



HIGH PERFORMANCE AND OPTIMUM DESIGN OF STRUCTURES AND MATERIALS



WIT*PRESS*

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S. Hernández &
C.A. Brebbia**

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Published by

WIT Press

Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK

Tel: 44 (0) 238 029 3223; Fax: 44 (0) 238 029 2853

E-Mail: witpress@witpress.com

<http://www.witpress.com>

For USA, Canada and Mexico

Computational Mechanics Inc

25 Bridge Street, Billerica, MA 01821, USA

Tel: 978 667 5841; Fax: 978 667 7582

E-Mail: infousa@witpress.com

<http://www.witpress.com>

British Library Cataloguing-in-Publication Data

A Catalogue record for this book is available
from the British Library

ISBN: 978-1-84564-774-2

eISBN: 978-1-84564-775-9

ISSN: 1746-4498 (print)

ISSN: 1743-3509 (on-line)

*The texts of the papers in this volume were set individually by the authors
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Printed in Great Britain by Lightning Source, UK.

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Preface

This book contains most of the papers presented at the 7th International Conference on High Performance and Optimum Design of Structures and Materials (HPSM) which incorporated the Seminar on Optimum Design in Engineering (OPTI).

The Meeting was held in Ostend, Belgium, co-organised by the Free University of Brussels, the Wessex Institute, UK and the University of La Coruña, Spain.

Some 125 years ago, the Paris World Exhibition of 1889, commemorating the anniversary of the French Revolution, unfolded the Eiffel Tower, a proof of the new possibilities offered by improved performances of construction materials and of the “rational design” methodology, introduced by Gustave Eiffel. The latter profited from a then dramatic development of the “mechanics of materials and structures”, as a consequence of new needs introduced by the industrial revolution. If this qualitative change of the city landscapes was obvious in Old Europe, also North America saw an explosive growth of its cities: the famous “skyscraper”, so celebrated by Louis Sullivan, compensated for the lack of space in the cities, but was dependent on an answer to “new challenges”: the construction in the vertical direction, but also the circulation, the latter being solved with the invention of the elevator by Elisha Otis.

Starting during the Nineties and with the coming change of the Century, the “Millennium” obsession set in, again not in the least in the world of structural engineering: every significant town in the world wanted its own landmark construction, commemorating the symbolic date of 2000.

Those were thus years of great creativity and, even today, some of these constructions still stand as witnesses for civil and structural engineering skills.

In our opinion, there were two important triggers for this change of view on the construction world.

In the first place an improved technical collaboration between the designers – architect(ural engineer) – and the constructors – structural engineers but also contractors – principally due to the development in the field of the calculation

and construction tools, but also to the challenge of lightweight, high rise and large span structures. Today, there is not a single structural engineer who did not hear about the contemporary icons like Santiago Calatrava, Sir Norman Foster, Renzo Piano, Cesar Pelli, Richard Rogers, Zaha Hadid, just to name a few. It is perhaps unfortunate that people are less aware of the role played by famous structural engineers and their contribution to the success of projects: think about the role of Peter Rice in the concept of the Centre Pompidou in Paris.

The second reason for the dramatic changes during the last twenty years is the evolution in ethical awareness: the building team in its totality is nowadays convinced that they should be accountable for the totality of the “design, build, operate, maintain and permanently recycle components and materials” processes in which they participate.

The construction industry is one of, if not the most important contributor to greenhouse gas production, energy consumption – inclusive embedded energy of the materials and components – but also in waste production. This should be compensated by a permanent research in durability of adopted solutions through what has now been called “sustainable design”. It is rejoicing to see that most of the educational sector quickly embraced these new concepts.

Another remark is appropriate here. During the whole design and build processes, a continuous need is felt to “optimise” the construction and this process is today present at the first stages of conceptual design. Important efforts are thus spent on the inclusion of optimization techniques during the preliminary design phase. Additionally, modern tools nowadays also allow for the simulation of the whole life cycle of a construction, which adds a new set of constraints to the overall process of optimization.

The HPSM Series originated in Seville, Spain in 2002 and continued in Ancona, Italy (2004); Ostend, Belgium (2006); the Algarve, Portugal (2008); Tallinn, Estonia (2010); and the New Forest, UK, home of the Wessex Institute. The Computer Aided Optimum Design in Engineering (OPTI) Series has an even older trajectory, having started in Southampton, UK in 1989 and reconvened thereafter in Boston, USA (1991); Zaragoza, Spain (1993); Miami, USA (1995); Rome, Italy (1997); Orlando, USA (1999); Bologna Italy (2001); Detroit, USA (2003); Skiathos, Greece (2005); Myrtle Beach, USA (2007); the Algarve, Portugal (2009); and the New Forest, UK in 2012.

It was felt appropriate to bring together these two prestigious meetings to stress the importance of design optimization to achieve the best performance of structures and materials systems. The joint conference brought together people from academia and industry involved in the design, manufacture, testing and optimization of challenging structures and innovative materials using the most up to date technologies.

The Editors would like to express their gratitude to all authors for their contributions. They are also indebted to the members of the International Scientific Advisory

Committee who reviewed the manuscripts efficiently and timely, ensuring their quality. As a consequence, this book is a valuable addition to the literature and useful to researchers and practitioners involved in the design of high performance materials and innovative structures.

The Editors

Ostend

2014

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