

CONFERENCE SPONSORS

THE CONSTRUCTION INDUSTRY COMPUTING ASSOCIATION THE CHARTERED INSTITUTE OF BUILDING INSTITUTION OF CIVIL ENGINEERING SURVEYORS "CONSTRUCTION COMPUTING" and

THE DEPARTMENT OF CIVIL ENGINEERING CITY UNIVERSITY, LONDON

CONFERENCE ADVISORY BOARD

Professor H. Adeli Ohio State University, Columbus, Ohio, U.S.A. Dr R. J. Allwood, University of Loughborough, Leicestershire, U.K. Professor A. K. Azad, King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia. Dr Martin Barnes, Martin Barnes Project Management, Deloitte Haskins & Sells, London, U.K. Dr Michael Barnes, The City Univesity, London, U.K. W. T. Bell, Contract Data Research, Castleton, Sheffield, U.K. Professor J. Christian, University of New Brunswick, Canada. Professor M. Crisfield, Transport & Road Research Laboratory, Crowthorne, Berkshire, U.K. Professor S. J. Fenves, Carnegie-Mellon University, Pittsburgh, Pennsylvania, U.S.A. M. J. Fort, representing the Institution of Civil Engineering Surveyors, Altrincham, Cheshire, U.K.

Professor John S. Gero, Architectural Computing Unit, Department of Architectural Science, University of Sydney, Sydney, Australia. Professor D. E. Grierson, University of Waterloo, Waterloo, Ontario, Canada. Professor L. Gruendig, Institut fur Geodasie und Photogrammetrie, Technische Universitat Berlin, West Germany. Ian Hamilton, CICA, Cambridge, U.K. Professor H. B. Harrison, School of Civil & Mining Eng., The University of Sydney, Sydney, Australia. Dr E. Hinton, University College of Swansea, University of Wales, Swansea, U.K. Professor R. M. W. Horner, University of Dundee, Dundee, U.K. Professor A. Jennings, The Queen's University of Belfast. Belfast, U.K. Professor P. W. Jowitt, Heriot-Watt University, Edinburgh, U.K.

Professor U. Kirsch, Technion-Israel Institute of Technology, Haifa, Israel. K. J. Lane, representing the Chartered Institute of Building and "Construction Computing", Ascot, Berkshire, U.K. Professor H. Liebowitz, The George Washington University, Washington D.C., U.S.A. Dr M. Papadrakakis, National Technical University, Athens, Greece. Professor Naruhito Shiraishi, Kyoto University, Kyoto, Japan. Professor W. R. Spillers, Renssaelaer Polytechnic Institute, Troy, New York, U.S.A. David Taffs, Ove Arup & Partners, London, U.K. Professor A. B. Templeman, University of Liverpool, Liverpool, U.K. Dr B. H. V. Topping, Heriot-Watt University, Edinburgh, U.K. Dr G. J. Turvey, University of Lancaster, Lancaster, U.K. Professor K. S. Virdi, The City University, London, U.K. Dr D. S. Wakefield, Buro Happold, Bath, U.K.



CIVIL-COMP 89

Proceedings

The Fourth International Conference on Civil and Structural Engineering Computing

Volume 2

Edited by B. H. V. TOPPING

CIVIL-COMP PRESS

published by

CIVIL-COMP PRESS

10 Saxe-Coburg Place Edinburgh

© Civil-Comp Limited, 1989

British Library Cataloguing in Publication Data

International Conference on Civil and Structural Engineering Computing (4th : 1989) Civil-Comp 89.
1. Civil engineering. Application of computer systems
I. Title II. Topping, B. H. V. (Barry H. V.), 1952 – 624'.028'5

ISBN 0-948749-10-5 ISBN 0-948749-12-1 V.2

The Fourth International Conference on Civil and Structural Engineering Computing was held 19th – 21st September, 1989 at The Department of Civil Engineering City University London

