SECED NEWSLETTER

THE SOCIETY FOR EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS

July 1989 Vol 3. No. 2

IN THIS ISSUE

We have two items in connection with the US National Centre for Earthquake Engineering Research (NCEER). Its director R.L. Ketter has recently died and a short tribute has been included. Also NCEER were participants in the team of experts visiting Armenia after the recent earthquake. An edited report from T.D.O 'Rourke from Cornell University provides a further article. This was the one promised in our April Newsletter.

Prof. S.F. Brown has provided information on cyclic soil testing facilities at Nottingham University and SECED Committee member Dr David Key presents the results of the survey on mid career training in respect of Earthquake Engineering and Dynamics.

We also have the text of the talk that Dr Stubbs was unfortunately prevented from giving at our January SECED meeting.

The TK Hsieh award is made annually by the Institution of Civil Engineers acting on the recommendation of SECED, for the best paper on civil engineering dynamics published in the ICE proceedings, Geotechnique or proceedings of ICE Conferences.

This year we understand from the Institutions Awards Panel, the award will be made to A. Putenberg and AC Heidebrecht for their paper 'Approximate Spectral Multiple Support Seismic Analysis: Travelling Wave Approach'.

We would confirm the resignation of Dr D. Papastamatiou as elected SECED committee member. Pressure of business has unfortunately meant Dimitri's return to Greece. Naturally we would wish to record our sincere thanks for his past work for the Society and hope that he is able to maintain his promised contact with us.

The SECED Newsletter is published four times a year by the SOCIETY FOR EARTHQUAKES AND CIVIL ENGINEERING DYNAMICS and is available to all members of the society. Articles for inclusion should be sent to The Editor, SECED Newsletter, C.R.Sharman, Allott & Lomax, Fairbairn House, 23 Ashton Lane, Sale, Manchester, M33 1WP

Produced by Fairbairn Services Ltd.

We would however also wish to welcome our new Committee member, Dr Peter Merriman. Peter is a Principal Engineer with BNFL at Risley and is a wisely elected choice, having shown for some time past a significant interest in the activities of the Society.

Regular Features

CONTENTS

Laboratory test facilities for cyclic loading of soils and granular materials at Nottingham

By Professor S.F. Brown

The Pavement and Geotechnical Engineering groups in the Civil Engineering Department at the University of Nottingham have been involved in the study of soil and granular material response to cyclic loading since the late 1960's. Applications of this work have been in pavement design, offshore structure foundations and, most recently, in earthquake engineering. The research has received support from the Science and Engineering Research Council, Shell, the Transport and Road Research Laboratory and the Department of Energy.

Various, quite sophisticated, test systems have been developed for the accurate measurement of load, deformation, pore pressure and volume change in different types of cyclic load test. Most of the work has been concerned with elastic response of silty-clays, clays and crushed rock and this has led to the formulation of non-linear elastic stress-strain models which have been used in numerical analyses, principally for pavement engineering. Other tests have examined how plastic strains accumulate under cyclic loading and the influence of drained rest periods between bursts of undrained cyclic loading, typical of the situation relating to offshore structures.

Recent experiments in the earthquake engineering field have been examining very low strain behaviour in cyclic load triaxial tests for consultants involved with seismic analysis of sensitive structures.

The latest facility for cyclic triaxial testing incorporates the background experience in instrumentation for accurate on-sample measurement of small deformations in both the axial and radial directions with computer based digital control and data acquisition systems. This equipment provides for the testing of 75mm diameter specimens, either from site or reconstituted. The latter embrace a small pore pressure transducer at the centre for accurate measurement of this parameter remote from end effects following the same philosophy as that applied to deformation measurement. Both deviator and confining stresses can be cycled if necessary, while specimen consolidation can follow K_o conditions using feedback from radial proximity transducers to control the applied stress ratio.

This equipment has been updated as part of the SERC initiative in earthquake engineering and is presently being used to investigate the response of silt with various percentages of clay contamination to cyclic stress or strain. Particular interest is being focussed on shear stiffness and its dependence on stress and strain levels.

