



AEES Newsletter

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Proceedings of the Pacific Conference on Earthquake Engineering held in Melbourne in November 1995 are available from Barbara Butler, Melbourne Uni, phone 61 3 9344 6712, fax 61 3 9348 1524.

PCEE '95 - Report by John Wilson

The Pacific Conference on Earthquake Engineering jointly organised by the AEES and NZNSEE and held at The University of Melbourne, November 20-22 1995 provided an excellent forum for the presentation of over 100 papers to over 220 delegates. Thirty percent of delegates were from Australia, 25% New Zealand, 20% Asia and Pacific Islands, 15% North America and 10% from Europe.

The five keynote speakers and their topics were as follows:

- Professor Bruce Bolt
Intraplate Seismicity and Zonation
- Professor Nigel Priestley
Reinforced Concrete Structures
- Professor Adrian Page
Unreinforced Masonry Structures
- Professor Michael Pender
Geotechnical Engineering
- Professor Helmut Krawinkler
Steel Structures

Professor Adrian Page's paper provided an excellent Australian overview of unreinforced masonry structures and their performance under earthquake excitation. Professor Nigel Priestley presented a state of the art paper on the aseismic design of structures using a displacement based approach, whilst Professor Helmut Krawinkler presented the latest research findings on the behaviour of steel moment resisting frames and lessons learnt from the Northridge earthquake.

The 1000 page, 3 volume set of proceedings is available from AEES for a modest fee of \$150 plus postage. The proceedings contain all the keynote addresses together with over 100 state of the art papers and 13 poster presentation papers.

The conference dinner was a memorable evening held in the magnificent Great Hall of the National Gallery with fine food and wine. Entertainment included a superb didgeridoo solo performance followed by an after dinner speech given by "Darcy" Dugan - the 'Rumpole' of Melbourne. Most found his anecdotes very entertaining although some questioned his role as the ex Chief Magistrate of Melbourne!

A special thanks to all those participants who attended and those who assisted in helping arrange PCEE '95. We make special mention of our sponsors and of Barbara Butler (AEES) and Michael Brice (NZNSEE) for the tremendous secretarial support provided from both sides of the Tasman.

The conference provided a great forum for the presentation and discussion of the latest developments in earthquake engineering. It was a great opportunity to meet and socialise with colleagues from around the world. In addition, the final surplus of \$26,000 from PCEE '95 was equally split between the AEES and NZNSEE providing a pretty useful boost to the societies' respective bank balances.

Sponsors:

- Australian Geological Survey Organisation
- Clay Brick and Paver Institute
- New Zealand Earthquake Commission
- BRANZ/BTL
- BHP
- Swiss Re Australia
- Australian Institute of Steel Construction

AEES Organising Committee:

- John Wilson (Chairman)
- Barbara Butler (Secretariat - Australia)
- David Bishop (Sponsorship)
- Professor Graham Hutchinson
- Dr Mike Griffiths

NZNSEE Organising Committee:

- Associate Professor Peter Moss (Ed)
- Les Megget (Assistant Editor)
- Michael Brice (Secretariat - NZ)
- Dr John Wood

This is a brief review of the ABS publication solely from the Earthquake Engineering point of view. The introduction says it is intended to be a statistical source book for the general public interested in the environment, and has been designed to complement the 1996 State of the Environment Report for Australia.

It uses the Population Environment Process framework to represent 'how the economy and the population interact with the stock of natural assets and natural processes.'

There are four parts to the document and our interest is focussed on Part 2 chapter 4 - Impacts of Natural Events. This chapter has only one section 4.1 which focuses on the impact of natural events such as drought, bushfires, floods, cyclones, severe storms and earthquakes.

Table 4.1.1 provides a summary of the risk of natural hazards occurring in Australia. Earthquakes are listed under Geological hazards as compared to Meteorological or Biological hazards. They are further listed as - 'once-per-decade' as opposed to landslides - occasional, tsunamis - rare and volcanoes - never (perhaps we should say hardly ever in view of Mt Schank in SA).

