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AEES is a Technical Society of Engineers Australia and is affiliated with IAEE

2/2006

AEES Newsletter

Contents

President's Column

Welcome and greetings to all our members to the mid-year edition of the newsletter.

The recent earthquake in Indonesia is another stark reminder of the damage that moderate events can cause if the building and infrastructure stock is not designed with some degree of robustness. The scenes of damage and destruction were disturbing, particularly since most building collapses would have been very preventable with some limited design input. The transfer of some basic earthquake engineering knowledge developed over the past 30 years to these communities is a real challenge for the developed nations. It is also a timely reminder that a magnitude 6.3 earthquake near an Australian city would also create significant damage, particularly to our unreinforced masonry buildings and irregular soft storey reinforced concrete buildings.

Mark Leonard and the team from Geoscience Australia are working hard to develop a stimulating annual conference this year in Canberra. We encourage members to spread the word, submit an abstract and join us in Canberra over the extended weekend of November 24-26. The annual conference is our flagship event and provides a great opportunity for sharing and discussing the latest developments in seismology, earthquake engineering and related fields such as blast engineering, USAR (Urban Search and Rescue), insurance, and emergency response management.

There is an ongoing need for AEES to raise community awareness in earthquake education in this country and to develop a response plan for emergency support and reconnaissance missions which could include the development of a register of professionals willing to be trained in undertaking reconnaissance missions and in assisting USAR taskforce teams. We arranged with the Melbourne Fire Brigade a one day course for Level One USAR training of engineers on 5 June 2006, with some 35 engineers registered. Mike Griffith and John Wilson led the training on behalf of AEES in conjunction with emergency services members. An AEES register of trained engineers will follow. We are very appreciative of the great support from our NZ colleagues, Des Bull and Dave Brunsdon in the development of the Level One course.

The updated Earthquake Loading Standard AS1170.4 is complete and was approved by the Loading Standards Committee BD6 in March 2006. We await publication which is in the control of Standards Australia and listing in the Building Code of Australia, which is controlled by the ABCB. Many thanks for the hard work and great stamina of Committee BD/6/11, all of whom are members of AEES, in developing the revised AS1170.4 and also in preparing the Commentary, which is an on-going exercise. I have recently made a presentation on the new standard on behalf of AEES to meetings of engineers in Sydney and Melbourne.

The Melbourne Executive Committee (John Wilson, Nelson Lam, Dee Ninis, Gary Gibson, Adam Pascale and Amy Brown and our new secretariat Kevin McCue) look forward to working with you to further develop AEES.

John Wilson

AEES President

AEES Executive

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Newsletter Editor	Kevin McCue

Both the membership database and subscriptions are managed by Engineers Australia and ALL members, whether they be members of Engineers Australia or not, will be issued with subscription notices by that organisation. Please direct any enquiries regarding subscriptions to Lois Wurzer at EA lwurzer@engineersaustralia.org.au

The mailing address for other matters has changed! To contact Kevin McCue at the Secretariat see the address top left front page.

AEES Annual Conferences

	Year	Place	Theme
1	1992	Sydney NSW	Earthquake Resistant Design and Insurance in Australia
2	1993	Melbourne Vic	Earthquake Engineering and Disaster Reduction
3	1994	Canberra ACT	Survival of Lifelines in Earthquakes
4*	1995	Melbourne Vic	PCEE'95
5	1996	Adelaide SA	The Australian Earthquake Loading Standard
6	1997	Brisbane Qld	Earthquakes in Australian Cities - can we ignore the risks?
7	1998	Perth WA	Meckering 30 years on – how would we cope today?
8	1999	Sydney NSW	The 10th Anniversary of the Newcastle Earthquake - Lessons learnt
9	2000	Hobart Tas	Dams, Fault Scarps and Earthquakes
10	2001	Canberra ACT	Loading Codes in the Real World
11	2002	Adelaide SA	Total Risk Management in the Privatised Era
12	2003	Melbourne Vic	Earthquake Risk Management
13	2004	Mt Gambier SA	Australian Earthquake Engineering in the new millenium – where to from here?
14	2005	Albury NSW	Earthquake Engineering in Australia
15	2006	Canberra ACT	tba

- ***held jointly with NZSEE***

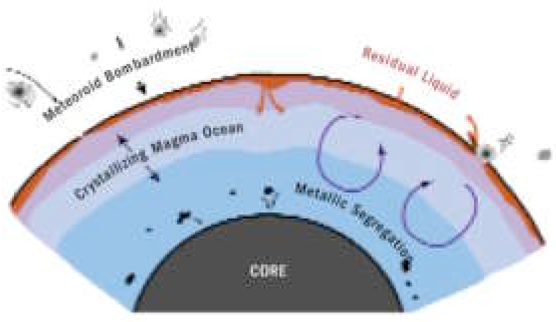
Copies of some of the Proceedings are still available, contact Dr Nelson Lam n.lam@civenv.unimelb.edu.au

Col Lynam's Column

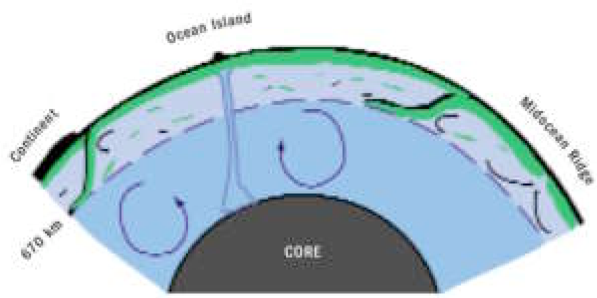
(Extracted from the daily blog of a "seismetrician")
(Col Lynam Earthquake Services with 35 years in Brisbane observatory seismology lynam@uq.edu.au*)*

Models of the Earth – a dim seismological view
(from Science Magazine, 22 July 2005)

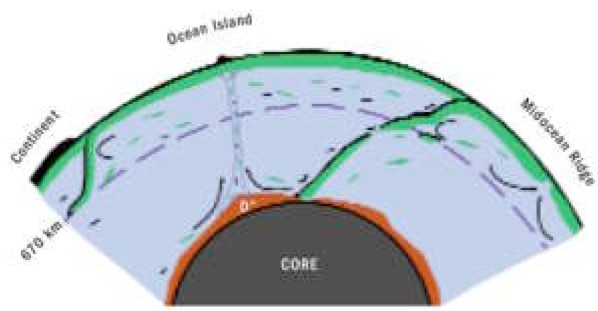
The Boyet and Carlson result requires the Earth to have differentiated early, within 30 million years, leaving most of Earth's mantle (light blue) depleted in elements that prefer melts over crystallizing solids.



EARTH BEFORE 30 MILLION YEARS



EARTH TODAY
CONVENTIONAL MODEL:
TWO-LAYER CONVECTION



EARTH TODAY
NEW MODEL

The chemical complement to the depleted mantle could be small and quite enriched in radioactive elements, such as uranium and thorium; this complementary material may coincide with the seismically observed D" layer, located between the core and the mantle some 2700 km deep. (Images courtesy Maud Boyet).

