

**Proceedings of the
Eighth International Conference on
Computational Structures Technology**

Civil-Comp Press publications on Computational Engineering

Proceedings of the Tenth International Conference on Civil, Structural and Environmental Engineering Computing

Edited by: B.H.V. Topping

Proceedings of the Eighth International Conference on the Application of Artificial Intelligence to Civil, Structural and Environmental Engineering

Edited by: B.H.V. Topping

Proceedings of the Seventh International Conference on Computational Structures Technology

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

Proceedings of the Ninth International Conference on the Civil and Structural Engineering Computing

Edited by: B.H.V. Topping

Proceedings of the Sixth International Conference on Computational Structures Technology

Edited by: B.H.V. Topping and Z. Bittnar

Saxe-Coburg Publications on Computational Engineering

Computational Modelling of Masonry, Brickwork and Blockwork Structures

Edited by: J.W. Bull

Finite Element Mesh Generation

B.H.V. Topping, J. Muylle, P. Iványi, R. Putanowicz and B. Cheng

Innovation in Civil and Structural Engineering Computing

Edited by: B.H.V. Topping

Progress in Computational Structures Technology

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

Computational Structures Technology

Edited by: B.H.V. Topping and Z. Bittnar

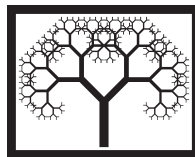
Computational Mechanics for the Twenty-First Century

Edited by: B.H.V. Topping

**Proceedings of the
Eighth International Conference on
Computational Structures Technology**

Edited by

B.H.V. Topping, G. Montero and R. Montenegro



CIVIL-COMP PRESS

© Civil-Comp Ltd, Stirlingshire, Scotland

published 2006 by

Civil-Comp Press

Dun Eaglais, Kippen

Stirlingshire, FK8 3DY, UK

Civil-Comp Press is an imprint of Civil-Comp Ltd

ISBN-10 1-905088-06-X (Book)

ISBN-10 1-905088-07-8 (CD-Rom)

ISBN-10 1-905088-08-6 (Combined Set)

ISBN-13 978-1-905088-06-5 (Book)

ISBN-13 978-1-905088-07-2 (CD-Rom)

ISBN-13 978-1-905088-08-9 (Combined Set)

British Library Cataloguing in Publication Data

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

Cover Image: Yarn failure and element stress distributions during simulation of knife penetration into a woven fabric. This image is used with the permission of W.M. Gao. For more details, see Paper 90.

Printed in Great Britain by Bell & Bain Ltd, Glasgow

Contents

Preface	xxvii
I	Computational Aspects for Damage, Robustness and the Service-Lives of Structures
	Session organised by C. Könke, W.B. Kraetzig and Y.S. Petryna
	1
1	Life Prediction of Aging Engineering Structures
	I. Mura
	3
2	Damage Simulation and Health Assessment of a Road Bridge
	Y.S. Petryna, A. Ahrens and F. Stangenberg
	5
3	Damage Tolerant Design
	C. Könke
	7
4	A Finite Element Analysis of Damaged Reinforced Concrete Beams Retrofitted with Fibrous Concrete
	W.B. Almajed and R.Y. Xiao
	9
5	Stochastic Simulation of Damage Evolution Processes in a Reinforced Concrete Short-pier Shear Wall Specimen
	J. Li and Y. Cao
	11
6	Inelastic Analysis of Reinforced Concrete Beams Strengthened with CFRP
	W.A. Thanoon, J. Noorzaei and M.S. Jaafar
	13
7	Nonlinear Damage Analysis of a Reinforced Concrete Short-Pier Shear Wall Specimen
	J. Li and Y. Cao
	15
8	Simulations of Fire Temporal Thermal Behaviour of Fibre Reinforced Polymer Bridge Decks
	W.I. Alnahhal, M. Chiewanichakorn, S. Alampalli and A. Aref
	17
9	Seismic Resistance of Unreinforced Masonry Buildings
	C. Butenweg and M. Mistler
	19
10	Multi-Objective Optimisation (Weight and Cost Oriented) of Impact Damage Resistant Stiffened Composite Panels
	M. Corvino, L. Iuspa, A. Riccio and F. Scaramuzzino
	21

11	Analysis of Debonding Failure Modes in FRP-Strengthened Reinforced Concrete Beams Using Genetic Algorithms R. Perera and F.B. Varona	23
12	Ultimate Compressive Strength of Plate Elements with Randomly Distributed Corrosion Wastage M.R. Khedmati and A.R. Karimi	25
II	Steel and Composite Structures	
	Session organised by L.F. Costa Neves	27
13	Analysis of Plates Stiffened by Beams of Arbitrary Cross Section E.J. Sapountzakis and V.G. Mocos	29
14	Computing Hoop Strains in Out-of-Round Pipes under Internal Pressure Z.W. Guan	31
15	A Three-Dimensional Hybrid Finite Element for Singular Stress Analysis in Composite Structures D. Crépin, G. de Saxcé and M. Pyrz	33
16	Finite Element Analysis of the Fiber Offsetting Effects on the Creep Behaviour of MMC Composites M. Mondali, A. Abedian and M. Pahlavanpour	35
17	The Use of CFRP Bars as Reinforcing Material Part I: Experimental Study M.M. Rafi, A. Nadjai, F. Ali and D. Talamona	37
18	The Use of CFRP Bars as Reinforcing Material Part II: Analytical Modelling M.M. Rafi, A. Nadjai and F. Ali	39
19	Modelling Hooked Steel Fibre Pull-Out in Fibre-Reinforced High-Strength Concrete E. Mistakidis, K. Georgiadi-Stefanidi and D. Pantousa	41
20	Numerical Analysis of Innovative Steel Connections for a Composite Wood-Steel-Concrete Floor A. Marzo, A. Formisano, B. Faggiano and F.M. Mazzolani	43
21	Numerical Analysis of Steel Sheeting with Indentations or Embossments, Used for Composite Slabs E. Mistakidis and K. Dimitriadis	45
22	A Three-Dimensional Numerical Model of Circular Concrete Filled Columns C. Lacuesta, M.L. Romero, S. Ivorra and J.M. Portoles	47
23	Ultimate Load Capacity Analysis of a Long-Span Rigid-Frame with a Flexible Concrete Filled Steel Tubular Arch Bridge G.J. He, K.K. Peng, S.D. Luo and A.G. Yan	49

24	Nonlinear Finite Element Analysis on the Stability of a Concrete Filled Steel Tubular Arch Bridge H. Yang, S.M. Zhang, Y. Geng and C.Y. Liu	51
25	Approximate Load Path Prediction in Postbuckled Composite Structures O. Seresta, M.M. Abdalla and Z. Gürdal	53
26	Analysis of Dissipated Energy in Compression Failure by Microbuckling in CFRP: Application to Modelling Crash Absorbers J.M. Guimard, O. Allix, N. Pechnik and P. Thevenet	55
27	Stacking Sequence Optimization for Laminated Cylindrical Panels Using the Globalized Nelder-Mead Method M.M. Aghdam, M. Shakeri, A. Alibeiglu and E. Ameri	57
28	Free Vibration of a Composite Timoshenko Beam Using the Dynamic Stiffness Method J.R. Banerjee	59
29	Dynamic Analysis of Three-Dimensional Composite Beam Elements Including Warping and Shear Deformation Effects E.J. Sapountzakis and V.G. Mokos	61
30	Dynamical Modelling of Steel Deck Composite Slabs with Geometric Orthotropy A.V. de Mello, J.G.S. da Silva, S.A.L. de Andrade, P.C.G. Vellasco, L.R.O. de Lima and L.F. Costa Neves	63
III	Probabilistic Approaches to Structural Mechanics Session organised by M. Karama and A. El-Hami	65
31	The Domino Effect and Integrated Probabilistic Approaches for Risk Analysis Q.B. Nguyen, A. Mébarki, F. Mercier, R. Ami Saada and M. Reimeringer	67
32	Probabilistic Study of Dynamic Contact Inside a Piezoelectric Engine A. Mohsine, B. Radib and A. El-Hami	69
33	Efficient Reliability-Based Design Optimization of Structural-Acoustic Problems A. Mohsine and A. El-Hami	71
34	Parameter Uncertainty Effects on the Stability of Cantilever Earth Retaining Structures B. Zeghlache, A. Mébarki, B. Tiliouine and S. Belkacemi	73