The Australian Hazard areas are given in a small but clear colour reproduction of the familiar poster Australia's Natural Hazard Zones produced by the Natural Disasters Organisation now known as Emergency Management Australia. Earthquakes are listed under Geological Hazards on p117 and the text is so short (approx 250 words) that it is reproduced in full as follows:-

Earthquakes in Australia are infrequent. This is because Australia is located away from the margins of the plates of the Earth's crust, where 95% of earthquakes occur. As can be seen from Figure 4.1.13 (sadly this figure has been omitted - Ed) the western and central parts of Australia are the most active earthquake zones. Many of the stronger earthquakes that have occurred in Australia have been in unpopulated regions where little damage has resulted. In contrast, earthquakes in built up areas such as Meckering and Newcastle have caused significant damage and disruption. Table 4.1.13 also shows the costs of major earthquakes since 1967. As with floods, there was significant damage that was not covered by insurance. The Newcastle earthquake in 1989 revealed that, although Australia is a low risk country for earthquakes, a lethal earthquake can occur, and that there is a strong correlation between geological conditions and potential for damage. This can be expected to result in improved building codes and practices and more intensive monitoring of seismic activity. More detailed understanding of

geological conditions beneath population centres would provide more accurate indication of the seismic risks. There is also the need to include long term consequences in emergency management planning.

Now as everyone knows I do regard Australia as a 'low risk country for earthquakes' by World standards but I suggest that the brevity of this item is underdoing it a bit, even for Australia. There is no reference to Earthquake Engineering or Seismology and none to the recording of strong ground motion from Australian earthquakes.

The only other mention of earthquakes is in Chapter 2 Environmental Pressures on Individuals - Natural Events. Table 2.2.1 lists major natural disasters since 1900, Australia and the World. For Australia only Newcastle is listed as an earthquake event with 13 lives lost. For the rest of the World, 10 earthquakes are listed with Tang Shan China being the worst with 655 000 lives lost. To keep it in perspective floods in Northern China in July 1959 are said to have cost 2 000 000 lives lost.

Table 2.2.2 lists impacts on individuals of selected natural disasters in Australia. The selection criterion is from 1967 only and is limited to those causing at least 3 deaths and 20 injuries. Both Meckering 1968 and Newcastle 1989 earthquakes are listed.

The cost of earthquakes in Australia is listed in table 4.1.13 and in this table Cadoux 1979 and Cessnock 1994 earthquakes are added. This table gives the magnitude as a single figure (rounded up) which thus increases Newcastle from magnitude 5.6 (which is given correctly on p 117) to magnitude 6 which is significantly greater and therefore incorrect. This should be corrected in the next edition. Some would also query the total damage cost of \$4080M given for the Newcastle event.

Earthquakes are listed as the only geological hazard in this chapter 4. There is no mention of landslides, which do cause significant problems and are likely to cause more, no mention of potential damage from building on expansive or reactive soils which can have considerable economic costs. These items should also be included in the next edition. I am not sure whose business it is but there is no reference to impact craters either.

The ABS welcomes feedback from users. Comments should be sent to: The Director, Environment and Energy Statistics Section, ABS, PO Box 10 Belconnen ACT 2616.

Please let us all contribute feedback to make the next edition better reflect the true (correct) balance of earthquakes as a natural hazard in Australia.

Charles

Reservoir Induced Seismicity - Lesotho Africa

Extracts from: Lesotho Highlands Development Authority press release
www page: <http://stargate.gov.za/dwaf/dwaf/projects/lhwp/pres1902.html>

In February 1996, the LHDA requested a technical assessment of seismic activity at Mapeleng near the Katse reservoir.

Mr Gary Gibson Director of the Seismology Research Centre of the Royal Melbourne Institute of Technology, Australia and Dr. Alfred Hendron Jr. Professor Emeritus of Civil Engineering at the University of Illinois, USA, were invited to conduct this technical assessment and advise the LHDA on what action to take in light of the seismic activity. The two independent experts were requested to comment on sensational scenarios of catastrophe implied in recent newspaper articles where the cracks manifested at Mapeleng were purported to indicate that the situation could be similar to the cracks preceding the Vaiont Dam disaster in Italy of October 1963 where a rockslide into the reservoir generated a wave which killed 2000 people.