Beaconsfield: rockburst or earthquake?

The ES&S website reports on the recent mine tragedy in Tasmania (www.esands.com):

2006 April 25, Beaconsfield, Tas, ML 2.2

1126 UTC, 146.86°E, 41.16°S, shallow depth [MEL] (Tuesday, April 25, 09:26 pm AEST)
A small earthquake occurred in northern Tasmania, about 10km southeast of Georgetown, or about 40km east of Devonport. There was a rockfall at the nearby Beaconsfield mine at the same time, killing one miner and trapping two others.

The following points have been extracted from a critical report on mine safety written by Matthew Denholm on 4 May 2006 in *The Australian*.

• *There may not have been sufficient natural rock pillars in mine tunnels to prevent their collapse after a small earthquake. A modified mining regime known as chequerboarding is designed to reduce stresses on rock strata.*

• *Any link between blasting and other mining activity and a spate of recent small earthquakes are unknown.*

• *Following a quake of 1.6 on the Richter scale on October 26 last year, the mine changed its mining regime, adopting the chequerboard method. The method - designed to reduce the impact of earth movements on the mine's structure - was approved by the Tasmanian Inspector of Mines.*

• *Concrete rock fill (CRF) is pumped into stopes after they had been mined to support the sloping wall and roof of stopes.*

A study of rockburst prediction and management by Nigel B Periera and available on the web reports:

In 1997 the number of fatalities per 1000 employees in Western Australia due to rock falls was 75% higher than that experienced in the South African gold mines. A growing percentage of these fatalities are the result of rockbursts. It is statistics such as these that emphasises the requirement for the Australian mining industry to implement guidelines for the management of rockburst prone conditions.

The format for a rockburst risk assessment has been determined by the Department of Mineral Resources in NSW. It is hoped that a risk assessment approach will be used to produce a set of guidelines for the management of rockburst prone ground conditions.

Calling such events earthquakes may be misleading even though Richter (1958) uses the term in reference to rockbursts which he defines (p156) as follows:

Rockbursts in mines are due to a failure of the rock under stresses resulting from removal of material… where the rock is very competent, or structurally resistant, the stresses may accumulate to high values before failure. The occurrence is then sudden, comparable to an explosion, and may be disastrous in the mine.

This Tasmanian rockburst on 25 April was small even by Australian standards. In WA rockbursts up to magnitude 4.5 equivalent have been recorded. The magnitude ML 5.2 Ellalong NSW event on 9 August 1994 is probably the largest known mine related seismic event in Australia (Ed.).

Engineering a safer, more beautiful world, one failure at a time

Extracts from an article by Cornelia Dean via Charles Bubb

DURHAM, N.C. — For an engineer, Henry Petroski seems strangely enthusiastic about failure.

Not his own, of course. Fear of failure is what sent him, with a bachelor's degree in mechanical engineering, to graduate school and then to a career of teaching and writing, not designing and building.

From his vantage point, failures in design and construction present perfect teaching opportunities. They are object lessons in the history and practice and beauty of engineering. "Failure is central to engineering," he said in an interview. "Every single calculation that an engineer makes is a failure calculation. Successful engineering is all about understanding how things break or fail."

So whether the subject is the building specs in "The Three Little Pigs," the development of the flip-top beverage can or the storage of nuclear waste (a current focus of his), Dr. Petroski thinks and writes in terms of failure.

Dr. Petroski, who is 64, has preached his gospel of failure in books, lectures and articles for publications as diverse as Forbes and American Scientist, where he has a regular column. In the process, he has amassed numerous honors and awards, including membership in the National Academy of Engineering. He has also achieved the status that a reviewer in the journal Science predicted for him after the publication in 1985 of his first book, a catalog of calamity called "To Engineer Is Human."

That first book has on its cover a photo of a famous failure, the collapse of the Tacoma Narrows Bridge, a graceful span across Puget Sound. Its roadway was so narrow and light that it swayed and twisted even in 40-mile an hour winds. It collapsed in 1940, a few months after it opened, in a disaster famously captured on film.

According to Dr. Petroski, the lesson of that bridge is not that it failed, but that it was deemed invulnerable to failure, a judgment that is always a mistake.

Or take Frank Gehry's design for the Walt Disney Concert Hall building in Los Angeles, which Dr. Petroski describes in his latest book, "Success Through Failure," published this year by Princeton

University Press. According to Dr. Petroski, the high gloss of one side of the building reflected so much light at a condo across the street that residents suffered blinding glare and 15-degree temperature increases until the offending wall was resurfaced in a matte finish. This problem is the kind of "latent failure" that emerges only when a design is in use.

And then there is the rolling suitcase Dr. Petroski's wife, Catherine, a writer, bought on a recent trip. She chose it because of its convenient design, he recalls. Only when she used it did she discover it does not roll smoothly when it is full. Moral: a device does not have to fail utterly to be a failure.

In designing and building, engineers calculate how components of their design must perform, and how much stress they can endure before they will give way, an analysis Dr. Petroski says they apply to tasks as varied as driving across a bridge and bending and unbending a paper clip. The paper clip exercise is one he often uses in Introduction to Structural Engineering, one of the classes he teaches at Duke, where he has appointments in both engineering and history.

The analysis of engineering's failures offers some good lessons, Dr. Petroski writes. For example:

Success masks failure. The more a thing operates successfully, the more confidence we have in it. So we dismiss little failures — like the repeated loss of a space shuttle's insulating tiles launchings — as trivial annoyances rather than preludes to catastrophe.

Systems that require error-free performance are doomed to failure. Computer simulations and other methods of predicting whether components will fail are themselves vulnerable to failure.

Devices can be made foolproof, but not damn-fool-proof. This engineering maxim is one of Dr. Petroski's favorites. Today's successful design is tomorrow's failure, in that expectations for technology are continually on the rise.

A device designed for one purpose may fail when put to another use. (Is it fair to call that a failure? Dr. Petroski smiled. "Good question," he said.)

He earned a bachelor's degree in mechanical engineering at Manhattan College, graduating in 1963. He had summer jobs in engineering, including a stint in the pre-computer-era agency that synchronized New York City traffic signals, but worried that he might fail when working on actual devices people would actually rely on. "Engineering is a huge responsibility," he said. "I didn't really feel prepared."

So he enrolled in graduate school at the University of Illinois, where he earned a doctorate in theoretical and applied mechanics in 1968. After a few years of teaching at the University of Texas, he joined Argonne National Laboratory, where he worked on failure — the fracture mechanics of metal components of nuclear reactors.

It was not exactly what Dr. Petroski had studied, but that did not matter a great deal, he said. In the first place, the field was relatively new, so many people were new to it. And secondly, "the whole philosophy of engineering education is to prepare you to do things you had never done" because that's what engineering is — a search for new ways to meet new goals.

At Argonne he discovered he was interested in the policy implications of engineering work and he really loved to write. But his schedule at Argonne offered him little free time. "We would go into our offices very early in the morning and break for dinner," he said. So when reactor research began to slow down after the accident at Three Mile Island, he thought about another academic job, one in which he would have time in the summer to write. He accepted an appointment at Duke, and moved to North Carolina in 1980.