35	Masonry Structures: Vulnerability and Risk Assessment for Floods N. Valencia, A. Mebarki and J.L. Salagnac	75
36	Numerical Modelling of the Effects of a Reliability Indicator for Damaged Elasto-Dissipative Composites S. Carbillet and M.L. Boubakar	77
37	Robust Prediction Tools for Variability and Optimization in Structural Mechanics M. Guedri, S. Ghanmi, R. Majed and N. Bouhaddi	79
38	A Complete Probabilistic Framework in Fatigue Design: Application to Exhaust Manifolds F. Perrin, M. Pendola, T. Moro, G. Morin and J.-M. Cardona	81
39	Sensitivity Analysis for Optimisation Problems with Random Fatigue Life Constraints S. Lambert, L. Khalij, E. Pagnacco and A. El-Hami	83
40	Reliability Design of Power Modules Using Probabilistic Approaches A. Micol, M. Karama, O. Dalverny, C. Martin and M. Mermet-Guyennet	85
41	Integration of a Multi-Physics Model in a Reliability-Based Design Framework: Application to Power Converters Z. Guédé, O. Pantalé and S. Caperaa	87
42	Probabilistic Assessment of Fatigue Life Using a Stress-Based Fatigue Criterion C. Schwob, L. Chambon, F. Ronde-Oustau and J.P. Bernadou	89
43	Probabilistic Serviceability Assessment of Structures J. Valihrach and P. Marek	91
44	Application of Robust Design Concepts to Multilayer Structures F. Rabier, C. Martin, N. Martin, M. Karama, M. Mermet-Guyennet and M. Piton	93
45	Bayesian Experimental Design for Parametric Identification of Dynamical Structures E. Pillet, N. Bouhaddi and S. Cogan	95
46	Reliability of Fibre-Reinforced Composite Cables H. Dehmous, H. Weleman, M. Karama and K. Aît Tahar	97
47	The Random Eigenvalue Problem for Stochastic Systems S. Kadry and A. Chateauneuf	99
48	Reliability and Optimization of a Fully Composite Stiffened Cylinder M. Olivier-Mailhé, S. Ben Chaabane, F. Léné, G. Duvaut and S. Grihon	101
49	Validation of Stochastic Structural Dynamics Models B. Faverjon, P. Ladevèze and F. Louf	103

IV	Tall Buildings: Analysis and Design	
	Session organised by J.W. Bull	105
50	Non-Planar Pierced Shear Walls with Plastic Beam-Wall Connections R. Resatoglu, E. Emsen and O. Aksogan	107
51	Static Analysis of Laterally Arbitrarily Loaded Non-Planar Non-Symmetrical Coupled Shear Walls O. Aksogan, R. Resatoglu and E. Emsen	109
V	Traffic Vibrations: Isolation and Propagation	
	Session organised by D. Le Houédec	111
52	Propagation in Soil of Vibrations due to a Tramway M. Maldonado and D. Le Houédec	113
53	High-Speed Train Induced Vibrations: A Comprehensive BE Model P. Galvín and J. Domínguez	115
54	Numerical Investigation of the Performance of Multi-Track High-Speed Railway Bridges under Resonant Conditions Retrofitted with Fluid Viscous Dampers M.D. Martínez-Rodrigo and P. Museros	117
VI	Robustness of Mechanical Systems against Uncertainties	
	Session organised by I. Doltsinis	119
55	Adaptive Uncertainty Quantification H.G. Matthies and A. Keese	121
56	Finite Element Model Updating and Validation in Structural Dynamics: From Deterministic Optimisation Procedures to a Stochastic Approach A. Calvi	123
57	Robust Optimization for Earthquake-Resistant Design J.E. Hurtado and N. Aguirre	125
58	Fuzzy Arithmetical Robustness Analysis of Mechanical Structures with Uncertainties M. Hanss, U. Gauger and S. Turrin	127
VII	Constitutive and Material Modelling	
	Session organised by M.H.B.M. Shariff	129
59	Lattice Modelling of Cellular Structures M. Borovinsek and Z. Ren	131
60	Modification of the Chen Plasticity Model for Hardening Concrete M. Frantová	133

61	Compressible Strain Induced Anisotropic Rubberlike Materials M.H.B.M. Shariff	135
62	Different Ways of Identifying Microplane Model Parameters Using Soft Computing Methods A. Kučerová, M. Lepš and J. Zeman	137
63	Numerical Analysis of Foundation Slabs T. Krejčí, T. Koudelka, J. Šejnoha and P. Kuklík	139
64	Non-Linear Analysis of Time-Dependent Response of Civil Engineering Structures J. Lopatič and F. Saje	141
65	Deformation and Permeability of Fractured Rocks J.F. Thovert, I. Bogdanov, V. Mourzenko and P.M. Adler	143
66	Analysis of Hardening Effects of Open-Celled Model Foams by Numerical Homogenization S. Demiray, W. Becker and J. Hohe	145
67	Strain Hardening Modelling of Rock Salt Behaviour M. Hamami and N. Chelghoum	147
68	Bipotential Versus Return Mapping Algorithms: Implementation of Non-Associated Flow Rules V. Magnier, E. Charkaluk, C. Bouby and G. de Saxcé	149
69	Mechanical Nose Responses Predicted by Associated and Non-Associated Elasto-Plastic Models S. Tsutsumi, M. Toyosada and K. Hashiguchi	151
70	Micromechanical Multiscale Simulation of Elastic Properties of Hydrating Concrete V. Šmilauer and Z. Bittnar	153
71	Plasticity-Based Computational Model for Masonry J. Brožovský, A. Materna and L. Lausová	155
VIII	Dynamics of Viscoelastically Damped Structures Session organised by G. Muscolino and S. Adhikari	157
72	A Method for the Dynamic Analysis of Suspended Cables Carrying Moving Masses G. Muscolino and A. Sofi	159
73	Identification of Damping Using Proper Orthogonal Decomposition M. Khalil, S. Adhikari and A. Sarkar	161
74	Forced Non-Linear Vibration of Damped Sandwich Beams by the Harmonic Balance - Finite Element Method N. Jacques, E.M. Daya and M. Potier-Ferry	163

75	On the Dynamics of a Duffing Oscillator with an Exponential Non-Viscous Damping Model D.J. Wagg and S. Adhikari	165
76	Multi-objective Optimization of Viscoelastically Damped Systems Combining Robust Condensation and Metamodels A.M.G. de Lima, B. Ait Brik, N. Bouhaddi and D.A. Rade	167
77	Eigenmotions of a One Degree of Freedom Viscoelastically Damped System P. Muller	169
IX	Masonry Structures Session organised by J.W. Bull	171
78	Stress Distribution and Failure Mode of Masonry Walls L. Abdou, R. Ami Saada, F. Meftah and A. Mébarki	173
79	Dynamic Analysis of Age-Old Masonry Constructions S. Degl'Innocenti, C. Padovani, A. Pagni and G. Pasquinelli	175
80	A Simplified Model of Shear-Capacity in Confined Masonry Walls S. Sanchez and A. Mébarki	177
81	Model Updating of a Real Multi-Span Masonry Bridge T. Aoki, D. Sabia and D. Rivella	179
82	An Induced Tension Model for Masonry Structures A. Mébarki, Q.H. Bui, R. Ami Saada, P. Delmotte and L. Abdou	181
83	Thermal Stress Evaluation and Safety Aspects Associated with Massive Concrete Constructions Joined to Existing Structures: The Case of a Masonry Gravity Dam S. Manenti and U. Ravaglioli	183
84	Structural Characterization of an Industrial Masonry Chimney F.J. Pallarés, S. Ivorra and A. Agüero	185
85	Seismic Evaluation of Old Masonry Buildings: Performance and Strengthening H. Varum, R. Vicente, H. Rodrigues and J.A.R. Mendes da Silva	187
86	The Application of a Digital Image Correlation Method for Crack Observation M.H. Shih, S.H. Tung, J.C. Kuo and W.P. Sung	189
87	Prediction of the Effective Fracture Energy in Quarry Masonry M. Šejnoha, J. Šejnoha, E. Novotná, J. Vorel and J. Sýkora	191
88	An Improved Material Model for Quarry Masonry J. Šejnoha, M. Šejnoha, J. Sýkora and J. Vorel	193