Printed in Scotland by MEIGLE PRINTERS Market Street, Galashiels

CONTENTS

X ANALYSIS AND DESIGN OF TENSION STRUCTURES

INTERACTIVE GRAPHIC CAD FOR TENSION STRUCTURES C. F. Ong, Teaching Company Associate, D. S. Wakefield, Büro Happold, Bath and M. R. Barnes, Department of Civil Engineeing, City University, London	1
THREE DIMENSIONAL CABLE ELEMENTS K. Ahmadi-Kashani, Ove Arup & Partners, London	7
AIDS FOR THE CONCEPTUAL DESIGN OF PRESTRESSED MEMBRANE STRUCTURES D. A. Chamberlain, Department of Civil Engineering, City University, London THE RESPONSE OF AIR-SUPPORTED STRUCTURES TO GUST LOADING M. R. Barnes, Department of Civil Engineering, City University, London	15 21
XI DYNAMIC ANALYSIS	
DYNAMIC ANALYSIS OF LAYERED BEAMS M. Heinisuo*, S. Malmi** and A. Miettinen**, *KPM-Engineering Ltd, Tampere, Finland, **Tampere University of Technology, Tampere, Finland	29
Finland ON THE ACCURACY OF A MODE SUPERPOSITION METHOD IN NONLINEAR DYNAMICS M. T. H. Elkatt* and M. A. Millar**, *Department of Structural Engineering, Alexandria University, Egypt, **Department of Civil and Structural Engineering, UMIST, Manchester	37
Manchester	
Science, University of Oklahoma, ***Monroc Inc., Idaho, United States of America	47
XII BRIDGE ENGINEERING	
EFFECT OF CHANGE OF THE FLEXURAL RIGIDITY IN OBLIQUE DIRECTIONS ON THE BEHAVIOUR OF ANISOTROPIC SKEW PLATES Dr M. Kamel, Department of Civil	
Engineering, El-Azher University, Cairo, Egypt DYNAMIC INSTABILITY OF SUSPENSION BRIDGES Dr T. J. A. Agar, Department of Civil Engineering, University of Glasgow, Glasgow, Scotland	53 63
XIII EARTHQUAKE AND SEISMIC ENGINEERING	
SENSITIVITY STUDY OF OPTIMUM SEISMIC INTENSITY BASED ON MINIMIZATION METHOD OF EXPECTED TOTAL COST M. Matsushima, K. Matui and S. Ide, Tokyo Electric	
Power Services Co, Tokyo, Japan BEHAVIOUR OF TUNNELS UNDER SEISMIC LOADS A. Y. Akl, M. Sobaih and M. M. Maher, Structural Engineering Department, Faculty of Engineering, Cairo University, Giza,	73
Egypt	81
XIV ANALYSIS OF PLATES AND SHELLS	
COMPUTER GENERATED ELASTO-PLASTIC DESIGN DATA FOR PRESSURE LOADED CIRCULAR PLATES G. J. Turvey and M. Salehi, Department of Civil Engineering, University of Lancaster, England	89
ANALYSIS OF RADIALLY TAPERED CIRCULAR PLATE SECTORS BY FINITE DIFFERENCE Professor A. K. Azad, M. K. Abdullah and M. H. Baluch, Department of Civil	07
Engineering, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia TRANSITION ELEMENTS IN PLATE/SHELL PROBLEMS C. K. Choi, Y. M. Park, J. W. Seo and W. H. Lee, Department of Civil Engineering, Korea Advanced Institute of Science	103
and Technology, Seoul, Korea	111
XV STRUCTURAL RE-ANALYSIS	
NORM OPTIMIZATION TECHNIQUES FOR IMPROVED STRUCTURAL REANALYSIS Dr S. Taye, Department of Civil Engineering, Technion-Israel Institute of Technology, Haifa,	