Over the years various pieces of apparatus for cyclic loading have been developed at Nottingham. While most effort has gone into development of the triaxial test configuration, simple shear, biaxial and, most recently, hollow cylinder, apparatuses have also been used. Present active equipment includes a 500mm x 280mm outside diameter, 28mm wall thickness, hollow cylinder facility which allows application of cyclic axial and torsional stresses together with confining stresses and on-sample deformation measurements. This is currently being used for the testing of granular materials. In addition to the 75mm diameter cyclic load triaxial apparatus, a larger facility accommodates 150mm diameter specimens. There is also a second triaxial apparatus for the smaller specimens. All these items of equipment use servo-hydraulic systems for the accurate control of cyclic loading.

SECED survey of needs for mid career professional training in UK in earthquake engineering and dynamics : Summary

Prepared by the Subcommittee for Research and Education

Response to the questionnaire survey on training issued to members was low - a total of eleven completed replies was received. This survey is concerned with continuing professional development for the practising engineer. The following types of course are envisaged:-

1. One day non residential lecture courses.

2. Two to five day residential courses.

3. In house courses where the instructing team present lectures at the host organisation's offices

4. Modular courses at MSc level where specific University course modules are accessible to part time industrial participants. Courses running ten weeks require attendance for two to four hours per week. Courses running for eight months (per year for two years) are part time MSc programmes organised by Imperial College. These latter cover all aspects of design and analysis of civil engineering structures to resist earthquakes and require attendance for two days per week.

There was very little interest in the part time MSc programme but for the ten week course interest was as follows:-

Structural dynamics.....	45%
Advanced numerical methods (Non-linear and dynamic analysis).....	45%
Soil and foundation dynamics.....	36%
Engineering seismology.....	18%

Interest in other subjects was expressed in Quality Assurance, Centrifuge Modelling and Missile Penetration. Training in the use dynamic analysis programs covering Soil Structure Interaction, Finite Elements, SWANDYNE, TARA, ANSYS, ASAS and AUTODYNE was also requested.

Particular organisations willing to offer support in the teaching of particular subjects are identifiable from the survey returns, but have not yet been tabulated.

SECED survey of needs for mid career professional training in UK in earthquake engineering and dynamics : Summary

Prepared by the Subcommittee for Research and Education

	Interest %	Support resources Yes/No
General introduction to:		
Earthquake engineering	45	Y
Wind engineering	27	Y
Hydrodynamics	27	Y
Earthquake hazard assessment	55	Y
Earthquake design:		
Buildings	45	Y
Nuclear industry	55	Y
Oil and chemical industry	18	N
Offshore oil industry	27	N
Dams	27	Y
Tanks	27	N
Bridges	18	N
Towers, masts and chimneys	45	Y
Foundations	36	Y
Dynamic wind loading	27	Y
Wave loading	27	N
Blast loading and design	45	Y
Seismic secondary structure analysis and design.	55	Y
Seismic design and analysis of plant	45	N
Dynamic analysis (structures)	36	Y
Dynamics of soils	45	Y
Dynamic soil-structure interaction	64	Y
Soil stability, liquefaction	36	Y
Foundation design for general dynamic loading	36	Y
Code of practice earthquake resistant design	45	Y
Detailing RC structures for earthquake resistance	45	Y
Detailing steel structures for earthquake resistance	45	Y
Vibration measurement and monitoring	45	Y
Experimental methods in dynamics (shake table, pseudo-dynamic, prototype, and field testing)	45	Y

Passive isolation and damping of structures for earthquake loading	36	Y
Serviceability considerations for vibrations in buildings	36	Y
Lifeline utilities:		
Overhead	18	N
Underground	27	N
Reliability assessment for natural hazard loading	27	N

Dr. David Key

26th June 1989

R.L. Ketter

In Buffalo, New York on April 24, 1989, International earthquake engineering expert Robert L. Ketter, 60, died Tuesday, April 18, of a heart attack at Millard Fillmore Hospital in Buffalo, New York. Ketter was director of the National Centre for Earthquake Engineering Research (NCEER), headquartered at the State University of New York at Buffalo. He was also a Leading Professor of Civil Engineering, and a Distinguished Service Professor of the State University of New York.

Known for his concern that a major earthquake is likely to occur in the eastern US, Ketter said, "I feel comfortable there will be a magnitude of 6 or higher within the next 20 years".

Established under Ketter's leadership in September 1986, NCEER is the first national earthquake engineering centre established by the National Science Foundation (NSF) and is the only NSF sponsored national research centre headquartered on a SUNY campus.

The national research centre consists of more than 80 researchers in the United States, including those at the centre's core facilities at Cornell University, Lamont-Doherty Geological Observatory of Columbia University, Lehigh University, Princeton University, Rensselaer Polytechnic Institute, and UB.

