Challenges for Civil Construction

2008 INTERNATIONAL CONFERENCE

"BRIDGE SCIENCE AND APPLICATIONS WITH ENGINEERING
TOWARDS INNOVATIVE SOLUTIONS FOR CONSTRUCTION"

edited by
A. Marques | L. Juvandes | A. Henriques | R. Faria | J. Barros | A. Ferreira

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CCC2008
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Challenges for Civil Construction
"Bridge Science and Applications with Engineering
Towards Innovative Solutions for Construction"

Safety, Sustainability and Rehabilitation with Innovative Solutions

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CCC2008 Secretariat

Faculdade de Engenharia da Universidade do Porto (FEUP)
Departamento de Engenharia Civil
R. Dr. Roberto Frias
4200-465 Porto, Portugal
Phone: (+351) 225 081 944
Fax: (+351) 225 081 446
Email: ccc2008@fe.up.pt

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PREFACE

Originally conceived in the Faculty of Engineering of the University of Porto (Portugal) in 2001, the CCC Composites in Construction Conference moved to Rende (Italy) in 2003 and to Lyon (France) in 2005. Thinking about the new challenges that are increasingly being put forward in civil construction, namely to provide innovative and sustainable materials and technical solutions, it was decided to redefine symbol CCC to mean Challenges for Civil Construction, as it appears in the present edition of the CCC2008 International Conference.

The Organizing Committee is convinced that the CCC2008, with the aim of "Bridging Science and Engineering Applications Towards Innovative Solutions for Construction", will provide a forum for dissemination of new design and construction solutions for Civil Engineering Structures, including issues of great actuality such as rehabilitation of built heritage and health monitoring.

It is the central aim of CCC2008 to bring together engineers, researchers and companies concerned with the new challenges in Civil Construction. For this purpose a set of topics such as Advanced Monitoring Systems, New Cement-Based Materials, Rehabilitation and Durability, Innovative Applications, New Construction Techniques and Systems, Guidelines and Codes and Numerical Modelling was selected to fit the new Conference scope, which received 90 papers, reviewed by an International Scientific Committee. Furthermore, four worldwide recognized researchers were invited to present the following keynote lectures:

- Frieder Seible (University of California, USA):
  "Safety of the New San Francisco-Oakland Bay Bridge"

- Christian U. Grosse (University of Stuttgart, Germany):
  "Monitoring of Structures Using Wireless Sensors and Acoustic Emission Techniques"

- Pedro Pacheco (University of Porto, Portugal):
  "Movable Scaffolding Systems Strengthened with Organic Prestressing"

- Michael Edén (Chalmers University of Technology, Sweden):
  "Design for Sustainable Building. A Swedish Perspective"

Finally, a special session in CCC2008 was dedicated to PhD students, providing them an opportunity to present underway R&D activities; the best contribution will be awarded with a prize.

The present Proceeding includes printed versions of the extended abstracts and keynote lectures, and the CD-Rom includes electronic versions of the full-length papers, published as prepared by and under the responsibility of the authors.

The Organizing Committee of CCC2008 wishes that this will be the basis of a long series of Conferences on updated topics related with Challenges for Civil Construction.

Porto, FEUP, April 2008

A. Torres Marques

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5. REHABILITATION AND DURABILITY

A MODEL TO SIMULATE THE CYCLIC AXIAL COMPRESSIVE BEHAVIOUR OF RC COLUMNS CONFINED WITH CFRP SHEETS

Rajendra K. Varma[*1], Joaquim A.O. Barros[*2], José Sena-Cruz[*3], Débora M. Ferreira[*4]

[*]ISISE, DEC, School of Engineering, University of Minho
Campus de Azurem, 4800-058 Guimarães, Portugal
e-mail: [1]rajendra@civil.uminho.pt, [2]barros@civil.uminho.pt, [3]jsena@civil.uminho.pt, [4]debora@ipb.pt
web page: www.civil.uminho.pt/composites

Keywords: Reinforced concrete columns, CFRP, concrete confinement, cyclic behaviour, fibrous model.

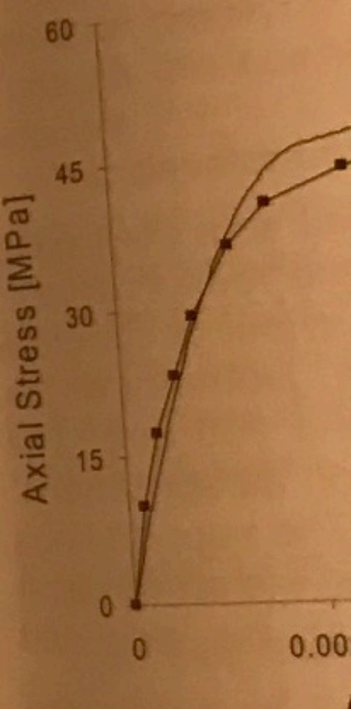
ABSTRACT

Concrete confinement strategy has been used, mainly, to increase the energy absorption capacity and the axial load carrying capacity of Reinforced Concrete (RC) columns pertaining to buildings in zones of high seismic risk. In the last years the use of wet lay-up Carbon Fiber Reinforced Polymer (CFRP) sheets to confine RC columns has increased continuously, as consequence of the high mechanical properties of this composite material, its high performance in terms of durability, its easy application and reduced impact in terms of changing the geometry of the strengthened structural elements.

