Innovation in
Civil and Structural
Engineering Computing

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Edited by: B.H.V. Topping and C.A. Mota Soares

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Preface

This volume comprises the Invited Lectures presented at The Tenth International Conference on Civil, Structural and Environmental Engineering Computing (Civil-Comp 2005) and The Eighth International Conference on the Application of Artificial Intelligence to Civil, Structural and Environmental Engineering (AICivil-Comp 2005) held in Rome, Italy, from 30 August to 2 September 2005. The Civil-Comp conferences are part of the series that commenced in 1983. These lectures add to a the wealth of information provided in the previous volumes of invited lectures presented at Civil-Comp Conferences and published by Saxe-Coburg Publications.

Over the last fifteen years researchers have looked for new uses for the emerging computational power. In many cases this research has been concerned with enhanced analytical and modelling tools which have improved our capability to predict the behaviour of civil engineering structures and processes. Other researchers have concentrated on the design process leading to new models for design procedures and the first three chapters deal with this theme.

In Chapter 1 Professor Bontempi reviews how new conceptual frameworks for structural analysis may be used in the design process. He relates his review to the design of the Messina Bridge that links Sicily to mainland Italy using a suspension bridge form of over three kilometres length. This review provides both the practitioner and researcher with an insight into the sturctural design process which is key to our profession. A important feature of the structural design process is how innovative designs are generated and whether this process can be modelled or simulated using computers. This and other important aspects of knowledge processing in the analysis and design of new structures is a key feature of this review.

The theme of innovation is taken up by Professor Arciszewski and Dr Kicinger in their review, in Chapter 2, of how the processes of nature may be used to generate innovative or novel designs. Their review concentrates on optimality, creativity and robustness. Most practising engineers are aware of how natural structures, for example sea shells, may be a source of inspiration for the shape of shell roofs leading to innova-

tive designs. In Chapter 2 it is the process of design using evolutionary computation, coevolutionary computation, cellular automata and TRIZ that is reviewed.

In Chapter 3, Dr Rafiq and colleagues take up the theme of evolutionary computing and demonstrate how these techniques may be used interactively with visualisation methods to generate knowledge and designs. They review the use of knowledge based systems in design and show how these systems are not sufficient for innovative design.

Increased computational power has provided engineers with the possibility of using refined and more complete models during the design process. The use of parallel processing, high performance computing, distributed computing and now the GRID provides the engineer with increased power to analyse complex models. In Chapter 4, Dr Dolenc reviews how GRID technology may be used in civil engineering. Here the question of how new and emerging standards, tools and middleware may be utilised in the development of engineering software. This review provides a starting point for those who wish to move forward with the use of GRID technology in engineering analysis and design.

The next four chapters of this book relate to new techniques for analysis and modelling of structures. In Chapter 5, Professor Levy and Dr Gal review how geometically non-linear shells should be analysed. They review the literature and present their own finite element for use in this context, which they demonstrate to be efficient, reliable and accurate. In Chapter 6, Professor Romero and colleagues describe nonlinear models for the analysis and design of concrete filled tubular columns. They demonstrate that these composite structures require special design considerations based on composite behaviour rather than extrapolating from the procedures for steel or concrete structures. In Chapter 7, Dr Bull reviews how the new Eurocode for the design of aluminium structures will change design procedures. He highlights how design procedures of the future will have to be based on finite element analysis rather than simplified or hand calculation methods. This approach to design is long overdue in the civil engineering industry.

In Chapter 8 Professor Montenegro and colleagues review their recent research into wind simulation techniques using adaptive tetrahedral mesh generation. These techniques have application to the simulation of wind carried air pollution studies and their paper uses a simulation of a real problem based on the topography of the Island of Gran Canaria to demonstrate their techniques. In Chapter 9 Professor Puppala and Dr Intharasombat describe computer controlled instrumentation systems that are used to measure the effectiveness of bio-stablisers in expansive soils. Both laboratory and field studies are used to provide better assessment of stabilisers.

I am grateful to the authors and co-authors of the invited lectures included in this volume. Their contribution both to the Civil-Comp conferences and this book is greatly appreciated.

Other papers presented at the conferences in 2005 are published as follows:

- *The Contributed Papers from Civil-Comp 2005 are published in:*
  Proceedings of The Tenth International Conference on Civil, Structural and Environmental Engineering Computing, B.H.V. Topping (Editor), (Book of Abstracts and CD-ROM), Civil-Comp Press, Stirling, Scotland, 2005.

- *The Contributed Papers from AICivil-Comp 2005 are published in:*
  Proceedings of The Eighth International Conference on The Application of Artificial Intelligence to Civil, Structural and Environmental Engineering, B.H.V. Topping (Editor), (Book of Abstracts and CD-ROM), Civil-Comp Press, Stirling, Scotland, 2005.

These conferences could not have been organised without the help and support of many people. I would like to thank Jelle Muylle (Civil-Comp Press) for designing and organising this book and the volumes of conference proceedings. Once again, I would like to thank Judy Tait (Civil-Comp Press) for her organisational skills, which were greatly appreciated.

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