Ketter had also served as the 11th president of the University at Buffalo from 1970 to 1982.

Frequently consulted in the U.S. and abroad on various engineering issues, Ketter was the author of more than 40 technical and educational articles and chapters in recognized journals and books in four different countries. He was co-author of Plastic Design in Structural Steel (1955). An Introduction to Modern Methods of Engineering Computation

(1960). Structural Analysis and Design (1979), and The Design of Single Story Rigid Frames (1981).

He served on a 15-member committee to guide revision of the National Earthquake Hazards Reduction Program.

Ketter was born on December 7, 1928, in Welch, West Virginia. A 1950 graduate of the University of Missouri, he earned his doctorate in civil engineering from Lehigh University in 1956 and served on the staff of the Fritz Engineering Laboratory at Lehigh. While at Lehigh, he attained the rank of research associate professor of civil engineering and engineering mechanics.

A report from Armenia

T.D. O'Rourke, Cornell University

On December 7, 1988 a 6.9Ms earthquake struck northern Armenia. The earthquake, which has been named by the Soviets as the Spitak earthquake, occurred at 11.41 a.m., a time frozen by electrical failure on the clocks of the city squares in Leninakan, the second largest city of Soviet Armenia. The strong ground shaking lasted about 30 seconds. In Leninakan, the consequences of the earthquake were most tragic. Among a population of approximately 300,000, 80% of the two million m^2 of living space was destroyed. Virtually all nine-story precast concrete frame buildings in Leninakhan were ravaged, many collapsing en masse into piles of rubble.

The epicenter of the earthquake was located near the city of Spitak, with a population over 30,000. About 10,000 of these were refugees from Nugorno-Karabakh in neighbouring Azerbaijan, who had moved from the political strife in that region and had been relocated in Spitak only days before the earthquake struck. Against the snow covered mountains of northern Armenia, the ruined city contrasted sharply with the beauty of its natural surroundings. It was a grim and astonishing sight: nearly complete destruction, with all industrial and residential buildings either collapsed or shattered as far as the eye could see.

The causitive fault of the earthquake broke the ground surface at the southwestern outskirts of Spitak. The fault is a reverse fault, dipping 55° to the northeast, with an average vertical offset of 1m. The fault was mapped from Spitak 8 km in a northwest direction to the village of Narlband. The village was levelled; not a structure was left intact. About 60% of the population of approximately 4,000 were killed.

During the week of December 12, 1988, a U.S. study team was assembled at the invitation of the Academy of Sciences of the U.S.S.R. The team consisted of 19 members from USGS, universities, and engineering firms.

The charges to the team were:

To provide technical expertise and assistance to the authorities of the Union of Soviet Socialist Republic regarding the use of geological, seismological, and engineering data with respect to immediate post-earthquake relief efforts including: establish a temporary array of seismographs in the epicentral region to record and locate aftershocks; provide rapid reporting of regional earthquakes; provide engineering assessments in such areas as soil and structural performance, architectural issues, ground failures, performance of lifeline systems and industrial facilities, and seismic risk; and provide support to geologic field surveys.

To gather data and information needed to assess the factors that contributed to the catastrophic nature of the earthquake, identifying knowledge gaps where focused research efforts can contribute to mitigating future earthquake devastation in the United States, the Soviet Union, and other earthquake-prone regions of the world.

With respect to assessing the seismic hazard, the USGS has established an array of seismometers in the area affected by the earthquake. Recording and analysing aftershock activity will permit a better definition of the causitive fault and disclose any migration of seismic activity. Ideally, such monitoring may allow advance warning of a strong aftershock and provide clues for future prediction. Within four days of establishing the seismometers, there were roughly 80 aftershocks recorded.

The evaluation of seismic performance will focus on both residential and industrial buildings. The U.S. team will assess how different types of structures responded to the earthquake and estimate the intensities of ground shaking that were manifested in various parts of the earthquake affected region.

U.S. observations of performance will clarify what changes in construction and design are most advantageous to reduce damage in future earthquakes. Moreover, the U.S. investigators may suggest ways of strengthening existing buildings in other parts of Armenia and the Soviet Union.

The post earthquake observations are most likely to benefit the U.S. practice for earthquake hazard mitigation in the areas of regional seismic response, earthquake performance of lifeline systems and existing buildings, emergency operations, geotechnical engineering, and societal impact.