They undertook a field inspection of the 1.5 kilometre long cracking pattern and the structures in the Mapeleng village.

They also reviewed the project documents related to the design earthquakes and reservoir induced earthquakes considered prior to design as well as recent background microseismic measurements before impounding and after impounding at Katse.

They reaffirmed that before the final design of Katse Dam, Lesotho Highlands Consultants (LHC) wrote a Seismic Risk Assessment for Katse Dam and Reservoir in November of 1988. In this report LHC gave the basis for the selection of the maximum credible earthquake for design of the dam. It was a magnitude 6.5 earthquake at an epicentral distance of 20 km which would produce maximum horizontal bedrock acceleration at the dam foundation of 0.3g. It is considered that this report was well done, adequately researched, and that the maximum credible earthquake motion selected was and still is appropriately conservative for the design of Katse Dam even after accounting for recent events.

The 1988 LHC report also indicated that reservoir induced earthquakes could possibly occur, taking into account the height of Katse Dam and the volume of the reservoir as compared with other reservoirs. It was specifically stated that magnitudes of events observed could be about the same as those of nearby Hendrik Verwoerd (now called Gariep) Reservoir where magnitudes of reservoir induced events ranged to ML 2.0. The Gariep Reservoir has about 2 times the volume of the maximum Katse Reservoir.

LHC had recommended that a seismograph network be installed around the reservoir to monitor background microseismic activity for background information prior to impounding and during impounding of the reservoir. LHDA acted on this recommendation and contracted this task to the Council for Geoscience, Geological Survey, Republic of South Africa. The seismograph network has recorded a low level of earthquake activity over the past four years before reservoir filling, including an event of magnitude 3.8, 50 km south-east of Maseru, on the 31 of July 1993.

Since Katse Reservoir filling commenced in October, a series of microearthquakes has occurred near Mapeleng village adjacent to the east side of the reservoir about 5km upstream of the dam. The largest of these earthquakes occurred on the 3rd of January 1996 and was of Richter magnitude 2.5. Events of this magnitude are very common and they can only be felt by people within a few kilometres. None of the recent events have been felt at Katse Dam or at other villages. However, they have been heard and felt strongly at Mapeleng village and structural damage to homes has been observed. In addition to the microseismic activity, a series of tension cracks has opened for a distance of about 1km along a pre-existing fracture or shear zone which passes through the village. Four springs have dried up and one recharged to about one-half its original flow in January, 1996. LHDA has provided a new water supply to the village.

Both Dr Hendron and Mr Gibson conclude that the damage to rockery walls of the houses at Mapeleng village are both a direct effect of a bedrock crack crossing a house and the accumulated effects of repeated ground vibrations from multiple tremors. The most likely safety hazard for villagers is related to inward collapse or partial collapse for those houses with the most poorly built walls. They have recommended that LHDA provide appropriate temporary housing or reinforce existing structures as required because the most likely hazard is local collapse of rockery walls due to shaking. This is not because the shaking is so intense but because some of the rock walls are marginally stable.

They have concluded that the cracking pattern is definitely associated with movements in a pre-existing fracture zone which has been re-activated by the reservoir impoundment. A study of the chronology of microearthquakes and rises in reservoir levels indicates that the events were reservoir induced.

There is no evidence associated with either the observed cracks or the geology which would indicate that the whole village or any large rock mass near the reservoir is in imminent danger of sliding into the reservoir as happened at Vaiont, Italy, in October of 1963. Dr. Hendron studied the Vaiont slide for 10 years for the U.S. Army corps of Engineers and British Columbia Hydro. It is his opinion after inspecting the cracks and geology at Mapeleng that there is no similarity between the present situation at Mapeleng and the situation at Vaiont before failure.

