Available online at www.sciencedirect.com

ScienceDirect

Procedia Structural Integrity 5 (2017) 155–162

Structural Integrity
Procedia

www.elsevier.com/locate/procedia

2nd International Conference on Structural Integrity, ICSI 2017, 4-7 September 2017, Funchal, Madeira, Portugal

Mechanical performance of a confined reinforced concrete beam

Y. Bouamra[1], K. Ait tahar[1]

[1]*University Akli Mohand Oulhadj of Bouira, Laboratory LM2D, Algeria*

Abstract

This study focused on the four-point bending behavior of the concrete beam subjected to an innovative internal axial confinement process. An experimental study was carried out to validate the effectiveness of this technique. The four-point bending tests was carried out on confined concrete beams by this technique which makes it possible to produce an induced a compression stress induced by the normal component of the tensile effort developed in the resistance reinforcement at the level of the anchoring of steel bars. The results show the increasing of the ultimate bending strength compared to the control beam. Two opposing half-cylindrical plates are welded to the level of the curvatures of the steel bars. Each bar has a hook at one end only. The two hooks are arranged in the taut area of the beam and diametrically opposite. This technique allows us to mobilize the confining stresses from the beginning of loading of the beam, contrary to the existing methods, without using other materials as a composite FRP. Furthermore, a theoretical study was proposed to predict the equivalent load to be applied to the reference concrete beam when it is subjected to an ultimate bending moment determinate in the confined concrete beam. The experimental and theoretical results confrontation shows a good agreement.

Peer-review under responsibility of the Scientific Committee of ICSI 2017

Keywords: Beam, Concrete, Axial Confinement, Mechanical testing, Strength; ;

* Corresponding author. Tel.: +213773892415.
E-mail address: bouamra.youcef@yahoo.com, aittahark@yahoo.fr,

1. Introduction

The development of construction is intimately linked to the actual development of design, implementation and realization techniques. Following the development of new materials, the designers have posed a new challenge, the first concern of which is to extend the life of the structures, while respecting the increasingly stringent safety and mechanical performance standards.

2452-3216
Peer-review under responsibility of the Scientific Committee of ICSI 2017
10.1016/j.prostr.2017.07.086

The behavior of reinforced concrete beams is very complex: several parameters influence its behavior (deep or slender beam, steel ratio, size, etc.) [1,7,12] .Various reinforcements have been made in order to curb diagonal cracks in order to avoid any catastrophe leading to the rupture of the structural elements or even the whole structure as a whole. There are many reasons for reinforcements / repairs such as structural changes, changes in use or even repairs after earthquakes or other phenomena [2,3,4,5].

For concrete beams, the confining of the concrete is ensured by the transverse reinforcement, generally in the form of closely spaced turns or steel frames [6,7]. For low stresses in concrete, the intervention of the transverse reinforcement (Frames and stirrups) as a confinement reinforcement is not significant therefore the concrete is considered as unconfined. The concrete becomes effectively confined when the stresses developed by the core of the concrete approach the limiting strength [10]. The transverse deformations become very important due to the progressive internal cracking in the concrete which relies on the transverse reinforcement, which in turn responds by a confinement reaction on the concrete [4,8, 9,10,11].

The reinforcement of the reinforced concrete beams is mainly aimed at the recovery of bending forces and shear forces. Several authors have proposed a lot of solutions of reinforcements with experimental arguments. Two techniques of reinforcement in the recovery of the bending force in the beams are used, such as: bonding plates or bonding strips to the external lower and lateral faces of beams [2, 9, 12, ,13,14]. In the late 1980s, a similar bonding technique was proposed, with the only difference being that the glued element is presented in the form of strips, adjustable to the reinforced structure [2, 15,16].

Initially, steel plates glued under the concrete elements were used as reinforcing elements, but they were gradually replaced by other innovative materials such as composite materials, which are a very attractive solution to meet the need for reinforcement Buildings and structures due to their mechanical performance such as strength, ductility and lightness. The work on confinement was developed more for the concrete columns subjected to an axial load of compression. Generally, the confinement or reinforcement of the concrete beams is achieved by bonding the composites 'FRP'. The reinforcement, using "PRF" composites is generally achieved by external bonding of the "PRF" lamellas glued to the support of the beam in question [8,9,13,16]. The majority of the researchers observed an increase in bearing capacity and ductility, accompanied by a change in the mode of rupture [2,8, 16].

The development of new, cost-effective reinforcement technologies is a topical issue. The proposed techniques for reinforced concrete reinforcement elements such as: beams, posts, column, slabs, .., must provide them with a clear improvement in terms of durability, rigidity and stability with a consequent carrying capacity [11,17,18, 19].

The critical analysis of the existing work led us to ask the following question: Is it possible to confine a reinforced concrete beam without using additional materials, such as 'FRP' composites, in order to improve its strength, rigidity and ductility under a bending load?

To answer this question, based on the theory of bar curvature and confinement studies, we propose, in this research work, an innovative method of internal axial confinement of the tensile concrete zone of the beam, based on the idea of the compression induced at the level of the anchorage due to the normal component of the tensile force acting on the traction metallic bars. This study focused on the four-point bending behavior of the concrete beam subjected to an innovative internal axial confinement process. This technique allows us to mobilize the confining stresses from the beginning of loading of the beam, contrary to the existing methods, without using other materials as a composite FRP.

In order to thoroughly understand the strengthening behavior of the proposed beams, the results of the theoretical study and 4-point bending tests carried out have made it possible to formulate comprehensible conclusions and to quantify the contribution in terms of increased strentgh and ductility compared to the reference beams. The experimental and theoretical comparison of the results shows a good agreement.