Several analytical models for the simulation of the compressive axial stress-strain constitutive law of FRP-based confined RC columns have been proposed and their performance was appraised [1-3]. However, according to the knowledge of the authors of the present work, a model for predicting the cyclic axial compressive behavior of RC columns confined with CFRP is still in development phase [4]. Based on the results obtained in an experimental program, where RC column elements confined with continuous and discrete CFRP arrangements (CFRP strips in between existent steel hoops) were submitted to cyclic direct compressive axial loading, a new constitutive model was developed and implemented into FEMIX computer program. The proposed model also considers experimental results derived from other researchers. A fibrous model approach was adopted, assuming that RC columns can be discretized by 3D bar finite elements, according to the 3D Timoshenko beam theory. For modeling the behavior of steel bars, a cyclic stress-strain model was also implemented into FEMIX.

The proposed model is composed of two parts, monotonic and hysteretic branches. The monotonic envelope curve is based on Lam and Teng model [2]. The cyclic constitutive laws are derived from by calibrating the parameters of cyclic laws proposed by Chang and Mander [6]. Figure 1 represents, schematically, the envelope and the hysteretic cyclic rules of the developed model, and Figure 2 illustrates its performance on predicting the tested RC column elements. The present work describes the developed model and appraises its performance.

Figure 1: S



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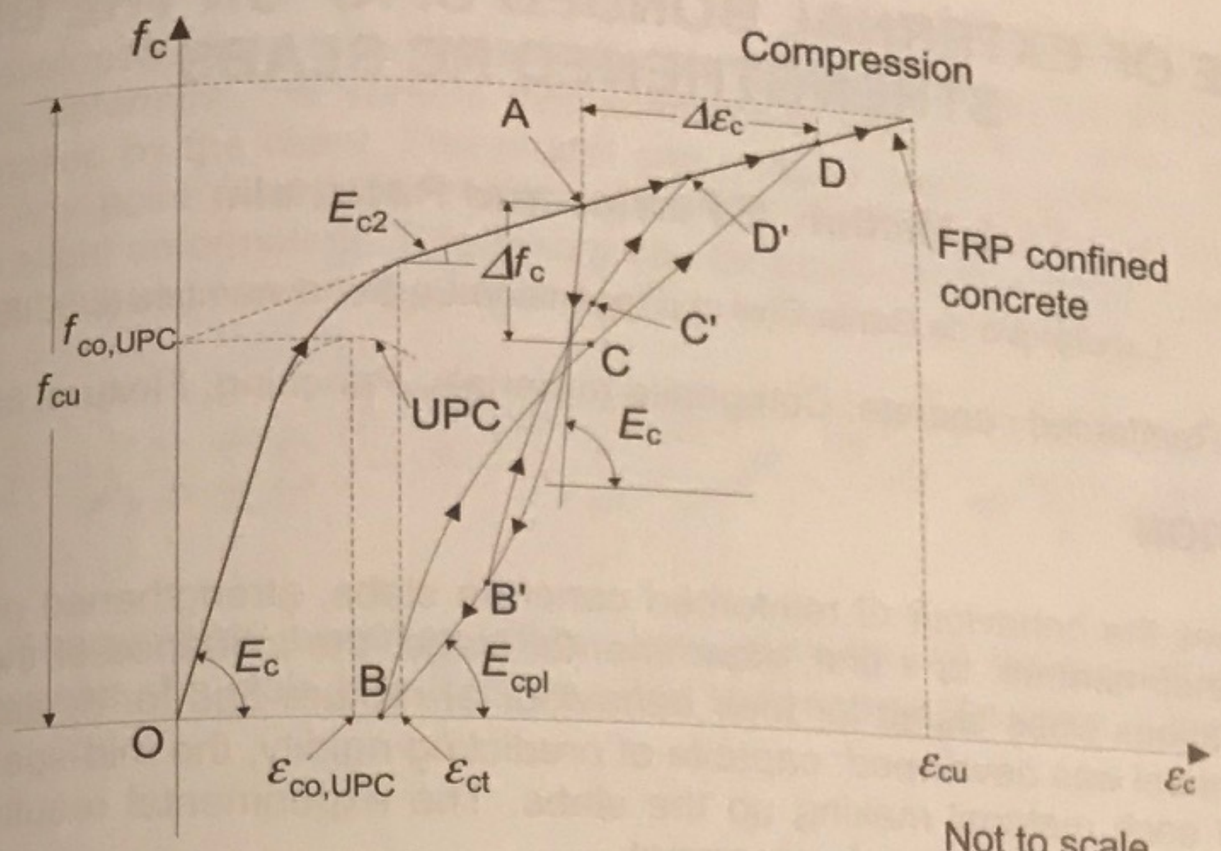
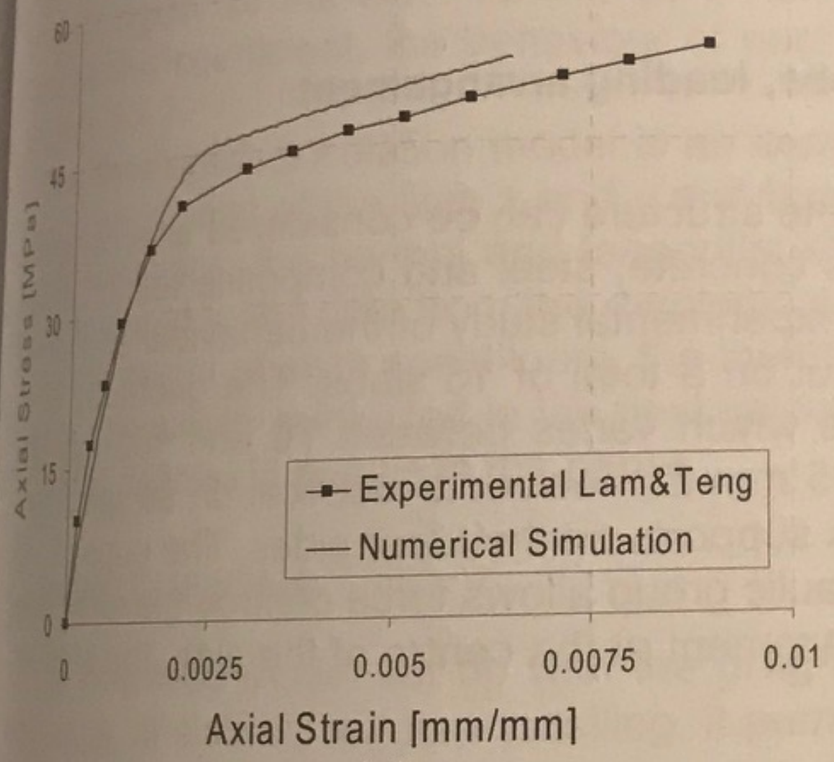