They have also indicated that the recent events give no cause to change the design earthquake for Katse Dam. The closest earthquakes on record in the area are the Kofüfontein (1912) and the Zastron (1957) earthquakes of magnitude 6.0 and 5.5 respectively. The maximum credible earthquake of 6.5 chosen within 20km of Katse is deemed adequately conservative for the design of Katse Dam as concluded in the comprehensive LHC Report of 1988. They have also indicated that the recent events give no cause to restrict filling the reservoir as long as the local problems at Mapeleng are remedied.

Thus far the magnitudes of reservoir induced earthquakes due to the Katse impoundment are not unusual as compared to similar events recorded at almost 200 reservoirs around the world. These events are small and shallow and that is why they have only been felt at Mapeleng. The most unusual aspect of the behaviour at Katse reservoir is the development of the cracks at Mapeleng. No other cases are known where surface ruptures have been caused by such small reservoir induced earthquakes. The village of Mapeleng thus needs special aid because it, by chance, just happens to be located where the small shallow earthquakes are occurring.

It is probable that the reservoir induced microearthquake activity will continue as the reservoir fills and may continue for sometime thereafter. The activity may also not remain restricted to Mapeleng.

A shallow magnitude 4.0 to 4.5 earthquake cannot be ruled out as filling progresses. There is no evidence from the activity that has occurred to date which would suggest that a deep seated earthquake is imminent. The microearthquakes and cracking are both near surface phenomena.

When compared with the active areas around the world, Lesotho has a low rate of earthquake activity. The rate has been low over the past hundred years, and there is no reason to suggest that this will change in the foreseeable future.

The Consultants:

- Mr Gary Gibson has experience in the measurement and interpretation of natural tectonic earthquakes and reservoir induced earthquakes for more than 60 reservoirs in Australia and for man-made reservoirs in Nepal, Thailand, Laos, Papua New Guinea, Indonesia, Fiji and China.

- Dr. Hendron has been a Consultant for the US Bureau of Reclamation on the evaluation of both embankment and concrete dams for earthquake motions. The most notable case being a revaluation of Hoover Dam for update earthquake motions. He has also served as an independent international consultant on dams and reservoirs in seismic areas such as Chile, Colombia, Venezuela, Papua New Guinea, Jordan, Israel, Alaska, New Zealand, Morocco and Egypt which included being a panel member for re-evaluation of the High Aswan Dam for earthquakes. Dr. Hendron is also chairman of the Panel of Engineering Experts for the Lesotho Highlands Water

Project, which is required and supported by the World Bank.

AEES members at the WCEE

At least two AEES members are attending the World Conference on Earthquake Engineering, Kevin McCue as Australian National Delegate to the IAEE for the second and last time, and Gary Gibson (Hon Sec) who has been invited to present one of the few oral papers. The format has changed with the emphasis on poster presentations (90%), with a few keynote and invited oral presentations (10%).

The NZNSEE will be bidding to host the next WCEE in Auckland New Zealand in the year 2000 and AEES delegates will give them our full support.

Number of earthquakes per year, magnitude 7.0 or greater 1900 - 1995

People often ask whether earthquakes have increased in frequency this century - make up your own minds with the aid of this table (one measure) reproduced from the NZNSEE Bulletin Vol 29 No 1, March 1996, p 63 (with permission)

1900	13	1935	24	1970	29
1901	14	1936	21	1971	23
1902	8	1937	22	1972	20
1903	10	1938	26	1973	16
1904	16	1939	21	1974	21
1905	26	1940	23	1975	21
1906	32	1941	24	1976	25
1907	27	1942	27	1977	16
1908	18	1943	41	1978	18
1909	32	1944	31	1979	15
1910	36	1945	27	1980	18
1911	24	1946	35	1981	14
1912	22	1947	26	1982	10
1913	23	1948	28	1983	15
1914	22	1949	36	1984	8
1915	18	1950	39	1985	15
1916	25	1951	21	1986	6
1917	21	1952	17	1987	11
1918	21	1953	22	1988	8
1919	14	1954	17	1989	7
1920	8	1955	19	1990	12
1921	11	1956	15	1991	11
1922	14	1957	34	1992	19
1923	23	1958	10	1993	16
1924	18	1959	15	1994	15
1925	17	1960	22	1995	17
1926	19	1961	18		
1927	20	1962	15		
1928	22	1963	20		
1929	19	1964	15		
1930	13	1965	22		
1931	26	1966	19		
1932	13	1967	16		
1933	14	1968	30		
1934	22	1969	27		

