP plates and fabric disposed 45º or 90º. The mechanical properties of the CFRP materials are given in Table 2.

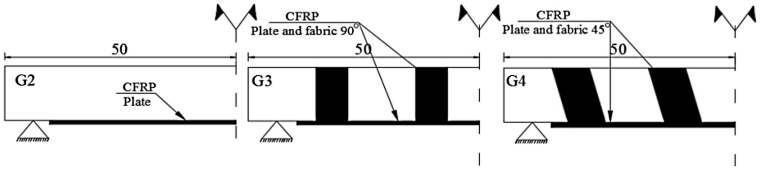

Fig. 2. Details of RC Test Beams[8]

Download English Version:

https://daneshyari.com/en/article/5028838

Download Persian Version:

https://daneshyari.com/article/5028838

Daneshyari.com