EIGHTH WORLD CONFERENCE ON EARTHQUAKE ENGINEERING SAN FRANCISCO, JULY 1984

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The Eighth World Conference on Earthquake Engineering (8WCEE) was held in San Francisco over the week 21-28 July 1984 with about 1,600 registrants attending from 54 countries. Also, 48 states of the United States were represented. The conference was held in the Fairmont Hotel atop Nob Hill, the hotel being one of the few major buildings to survive the 1906 San Francisco earthquake (M8.3) and subsequent fire. Twenty-six New Zealanders attended.

The conference opened with registration and the welcoming reception on the Sunday (22nd) evening. The reception was held in two shifts at the de Young Museum in Golden Gate Park and it gave everyone a chance to meet old friends and associates as well as be introduced to new people, many whose names were already familiar from earthquake engineering journals and associated publications.

The welcoming address at the Masonic Auditorium on the Monday morning was given by the President of the International Association for Earthquake Engineering (IAEE), Donald E Hudson. In his address, he commented that since the first WCEE at Berkeley in 1956, 447,000 deaths had occurred due to earthquakes and of those, about 15,000 deaths had occurred since the seventh WCEE in Turkey (1980).

In the opening keynote address entitled "The Role of Science and Engineering in Mitigating Natural Hazards", Dr Frank Press (President US National Academy of Sciences) spoke on the question of keeping up public interest in earthquake engineering. He said most of the loss in earthquakes was due to the failure of human-made structures and while earthquake prediction was uncertain, hazard reduction was paramount in aiming to reduce future loss.

While hazard assessment was the professionals' responsibility, hazard management was the politcians' responsibility. Dr Press felt that the professions often receive large amounts in public funds, but do not report back to the public enough; there is a lack in public education about seismic risk and he recommended new programmes in hazard reduction. The three main factors of the earthquake hazard are earthquake magnitude, distribution of shaking and community preparedness. Dr Press expressed the view that governments should spend more on preparedness, mobilise resources, fund research and development programmes, prepare codes of practice and assist in public education. He added that governments will be judged by their planning for disasters. Dr Press proposed the establishment of an international programme to reduce the effects of natural hazards and to establish national plans for every country. Such a programme could improve communication within developing countries and establish international design facilities and global strong-motion instrument networks.

He concluded by saying that the risk of loss in earthquakes is greater now than at the time of the first WCEE due to greater population, greater frailty of lifelines and the construction of larger structures.

The conference lecture "The History of Earthquake Engineering" was delivered by Dr George Housner, an Honorary Member of IAEE. He noted that there were ten times the number of participants at the eighth WCEE than at the first, where only eleven countries were represented. His lecture traced the history of earthquake engineering from the early 19th century (Robert Hooke and Thomas Young) through to today where he felt earthquake engineering was entering its 'golden age'.

Points of interest were that the 1908 Messina (Sicily, M7$\frac{1}{2}$) earthquake killed 83,000 people and caused the birth of earthquake engineering. Buildings were mainly unreinforced masonry of low height and engineers were only educated in the laws of statics up to that time. The report on the Messina earthquake recommended the use of the factor of gravity static lateral load still used in most seismic codes today. In 1933, the first seismograph strong-motion record was obtained during the Long Beach earthquake. After the San Fernando shake of 1971, the Los Angeles building code required dynamic analyses for proposed buildings over 160 ft high (48.8 metres).

Dr Housner said more effort should be put into better defining of the maximum credible and the design earthquake(s), and that modern codes had not been as yet tested; the only real test being a strong earthquake. He also agreed with Dr Press that more effort in preparing for the major earthquake should be a higher priority of the professionals, government and the community.

After the completion of the opening ceremonies, the participants were taken by bus to the pier at Fort Mason for a gala luncheon. This turned out to be an American extravaganza with a mini-circus, bands and long queues waiting for at least an hour to be served a very American meal (hamburgers, hotdogs, salad and beer). Everyone was taken back to the Fairmont

Hotel in time for the first technical sessions in mid-afternoon.