X	Fabric, Cable and Membrane Structures	
	Session organised by B.H.V. Topping and P. Iványi	195
89	The Use of the Medial-Axis Construction in the Design of Cable-Membrane Structures P. Iványi	197
90	Finite Element Simulation of Yarn Breakage During Knife Penetration of Woven Fabrics L.J. Wang, S. Zhang, W.M. Gao and X.G. Wang	199
91	Thermoforming Process Analysis of Woven Fabric Reinforced Thermoplastic Composites M.T. Abadi	201
92	Pre-Stressed Roof Networks with Different Contour Structures J. Idnurm and V. Kulbach	203
93	A Nonlinear Model of a Curved Beam for the Analysis of Galloping of Suspended Cables A. Luongo, D. Zulli and G. Piccardo	205
94	Time-Dependent Non-Linear Closed-Form Solution of Cable Trusses S. Kmet and Z. Kokorudova	207
95	Deployment of Membranous Tubes by Air Inflation at Low Pressure S. Buytet, R. Bouzidi and Ch. Dupuy	209
96	An Algorithm Based on the Finite Element Method and the Catenary Equation to Compute the Initial Equilibrium of Railway Overhead A. Carnicero, O. Lopez-Garcia, V. Torres and J.R. Jiménez-Octavio	211
97	On the Dynamic Response of Multi Cable-Beam Systems for Façade Tension Structures R. Gori and A. Mastropasqua	213
XI	Composite and Adaptive Structures: Modelling and Simulation	
	Session organised by C.M. Mota Soares and A. Benjeddou	215
98	Semi-active Vibration Isolator Based on Elastomer Material Controlled by an SMA actuator J. Heinonen, T. Kärnä, I. Vessonen, P. Klinge and T. Lindroos	217
99	Modelling Frequency Adjustment Effects Using Shape Memory Alloy Oscillators L.X. Wang and R.V.N. Melnik	219
100	The First Use of the Shear Actuation Mechanism for Valve-Less Piezoelectric Micro-Pump Design A. Benjeddou, C. Poizat and M. Gall	221

101	Damage Quantification in Smart Beams Using Modal Curvatures: Direct and Inverse Approaches	223
	A. Benjeddou, S. Vijayakumar and I.H. Tawfiq	
102	The Effects of Thermal Residual Stresses on the Fatigue Life of Aluminum Panels Repaired with Various Bonded Composite Materials	225
	H. Hosseini-Toudeshky, B. Mohammadi and M. Musivand-Arzanfudi	
103	A State Space Method for Free-Vibration Analysis of a Radially Polarized Laminated Piezoelectric Cylinder Filled with Fluid	227
	J.F. Deü and W. Larbi	
104	A Finite Element Formulation for Modal Analysis of Piezoelectric Composite Conical Shells Filled with a Compressible Fluid	229
	W. Larbi and J.F. Deü	
105	A Three Dimensional Semi-Analytical Finite Element Model for the Analysis of Piezoelectric Shells of Revolution	231
	H. Santos, C.M. Mota Soares, C.A. Mota Soares and J.N. Reddy	
106	A Mixed Finite Element Model based on Least-Squares Formulation for the Static Analysis of Laminated Composite Plates	233
	F. Moleiro, C.M. Mota Soares, C.A. Mota Soares and J.N. Reddy	
107	Finite Element Modelling of Effective Moduli of Porous and Polycrystalline Composite Piezoceramics	235
	S.V. Bobrov, A.V. Nasedkin and A.N. Rybjanets	
XII	Steel Structures: Modelling, Analysis and Design	
	Session organised by M. Iványi	237
108	Plastic Design of Frames Using Heuristic Algorithms	239
	A. Kaveh and M. Jahanshahi	
109	The Influence of Rotational Restraint on the Behaviour of Cold-Formed Steel Continuous Purlins Attached to Roof Sheeting	241
	K.B. Katnam, M. De Strycker, R. Van Impe and G. Lagae	
110	Geometric Imperfections and Their Influence on the Ultimate Load of Thin-Walled, Cold-Formed Steel Purlins	243
	M. De Strycker, K.B. Katnam, W. Vanlaere, G. Lagae and R. Van Impe	
111	Realization of a Platform for Multidisciplinary Optimization Applied to Steel Constructions	245
	A. Benanane, S. Caperaa, D. Kerdal and L. Geneste	
112	A Finite Element Model for Beam-To-Column Bolted End Plate Connections	247
	A. Moreno, A. Foces and J.A. Garrido	
113	Numerical Simulation of the Stressed Skin Diaphragms	249
	Y. Liu and Q.L. Zhang	

114	Rehabilitation of Composite Steel Bridges Using Pultruded GFRP Plates M.M. Abushagur, E.M. Galuta and A.F. Saud	251
115	An Improved Saddle-Like Connection for Steel Structures M.A. Barkhordari and M. Foroughi	253
116	Numerical and Experimental Analysis of a New Type of Orthotropic Plates M. Iványi Jr., R. Bancila and M. Iványi	255
117	Numerical Modelling of PTED Connections for Steel Moment Resisting Frames M. Esposito, B. Faggiano and F.M. Mazzolani	257
118	Simplified Finite Element Modelling of Beam-Column Bolted Connections with Shell Elements S. Taufik and R.Y. Xiao	259
119	Three-Dimensional Finite Element Modelling of Flush End Plate Connections with High Strength Steel S. Taufik and R.Y. Xiao	261
120	Minimum Cost Design with Advanced Analysis for Elastic Planar Steel Frames G. Sánchez and P. Martí	263
121	Dynamic Collapse of Steel Rack Structures A.L.Y. Ng, R. Beale and M. Godley	265
122	Torsional Analysis of Wide Flange Beams Including Shear Deformation Effects M. Mohareb, F. Nowzartash and R.E. Erkmen	267
123	Probabilistic Evaluation of the Test Results of Steel I-beams with Web Openings G. Bayramoglu and A. Ozgen	269
XIII	Reinforced Concrete Structures: Modelling and Analysis	271
124	Effect of Bond Deterioration on Behaviour of Concrete Beams Y.G. Du and J. Cairns	273
125	Smearred Crack Models for Reinforced Concrete Bridge Piers under Cyclic Loading V.B. Nguyen and A.H.C. Chan	275
126	Numerical Analyses of the Biaxial Shear Capacity of Transverse Reinforced Concrete Members V. Birtel and P. Mark	277
127	Comparison between Modelling of Ribbed Decking Composite Slabs With and Without Slip in Finite Element Analysis S. Baharom and R.Y. Xiao	279

128	Post Cracking Behaviour of Reinforced Concrete Structures J. Razzaghi and I.M. May	281
129	Limit Analysis of Reinforced Concrete Rectangular Plates with Free Edges I. Mura	283
130	Application of the Circumferential Notch Method to Fibre Reinforced Concrete P.P. Procházka and A.E. Yiakoumi	285
131	Three-Dimensional Non-Linear Modelling Aspects of a Full-Scale Reinforced Concrete Banded-Joist Floor A.B. Shuraim	287
132	Shear Bearing Capacities of RC Beams with Circular Sections: Computational Modelling and Design M. Bender and P. Mark	289
133	Modelling of Interaction between Reinforcement and Matrix Using the FETI Method J. Kruis and P. Štemberk	291
134	Finite Element Modelling of the Bond Between Concrete and FRP Rebars H.M.H. Ibrahim	293
XIV	Aluminium Structures: Modelling, Analysis and Design	295
135	Redesigning Monorail Steel Trusses to Satisfy Aluminium Design Requirements R.I. Jackson and J.W. Bull	297
136	Increasing Fatigue Life and Reducing Deflections in Aluminium Bridge Structures D. Hill, M. Colledge and J.W. Bull	299
137	Numerical Analysis of Welded Aluminium T-Stub Joints under Monotonic Loading M. Brescia, G. De Matteis, A. Formisano and F.M. Mazzolani	301
XV	Bridge Engineering	303
138	A Pultruded GFRP Bridge Deck-to-Girder Connection System K.T. Park, Y.K. Hwang, Y.H. Lee and J. Jeong	305
139	Statistical Computation for Extreme Bridge Traffic Load Effects C.C. Caprani and E.J. OBrien	307
140	The Behaviour of Bridges with Jointless Decks Subjected to Time-Dependent Effects A. El-Safty	309

