Advanced Computational Engineering and Experimenting II

Edited by
Andreas Öchsner and Holm Altenbach

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Selected, peer reviewed papers from the
Sixth International Conference on
Advanced Computational
Engineering and Experimenting
(ACE-X 2012),
July 1-4, 2012, Istanbul, Turkey

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Trans Tech Publications Ltd
Kreuzstrasse 10
CH-8635 Durnten-Zurich
Switzerland
http://www.ttp.net

Volume 553 of
Key Engineering Materials
ISSN print 1013-9826
ISSN cd 1662-9809
ISSN web 1662-9795

Full text available online at *http://www.scientific.net*

***Distributed** worldwide by*

Trans Tech Publications Ltd
Kreuzstrasse 10
CH-8635 Durnten-Zurich
Switzerland

Fax: +41 (44) 922 10 33
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Preface

This special issue of Key Engineering Materials contains selected refereed papers presented at the Sixth International Conference on Advanced Computational Engineering and Experimenting (ACE-X 2012) held at Kalyon Hotel (Istanbul), Turkey during the period 1st - 4th July, 2012.

The goal of the conference was to provide a unique opportunity to exchange information, to present the latest results as well as to review the relevant issues on contemporary research in mechanical engineering. Young scientists were especially encouraged to attend the conference and to establish international networks with well-known scientists.

During the conference, special sessions related to *COMPUTATIONAL FLUID DYNAMIC* (organised by Dr. Ku Zilati Ku Shaari and Dr. Mokhtar Awang), *PLASTICITY AND CONSTITUTIVE MODELLING* (organised by Prof. A. Öchsner), *BIOMECHANICS & BIOMATERIAL* (organised by Prof. Saied Darwish), *NANOMATERIALS* (organised by Prof. A. Shokuhfar and Prof. Constantin Politis), *COMPUTATIONAL METHODS FOR LAMINATED STRUCTURES* (organised by Prof. Antonio J.M. Ferreira), *ALTERNATIVE ENERGIES* (organised by Dr. Germán Ferreira), *NANOSYSTEMS* (organised by Prof. J.N. Reddy), *BIOMECHATRONICS AND APPLIED ENGINEERING FOR THE DESIGN OF PROSTHESIS* (organised by Prof. J.A. Beltrán Fernández), *OPTIMIZATION OF STRUCTURES AND COMPONENTS* (organised by Prof. Pablo A. Muñoz-Rojas), *NUMERICAL MODELING OF STRUCTURES* (organised by Prof. Alen Harapin, Prof. Boris Trogrlic and Prof. Mirela Galic), *SCIENTIFIC VISUALIZATION AND IMAGING SYSTEMS* (organised by Prof. Fabiana Rodrigues Leta) and *NEMS, MEMS AND MICROSYSTEMS DESIGN AND FABRICATION* (organised by Prof. Levent Trabzon) were organised.

More than 200 scientists and researchers coming from more than 41 countries attended the conference. The large number of presented papers emphasises the considerable academic and industrial interest in the conference theme. The editors wish to thank the authors and delegates for their participation and cooperation, which made this sixth conference especially successful.

Finally, we wish to express our warm thanks and appreciation to our colleagues and associates for their sustained assistance, help and enthusiasm during the preparation of the conference.

The seventh conference, ACE-X-2013, will be held in Madrid, Spain, from 1-4 July, 2013 (http://www.acex-conference.com/).

February 2013

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Table of Contents

Key Engineering Materials Vol. 553 (2013) pp 1-6

doi:10.4028/www.scientific.net/KEM.553.1

Inclusion of Tapered Tubes in Enhancing the Crash Performance of Automotive Frontal Structures

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Keywords: impact; tapered tubes; energy absorption; finite element; crashworthiness

Abstract. This paper treats the design and analysis of an energy absorbing system. Experimental tests were conducted on a prototype, and these tests were used to validate a finite element model of the system. The model was then used to analyze the response of the system under dynamic impact loading. The response was compared with that of a similar system consisting of straight circular tubes, empty and foam-filled conical tubes. Three types of such supplementary devices were included in the energy absorbing system to examine the crush behavior and energy absorption capacity when subjected to axial and oblique impact loadings. The findings were used to develop design guidelines and recommendations for the implementation of tapered tubes in energy absorbing systems. To this end, the system was conceptual in form such that it could be adopted for a variety of applications. Nevertheless, for convenience, the approach in this study is to treat the system as a demonstrator car bumper system used to absorb impact energy during minor frontal collisions.

Introduction

In recent years, increased interest in impact mitigation has led to comprehensive research on the crash response of energy absorbing devices using analytical, finite element and experimental techniques. Various types of thin-walled tubular structures namely squares, rectangular, circular, hat-section, tapered rectangular and conical tubes, have been used as energy absorbers to mitigate the adverse effect of impact and hence protect the vehicle or structure in a well-controlled manner [1-8]. There have been numerous studies on the crushing and energy absorption response of such thin-walled tubes under axial impact loading conditions. In many applications energy absorbers are frequently incorporated with other structural components in the system design. It is therefore of particular interest how individual energy absorbers behave when they are incorporated into an energy absorbing system. Furthermore, the absorbers are commonly mounted to other structural members. Thus, the absorber response may differ to when the absorbers are analysed individually. The presence of supplementary devices in the energy absorbing system seems to improve crush stability and enhance the energy absorption capacity [9-10]. It is evident that the inclusion of foam-filled conical tubes and tapered rectangular tubes in the design of rollover protective structures may improvise the capability of the structure in absorbing impact energy. The present study treats the energy absorption performance of automotive frontal structures namely bumper beams under axial and oblique impact loadings using validated computer models. The relative effect of geometry and loading parameter on the energy absorption responses was examined. Overall the results demonstrate the advantages of including tapered tubes in energy absorbing system with a noticeable improvement in energy absorption capacity.