For Dr. Petroski, acceptance of uncertainty and possible failure — he calls it "coping with the imponderable" — is what separates the "given world" of the scientist from the "built world" of the engineer. He took on what might be the ultimate imponderable assignment when he joined the federal government's Nuclear Waste Technical Review Board, a panel of scientists and engineers evaluating the possible use of Yucca Mountain in Nevada as a long-term storage site for nuclear waste.

The scientific analysis of the site, the possible movement of water through it, and so on, is largely complete, he said. Now the engineers must determine what might happen if radioactive waste were stored there — in particular, if it can be stored safely for a million years, the design criterion.

A million-year time frame is a challenge, even an unreasonable challenge, Dr. Petroski said. "But that's what interested me in the problem, a million years. The question is, what kind of society would even be around?"

Knowledge of failure is crucial in considering this kind of problem, Dr. Petroski said. "I basically argue that engineers should arm themselves with all these case histories of failure and reason by analogy."

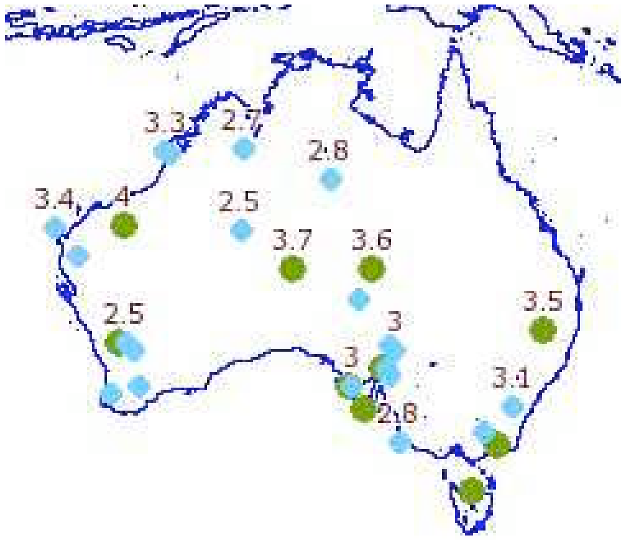
Dr. Petroski acknowledges that even though he is "an engineer who writes," and not a writer who happens to be an engineer, writing is his major contribution to the field.

But, he said: "I have been told by a good number of engineers that they give my books to young engineers because they do see the value in this message. This is very heartening, because I am getting the validation of the real engineers."

Earthquakes in Australia

Earthquakes of magnitude 2.5 or more in the period January to April 2006 and located by Geoscience Australia, ES&S or PIRSA are shown in the following table. The largest earthquake was the small ML 4.0 event in WA on 2nd April. No damage was reported in any event though several events were felt, as indicated.

Dat	TIME UTC	LAT	LON	M	COMMENTS
Jan					
08	220241.2	-31.54	139.23	3.0	W Curnamona SA
19	161500.0	-40.75	146.39	3.6	Off Devonport TAS
22	004904.8	-28.11	136.12	2.8	SE Oodnadatta SA
22	201509.8	-33.38	118.29	2.5	SW L Grace WA.
25	115332.3	-34.14	135.63	3.0	Yeelanna SA.
25	115414.1	-34.17	135.62	3.1	Yeelanna SA.
25	115628.0	-34.14	135.71	2.7	Yeelanna SA.
25	115820.4	-34.15	135.56	3.6	Yeelanna SA.
29	094016.4	-21.68	113.45	3.4	W Exmouth WA
Feb					
04	163157.6	-37.56	148.18	3.9	NW Orbost Vic Felt
05	200629.4	-23.74	114.96	2.6	NE Carnarvon WA
09	041625.1	-32.87	138.13	3.5	N P Pirie SA. Felt.
10	214434.3	-34.16	135.68	2.6	Cummins SA.
16	004611.9	-17.59	122.49	2.7	NE Broome WA.
18	171654.0	-32.88	138.57	2.6	Booleroo SA.
27	092704.5	-19.80	134.01	2.8	SW Tennant Ck NT
28	051312.9	-36.81	147.13	2.9	SW Mt Beauty Vic
Mar					
02	061747.3	-34.80	149.18	3.4	S of Oolong NSW
04	170259.9	-33.62	115.91	2.7	N of Kirup WA
07	010608.1	-30.15	117.14	3.6	N of Kalannie WA
08	142900.8	-23.14	127.30	2.5	SW L Mackay WA
11	103549.5	-35.80	136.70	3.5	W Kingscote SA
17	045526.8	-30.76	118.26	2.5	N of Mukinbudin WA
23	161445.7	-31.29	138.76	2.5	Parachilna SA
27	215732.1	-29.32	150.76	3.5	NW Inverell NSW
29	125739.7	-30.28	117.69	3.0	NW Beacon WA
Apr					
01	010918.4	-25.99	130.99	3.7	S of Yulara SA
02	083944.6	-22.13	118.66	4.0	NE Tom Price WA
04	100642.7	-33.43	138.75	3.3	Hallett SA. Felt
19	185912.6	-37.86	139.89	2.8	S Beachport SA
21	081150.3	-34.81	149.14	3.1	S of Dalton NSW.
23	142306.1	-17.29	122.08	2.6	N of Broome WA.
26	142405.5	-17.44	122.16	3.3	N of Broome WA.



Other News

Settlement of Earth's crust causing New Orleans to sink

By: Peter N. Spotts, Staff writer of The Christian Science Monitor, 31/03/2006

Hurricane Katrina's devastating strike on New Orleans last fall highlighted shortcomings in the city's levee system. It also focused attention another long-term problem: The city and the region around it are sinking.

New research suggests, however, that at least for nearby Michoud, La., the dominant driver pulling the region under may not be among the usual suspects: oil extraction, pumping groundwater to the surface, or diverting the Mississippi for navigation.

Instead, the King of Slump may be a deep fault that cuts across southeastern Louisiana and under Michoud. During the 1970s, the fault appears to have contributed from 50 to 73 percent of the subsidence in this section of Orleans parish, depending on the time period measured. If sustained over a century, that would equate to as much as a six-foot sea-level rise, independent of any increase tied to global warming.

"Something dynamic is going on down there," says Roy Dokka, who heads the Center for GeoInformatics at Louisiana State University in Baton Rouge, La. "It doesn't occur everywhere," but it certainly appears to be affecting Orleans parish, he adds.

If these results hold up, they would imply that to build new levees properly, engineers will have to take into account the effects of further slumping along the fault - data are hard to come by because the fault is so deep and difficult to study.

The work is controversial. It builds on a study Dr. Dokka and Kurt Shinkle of the National Oceanic and Atmospheric Administration's National Geodetic Survey (NGS) completed in 2004 for NOAA. That study drew on some 2,700 measuring points around southern Louisiana to measure subsidence rates. It yielded far higher sinking rates than other scientists had calculated.

