

EARTHQUAKE ENGINEERING IN AUSTRALIA

Conference - 2006



Proceedings of a conference held by the

**Australian Earthquake Engineering
Society**

Canberra, ACT

24 – 26 November 2006

This work was published by the Australian Earthquake Engineering Society. The views expressed in the papers are those of the authors and not necessarily those of the Society.

© Australian Earthquake Engineering Society

ISBN 0-646-46921-5

Technical Review Committee:

Trevor Allen
Bill Boyce
David Burbidge
Dan Clark
Clive Collins
Russell Cuthbertson
Ken Dale
Trevor Dhu
Mark Edwards
Gary Gibson
Peter Gregson
Mike Griffith
Hong Hao

Amy Heath
Gerhard Horoschun
Nelson Lam
Mark Leonard
David Love
Kevin McCue
Andrew McPherson
Mike Sandiford
Cvetan Sinadinovski
Paul Somerville
Mike Turnbull
George Walker
John Wilson

Editors: Kevin McCue
Sonja Lenz

Publisher: Australian Earthquake Engineering Society

Cover Illustration: Parliament House, Canberra
Designed by Lindy Gratton GA

MAJOR SPONSORS

We gratefully acknowledge the support of the following sponsors:



Australian Government

Geoscience Australia



FOREWORD

The Conference Organising Committee warmly welcomes you to the 2006 Australian Earthquake Engineering Society Conference in Canberra. The conference will follow the very successful format introduced in 2004, borrowed unashamedly from the NZSEE, of three half-day sessions starting Friday afternoon and flowing over the weekend to allow for both technical discussions and social interaction.

This year's conference repeats last year's broad theme aimed at industry participation with discussion of the new earthquake loading standard, a number of earthquake design case studies, an introduction to extreme blast loading, tsunamis and insurance related issues. The format involves the oral presentation of 21 papers with a further 23 papers presented in poster form with extensive dedicated time to discuss the posters in detail with authors.

We thank our sponsors Geoscience Australia who provided this year's venue and ES&S Melbourne who host the AEES website. Here is an introduction to our keynote speakers:

- *Tony Pearce* is the head of Emergency Management Australia with a background in the Australian intelligence and emergency management sectors. In 2005 he was a member of the Prime Minister's Science, Engineering and Innovation Council Tsunami Working Group following the Indian Ocean tsunami.
- *Gail Atkinson* is a well-known seismologist and professor at Carleton University Canada (our first invited speaker from this Commonwealth country) who will discuss the art and science of earthquake forecasting.
- *John Wilson* is Professor of Civil Engineering at Swinburne, Fellow of IEAust, President of the Australian Earthquake Engineering Society, Chairman of the Standards Committee BD/6/11 Earthquake Loading Standard and one of the drivers behind establishment of Urban Search and Rescue (USAR) in Australia.
- *Gary Gibson* founded the Seismology Research Centre in 1976. He is an Honorary Research Fellow at Monash University, Chairman of the Executive Committee of the International Seismological Centre, and a member of the IASPEI committee on Seismic Risk, Education and Outreach, and of the Asian Seismological Commission.

We thank all our speakers and presenters who have contributed considerable time and effort to share their research and observations with all of us.

The conference fulfils a fundamental mission of AEES to raise public awareness of earthquakes and progress the understanding of engineering seismology and earthquake engineering in Australia. We thank all involved in presenting and participating in this conference, with a special thanks to Barb Butler for frequent advice.

*Mark Leonard (Chair), Mark Edwards, Trevor Dhu, Trevor Allen and Kevin McCue
Organising Committee*

1992	Sydney	Earthquake Resistant Design and Insurance in Australia
1993	Melbourne	Earthquake Engineering and Disaster Reduction
1994	Canberra	Survival of Lifelines in Earthquakes
1995	Melbourne	PCEE'95
1996	Adelaide	The Australia Earthquake Loading Standard
1997	Brisbane	Earthquakes in Australian Cities - can we ignore the risks?
1998	Perth	Meckering 30 years on - how would we cope today?
1999	Sydney	The 10th Anniversary of the Newcastle Earthquake - Lessons learnt
2000	Hobart	Dams, Fault Scarps and Earthquakes
2001	Canberra	Loading Codes in the Real World
2002	Adelaide	Total Risk Management in the Privatised Era
2003	Melbourne	Earthquake Risk Management
2004	Mt. Gambier	Australian earthquake engineering in the new millennium - where to from here?
2005	Albury	Earthquake Engineering in Australia

KEYNOTE SPEAKERS

- **Tony Pearce, Director General, Emergency Management Australia
Canberra**

*The role of science, engineering and risk identification in
catastrophic disaster preparedness and response*

- **Gail M. Atkinson, Carleton University, Ottawa, Canada**

Forecasting earthquake ground motions

- **Prof. John Wilson, Swinburne University of Technology, Melbourne**

*Recent developments in the research and practice of earthquake engineering in
Australia*