141	Static Behaviour of a Five-Span Concrete Filled Steel Tubular Arch Bridge Y.Y. Wang, S.M. Zhang, X.L. Wang and T. Zhang	311
142	Moving Force Identification for Two-Span Continuous Bridges Using an Eigenvalue Reduction Technique C.W. Rowley, E.J. OBrien and A. González	313
143	Evaluation of the Damping Matrix and Its Effect on the Dynamic Response of Suspension Bridges S. Esteki and S. Pourzeynali	315
XVI	Timber Structures	317
144	Numerical Modelling of Charring in Timber Beams Exposed to Fire S. Schnabl and G. Turk	319
XVII	Offshore Structures	321
145	Nonlinear Finite Element Modelling of Flexible Risers Using a Pipe Elbow Element S.A. Hosseini Kordkheili and H. Bahai	323
146	Risk Modelling of Fires and Explosions on Offshore Platforms J.L. Lewthwaite and J.D. Andrews	325
147	The Development of a Novel Non-Linear Spectral Model for Analysing Offshore Structures, Part I: Development of Drag Force Terms and System Receptances M. Hartnett	327
148	The Development of a Novel Non-Linear Spectral Model for Analysing Offshore Structures, Part II: Development of Response Spectra and Model Application M. Hartnett	329
XVIII	Porous Media	331
149	Surface Vibration of Porous Media: Wave Number and Spatial Results G. Lefeuvre-Mesgouez, A. Mesgouez, H. Bolvin and A. Chambarel	333
XIX	Structural Joints and Connections	335
150	Calculation and Design of Integrated High Performance Composite Pin-Joints M. Růžička, T. Mareš, K. Blahouš, V. Kulíšek and M. Sirový	337

151	Finite Element Simulation of Semi-Continuous Connections and Appraisal of Results R.Y. Xiao and J.D. Parameshwar	339
152	A Study of the Modified Advanced First Order Second Moment Method for Beam-to-Column Connections S.M. Shin, D.K. Lee and S.S. Park	341
XX	Plates	343
153	Improvement of the Performance of the Wave Based Method for the Steady-State Dynamic Prediction of Structural Bending Problems C. Vanmaele, W. Desmet and D. Vandepitte	345
154	Dual Analysis for Finite Element Solutions of Plate Bending J.F. Debongnie, N.X. Hung and N.H. Cung	347
155	Deflection and Strength of Porous Flat Heads of Cylindrical Vessels M. Malinowski and E. Magnucka-Blandzi	349
156	Estimation of Critical Speed of an Orthotropic Rectangular Plate in Supersonic Flow I. Takahashi	351
157	Finite Strip Analysis of Functionally Graded Plates Under Pressure Loads S.A.M. GhannadPour, H.R. Ovesy and M. Kharazi	353
158	Comparison of Bicubic Rectangular and Full Cubic Triangular Mindlin Plate Finite Elements H. Werner, K. Fresl, D. Lazarević	355
159	Bending Analysis of Curve-Sided Quadrilateral Thin Plates Using the Extended Kantorovich Method M.M. Aghdam and M.H. Babaei	357
XXI	Shells	359
160	Application of the Finite Volume Method for Shell Analysis: A Membrane Study F. Hatami, N. Fallah and S. Pourzeynali	361
161	Different Enhanced Assumed Strain Formulations for Large Rotation Analysis of Shells B. Brank	363
162	Geometrical Non-linear Analysis of Shells: A New Positional Finite Element Method H.B. Coda and R.P. Paccola	365

163	Parametric Instability Analysis of Stringer Stiffened Circular Cylindrical Shells under Axial Compression and External Hydrostatic Pressure	367
	M.R. Khedmati, M.J. Mazaheri and A.R. Karimi	
XXII	Finite Element Methods	369
164	Discrete Green's Functions for Time-Harmonic Wave Problems on Unbounded Domains with Periodic Variation of Material Properties	371
	B. Boroomand and F. Mossaiby	
165	A General Form of Dirichlet Boundary Conditions Used in Finite Element Analysis	373
	L. Jendele and V. Červenka	
XXIII	Discrete Element Methods	375
166	Numerical Modelling of Mechanical Tests Using the Discrete Element Method	377
	M. Guessasma, J. Fortin and E. Bellenger	
167	Discrete-Continuum Coupling for Impacted Structures	379
	E. Frangin, P. Marin and L. Daudeville	
XXIV	Boundary Element Methods	381
168	Plate Analysis under Harmonic Loads Using the Reissner Model with the Boundary Element Method	383
	L. Palermo Jr.	
169	An Iterative Radial Simplex Method for Elastostatic and Elastodynamic Boundary Elements	385
	K. Davey and M.T. Alonso Rasgado	
170	Flanking and Direct Sound Transmission Modelled Using a Boundary Element Method Approach	387
	P. Santos	
171	A New Boundary Element Method Formulation in Three-Dimensional Exterior Elastodynamics	389
	C.G. Provatidis and N.K. Zafiroopoulos	
172	Different Approaches to the Corner Problem in the Boundary Element Method with Application to Tunnel Excavation	391
	U. Eberwien, C. Duenser and G. Beer	
173	A Boundary Element Method Based Meshless Method for Buckling Analysis of Elastic Plates	393
	B. Chinnaboon, S. Chuchepsakul and J.T. Katsikadelis	

XXV	Iterative Solution Methods	395
174	A High Performance Algorithm to solve the Static Stiffness Problem of a Catenary A. Alberto, E. Arias, D. Cebrian, T. Rojo, F. Cuartero and J. Benet	397
175	Reordering for the Iterative Solution of Hybrid Elastic Structures A. Comerlati, G. Gambolati and C. Janna	399
176	A Conjugate Gradient Quasi-Newton Method for Structural Optimisation K. Davey	401
XXVI	Meshless Methods	403
177	An Equilibrium Model in the Element Free Galerkin Method B.Q. Tinh and H. Nguyen-Dang	405
178	Extension of the Fixed Grid Finite Element Method to Three-Dimensional Analysis F.S. Maan, O.M. Querin and D.C. Barton	407
179	Investigation of the Use of the Radial Basis Functions Method for Solving Elastostatic Problems N.A. Libre, A. Emdadi, M. Rahimian and M. Shekarchi	409
180	Improvements in the Parametric Meshless Galerkin Method H. Hosseini-Toudeshky and M. Musivand-Arzanfudi	411
XXVII	Multiscale Methods	413
181	Multiscale Finite Element Simulation for Heterogeneous Materials with Reference to the Effective Tangent Modulus Computation A.J. Carneiro Molina, E.A. de Souza Neto and D. Peric	415
XXVIII	Probabilistic and Reliability Based Methods	417
182	Toward the Stochastic Modelling of Disc Brake Dynamics D. Clair, D. Daucher, M. Fogli and Y. Berthier	419
183	Simulation of the Load-Bearing Capacity of Structures Using Fuzzy Random Processes B. Möller, W. Graf, A. Hoffmann and J.-U. Sickert	421
184	A One-Dimensional Transformation Method for Reliability Analysis S. Kadry, A. Chateauneuf and K. El-Tawil	423
185	Evaluation of Wave Damage in Urbanized Lagoons S. Manenti and G. Cecconi	425