Undaunted, Dokka says he suspected that tectonic forces might account for the difference. So he analyzed measurements from a smaller group of these "benchmarks" that straddle the Michoud Fault. Several benchmarks are associated with water-well casings that reach as deep as 1.2 miles - far below sediment layers that would be affected by removing ground-water in the region or by compaction, Dokka says.

He found that the deepest layer contributed far more to subsidence during the study periods than did intermediate and upper layers of sediment. He attributes the high rates to the fault, which appears to release stress in a creeping "earthquake," rather than in a sudden snap. The results appear in the April edition of Geology, a journal of the Geological Society of America.

To Arthur Berman, a petroleum geologist in Houston who has tracked the issue, Dokka's work is solid. His only quibble: The study is using the best available data, but they're from 1988. So they don't reflect what is going on today. Updating the 1988 NGS survey would cost millions of dollars.

Still, he says, he's not surprised by the results. "This is solid geology," he says. "When there are changes, the first thing I would look at is the basin itself."

The next step, Dokka says, is to apply GPS satellite-navigation technology to the problem. As they have elsewhere, he says, GPS receivers should be able to track changes in height and any lateral movement in the land in great detail. This could help apportion the causes of subsidence among the various factors scientists have identified and cover a wider area.

Recent earthquakes

Tonga: Government finalises earthquake damage repair plan

U.S. GEOLOGICAL SURVEY
UTC TIME LAT LONG DEP GS MS MW
MAY 03
152639.8 20.130S 174.164W 55G 7.1 7.8 7.9 (GS)
One person injured, windows broken and items knocked from shelves (VIII) at Nuku`alofa. Felt at Hihifo, Neiafu and Vaini. Felt (III) at Apia, Samoa. Felt at Atiu and Avarua, Cook Islands; at Alofi, Niue; at Mulifanua, Samoa. A tsunami was generated with recorded wave heights (peak-to-trough) of 0.30 m at Pago Pago, American Samoa and 0.42 m on Niue.

Pacific Magazine, Monday: May 15, 2006

The Government of Tonga has finalized its response to the damaged public facilities caused by the recent earthquake on May 4.

The main priorities are to:

(1) Restore services to the Niu'ui Hospital by providing: 2 temporary water tanks, construction workers, generator until the electricity supply is re-checked, plumbing and building materials. The government has approved $150,000 for the repairs to the hospital.

This will involve restoring essential water supply to the hospital by constructing 2 temporary water tanks on the hospital premises.

Water from the local government primary schools will be used to fill up the temporary hospital tanks. This will be a temporary measure while the main water facilities to the hospital are being repaired.

On Saturday, workers from Tonga were sent to help restore facilities and begin the repairs to the hospital. The damage reported by the Ministry of Health included major damage to the three houses occupied by hospital staff. These staff members and families will be temporarily relocated into other temporary housing while staff quarters are being repaired.

The damage to the main hospital building was restricted to one half which included the theatre room, lab and x-ray room as well as other offices. Patient wards were untouched except for plumbing and electrical problems. All patients have been sent home bar one who is being cared for in the main ward.

Currently, the public is using one of the local doctor's home as a temporary hospital facility until the main hospital is repaired.

(2) Repair damage to Ha'apai's Taufa'ahau wharf.

The government has also approved a budget of $K30 - 40 to repair damages to the Taufa'ahau wharf.

Source: Tongan Govt Media Release

Pakistan quake forgotten by the world

From New Scientist Print Edition, 29 April 2006
IT WAS the world's third-deadliest natural disaster in the past 25 years. Yet the quake that struck Pakistan and India on 8 October 2005 has already dropped off the public radar, leaving Pakistan, especially, in dire need of aid.

That is the plea from Richard Brennan of the International Rescue Committee and Ronald Waldman of Columbia University in New York City, writing in The New England Journal of Medicine (vol 354, p 1769). *When you have an acute crisis with a lot of dramatic scenes, that lends itself to dramatic television*, says Brennan. *But after the rescues are done there are 2.8 million homeless in some of the most remote, austere areas in Pakistan. October's quake has dropped off the public radar, leaving Pakistan in dire need of aid.*

Only 66 per cent of the money requested by the United Nations for emergency needs has been donated, say the authors, and funding for recovery is likely to be even more limited. Among other things, incentives are needed to keep female doctors and nurses in the area, says Brennan, as many Muslim men will not allow their wives and daughters to be treated by male doctors.

Charles

Indonesia

This magnitude 6.3 earthquake in the southern urban area of greater Yogyakarta, SE Java on 27 May caused a tragedy: 6200 killed, 1800 injured and 200,000 people homeless.

Australia, through its international aid agency AusAID, sent more than 80 disaster experts to Yogyakarta and committed $7.5 million to provide urgently needed medical care, food, water and shelter.

The teams of doctors, nurses, paramedics and logisticians were joined by essential services engineers and AusAID's infrastructure expert to assist the international relief effort. Medical, hospital and relief supplies, including $200,000 of orthopaedic instruments have also been provided.

There has been significant structural damage to the south and centre of Yogyakarta city. It is estimated 67,500 houses have been destroyed.

A team of Australian essential services engineers is working with UNICEF to help restore essential services such as water and sanitation, and assist local authorities determine the status and safety of public buildings. See http://www.ausaid.gov.au/

This was a large earthquake about the size of that in 1979 near Cadoux WA which caused no fatalities despite severe damage to masonry buildings in Cadoux. Australia experienced about 10 earthquakes of this size in the 20th century.

IAEE

The new Executive Committee of IAEE elected at the General Assembly of delegates (John Wilson was the Australian delegate at the meeting) is:

President T Katayama (Japan)
Past President L Esteve (Mexico)
Executive vice-President P Gulcan (Turkey)
Directors M Belazought (Algeria), D Hopkins (NZ), E Faccioli (Italy), S K Jain (India), P Fajfar (Slovenia), T C Pain (Singapore), L E Garcia (Colombia), L Wylie (USA).

The 14th WCEE will be held in China in August 2008 following the Olympic Games. www.IAEE.or.jp

Modelling earthquakes in California USA

In southern California, there is significant seismic hazard from a major earthquake on the San Andreas fault. The southern part of the fault has not seen a major event since 1690, and the accumulated slip may amount to as much as six metres, setting the stage for an earthquake that could be as large as magnitude 7.7. But scientists and engineers wanted to know in more detail just how intensely the earth will shake during such an event—and what impact this will have on structures, particularly in the populated sediment-filled basins of southern California and northern Mexico.

Members of the SCEC/CME collaboration including 33 earthquake scientists, computer scientists, and others from eight institutions have produced the largest and most detailed simulations yet of just what may happen during a major earthquake on the southern San Andreas fault.

The TeraShake simulations modeled the earth shaking that would rattle southern California if a 230 kilometre section of the San Andreas fault ruptured producing a magnitude 7.7 earthquake. Two rupture scenarios were simulated, one rupturing from north to south, beginning near Wrightwood, California, and a second one rupturing from south to north, starting near Bombay Beach, California.