Total 1900 - 1994 = 1895 events; 20 per year on average. Note how infrequently the average happens and that the activity has been below average since 1976. The highest and lowest numbers appear bold.

Building vibration in Adelaide from the 1988 Tennant Creek earthquakes by David Love, Mines & Energy Dept South Australia

On the 22nd January 1988 three large earthquakes of magnitudes Ms 6.3, 6.4 and 6.7 occurred near Tennant Creek. The resulting fault scarp, damage to the gas pipeline, and aftershock activity are well documented, but it is perhaps less well known that these earthquakes were felt in multistorey buildings in Darwin, Cairns, and even Adelaide, which is 1800 km away.

Within minutes of the first event occurring, I began to receive calls from concerned people in Adelaide. This to me, as a fledgling seismologist was incredible and warranted further investigation while the trail was hot. A questionnaire was quickly produced and circulated through tall buildings, mainly in the city, but also some in the suburbs. Circulation was generally from the 8th floor upwards. There were approximately 300 returned forms plus a number of letters and phone calls. Unfortunately these replies were very unevenly spread and many floors unoccupied, making it difficult to draw clear conclusions. An unsupportive comment from an engineer, "won't be of much value" eventually saw the results go to the archives. Our earnest editor, ever on the lookout for more news brought it to the light of day again.

There were 47 buildings from which replies were received and 28 of these do not appear to have felt the events. Of the 19 where someone did feel the earthquake there were about 5 where it appeared that most people above the 7th floor had felt the movement. There were only a few buildings over 17 storeys, however of these it appears that some felt vibration in the middle storeys but not at the top.

This suggests a predominance of 1 second waves, either from the spectrum being emitted by the earthquake and attenuated, or to 1 second resonance in the surface geology under the city. Low level storeys were not polled to see if this phenomenon occurred also in lower buildings.

As far as I am aware, no buildings in Adelaide have any reasonable instrumentation for weak or strong motion monitoring. There are two basements containing old accelerometers recording to film, but these have not triggered since installation nearly 20 years ago. Given that minor to moderate damage has occurred in Adelaide 3 times in the last 150 years, it is hoped that this shortcoming will soon be rectified. Accelerographs installed on open ground in Adelaide in the last few years have already triggered during a couple of local events of magnitude ML 3.5 - 4.5.

Quakes Bulletin Board by Russell Cuthbertson

The Queensland University Advanced Centre for Earthquake Studies (QUAKES) has set up an earthquake bulletin board designed primarily to improve communication and the exchange of ideas amongst seismologists working in the Australian-Oceania region. The board will also be of interest to researchers in the solid-earth geophysics and engineering fields who may have questions or comments relating to seismology.

Current subject headings are :- Equipment, Software, Earthquake data and General, but these may change in the future should the need arise. While currently in its infancy it is hoped that with some new inputs this board will become a much used means of information exchange.

Access, using Netscape version 1 or higher, is via "<http://shake2.earthsciences.uq.edu.au/~quakes/board/>". If you experience any problems with, or have any comments or suggestions relating to, the operation of this bulletin board contact Russell Cuthbertson (russell@earthsciences.uq.edu.au).

Tsunami Workshop, AGU - Western Pacific Meeting, Brisbane, Australia by Col Lynam

A workshop dealing with tsunami hazard in the southeast Asian and western Pacific region has been organised for the Western Pacific AGU conference in July. The workshop is a cross disciplinary event for coastal engineers and tsunami researchers. It will also be of interest to counter disaster agencies and ocean tidal monitoring agencies.