- **Gary Gibson, Environmental Systems and Services, Melbourne**

Seismological contributions to earthquake risk mitigation



TABLE OF CONTENTS

Foreword

iv

Oral presentations

<i>Title</i>	<i>Authors</i>	<i>Page</i>
The role of science, engineering and risk identification in catastrophic disaster preparedness and response	Tony Pearce	1
Lessons from Cyclone Larry in co-ordinated earthquake post-disaster surveys	Mark Edwards & Neil Corby	3
Protecting life and reducing damage in earthquakes and terrorist attacks	Colin Gurley	9
Reconciling neotectonic and seismic recurrence rates in SW WA	Mark Leonard & Dan Clark	19
Site classification for earthquake hazard and risk assessment in Australia	Andrew McPherson & Lisa Hall	25
Forecasting earthquake ground motions	Gail Atkinson	31
Seismic fragility curves for un-reinforced masonry walls	Elisa Lumantarna, Jerry Vaculik, Mike Griffith, Nelson Lam & John Wilson	33
Seismological contributions to earthquake risk mitigation	Gary Gibson	41
An approach to response spectrum attenuation modelling for southeastern Australia	Graeme McVerry	55
Comparison of earthquake source spectra and attenuation in southeastern Australia and eastern North America	Trevor Allen & Gail Atkinson	63
A seismic source zone model based on neotectonic data	Dan Clark	69
Structural condition assessment from recorded earthquake response data	Wirtu Bayissa, Nicholas Haritos & Sven Thelandersson	77
Bounds on the distribution of amplitudes in ground motion prediction models	Jeff Fisher, Paul Somerville, John Zhao & Jian Zhang	85
Seismic fragility curves for soft-storey buildings	Kittipoom Rodsin, Nelson Lam, John Wilson & Helen Goldsworthy	91
Recent developments in the research and practice of earthquake engineering in Australia	John Wilson & Nelson Lam	101
Preliminary test of the EEPAS long term earthquake forecast model in Australia	Paul Somerville, Jeff Fisher, David Rhoades & Mark Leonard	117
Ground displacement at the North Shore Pier of the Narrows Bridge during the Meckering earthquake	Geoffery Cocks & Michael Hillman	123
Validation of using Gumbel probability plotting to estimate Gutenberg-Richter seismicity parameters	Mike Turnbull & Dion Weatherley	127
Automatic calculation of seismicity rates in eastern Queensland	Russell Cuthbertson	137
Coulomb stress changes due to Queensland earthquakes and the implications for seismic risk assessment	Dion Weatherley	145
Historical earthquakes: a case study for the Adelaide 1954 earthquake	Cvetan Sinadinovski, Stewart Greenhalgh & David Love	151

Note: Papers were, in accordance with DEST requirements, subjected to an independent critical review process by two experts from the field in which the material was written.

All care was taken reformatting submitted manuscripts. The editors apologise for errors in transcription.

Poster presentations

<i>Title</i>	<i>Authors</i>	<i>Page</i>
Attenuation structure beneath Australia	Agus Abdulah	159
Seismic fragility curves for damage to building contents	Haider Al Abadi, Nelson Lam & Emad Gad	161
Use of microtremors for site hazard studies in the 2D Tamar Rift Valley, Launceston, Tasmania	Maxime Claprood & Michael Asten	169
Shear wave velocity measurement at Australian ground motion seismometer sites by the spectral analysis of surface waves (SASW) method	Clive Collins, Robert Kayen, Brad Carkin, Trevor Allen, Phil Cummins & Andrew McPherson	173
Structural vulnerability estimation under tsunami loads	Ken Dale & Shaun Flay	179
A new network of low-cost recorders in WA	Vic Dent, Dan Heal & Paul Harris	185
Paleoseismic investigation of a recently identified Quaternary fault in Western Australia: the Dumbleyung Fault	Beatriz Estrada, Dan Clark, Karl-Heinz Wyrwoll & Mike Dentith	189
The correlation between physiography and neotectonism in southeast Queensland	Jane Hodgkinson, Stephen McLoughlin & Malcolm Cox	195
Seismic hazard assessment through predictive modelling of local stress changes due to hot fractured rock (HFR) geothermal energy operations in the Cooper Basin of South Australia	Suzanne Hunt, C Morelli, P J Boulton, M Malavazzos, T Hill & Cvetan Sinadinovski	203
Volcano-tectonic earthquakes and magma reservoirs; their influence on volcanic eruptions in Rabaul caldera	Ima Itakarai, Brian Kennett & Cvetan Sinadinovski	205
Simulation of strong ground motions with a combined Green's function and stochastic approach	Zhong Yuan Liang, Hong Hao, Brian Gaull & Cvetan Sinadinovski	213
New Adelaide earthquake monitoring network	David Love	221
Earthquake patterns in the Flinders Ranges - temporary network 2003-2006, preliminary results	David Love, Phil Cummins & Natalie Balfour	225
Remote triggering of earthquakes in intraplate Australia	Kevin McCue	231
An ongoing role for intensity data in Australia	Kevin McCue	235
An improved understanding of earthquake ground-shaking in Australia	Andrew McPherson & Trevor Allen	239
Developing a seismotectonic model using neotectonic setting and historical seismicity application to central New South Wales	Dee Ninis & Gary Gibson	245
Investigation of near source effects in array-based (SPAC) microtremor surveys	James Roberts & Michael Asten	251
Floor vibrations due to human excitation - damping perspective	Ibrahim Saidi, Nick Haritos, Emad Gad & John Wilson	257
Concrete damage assessment for blast load using pressure-impulse diagrams	Zubair Syed, Priyan Mendis & Nelson Lam	265
Estimation of Gutenberg-Richter seismicity parameters for the Bundaberg region using piecewise extended Gumbel analysis	Mike Turnbull	275
Simple model accounting for the soil resonance phenomenon	Srikanth Venkatesan, Nelson Lam & John Wilson	281
Simplified component model for curved T-stub connection to concrete-filled steel tube with blind bolts and extensions	Huang Yao, Helen Goldsworthy & Emad Gad	289
About the authors		297
Author index		303