The geographic region for the simulations was a large rectangular volume or box 600 km by 300 km by 80 km deep, spanning southern California from the Ventura Basin, Tehachapi, and the southern San Joaquin Valley in the north, to Los Angeles, San Diego, out to Catalina Island, and down to the Mexican cities of Mexicali, Tijuana, and Ensenada in the south.

To model this region, the simulations used a 3000 by 1500 by 400 mesh, dividing the volume into 1.8 billion cubes with a spatial resolution of 200 metres on a side, and with a maximum frequency of .5 hertz—the biggest and most detailed simulation of this region to date. In such a large simulation, a key challenge was to handle the enormous range of length scales, which extends from 200 metres—especially important near the ground surface and rupturing fault—to hundreds of kilometres across the entire domain.

The results and resources produced by these simulations are summarized at the following site.

http://epicenter.usc.edu/cmeportal/TeraShake.html

Charles

Drill digs deeper than ever into Earth's crust

From New Scientist Print Edition 29 April 2006

SINCE the 1950s, people have dreamed of drilling through the Earth's crust to the mantle. We are now a step closer, having reached the *gabbro* layer of oceanic crust for the first time.

About 60 per cent of the Earth's surface is covered in oceanic crust, but there are still many questions about how it forms. Gabbro, a coarse-grained rock that forms as trapped magma slowly cools, might hold some of the answers.

To get their hands on some of the stuff, a team led by Douglas Wilson of the University of California at Santa Barbara bored into the ocean floor 800 kilometres west of Costa Rica.

The tough rock at times only allowed their drills to burrow 10 metres per day, but eventually, at 1157 metres, the team hit gabbro. The hole, now 1500 metres deep, is still about 4 kilometres short of the mantle (Science, DOI: 10.1126/science.1126090).

From the States

South Australia: from David Love

Recent earthquakes

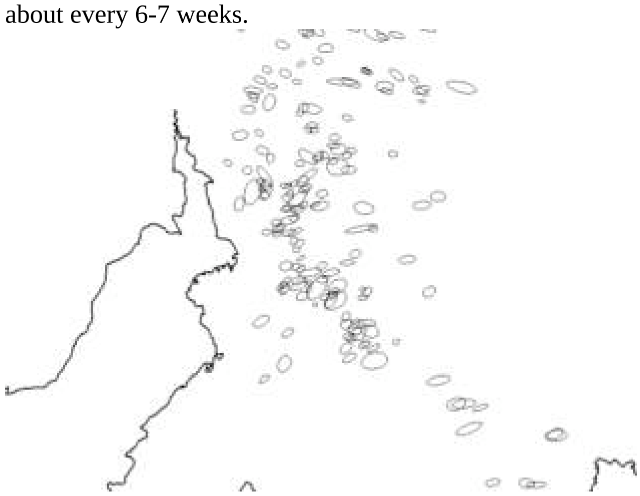
Earthquakes seem to drift around in space and time. In 1996 we noted a change in activity with the number of small earthquakes dropping. Was this some kind of a sign that the Burra earthquake (Mar 97 ML 5.1) was about to come? This year we have had the excitement of a few more magnitude 3+ events nearer to populated areas (see map below).

We hope that by this time next year we will be auto-matically locating these with the new Adelaide network. Most new sites have now been chosen. We currently are waiting, and waiting, to get two phone lines into the first sites. Two other sites are likely to require radio link to a phone line or internet connection.

Map 1 Earthquakes ML ≥ 3, January - April 2006

Flinders Ranges Project

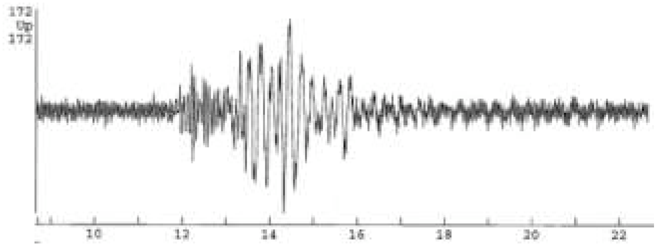
Our joint project with GA is expected to finish in June this year. From September 2003 until June 2005 about 20 digital recorders were operating through the Flinders Ranges. This included a number of broadband sensors from ANSIR. In June most recorders were removed, but since a considerable amount of activity was detected at the north end of the survey, 8 instruments were installed in a smaller area around this activity. Instruments have been visited about every 6-7 weeks.



Map 2 Error ellipses for more accurate locations in part of the survey area. Is the previous cloud of activity beginning to show some patterns?

Project initiation and planning was mainly by Phil Cummins, Natalie Balfour has done most of the local event location, and Trevor Allen has been working on the attenuation. Results are now beginning to come from the data. Unfortunately Natalie has now left to pursue further study, but we are expecting a paper on stress inversion to be forthcoming. Some of the local earthquake information may also be included in a tomographic study being done by Peter Clifford at Adelaide University.

A blast occurred in the Adelaide CBD at 3:19am on Tuesday 2nd May. One person was killed, and a building was partly demolished.



The above accelerogram is from a JUMP recorder (GHS) installed a few blocks away. The equipment is a triggered Kelunji Classic KA1 with a Guralp CMG-5T accelerometer. The vertical component is shown above. The P wave is visible from just before 12 seconds, and the ground roll (surface wave) is very clear from 13.5 seconds. 2,000,000 counts is approximately 1g.

Western Australia: from Hong Hao

Associate Professor Nawawi Chouw visiting from Japan

Associate Professor Nawawi Chouw from Okayama University, Japan is currently visiting Professor Hong Hao of the University of Western Australia. Nawawi will stay in UWA for a year. He will work with Hong on a project studying bridge responses to spatially varying earthquake ground motions, including pounding and soil-structure interaction effect.

Dr Chouw received both his undergraduate and postgraduate education at the Ruhr University Bochum in Germany, where he received the degree Dr.–Ing in 1993. His research interests include analysis of dynamic soil-structure interaction, base-isolation modeling, boundary element method and wave propagation modeling and reduction techniques, and their application in earthquake engineering and modeling vehicle and train induced ground vibrations.

Nawawi is one of the few leading researchers in the world working in the field of nonlinear soil-structure interaction. For his outstanding research work the Fritz-Peter-Mueller-Prize, the highest prize in the field of structural dynamics in Germany, was awarded to him in 1996. He was also awarded the best research prize in 2002 by the Chugoku Denryoku Research Institute in Japan. The prize is given for the best of all research works in the field of earthquake engineering supported by the research institute in every five years. He also developed a technique named 'Wave-

Impeding Barrier' to reduce wave transmission in the ground. The technique is patented in Germany and has been used in more than 30 projects in Japan. The technique is very useful and effective in reducing environmental vibrations caused by human activities.

Nawawi visited UWA in 2003 as a Gledden Visiting Senior Fellow for three months in 2003. During that visit, he and Hong Hao established very close research collaborations, working on bridge responses to spatially varying earthquake ground motions. They jointly received a research grant from Japanese government for three years (2003-2005) working on evaluating the adequacy of relative displacement response specifications in the new Japanese bridge design code to earthquake loadings. Their research collaboration is very fruitful. In the past three years, they have jointly published 8 Journal and 9 refereed Conference papers.