Figure 1: Schematic representation of the FRP-confined concrete constitutive model.



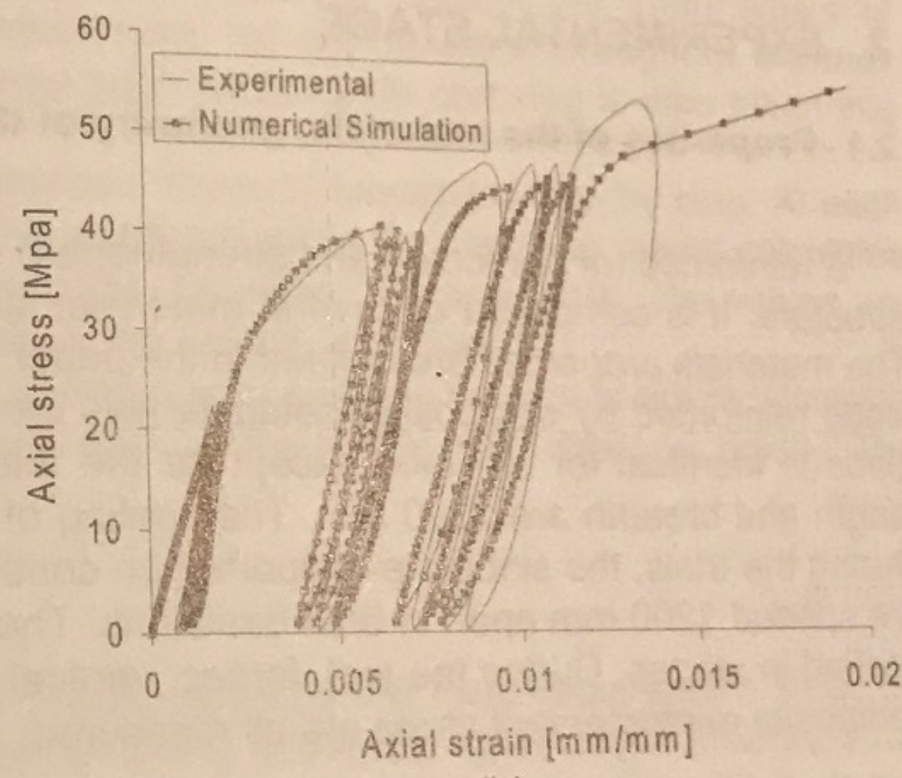


Figure 2: Experimental and numerical simulation.

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