The technical papers were presented in poster session format and the normal oral presentation. 807 papers were listed in the final programme and of these, 709 were presented orally. The papers of non-attending authors were not presented. For most sessions, there was a choice of seven or eight parallel sessions, so it was possible only to attend about an eighth of the presentations. Presenting authors were limited to a presentation time of between ten and twelve minutes, with about three minutes being available for discussion. Presentations on the whole were only fair in my opinion, as many authors struggled with the unfamiliar English language and attempted to show far too much detail on their slides. Some authors showed slides of text taken directly from their papers; this being difficult to comprehend in the front rows and impossible for those sitting twenty rows back. There were over 300 Japanese participants at the conference and many of them presented papers. Some presentations were excellent, but many lacked the experience of presenting in English, and thus much important information was not presented to the audience. In future world conferences, a translation service would be a worthwhile facility. Discussion was very limited with many papers not even soliciting one question - in fact, it seemed that in some sessions only New Zealand participants were asking questions! As far as I could tell, no record was kept of the discussion. The papers were printed in seven bound volumes (14 kg total), each of over 1,000 pages. As each paper was restricted to a maximum of eight pages, many papers contained only the briefest details.

The first technical session the author attended was on "Case Studies of Earthquake Response" and contained some interesting papers: one about lessons drawn from the 1980 El-Asnam earthquake pointed to the significance of vertical accelerations which were often greater than the horizontal accelerations. The presenter commented that the rapid change in vertical force in columns caused many building failures, but a lack of transverse confining steel was also evident. The session contained three papers on the response of the Imperial County Services building during the 15 October 1979 El Centro earthquake. This building, although repairable, has been demolished due to a lack of confidence in its future seismic behaviour by the building's tenants.

The session on "Experimental Studies on Reinforced Concrete Elements - 1" gave an overview of the range of concrete research being done around the world. The US concrete industry is promoting the use of lightweight concrete and some tests on lightweight concrete beam-column tests were reported. The beam-column joint region failed in several tests and the use of column cross-ties with a 90° bend at one end (135° at the other end) showed tie pull-out at the deflection ductilities of 8 and above. This cross-tie detail is allowed and is used in the US due to its ease of placement on site. The use of lightweight concrete is not encouraged for concrete compressive stresses greater than 30 MPa. Some testing was reported on the use of steel fibre reinforcement in columns and joints; the results warranting further study.

The Tuesday luncheon address, entitled "Seismology as a Factor in Earthquake Engineering" by Dr Bruce Bolt from the University of California at Berkeley, concentrated on the divergence of engineering and seismology. He said that an engineer's view of seismological information 'is that it is important, but it may not be true' and he felt that engineers need to tell seismologists the range of response they are interested in.

Dr Bolt's opinion was that earthquake prediction has fallen on hard times and while the prediction of ground motion is based on good physical principles, the need has arisen for more recorded 3-D ground motions. A seismological study of variation in time, space and frequency of earthquakes was necessary and the question of scaling up of medium earthquake motions to great earthquakes (M>7). To assist with this problem, the right instrumentation needs to be in the right place and to this end, more carefully designed strong-motion networks are required. He felt there had been too much exterpolation of seismological effects up till now, and he feared the divergence between earthquake engineering and seismology would increase in the near future.

The second session on reinforced concrete elements dealt mainly with beam-column joint testing carried out in the USA and Japan. Three-dimensional testing of beam-column beams and the contribution of the slab are important considerations in attempting to rationalise the performance of the beam and joint regions during major seismic excitation.

The Tuesday evening was given over for a short organ recital at the Grace Cathedral, situated two blocks from the Fairmont Hotel. This modern cathedral, built of reinforced concrete and structural steel, is built on the site of a former mansion destroyed in the 1906 earthquake. The owner gave the land to the Church after the earthquake and fire. The recital effectively emphasised the range of the organ with the booming base notes resounding through one's head.