During his second visit to UWA, Nawawi will continue to work with Hong. They will first wrap up the work they have done in the last three years, and then continue to work on dynamic responses of bridge structures to earthquake loads. New research topics, in particular, an innovative soft layer isolation system for low-rise structures that are popular in Australia will be investigated. They have been discussing this idea since late 2004 when Hong visited Nawawi in Japan. This will be a cost effective isolation system, will be useful for low-rise structures subjected to high frequency contents earthquake ground motions, such as the case in WA.

Effects of the Indian Ocean tsunami in WA from Brian Gaull

Brian has submitted a report on the effects in WA of the tsunami that swept across the Indian Ocean following the Sumatran earthquake of 26 December 2004 (see AEES Newsletter 1/2005). An abstract is printed at the end of this Newsletter, the article can be viewed in whole at www.aees.org.au/

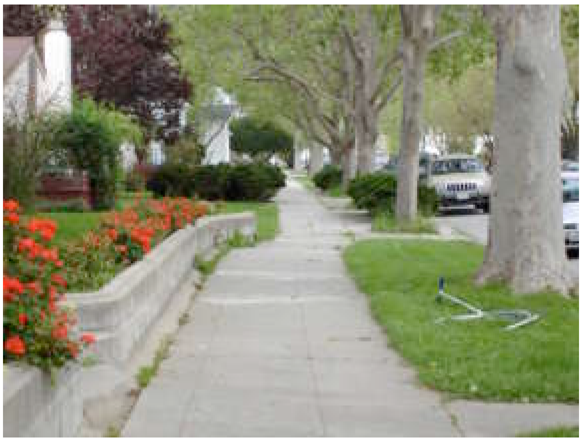
Queensland: from Russell Cuthbertson

Review of Queensland State Government Monitoring Contracts

A review is currently underway by CERA Pty Ltd into the Queensland Earthquake monitoring network and operations. The last three contracts that the state government has let (to the University of Queensland and then to Environmental Systems and Services - ES&S) are being audited with a view to finding an acceptable model for future monitoring. As an interim measure, while the review is being finalised, the current contract between the state government and ES&S, which expired at the end of May this year, has been extended for six months to the end of November.

Active faults?

From time to time earthquake geologists are asked to explain the difference between a fault and an *active* fault. Pictures are better than words. The photo below was taken by Susan Hough, in Hollister California, USA across a famous right-lateral strike-slip active creeping fault.



Conferences and Seminars

Readers are encouraged to provide information to the editor on upcoming conferences and seminars.

- **2006/06/22-25 11th Symposium on Natural and Human-Induced Hazards**, Patras Uni, Greece.
  I am glad to let you know that the *International Society for the Prevention and Mitigation of Natural Hazards* (known as NHS) organizes the 11th Symposium on Natural and Human-Induced Hazards at the Univ. of Patras, Greece, the cultural capital of Europe for 2006, from 22 to 25 June 2006. In parallel with this event, the 2nd Workshop on Earthquake Prediction (European Seismological Commission) will take place from 22 to 23 June 2006. Detailed information can be obtained from the website https://www.rr.upnet.gr/Hazards2006/
  I hope to see you all in Patras next June.
  Regards,
  Gerassimos Papadopoulos
  NHS President

- **2006/07/2-6 Australian Earth Sciences Convention 2006**. Melbourne Convention and Exhibition Centre. This convention will be organised into broad themes to integrate the scientific interests of the GSA and ASEG. The aim is to foster increased collaboration and innovation in addressing major contemporary and geological issues facing Australian society and the Australian earthscience community. /Please note that an SG^2 AGM to be held during the Conference/. For more information: http://www.earth2006.org.au/

2006/07/11 – 13 The Fourth World Conference on Structural Control and Monitoring (4WCSCM)

University of California, San Diego.

Organized by the International Association for Structural Control and Monitoring (IASCM). For more information on this event, please visit: http://www.usc.edu/4wcscm

New Books and Journal Publications

Earthquake Design Practice for Buildings 2nd ed.
E. Booth and D. Key, Consulting Engineers. Publ. Thomas Telford Ltd., 336pp.
Price: £ 65.00
ISBN: 0727729470
Format: Hardbound
Publish Date: 31/03/2006

This book provides comprehensive, practical and easy to read advice for all designers and analysts of earthquake resistant structures. The entire text is completely revised to account for the many developments that have taken place since the publication of the first edition in 1988.

This includes advances in the understanding of how structures and the soils that support them respond to ground shaking, development of new robust forms of earthquake resistant construction, and improved forms of analysis and assessment.

The scope includes buildings in concrete, steel, timber and masonry; site effects, soil liquefaction and foundation design. Extensive references are made to the recently published European seismic code, *Eurocode 8* and to US seismic codes and standards. There are also chapters on seismic analysis, the retrofit of existing buildings, building contents and seismic isolation.

As well as being a practical guide to design, the book is also a valuable reference work, offering excellent bibliographies on all the major topics, and valuable suggestions for follow-up study where needed. For these reasons and many more this book will be appreciated – and enjoyed – by all those who have responsibility for the design, construction and maintenance of buildings in earthquake areas, both in the European area and worldwide.

Professor Robin Spence
President, European Assoc Earthquake Engineering

Catalogue of earthquakes and tsunamis in the Mediterranean area from the 11th to the 15th Century.
Emmanuel Guidoboni and Alberto Comastri

A new catalogue of earthquakes and tsunamis of the medieval Mediterranean area is now available (published September 2005). It brings together the results of research conducted on original sources, which amounted to several years' work with a team of historian and philologist scholars.
http://www.sga-storiageo.it

Newsletter articles (could authors please send the references to any relevant research publications – you are usually the first to know).

The Society website/email list

Dear AEES Members,

The AEES website (www.aees.org.au) is being overhauled and new content added. Any contribution from you on the following topics is most welcome:

- details of interesting recent publications
- significant research projects in earthquake engineering (in Australia?)
- links to other relevant websites.

Please email me your contributions/suggestions.