186	A Suitable Representation of the Stiffness for the Analysis of Linear Uncertain Structures G. Falsone and N. Impollonia	427
187	Probabilistic Reliability Assessment of Structural Systems in the Computer Era V. Křivý, L. Václavek, P. Marek and J. Valihrač	429
XXIX	Adaptivity and Errors	431
188	Strict Bounds for Computed Stress Intensity Factors J. Panetier, P. Ladevèze and F. Louf	433
XXX	Buckling and Post-Buckling Behaviour	435
189	Analytical Evaluation for Local and Overall Buckling Behaviour of H-Section Truss Members T. Ohtsuka and S. Motoyui	437
190	Estimation of the Dynamic Buckling Strength of a Spacer Grid Assembly for PWRs Using a Finite Element Model K.N. Song and S.H. Lee	439
191	Generalised Beam Theory Formulation to Analyse the Post-Buckling Behaviour of FRP Composite Thin-Walled Members N.F. Silva, N. Silvestre and D. Camotim	441
192	Extension of the Finite Volume Method for Instability Analysis of Columns with Shear Effects N. Fallah and F. Hatami	443
193	Shakedown Boundary of Limited Ductility Structures Accounting for Buckling L. Palizzolo, A. Caffarelli and M. Zito	445
194	Nonlinear Buckling and Postbuckling Analyses of Elastically Supported Arches Y.L. Pi, M.A. Bradford and F. Tin-Loi	447
XXXI	Structural Analysis	449
195	Beam Element for Creep Analysis for a Large Displacement Regime D. Lanc, G. Turkalj and J. Brnić	451
196	Non-Orthogonal Solutions for Thin-Walled Members: Generalized Expressions for Stresses R.E. Erkmen and M. Mohareb	453
197	Transient Elastodynamic Analysis of Plane Structures Using Coons-Patch Macroelements and Modal Superposition C.G. Provatidis	455

XXXII	Re-Analysis	457
198	A Method for the Dynamic Re-Analysis of Nonlinear Systems P. Cacciola, F. Giacobbe and G. Muscolino	459
XXXIII	Optimization	461
199	A New Hybrid Meta-Heuristic Method for Optimal Design of Space Trusses with Elastic-Plastic Collapse Constraints A. Csébfalvi and G. Csébfalvi	463
200	Robust Design of Frames under Uncertain Loads by Multiobjective Genetic Algorithms D. Greiner, J.M. Emperador, B. Galván and G. Winter	465
201	The Use of Morphological Indicators and Genetic Algorithms in Structural Optimisation Considering Stiffness Constraints T. Vandenbergh, B. Verbeeck, W.P. De Wilde and P. Latteur	467
202	Sensitivity Analysis and Optimization of a Shape Memory Alloy Gripper M. Langelaar and F. van Keulen	469
203	Optimal Design of the Active Twist for Helicopter Rotor Blades E. Barkanov, S. Gluhih and A. Kovalov	471
204	Bias-Specified Robust Design Optimization: An Alternative Approach G. Steenackers and P. Guillaume	473
205	Morphological Indicators and Scale B. Verbeeck, P. De Wilde, T. Vandenbergh and W. Ponsaert	475
206	The Effect of Non-linearity on the Design Optimization of Truss Structures T. Talaslioglu	477
207	Optimisation of Anisotropic Cylinders Accounting for Manufacturing Tolerances P.Y. Tabakov and M. Walker	479
208	Heuristic Optimization of Reinforced Concrete Road Bridge Frames C. Perea, V. Yepes, J. Alcalá, A. Hospitaler and F. Gonzalez	481
XXXIV	Topology and Shape Optimization	483
209	New Exact Analytical Solutions as Benchmarks for Numerical Topology Optimization G.I.N. Rozvany, T. Lewinski, J. Lógó and V. Pomezanski	485
210	Topology Optimization Using Probabilistic Compliance Constraints J. Lógó, S. Kaliszky and M. Ghaemi	487

211	Numerical Methods to Avoid Topological Singularities V. Pomezanski	489
212	A New Algorithm for Three-Dimensional Topology Optimisation in Structural Mechanics Using a Level-Set Method H. Andrä, S. Amstutz, I. Matei and E. Teichmann	491
213	Mixed Finite-Element Approaches for Topology Optimization C. Cinquini, M. Bruggi and P. Venini	493
214	Optimality Criterion Methods and Sequential Approximate Optimization in the Classical Topology Layout Problem A.A. Groenwold and L.F.P. Etman	495
215	Topology Optimization in the Case of Uncertain Loading Conditions J. Lógó, M. Ghaemi and A. Vásárhelyi	497
216	Shape Optimization of Thin-walled Structures Based on a New Shell Element and Uniform Strain Energy Density Criterion P. Khosravi, R. Sedaghati and R. Ganesan	499
217	Representative Optimal Solutions for Shape Optimisation S.I. Valdez, S. Botello and A. Hernández	501
XXXV	Simulation	503
218	Model Reduction Applied to Real Time Simulation of Mechanical Behaviour for Flexible Parts F. Druesne, J.L. Dulong and P. Villon	505
219	Real-Time Simulation Analysis of a Floating Dock Based on a Finite Element Model Y.D. Liu, Ch.M. Sun and G. Bian	507
XXXVI	Design Methods and Studies	509
220	Building on IFC: E-Interaction for Computer Aided Structural Design M. Hassanien Serror, J. Inoue, Y. Adachi and Y. Fujino	511
221	A Structural Engineering Perspective on Progressive Collapse: Examination of Analysis and Modelling Methods O.A. Mohamed	513
222	Analysis and Optimization of a Safety Line under Dynamic Loads C. Gomez, L. Sgambi and F. Bontempi	515
223	Influence of Shear Deformation on the Optimal Design of a Column under Compression A. Samartin, J.C. Mosquera and C. Castro	517

224	Reinforcement Design in Concrete Plates and Shells Using Optimization Techniques A. Tomás and P. Martí	519
225	Optimal Design of an Auto-Leg System for Washing Machines H.S. Seo, M.H. Hong, T.H. Lee, J.W. Chang and S.M. Jeon	521
XXXVII Finite Element Studies		523
226	A Finite Element Model of Orthogonal Cutting W. Mieszczak and J. Kosmol	525
227	A Study on the Strain Rate Effect of Vehicle Guard Fences Using Numerical Collision Analysis T. Hirai, Y. Itoh and B. Liu	527
228	Finite Element Analysis of Header Dies for Taper Upsetting M. Ceran, M.I. Gökler, H. Darendeliler	529
XXXVIII Contact		531
229	Simulation of Orthotropic Frictional Contact with Non-Associated Sliding Rule G. de Saxcé, Z.Q. Feng, M. Hjjaj and Z. Mróz	533
XXXIX Multibody Dynamics		535
230	Evolutionary Optimization of Strategies for the Demolition of Buildings with Explosive Charges Using Multibody Dynamics M. Baitsch, M. Breidt, M. Ilikkan and D. Hartmann	537
XL Dynamics		539
231	Some Remarks on Displacement Based Dynamic Measurements I. Kožar	541
232	Frequency-Domain Identification of Riser Dynamics Using Complex Singular Value Decomposition for Reduced-Order Spatiotemporal Modelling and Structural Control N.I. Xiros and I.K. Chatjigeorgiou	543
233	An Identification Strategy for Highly Corrupted Measurements in Non-Linear Transient Dynamics H.M. Nguyen, O. Allix and P. Feissel	545
234	New Schemes for the Finite Element Dynamic Analysis of Elastic Solids with Voids G. Iovane and A.V. Nasedkin	547

235	A Frequency Domain Approach for Transient Dynamic Analysis over the Low and Medium Frequency Ranges: Application to Structures with Heterogeneities	549
	L. Blanc and M. Chevreuril	
236	Analysis of the Wind Dynamic Response of Towers and Metallic Masts	551
	R.F. Almeida and R.C. Barros	
237	On the Dynamic Behaviour of a Singular Geometry Concrete Belfry	553
	S. Ivorra, F.J. Pallarés and M.L. Romero	
XLI	Vibration Problems	555
238	Derivation of Diffusion Equations for High-Frequency Vibrations of Randomly Heterogeneous Structures	557
	É. Savin	
239	Axisymmetric Vibration of Transversely Isotropic Annular Plates	559
	V.K. Agarwal, S. Chakraverty and R. Jindal	
XLII	Railway Engineering	561
240	Physical and Finite Element Shear Load Response Modelling of Viscoelasticity Materials	563
	R. Čajka and P. Maňásek	
241	Microtremors from Railway Traffic	565
	J. Benčat	
XLIII	Earthquake and Seismic Engineering	567
242	Generation of Ground Motion Records from the Zarand (Iran) Earthquake Based on a Stochastic Model	569
	A. Nicknam, S. Yaghmaei and A. Yazdani	
243	L_p Deconvolution of Seismic Data Using the Iterative Re-Weighted Least Squares Method	571
	A.A. Chanerley and N.A. Alexander	
244	Real Earthquake Accelograms as Input for Seismic Analysis	573
	D. Cizmar, J. Radic, D. Mestrovic and A. Nizic	
245	Stochastic Simulation Based on Finite-Fault Modelling from the 22 February 2005 (M 6.4) Zarand Earthquake in Iran	575
	A. Nicknam, A. Yazdani and S. Yaghmaei	