The session on "Concepts in Base Isolation" the next morning also covered the range from theoretical schemes to the base-isolation systems already put into practice in New Zealand. The Chinese suggested using a layer of sand to isolate single-storey masonry homes while an American is suggesting the use of thousands of ball-bearings as the isolating medium, and large cantilever beams as the energy absorbing device. Dr Ivan Skinner (PEL, DSIR) made a press statement on aspects of base isolation, and the following morning a quarter page article on base isolation was printed in the "San Francisco

Chronicle" (the only article about 8WCEE the author saw in the newspapers). Also, a network TV news article on base isolation was shown later that day. The "Chronicle" article included some inaccuracies (of their making), but was a good advertisement for the New Zealand developed rubber and lead plug bearings. Dynamic Isolation Systems Inc of Berkeley (whose staff is mainly ex-patriot New Zealanders) has the US licence for rubber-lead bearings and their first use in retrofitting a bridge in California is at present under construction.

Wednesday afternoon was programmed as free time which gave the participants a chance to do some shopping or touring as they wished. I doubt if many of the New Zealanders spent much, because after multiplying the $US price by two to convert to $NZ, almost everything seemed rather expensive. (Overseas readers note that New Zealand devalued 20 percent just prior to the conference.)

Thursday morning (26 July) the technical sessions reconvened with the session topics including "Data Processing and Seismic Modelling", "Effects of Soils and Local Geology on Ground Motion", "Behaviour of Piles", "Analysis of Reinforced Concrete Buildings", "Masonry Structures - Experiments, Analysis and Design", "Industrial Facilities and Critical Structures", "Torsional Response of Structures" and "Behaviour of Earth Dams, Embankments and Slopes". As can be seen, a wide range of topics was covered and it was often difficult to decide which session to attend. Many participants did seem to move between sessions, attempting to hear certain presentations and to assist this a list of papers being presented was standing outside each venue, with an indicator showing which paper was being presented at that time.

On the Thursday afternoon I joined four bus loads of participants on a tour of UC Berkeley. This tour included the Structural Research Laboratory in Davis Hall and the earthquake simulator facility of the Earthquake Engineering Research Center at the Richmond Field Station. Large scale testing of reinforced concrete and structural steel assemblages were being or had recently been tested. The most interesting test application explained was the pseudodynamic test facility. "In this system, the earthquake response of a test specimen is stimulated using conventional electrohydraulic actuators. The displacement histories imposed on the specimen are determined during the test on the basis of user specified inertial and damping characteristics for the specimen, measured restoring force characteristics of the deformed specimen, and a numerically specified ground motion. Since the computer algorithms used explicitly incorporate the dynamic aspects of the response, the displacements computed can be imposed quasi-statically. Thus, specimens too large, massive or strong for available shaking tables can be conveniently tested." A one-storey steel frame structure was being tested in the rig, in an effort to assess the viability of the facility.

The Richmond Field Station incorporates the large shaking table (20 ft square) on which a two-storey high concrete block partition wall was placed and the table was excited with the El-Centro N-S (1940) earthquake record in the out of plane direction of the wall. We were also shown the Structural Research Laboratory next door where Professor Bertero was testing a seven-storey reinforced concrete coupled shear wall. He has also recently completed a one-fifth scale seven-storey model reinforced concrete frame-wall building tested on the shaking table. This project formed part of the joint US-Japan cooperative research program, the results of which were presented in two sessions on the Friday of the conference.

The conference reception and banquet were held in the Fairmont Hotel Ball Room and Terrace Room. Extra tickets were selling for $US75 each, and if that was the actual cost, I do not think the participants got their money's worth. The banquet did not reach the English definition of the term and the wine supply was exhausted by 9.30 pm!