The AEES email list is operated by the ES&S Seismology Research Centre, Melbourne. If you would like to register please notify me at adam.pascale@esands.com

Regards
Adam Pascale

We need email addresses for the following AEES members to send notification of the availability of the Newsletter, please send to mccue.kevin@gmail.com:

Mr B H Aldcroft MIEAust CPEng
Mr J L Ballantyne FIEAust CPEng
Mr J Bay Hoon Sang MIEAust CPEng
Mr M J Brock MIEAust CPEng
Mr W M Buckland MIEAust CPEng
Mr C W Chang
Mr K E Christesen MIEAust CPEng
Mr W J Clarke MIEAust CPEng
Mr Daniel Po Kei Tam MIEAust
Mr P J Dimauro MIEAust CPEng
Mr D J Dineen MIEAust CPEng
Mr B Dorien-Brown GradIEAust
Mr R J Drew MIEAust CPEng
Mr J Giedl
Mr M Gregory
Mr S L Harriott MIEAust CPEng
Mr R S Heggie FIEAust CPEng
Mr B R Jones GradIEAust
Mr D Kew GradIEAust
Mr N Lal MIEAust CPEng
Mr R G Lewis MIEAust CPEng
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Mr R J Potter MIEAust CPEng
Mr J J Quinn MIEAust CPEng
Mr R G Rollo MIEAust CPEng
Ms J Ruddle
Mr H Schultz MIEAust CPEng
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Mr J M M Talty FIEAust CPEng
Mr G N Tankov MIEAust CPEng
Mr J P Thompson MIEAust CPEng
Mr G H Vasilareas MIEAust CPEng
Mr R Vegners MIEAust CPEng
Mr D G Whiting MIEAust CPEng
Mr D J Wilson MIEAust CPEng

Tsunami Effects along the Western Australian coastline

Brian Gaull, *Guria Consulting;* PO Box A122 Australind, W.A. 6233

1) Introduction

In order to improve tsunami modelling in the Indian Ocean, *Geoscience Australia* contracted *Guria Consulting* to collect and collate as much (mainly tsunami runup) information as possible along the W.A. coastline in the aftermath of the Sumatran Tsunami (26th December 2004). Because of the time-lag between the tsunami and the fieldwork, little direct effects remained and hence the observations were based predominantly on anecdotal and photographic evidence. This article summarises some of the key results from this work.

2) The "tsunami runup"

The term *Tsunami runup*, refers to the peak vertical rise of the water during the complete passage of the surges of the tsunami above the normal tide. Essentially, the fieldwork was about measuring this "runup" from points where the water was known to reach back down to mean sea level (MSL). This was done using a dumpy level. Corrections like the height of the dumpy and the difference between the MSL with the tide at the time of the runup needed to be applied later.

3) Results

A) From the "Residual tidal data" (predicted minus the actual tide) for the period of the tsunami at 15 tide stations in W.A. the following observations were made:
1) Tidal movements were visibly disturbed for several days at most gauges;
2) No significant effects could be seen at Wyndham and Broome;
3) Residual tidal effects from Pt Hedland to Carnarvon were of the order of half a metre, the smallest amplitudes seen were at Exmouth Gulf.
4) Geraldton was the standout with residual tidal amplitudes up to one and a half metres registered. This together with a peak tide in the evening of the 26/12/04 gave rise to a water level 0.6 metre greater than had hitherto been recorded
5) Heading south from Geraldton, the residual tidal amplitudes at main centres returned to "normal" (about _ m) until Bunbury when amplitudes up to about a metre were seen.
6) No amplification effect was seen in Fremantle, as in Geraldton; but there was a noticeably much longer period (2-3 hours) associated with the surges in Gauge Roads (the protected water between Fremantle and the nearby islands of Garden, Carnac and Rottnest Islands).
7) Small effects were observable at the Perth Barracks St Jetty, some 20 km along the Swan River from Fremantle.
8) The tsunami arrived first in Exmouth, then in Jurien, ahead of the other 14 reporting towns. This implies the most consistently deep seafloor path between the epicentre and the WA Coastline emerges at Exmouth.
9) Low amplitude (about 1/4 m double amplitude), long period diffracted tsunamigenic effects were also observed in Albany and Esperance.

B) <u>Runup data based on levelling observations</u> as described above are provided hereunder. Except for the Geraldton results, tidal corrections have still to be applied.

1) Credible anecdotal evidence suggests that the water from the tsunami crossed the isthmus at Pelican Point beach near <u>Carnarvon.</u> For this to take place, minimum water heights estimated were between 2.66 and 2.89 metres above MSL.
2) <u>Coral Bay</u> – Two blokes were sitting under a tree about 75 m from the water, drinking beer and watching the Boxing Day cricket on TV (as you would!). They didn't mind getting their feet wet, as it was a warmish sort of a day but when their esky started floating off they became alarmed.
3) A reliable witness reported water in a carpark above a beach on the west coast of <u>NW Cape</u> (just south of the Yardi Creek Caravan Park). A levelling observation showed that the water had to rise more than 2 metres from the mean level (MSL) of the ocean at the time of the observation for this to occur. It is interesting to note that the equivalent runup observations in Exmouth Gulf, on the other side of the Cape, were very much attenuated at about 0.5m.
4) Considerable damage was incurred at the "Fisherman's wharf" at <u>Geraldton</u> eg water inundated the local "fish-n-chip" shop to a reported 0.8 m and caused havoc for the boats tied to the wharf (see photos on AEES website).

5) Other (preliminary) corrected runup estimates in the northern suburbs of Geraldton were between 1.4 – 1.9 m with about 0.2 m less in the marina.
6) Uncorrected runup observations diminished on the way south from Geraldton as seen at Pt Denison and Jurien Bay, where of the order of 1.5 m were observed.
7) Heading south from Fremantle including Mandurah, Bunbury, Busselton (marina), the Margaret River region including Augusta (Flinders Bay), uncorrected runup estimates diminished in amplitude further overall resulting in observations of between about 0.6 and 1.5 metres.
8) The Flinders Bay boat ramp and jetty was left high and dry, showing that extremes of tide were common along the west coast of Australia.
9) A professional fisherman from Hamelin Bay (south of Margaret River) said that Pelagic (Deep-Sea) “Oar Fish” 10 to 12’ long (deep sea) were stranded up on beach! The surges also swept much debris onto many beaches of W.A.
10) Another fisherman from that region said according to his echo-sounder his boat rose and fell a total of 2 fathoms (about 3.5 m) when out Cray fishing, during the passage of the tsunami.

11) It is uncertain the exact number of people swept away in the strong currents generated by the tsunami in Western Australia, but we are aware of two campers at d’Alambre Island off Dampier getting washed into the sea still inside their tents; more than 100 people were rescued when trying to cross to and from Penguin Island via a sandbank which stretches to the island from the mainland at Safety Bay (south of Perth); a further three people that had to be saved after being swept away near Busselton and one man was rescued by boat 200 metres off Flinders Bay, near Augusta.

For more information including photographs and recommendations see the AEES website at http://www.aees.org.au/

Report on the 100th Anniversary Earthquake Conference in San Francisco 2006

Dr Cvetan Sinadinovski, Research School of Earth Sciences, ANU, Canberra ACT

This year the Seismological Society of America's (SSA) conference was held in San Francisco CA, 18 - 22 April, as part of the anniversary of the great earthquake which destroyed the city exactly 100 years ago. The 1906 earthquake ranks as one of the worst natural disasters in US history and one of the most significant earthquakes of all time. Scientific studies of the 1906 quake gave birth to the elastic-rebound theory and marked a new era for seismology.