246	Considering Ground Motion Uncertainties in Stochastic Seismic Analysis of Structures	577
	N. Impollonia, G. Ricciardi and M.P. Santisi d'Avila	
247	Post-Seismic Structural Damage Evaluation: An Integrated Probabilistic Proposal	579
	A. Mébarki	
248	Debonding, Slipping and Crushing Effects on the Seismic Response of a Roller Compacted Concrete Dam	581
	H.A. Thanoon, M.S. Jaafar, W.A. Thanoon, T.A. Mohammed and J. Noorzaei	
249	Structural Optimisation for Earthquake Loading Using Neural Networks and Genetic Algorithms	583
	E. Salajegheh, J. Salajegheh and S. Gholizadeh	
250	Seismic Design of Pre-Cast Reinforced Concrete Structures Using Additional Viscous Dampers	585
	C. Ceccoli, T. Trombetti, S. Silvestri, and G. Gasparini	
251	Seismic Performance of Slab-on-Girder Bridges Using New Ductile End-Diaphragm Retrofitting Systems	587
	M. Lotfollahi and M. Mofid	
252	Seismic Behaviour of an Asymmetric Three-Dimensional Steel Frame with Base Isolation Devices	589
	R.C. Barros and M.B. César	
253	Reinforced Concrete Wide-Beams vs. Deep-Beams: A Comparison of their Behaviour under Seismic Loads, Employing Pushover Analysis	591
	J. Lavado, M. Moll and R. Lopez	
254	Seismic Behaviour of Irregular Structures	593
	T. Branci, B. Tiliouine and A. Mébarki	
255	Energy Dissipation and Behaviour of Building Façade Systems under Seismic Loads	595
	R. Hareer, D. Thambiratnam and N. Perera	
256	Seismic Response of Structures with Uncertain Parameters	597
	P. Štemberk and J. Kruijs	
257	Robust Design of Passive Mass-Uncertain Tuned Mass Dampers on Building Structures	599
	A. De Stefano and E. Matta	
258	A Case Study for Seismic Dampers Placed Between Non-Moment-Resisting Steel Frame Structures and Lateral Resisting Concrete Cores	601
	G. Gasparini, T. Trombetti, S. Silvestri and C. Ceccoli	

259	The Use of a Toggle Brace System for the Amplification of Seismic Damper Motion in Building Structures T. Trombetti, S. Silvestri, G. Gasparini and M. Bottazzi	603
XLIV	Composite Materials: Modelling, Analysis and Design	605
260	Problems with the Cutting of Fibre Reinforced Composites Using Abrasive Waterjet Machining T. Wala and J. Kosmol	607
261	The Simplified Unit Cell Method for Micromechanical Studies of Viscoelastic Properties of Unidirectional Fibre-Reinforced Composites M. Salehi, M.M. Aghdam and S.R. Falahatgar	609
262	A Modified Three-Dimensional Analytical Model for Stress Prediction in Short Fibre Composites M. Pahlavanpour, A. Abedian and M. Mondali	611
263	A Modified High-Order Theory for Sandwich Beams under Contact Loading F. Mortazavi and M. Sadighi	613
264	A Two-Layer Beam Element with Interlayer Slip and Shear S. Schnabl, I. Planinc, M. Saje and G. Turk	615
265	Solution of an Elastostatic Problem with Imperfect Bonding Using a Two Scale Finite Element Method G. Mejak	617
266	Metis Element Model for Interlaminar Stresses in Composite Laminates N.T. Duong and H. Nguyen Dang	619
267	Micromodel Based Computations for Laminated Composites D. Violeau, P. Ladevèze and G. Lubineau	621
268	Comparison of Beam Theories with Finite Element Analysis in Three-Point Bending of Thick Composites F. Duchaine, E.M. Baten, H. Champlaud and H.E.N. Bersee	623
269	Predicting the Macroscopic Behaviour of Metal-Matrix Composites Embedding an Interphase A. Taliervo	625
270	The Buckling of Laminates Including Bending-Twisting Coupling Effects with Multiple Delaminations Using Spring Simulation M. Kharazi, H.R. Ovesy and S.A.M. GhannadPour	627
271	Triangulation of Three-Dimensional Aggregate Particles D. Rypl	629
272	A New Shell Element for Hybrid Vibration Control of Sandwich Structures H. Boudaoud, E.M. Daya, S. Belouettar and M. Potier-Ferry	631

273	Stacking Sequence Optimization of Laminated Cylindrical Panels Using a Genetic Algorithm and Neural Networks M. Shakeri, A. Alibiglou and M. Abouhamze	633
XLV	Piezoelectric Materials: Modelling and Analysis	635
274	Modelling and Analysis of PVDF Copolymer-Ceramic Composite Thin Films D.R. Mahapatra and R.V.N. Melnik	637
275	Analysis of the Free-Edge Effect in Piezoelectric Laminated Plates by the Scaled Boundary Finite-Element Method J. Artel and W. Becker	639
276	Stress Analysis and Failure Theory in Piezoelectric Materials Z.B. Kuang and Z.D. Zhou	641
277	Deflection Control of Smart Functionally Graded Beams M.R. Eslami, A.A. Bidokhti, M. Sadighi and A. Gharib	643
278	Calculation of Eigenvalues of a Piezoelectric Beam with the Pseudospectral Method M. Kekana	645
279	Structural Modal Parameter Estimation with Collocated Piezoelectric Patch Actuators and Sensors J. Dennerlein, U. Gabbert, H. Köppe, S. Nunninger and M. Bechtold	647
280	An Electro-Mechanical Impedance Approach for Vibration Control Using Multiple Piezoelectric Actuators and Sensors C.P. Providakis, D.P.N. Kontoni and M.E. Voutetaki	649
281	Sensitivity Analysis of Laminated Beams Integrated with Piezoelectric Sensors/Actuator Using Layerwise Theory A. Zabihollah, R. Ganesan and R. Sedaghati	651
282	Elasticity Solution of Laminated Cylindrical Shells with Piezoelectric Actuator and Sensor Layers M. Shakeri, M.R. Saviz and M.H. Yas	653
XLVI	Elasto-Plasticity, Plasticity and Visco-Elasticity	655
283	Three-Dimensional Numerical Modelling of Mechanical Joining Processes: From Joining down to Structural Analysis P.O. Bouchard, S. Fayolle and K. Mocellin	657
284	Force-Deflection Analysis of Indented Pipes with Spring Type Supports T.H. Hyde, R. Luo and A.A. Becker	659

285	A Damage Plasticity Bounded Rate Model for the Consistent Prediction of Ductile Failure G. Court, O. Allix and M. Mahé	661
286	Viscoelastic Analysis of a Bernoulli-Navier Beam Resting on an Elastic Medium C. Floris and F.P. Lamacchia	663
XLVII	Homogenisation	665
287	Flexural Response of Heterogeneous Structures Using Computational Homogenisation B. Mercatoris and T.J. Massart	667
XLVIII	Graph Theory	669
288	Improved Group-Theoretical Method for Eigenvalue Problems of Special Symmetric Structures Using Graph Theory A. Kaveh and M. Nikbakht	671
XLIX	Damage, Identification and Detection	673
289	Symptomatic and Time-Frequency Techniques for Non-Linear Structural Identification A. De Stefano, G.V. Demarie and R. Ceravolo	675
290	Multiobjective Fault Identification Using Genetic Algorithms R. Perera, A. Ruiz and C. Manzano	677
291	An Approximate Damage Model for Concrete under Finite Deformation S. Khajepour, G.D. Morandin and R.G. Sauvé	679
292	Material Parameter Identification for Damage Models with Cracks A. Kučerová, D. Brancherie and A. Ibrahimbegović	681
293	Damage Identification of Simply-Supported Beams Using Dynamic Analysis: Experimental and Theoretical Aspects F. Garcés, P. Garcia, C. Genatios, A. Mébarki and M. Lafuente	683
294	An Improved Structural Damage Detection Method Based on Modal Strain Energy G.J. He, M. Yuan and L. Elfgren	685