Date:- Wednesday 24th July, 1996 - (1:30 -5:10 pm)
Venue:- Room M7/8 at Southbank Convention centre

The agenda will address four areas of interest:

1. International visiting tsunami researchers - "recent tsunami destruction, risk and awareness"
2. Australian governmental agencies and University research bodies - "Evidence of tsunamis on the Australian coastline"
3. Design problems for coastal engineering
4. Panel discussion on data collection and risk analysis

There will be a separate publication of abstracts and papers, collated by IEAust. Any persons wishing to attend the workshop must have AGU conference or a 1 day, Institution of Engineers, Australia (IEAust) workshop registration.

Contact Mr Col Lynam, QUAKES, Dept of Earth Sciences, University of Queensland, Queensland 4072 for more details Phone: 07 3365 3197 email: lynam@earthsciences.uq.edu.au.

Next AEES AGM

Where: University of Adelaide, South Australia
When: Thursday & Friday, 3 & 4 October 1996

The organising committee comprises Dr M Griffith, J Woodside, L Noicos, P McBean and D Love. A call for papers and expressions of interest has been circulated. Sponsors are being sought to cover costs of keynote and after-dinner speakers. For further details contact Barbara Butler.

The Society - AEES

AEES Executive:

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Mike Griffith (SA) and
Kevin McCue (ACT) & Newsletter Editor

Secretariat:

Barbara Butler, P.O. Box 829, Parkville, 3052

The AEES subscription year is from 1 November to 31 October. Thank you to all who responded to our recent subscription status survey. To date we have had about a 50% response rate, so those who have not yet completed their survey, please return to Barbara Butler. If you are presently unfinancial, please send a cheque for \$25.00 made out to "Australian Earthquake Engineering Society" and address to John Wilson or Barbara Butler at the above secretariat address. Unfortunately a few members requested to be deleted from the mailing list but did not include their name on the survey form - please notify us so that we can amend our membership list. Also, if you change your address, please advise the secretariat so that the mailing list can be kept up to date.

Conference Proceedings AEES

The main function of our Society is the Annual Seminar. You can keep informed about the latest developments in Earthquake Engineering and Engineering Seismology in Australia by purchasing the Proceedings.

1994 Proceedings \$30.00, 1992 and 1993 Proceedings \$25 and \$35, or \$45 for both. Postage within Australia is an additional \$5.

Conference Proceedings PCEE '95

1995 Melbourne Proceedings \$150 + P&P from Mrs Barbara Butler phone 03 9344 6712.

1987 and 1991 Proceedings NZ\$50 plus P&P from Admin Secretary, NZNSEE, PO Box 312 Waikanae, New Zealand

Forthcoming Conferences

(Flyers for some conferences are available from Ed)

- 23 - 28 June 1996 Acapulco Mexico
11th World Conference on Earthquake Engineering.
Contact: 11WCEE Fax: 52 5 616 1514
- 23 - 27 July 1996 Brisbane Australia
Western Pacific Geophysics Meeting
AGU/SEDI Contact: Fax: 61 7 374 2059
- 6 - 8 November 1996 Manila Philippines
4th International Conference on Civil Engineering
Fax: 63 2 522 3524

New Books

Earthquake Engineering Proceeding of the 10th European Conference, Vienna Austria 28 Aug - 2 September 1994, Balkema, Ed G Duma, price \$593.00

Tsunami - Progress in Prediction, Disaster Prevention and Warning in Advances in Natural and Technological Hazards Eds Yoshito Tsuchiya & Nobuo Shuto. Kluwer Academic price \$240

Isoseismal Atlas of Australian Earthquakes - Part 3 AGSO Record 1995/44, AGSO Sales Centre phone: 06 249 9519, fax: 06 249 9982

Australian Seismological Report - 1994 AGSO Sales Centre ph: 06 249 99519, fax: 06 249 9982

Isoseismal map of the Melbourne earthquake 9 July 1904 (from Atlas Part 3)