The Earthquake

At 5:12am on April 18, 1906, a violent earthquake lasting 46 seconds struck San Francisco. Shock waves from the quake were felt from southern Oregon to Los Angeles, and as far as central Nevada. The Rossi-Forel scale, one of the first scales used to measure earthquakes using a "I to X" format, gave the 1906 earthquake an IX rating: *Extremely strong shock. Partial or total destruction of some buildings*. The magnitude of the 1906 earthquake was originally estimated at 8.3 on the Richter scale. Recent studies have revised it downward to 7.8.

Northern Californian urban areas, such as Santa Rosa, San José, and Santa Cruz, were devastated by the earthquake, which affected more than 900,000 square kilometers, half of it in the Pacific Ocean. Recent studies locate the epicenter under the Pacific Ocean, about 1.5km west of Daly City. The ground surface ruptured along the San Andreas fault for about 450kms in the 1906 quake. In comparison the 1989 Loma Prieta quake ruptured about 40km. The 1906 earthquake caused 8m of right-lateral surface slippage near Point Reyes Station. It shifted the ground at an estimated 1.5m per second, while the rupture traveled at about 9,000km per hour.

The earthquake caused property damage estimated at $400 million, more than $8 billion in today's US dollars. More than 225,000 of the city's 400,000 residents were homeless after the earthquake. The exact number of people who died in the earthquake and fire was impossible to determine. The death toll published at the time was 478, but more recent research suggests that it was over 3,000.

Fires following the earthquake burned for three days and three nights in San Francisco and destroyed about 28,000 buildings and 500 blocks (one-quarter of the city). Insurance companies were only liable for buildings that remained standing after the earthquake, not those that burned. Photos of San Francisco after the 1906 earthquake can be found on http://www.1906eqconf.org/photoResources.htm.

The Conference

More than 4000 engineers, seismologists and other professionals with a substantial number of policy makers from all over the world participated in this year's conference in the Moscone Center. The conference main themes were *Managing Risk in Earthquake Country* and *When the Big One strikes Again*.

Over the six days there were more than hundred technical sessions and workshops led by internationally renowned experts and scholars, as well as policy events, tens of tutorials and field trips. They included poster and oral presentations in the framework of SSA, Disaster Resistant California (DRC) and 8th US National Conference on Earthquake Engineering (8USNCEE) meetings. Besides seismological matters, the sessions addressed various other issues such as geotechnical, nuclear explosion monitoring etc. The first 80 technical sessions were the following:

1 The Impact of the 1908 Lawson Report on Earthquake Science
2 Nuclear Explosion Monitoring Anniversary Session I
3 Earthquake Science in the 21st Century:
4 Preparing for a Pandemic
5 The HAZUS Data Standardization Project
6 Hurricane Katrina Mission: 28 August - 9 September
7 Performance-Based Earthquake Engineering – Buildings
8 New Zealand: Earthquake Engineering Highlights from Middle Earth
9 The Seismic Provisions of the 2006 IBC
10 SEAOC at 75: History and Legends of the Profession
11 Retrofit and Strengthening of RC and Masonry Buildings
12 Steel and Composite Steel-Concrete Buildings
13 Seismic response of bridge components and subsystems
14 Geotechnical Aspects of the 1906 San Francisco Earthquake
15 Seismic Stability of Geo-Systems
16 Earthquake Reconnaissance - Improving the Practice
17 Tools for Response and Recovery
18 The Northern San Andreas Fault: 100 Years of Scientific Study
19 Nuclear Explosion Monitoring Anniversary Session II
20 Earthquake Science in the 21st Century:
21 Future Savings from Mitigation: the MMC Report
22 Private Industry Emergency Managers Forum
23 Performance of Utility Lifeline Components and Systems
24 New Zealand: Earthquake Engineering Highlights from Middle Earth
25 The Seismic Provisions of the 2006 IBC - Part 2
26 Design and Performance of Concentrically Braced Steel Frames
27 Seismic Risk Assessment and Upgrade for Sustainable Buildings
28 Seismic Performance of Industrial and Non-building Structures
29 Hybrid Simulation Algorithm Development
30 Liquefaction-Induced Ground Failure
31 ATC-1: New Knowledge of Earthquake Hazard in the United States and Implications for Seismic Design Practice
32 Advances in the characterization of site effects on ground motions
33 Tools for Response and Recovery
34 Issues in Response and Recovery
35 The Giant Sumatran Earthquakes of 2004 and 2005
36 Near-Fault Ground Motions from Large Earthquakes 200
37 Beyond the San Andreas, The Other Active Faults of Northern California
38 Extending ANSS: Next Generation Earthquake Monitoring
39 The M7.6 Kashmir Earthquake of 8 October 2005
40 Tsunamis
41 Advances in Volcano Seismology: Enhanced Monitoring Capability Via Application of Complementary Methods
42 Disaster Preparedness and Mitigation: Local Government Perspective
43 The Challenge of Protecting Historic Resources
44 Priorities and Partnerships-Is California the next Katrina?
45 Hurricane Katrina: The Challenge of Meeting the Needs of Vulnerable Populations
46 Emergency Public Information Systems
47 Catastrophic Insurance for Natural Disasters Is now the time?

48 Advances in Information and Communication Interoperability
49 NEES Research on Buildings
50 Fire Following Earthquakes
51 Enhancing Seismic Resilience: Conceptualization and Operationalization
52 ATC-2: Projects on Emerging Seismic Engineering Issues
53 China: Advances in Earthquake Engineering Research in China
54 Turkey: Seismic Risk Assessment in Istanbul
55 Nonlinear Time-History Simulation of Building Response
56 Performance of Levee Systems During Extreme Events
57 Soil Liquefaction
58 Energy, Displacement and Performanced Based Seismic Analysis and Design Procedures
59 Tools for Response and Recovery
60 How seismologists, engineers and emergency planners can work with policymakers to improve disaster planning and mitigation
61 Building Performance Assessment and Enhancement
62 Seismic response of bridge systems
63 Special Topics in Seismic Analysis and Retrofit Design
64 Lifeline System Analysis
65 Innovations in Reinforced Concrete Construction
66 Seismic Assessment by Nonlinear Static Analysis
67 Earthquake Recovery
68 Next Generation of Ground Motion Attenuation Models
69 Key Advances in Liquefaction Evaluation
70 Dynamic Soil Properties
71 Loss Estimation
72 Hybrid Simulation Frameworks and Methods
73 Analysis and Behavior of Reinforced Concrete Frame Components
74 Challenges and Changes to the Structural Engineering Profession in the Era of Performance-Based Eq Eng
75 PEER Building Testbed Studies
76 Improving the Science of Empirical Ground Motion Predictions
77 California's Seismic Hazards Mapping Act
78 Liquefaction of Fine-Grained Soils
79 Performance and Mitigation of Pipelines
80 Shape Memory Alloys / Bracing Systems

The full list of the sessions can be found on http://www.1906eqconf.org/con_sessions.htm. Overall the 100th Anniversary Earthquake conference in San Francisco 2006 was one of the biggest conferences of its kind and was organised very successfully. The proceedings of this centennial conference are available on the web site.

Photo After the earthquake and fire, Courtesy of California Historical Society