L	Education	687
295	MYSPEC: Educational Software for Structural Dynamics and Hysteretic Systems A.E. Charalampakis and V.K. Koumouis	689
	Author Index	691
	Keyword Index	699

**The Eighth International Conference on
Computational Structures Technology
sponsors:**



Preface

This volume comprises the extended abstracts of contributed papers presented at The Eighth International Conference on Computational Structures Technology (CST 2006) held at Las Palmas de Gran Canaria, Spain, from 12 to 15 September 2006. The full papers from the conference are available on the accompanying CD-ROM. This conference series began in Edinburgh during 1991. The 2006 conference was held concurrently with The Fifth International Conference on Engineering Computational Technology (ECT 2006)

The special sessions included in this volume of Proceedings are:

- Computational Aspects for Damage, Robustness and the Service-Lives of Structures
organised by C. Könke, W.B. Kraetzig and Y.S. Petryna
- Steel and Composite Structures
organised by L.F. Costa Neves
- Probabilistic Approaches to Structural Mechanics
organised by M. Karama and A. El-Hami
- Tall Buildings: Analysis and Design
organised by J.W. Bull
- Traffic Vibrations: Isolation and Propagation
organised by D. Le Houédec
- Robustness of Mechanical Systems against Uncertainties
organised by I. Doltsinis
- Constitutive and Material Modelling
organised by M.H.B.M. Shariff
- Dynamics of Viscoelastically Damped Structures
organised by G. Muscolino and S. Adhikari
- Masonry Structures
organised by J.W. Bull
- Fabric, Cable and Membrane Structures
organised by B.H.V. Topping and P. Iványi
- Composite and Adaptive Structures: Modelling and Simulation
organised by C.M. Mota Soares and A. Benjeddou
- Steel Structures: Modelling, Analysis and Design
organised by M. Iványi

We are particularly grateful to the organisers of these special sessions.

The following sessions are also included in this volume:

- Reinforced Concrete Structures: Modelling and Analysis
- Aluminium Structures: Modelling, Analysis and Design
- Bridge Engineering
- Timber Structures
- Offshore Structures
- Porous Media
- Structural Joints and Connections
- Plates
- Shells
- Finite Element Methods
- Discrete Element Methods
- Boundary Element Methods
- Iterative Solution Methods
- Meshless Methods
- Multiscale Methods
- Probabilistic and Reliability Based Methods
- Adaptivity and Errors
- Buckling and Post-Buckling Behaviour
- Structural Analysis
- Re-Analysis
- Optimization
- Topology and Shape Optimization
- Simulation
- Design Methods and Studies
- Finite Element Studies
- Contact
- Multibody Dynamics
- Dynamics
- Vibration Problems
- Railway Engineering
- Earthquake and Seismic Engineering
- Composite Materials: Modelling, Analysis and Design
- Piezoelectric Materials: Modelling and Analysis
- Elasto-Plasticity, Plasticity and Visco-Elasticity
- Homogenisation
- Graph Theory
- Damage, Identification and Detection
- Education

Other papers presented at the conferences in 2006 are published as follows:

- *The Invited Lectures from CST 2006 are published in:*
Innovation in Computational Structures Technology, B.H.V. Topping, G. Montero and R. Montenegro, (Editors), Saxe-Coburg Publications, Stirlingshire, Scotland, 2006.

- *The Invited Lectures from ECT 2006 are published in:*
Innovation in Engineering Computational Technology, B.H.V. Topping, G. Montero and R. Montenegro, (Editors), Saxe-Coburg Publications, Stirlingshire, Scotland, 2006.
- *The Contributed Papers from ECT 2006 are published in:*
Proceedings of the Fifth International Conference on Engineering Computational Technology, B.H.V. Topping, G. Montero and R. Montenegro, (Editors), (Book of Abstracts and CD-ROM), Civil-Comp Press, Stirlingshire, Scotland, 2006.

We wish to acknowledge and express our gratitude to the conference sponsors:

- University of Las Palmas de Gran Canaria (ULPGC)
- University Institute of Intelligent Systems and Numerical Applications in Engineering (IUSIANI) at ULPGC
- Spanish Society for Numerical Methods in Engineering (SEMNI)
- Spanish Society for Applied Mathematics (SEMA)
- International Journal of Computers and Structures (published by Elsevier, Ltd)
- Government of the Canary Islands, Advisory Board for Industry, Commerce and New Technology
- Firgas Mineral Water Company
- Spanish Government, Ministry of Education and Science, Acción Complementaria TIN2005-25867-E and FEDER CGL2004-06171-C03-02
- Department of Mathematics, ULPGC
- Gran Canaria Convention Bureau
- Computational Technology Solutions, UK

We should like to thank the members of the CST 2006 Conference Editorial Board for their help before and during the conference: Prof. H. Adeli, USA; Dr. S. Adhikari, UK; Prof. E. Alarcon, Spain; Prof. M. Amabili, Italy; Prof. S.A. Anagnostopoulos, Greece; Prof. C.A.C. Antonio, Portugal; Prof. T. Aoki, Japan; Prof. A.J. Aref, USA; Prof. F. Armero, USA; Prof. J.R. Arruda, Brazil; Prof. H. Askes, UK; Prof. N.O. Attoh-Okine, USA; Dr. C.E. Augarde, UK; Prof. J. Awrejcewicz, Poland; Dr. A. Bahreininejad, Iran; Prof. B. Balachandran, USA; Prof. J.R. Banerjee, UK; Prof. C.C. Baniotopoulos, Greece; Prof. A. Baratta, Italy; Prof. H.J.C. Barbosa, Brazil; Dr. C. Bardos, France; Dr. E. Barkanov, Latvia; Dr. F. Bartolozzi, Italy; Prof. K.J. Bathe, USA; Prof. F. Bay, France; Prof. Z.P. Bazant, USA; Prof. A.A. Becker, UK; Prof. W. Becker, Germany; Dr. G. Beer, Austria; Dr. D.W. Begg, UK; Prof. A. Benjeddou, France; Dr. M. Bischoff, Germany; Prof. M.L. Bittencourt, Brazil; Dr. J. Blachut, UK; Prof. D. Boffi, Italy; Prof. P. Boisse, France; Prof. M. Bonnet, France; Prof. F. Bontempi, Italy; Assoc. Prof. B. Boroomand, Iran; Prof. P. Bouillard, Belgium; Prof. M.A. Bradford, Australia; Prof. F.A. Branco, Portugal; Dr. B. Brank, Slovenia; Prof. D. Briassoulis, Greece; Dr. M. Brunig, Germany; Dr. J.W. Bull, UK; Prof. D. Camotim, Portugal; Prof. R. Carneiro de Barros, Portugal; Prof. E. Carrera, Italy; Prof. M.P. Cartmell, UK; Prof. F. Casciati, Italy; Prof. J.M.A. Cesar de Sa, Portugal; Prof. A.H.C. Chan, UK; Dr. S. Chandra, India; Prof. C.N. Chen, Taiwan; Prof. W.F. Chen, USA; Prof. G.D. Cheng, China; Dr. R.C. Cheng, USA; Prof. J.L. Chenot, France; Prof. G. Chiandussi, Italy; Prof. C. Cinquini, Italy; Prof. H.B.