The closing ceremonies were held on Friday afternoon, where Professor Hajime Umemura, Professor Emeritus, University of Tokyo and Professor, Shibaura Institute of Technology, was presented as the new President of IAEE and the announcement was made that the ninth World Conference on Earthquake Engineering would be held in Japan in 1988. (The alternative venue was the Philippines.) The new IAEE Officers were also announced, including Professor Tom Paulay of Canterbury University, who became a Director.

The Saturday was spent on the Bay Area Fault tour which travelled 300 kilometres and visited sites along the San Andreas and Hayward faults. The first stop was at the Point Reyes National Seashore in Marin County (50 kilometres north of San Francisco) where we walked the Earthquake Trail and were shown evidence of the fault movement which occurred in the 1906 earthquake. The second stop was in the town of Hayward which crosses the active Hayward fault (believed to be the source of the 1836 and 1868 earthquakes). We were shown evidence of continual fault creep (about 5 mm/year), but to the uninitiated it just looked like a few cracks in the tarseal. In several places on the fault zone, new housing developments are being built. Creep meters are installed across the fault in downtown Hayward and these record continuous displacements.

The final stop was an overview of the Crystal Springs lakes and sites of 1906 surface faulting. 'In 1906, three dams, two of which were impounding water, were located in this San Andreas Valley and were subjected to the earthquakes. These structures are still functional.' The 1906 faulting transversed the eastern end of the causeway separating the lakes offsetting the road about 2.4 metres horizontally.

Some aspects of the 1906 earthquake damage

were pointed out during our return to the Fairmont Hotel. Liquefaction occurred in downtown San Francisco and elsewhere. In the downtown area, liquefaction occurred in fills placed over marshland and in creek channels. The majority of the water line and sewer breaks were in these filled areas and because of these breaks, there was no water to fight the fires which devastated the city. An estimated 85 percent of the total damage to San Francisco was caused by post-earthquake fires.

The eighth WCEE was a success; the general organisation was first class, with sessions running to time even with the large number of papers presented. The social events were enjoyable and memorable, even if they were exceedingly expensive in our devalued currency. Technically, the conference confirmed that New Zealand earthquake engineering is 'up with the play' and in my opinion, there are no areas of interest to us where we are falling behind. One feature coming through was that we should be more concerned with the effects of the medium magnitude earthquake - the one which could occur several times during a structure's life. More emphasis is being placed on drift limitations to protect the non-structural elements of buildings with the aim of having many more structures usable soon after the medium strength shake.

APPENDIX

PAPERS PRESENTED BY DOMICILED NEW ZEALANDERS AT 8WCEE

"A Design Procedure for Interacting Wall-Frame Structures Under Seismic Actions", J Goodsir, T Paulay* and A J Carr.

"Experimental Behaviour of Ductile Hollow Reinforced Concrete Columns", J B Mander*

"Strength and Ductility of Reinforced and Prestressed Concrete Columns and Piles Under Seismic Loading", R Park*, F A Zahn and T J Falconer.

"The Seismic Performance of Steel-Encased Reinforced Concrete Bridge Piles", R J T Park, M J N Priestley and W R Walpole*.

"Base Isolated Structures in New Zealand", R I Skinner*.

"The Design and Construction of a Base-Isolated Concrete Frame Building in Wellington, New Zealand", L M Megget*.

"Developments in Energy Absorbing Devices at the Physics and Engineering Laboratory, DSIR, New Zealand", R G Tyler.

"Static and Dynamic Lateral Loading of Two Piles", D N Jennings, S J Thurston and F D Edmonds.

"Seismic Design of a Major Petrochemical Complex", A G Gillies*, J P Hollings and W B Shelton.

"Laboratory Testing of a Variety of Strengthening Solutions for Brick Masonry Wall Panels", D L Hutchison*, P M F Yong and G H F McKenzie.

"A Steel Beam Concrete Column Frame System", A J O'Leary* and D N Undrill.

* Presenting author