XVI OPTIMUM STRUCTURAL DESIGN

FEASIBILITY AND OPTIMALITY IN STRUCTURAL DESIGN Professor U. Kirsch*, Department of Civil Engineering, Technion – Israel Institute of Technology, Haifa, Israel (*currently Visiting Professor and Carnegie Research Fellow, Department of Civil Engineering, Heriot-Watt University, Edinburgh)	125
S. Kanagasundaram and Professor B. L. Karihaloo, School of Civil and Mining Engineering,	
The University of Sydney, Australia	133
OPTIMUM DESIGN OF STEEL FRAMES WITH STABILITY CONSTRAINTS	
Dr M. P. Saka, Department of Civil Engineering, University of Bahrain, Bahrain MINIMUM WEIGHT DESIGN OF STEEL FRAMES H. F. Erbatur and M. M. Al-Hussainy,	141
Civil Engineering Department, King Saud University, Riyadh, Saudi Arabia A NUMERICAL MODEL FOR THE COMPUTER-AIDED OPTIMUM DESIGN OF STEEL	157
FRAMES V. N. Alekhin and Ya I. Ol'kov, The Urals Polytechnical Institute, Sverdlovsk,	
USSR	161
ANALYSIS OF OPTIMIZED PLATES FOR BUCKLING R. Levy and A. Ganz, Faculty of	
Civil Engineering, Technion-Israel Institute of Technology, Technion City, Haifa, Israel OPTIMUM DESIGN OF GEOMETRICALLY NONLINEAR SPACE TRUSSES Dr M. P. Saka, University of Bahrain, Civil Engineering Department, Bahrain, Dr M. Ulker, University of Firat,	167
Civil Engineering Department, Turkey	175

XVII WATER AND PUBLIC HEALTH ENGINEERING

COMPUTER MODELLING OF A HYDROLOGICAL FORECASTING SYSTEM FOR	
CATCHMENT AREAS D. A. Fernando+ and K. S. Fernando++, +Trafalgar House	
Technology Ltd, Croydon, Surrey, ++London Borough of Tower Hamlets, London	185
A METHOD OF OPTIMIZING WATER SUPPLY SYSTEMS J. Bäuerle and Professor L.	
Gründig, Institute for Geodesy and Photogrammetry, Technical University of Berlin, West Berlin	197
A PROGRAM FOR DESIGN OF MEL CULVERTS L. T. Isaacs, Department of Civil	
Engineering, University of Queensland, Australia	203

XVIII GEOTECHNICAL ENGINEERING

7
3
3
)
,
Į
)
;
;

XIX TRANSPORT SYSTEMS ENGINEERING

TOLL BOOTH MANAGEMENT VIA SIMULATION E. Kopanezou, S. Lambropoulos and	
N. Manolopoulos, Department of Civil Engineering, National Technical University of Athens,	
Greece	275
THE CONTRIBUTION OF EXPERT OPINION TO THE DESIGN OF HIGH CAPACITY BUS	
PRIORITY SYSTEMS N. A. Tyler, Transport Studies Group, University College, London	285
A TIME SERIES MODEL FOR DAILY TRAFFIC VOLUME FORECASTING H. Kopanezou,	
Hellenic Ministry of Public Works, Athens, Greece, Th. Trivellas, Democritus University of	
Thrace, Greece	295

XX DATA ACQUISITION AND PROCESSING

A. NOVEL DYNAMIC DEFLECTION MEASUREMENT SYSTEM FOR LARGE	
STRUCTURES J. G. Leitch, Brown and Root Vickers Ltd, London, A. Thompson and T.	
D. Sloan, Civil Engineering Department, The Queen's University of Belfast, Belfast, Northern	
Ireland	301
CAT: COMPUTER AIDED TESTING SYSTEM Dr I. Shehata, Department of Civil	
Engineering, The Federal University of Rio de Janeiro, Brazil	307
DEVELOPMENT OF AN AUTOMATIC DATA COLLECTION SYSTEM FOR A MAJOR BOX	
GIRDER BRIDGE T. D. Sloan and A. Thompson, Civil Engineering Department, The	
Queen's University of Belfast, Belfast, Northern Ireland	313

XXI COMPUTERS AND EDUCATION

HYPOL – A COMPUTER AID FOR TEACHING HYDRAULIC DESIGN L. T. Isaacs,	
Department of Civil Engineering, University of Queensland, Australia	319
THE USE OF COMPUTER GRAPHICS FOR COMPUTER ASSISTED LEARNING IN CIVIL	
ENGINEERING I. N. A. Cheah, Department of Civil and Structural Engineering, South Bank	
Polytechnic, London	323