Coda, Brazil; Prof. J.Y. Cognard, France; Prof. M. Cuomo, Italy; Prof. V.D. da Silva, Portugal; Prof. S. De, USA; Prof. R. de Borst, Netherlands; Prof. G. De Roeck, Belgium; Prof. G. de Saxcé, France; Prof. A. De Stefano, Italy; Prof. M. Di Paola, Italy; Prof. I. Doltsinis, Germany; Dr. J. Duane, USA; Prof. L. Dunai, Hungary; Prof. N.F.F. Ebecken, Brazil; Prof. A El-Hami, France; Prof. I. Elishakoff, USA; Prof. A. Eriksson, Sweden; Dr. D. Eyheramendy, France; Prof. M. Farshad, Switzerland; Dr. J.M. Figueiredo, Portugal; Prof. D.M. Frangopol, USA; Prof. M.I. Friswell, UK; Prof. M. Fuchs, Israel; Prof. G. Gambolati, Italy; Prof. L. Gastaldi, Italy; Prof. L. Gaul, Germany; Prof. J.C. Gelin, France; Prof. R.I. Gilbert, Australia; Prof. D. Givoli, Israel; Prof. R. Gori, Italy; Dr. P. Gosling, UK; Prof. P.L. Gould, USA; Prof. R.V. Grandhi, USA; Prof. D.E. Grierson, Canada; Prof. A.A. Groenwold, South Africa; Dr. Z.W. Guan, UK; Prof. R.M. Guedes, Portugal; Prof. F.C. Hadipriono, USA; Prof. I. Hagiwara, Japan; Prof. P. Hajela, USA; Prof. P. Hamelin, France; Prof. D. Hartmann, Germany; Prof. M. Hoit, USA; Prof. J. Holnicki-Szulte, Poland; Prof. T.J.R. Hughes, USA; Prof. A. Ibrahimbegovic, France; Prof. K. Ishii, Japan; Dr. I. Iskhakov, Israel; Prof. M. Ivanyi, Hungary; Dr. P. Ivanyi, Hungary; Dr. B.A. Izzuddin, UK; Dr. P. Joly, France; Dr. E.S. Kameshki, Bahrain; Dr. M. Kaminski, Poland; Prof. T. Kant, India; Prof. J.D. Kaplunov, UK; Prof. D.L. Karabalis, Greece; Prof. M. Karama, France; Prof. J.T. Katsikadelis, Greece; Prof. A. Kaveh, Iran; Dr. A.I. Khan, Australia; Prof. U. Kirsch, Israel; Prof. C. Koenke, Germany; Prof. L. Kossovich, Russia; Prof. W.B. Kraetzig, Germany; Prof. B.H. Kroeplin, Germany; Dr. J. Kruis, Czech Republic; Prof. H.G. Kwak, Korea; Dr. A.S.K. Kwan, UK; Prof. Y.W. Kwon, USA; Prof. R. Lackner, Austria; Prof. P. Ladeveze, France; Prof. K.L. Lawrence, USA; Prof. D. Le Houédec, France; Dr. J. de Paulo Barros Leite, Brazil; Dr. C.J. Leo, Australia; Prof. A.Y.T. Leung, Hong Kong; Prof. R. Levy, Israel; Prof. R. Lewandowski, Poland; Prof. R.W. Lewis, UK; Dr. X.K. Li, China; Prof. J. Y. Richard Liew, Singapore; Prof. K.M. Liew, Hong Kong; Prof. A. Liolios, Greece; Dr. J. Logo, Hungary; Dr. P.B. Lourenco, Portugal; Mr J. Mackerle, Sweden; Prof. I.A. MacLeod, UK; Prof. C.E. Majorana, Italy; Prof. H.A. Mang, Austria; Prof. G.D. Manolis, Greece; Prof. Dr. K. Marti, Germany; Prof. H. Matthies, Germany; Dr. Ing. K. Maute, USA; Prof. I. May, UK; Prof. F.M. Mazzolani, Italy; Prof. G. McClure, Canada; Dr. G. Mejak, Slovenia; Prof. C. Meyer, USA; Assoc. Prof. E.S. Mistakidis, Greece; Prof. B. Moeller, Germany; Dr. T. Molyneaux, Australia; Prof. C.A. Mota Soares, Portugal; Prof. C.M. Mota Soares, Portugal; Prof. J.E. Mottershead, UK; Prof. K. Moussa, France; Prof. G. Muscolino, Italy; Prof. J.P. Muzeau, France; Dr. L.C. Neves, Portugal; Prof. L.F. Costa Neves, Portugal; Prof. H. Nguyen-Dang, Belgium; Prof. R.M. Nieminen, Finland; Prof. G.P. Nikishkov, Japan; Dr. D. O'Dwyer, Ireland; Prof. R. Ohayon, France; Prof. E. Onate, Spain; Prof. M. Papadrakakis, Greece; Prof. P.Y. Papalambros, USA; Dr. B. Patzak, Czech Republic; Prof. M.N. Pavlovic, UK; Prof. S. Pellegrino, UK; Prof. Y. Petryna, Germany; Dr. J. Plesek, Czech Republic; Assoc Prof. Ch.G. Provatidis, Greece; Dr. E. Providas, Greece; Prof. C.V. Ramakrishnan, India; Prof. F.G. Rammerstorfer, Austria; Prof. O. Rand, Israel; Prof. M. Raoof, UK; Prof. B.D. Reddy, South Africa; Prof. J.N. Reddy, USA; Prof. Z. Ren, Slovenia; Dr. Y. Ribakov, Israel; Dr. P.L. Ribeiro, Portugal; Dr. A. Riccio, Italy; Prof. H. Rodrigues, Portugal; Prof. Dr. Ing. R. Rolfes, Germany; Prof. C.T.F. Ross, UK; Prof. G. Rozvany, Hungary; Prof. U. Rueppel, Germany; Dr. D. Rypl, Czech Republic; Prof. E. Salajegheh, Iran; Prof. A. Samartin, Spain; Prof. C. Sansour, Australia; Prof. L.M. Santos Castro, Portugal; Dr. E.J. Sapountzakis, Greece;

Prof. K. Schittkowski, Germany; Prof. E. Schnack, Germany; Prof. G. Schueller, Austria; Prof. K. Schweizerhof, Germany; Prof. J. Sejnoha, Czech Republic; Dr. O. Shai, Israel; Prof. S.K. Sharan, Canada; Dr. M.H.B.M. Shariff, United Arab Emirates; Dr. J. Sienz, UK; Dr. R.C.C. Silva, Brazil; Prof. L.M.C. Simoes, Portugal; Prof. L. Simoni, Italy; Prof. A.V. Singh, Canada; Dr. J. Sladek, Slovakia; Prof. S.W. Sloan, Australia; Prof. J.E. Souza de Cursi, France; Dr. R. Spallino, Germany; Dr. K.V. Spiliopoulos, Greece; Prof. G.P. Steven, Australia; Prof. B. Stok, Slovenia; Prof. Y. Sugiyama, Japan; Prof. C.A. Symakezis, Greece; Dr. K. Tai, Singapore; Prof. I. Takahashi, Japan; Prof. I. Takewaki, Japan; Dr. S. Tanaka, Japan; Prof. T. Tarnai, Hungary; Dr. Ing. J. Tessmer, Germany; Prof. G. Thierauf, Germany; Prof. V.V. Topopov, UK; Dr. D. Tran, Australia; Dr. J. Trevelyan, UK; Dr. G.J. Turvey, UK; Prof. V. Tvergaard, Denmark; Prof. S. Valliappan, Australia; Prof. F. van Keulen, Netherlands; Prof. R. Veldman, USA; Prof. P. Venini, Italy; Prof. J.R. Vinson, USA; Prof. W. Wagner, Germany; Prof. M. Walker, South Africa; Prof. X. Wang, USA; Dr. J.P. Wideberg, Spain; Prof. M. Wiercigroch, UK; Prof. K.S. Woo, Korea; Dr. Q. Xiao, Wales; Dr. R.Y. Xiao, UK; Prof. M. Xie, Australia; Prof. G. Yagawa, Japan; Prof. Y.B. Yang, Taiwan; Dr. J.Q. Ye, UK; and Prof. A. Zingoni, South Africa.

These conferences could not have been organised without the help and support of many people. In particular, we would like to thank the members of the local organising committee from the University of Las Palmas de Gran Canaria, Spain: Dr R. Berriel, Dr F. Cabrera, Dr J.M. Escobar, Dr E. Flórez, Dr M.D. García, Dr L. González, Dr V. Hernández, Dr J. Rocha, Dr E. Rodríguez, Dr A. Suárez, J.M. González-Yuste and M. Quintana.

Finally, we are grateful to Jelle Muylle (Computational Technology Solutions) for designing and organising this and the other three volumes of conference proceedings (listed above). Once again we would like to thank Judy Tait (Civil-Comp Press) for her organisational skills, which were greatly appreciated.

B.H.V. Topping
Heriot-Watt University, Edinburgh, UK & University of Pécs, Hungary
G. Montero
R. Montenegro
University of Las Palmas de Gran Canaria, Spain