The Spitak earthquake marks one of the first occasions of widespspread building destruction in cities with modern gas distribution systems. The performance of the gas piping networks and their relationships with post-earthquake fires are subjects of vital concern for U.S. cities vulnerable to earthquakes. Regionally, the structural damage in northern Armenia showed some remarkable patterns, with heavily damaged villages and sections of cities adjacent to areas with few problems. A regional study of the damage pattern in relation to the fault plane and rupture mechanism should provide valuable information on how regional geologic structure, soils, and groundwater conditions affect seismic intensities.

Several large landslides occurred - one estimated at several million m^3 and another which destroyed water pipelines supplying Leninakan. Additional study of these and other ground failures will provide valuable information about geotechnical failure mechanisms in relation to seismic intensity and site characteristics.

SECED MEETINGS

As noted in the April Newsletter, Dr. Rodney Stubbs who was unable to give his proposed talk on Soil Structure Interaction at our January meeting, offered to provide the text of his lecture for a future Newsletter. We have now received this item which is provided below.

Members should note that in respect of the SECED Conference at Bristol during March 1988, there has been an unfortunate delay in the printing of the proceedings. This has been due primarily to late submission of the final copies of some papers.

This has now been overcome and the proceedings are at the printers. We hope to have copies in the mail to participants soon.

Second Mallet - Milne Lecture

The extended text of Professor. Housner's lecture, 'Coping with Natural Hazards, given at the Royal Institution in May 1989, will be published later this year by SECED. The publication will include a biographical introduction by Professor. Geoffrey Warburton (Nottingham University), Dr. D'Souzar's vote of thanks on 'The needs for grassroots involvement and some notes on Robert Mallet and John Milne by Dr. Muir-Wood.

The publication will cost £10-50. It is available at the special pre publication price of £7.00 (post free in the U.K.).

If you require a copy at the special prepublication price, please send your cheque (made payable to the Institution of Civil Engineers) to the Secretary, SECED, Institution of Civil Engineers, 25 Eccleston Square, London SW1V 1NX.

Meetings arranged for next season are as follows. Further information will be provided via the normal programme sheets.

Wednesday 27th September 1989
Half Day meeting 'Recent Earthquakes and Re-Construction in USSR'

Wednesday 25th October 1989
At Herriot-Watt University 'Integrity Monitoring'

Wednesday 22nd November 1989
NAFEMS Dynamics Benchmarks

Wednesday 24th January 1989
'Blast and Impact Analysis in Civil and Structural Engineering'. To be held at BRE.

Soil Structure Interaction - The International Scene

By Dr. R. Stubbs

In this article I intend to give a brief resume of the talk I had intended to give at the seminar earlier this year. I intend to outline international research activity in the field of soil structure interaction, in particular that carried out in connection with the nuclear power industry. My selection is unavoidably biassed due to the short space available, although I hope to include all the major work that is being carried out, or has been in the recent past. In order to assist I have given some references so that those interested can investigate further. I hope the article will encourage further reading.

Introduction

In the nuclear industry the United States Nuclear Regulatory Commission (USNRC) have a major influence worldwide on the safe design of commercial Light Water Reactors (LWR). This has arisen because the LWR technology originating in the USA has been exported to

most other countries with commercial nuclear power programs. As a result the USNRC safety philosophy has been carried over in varying degrees into the safety requirements in many of these countries.

In the case of seismic design and in particular soil structure interaction (SSI), the basic USNRC regulatory approach is given in their Safety Review Plan (USNRC NUREG 0800), which since the late 1960s has required the consideration of SSI in the seismic analysis of nuclear power plant structures. Because of the uncertainties inherent in the analysis the USNRC required that the design should accommodate responses which either;

a) envelope the results of a finite element analysis technique and an elastic half space analysis technique, or
b) use results from either technique with conservative design considerations of the effects from the other technique, or
c) combinations of (a) and (b) with provisions for adequate conservatism in the design.

This suggested approach, it is <u>not</u> a requirement, led to many difficulties and much concern, not least that it was overly conservative. Consequently in the late 1970s the nuclear industry in general considered that SSI techniques were advanced enough so that one method adequately validated should be sufficient. (For instance in proceedings of the SMIRT conferences). The USNRC conducted research and recommendations were made in report USNRC NUREG/CR-1161. It is against this background that considerable research got underway worldwide, much of it with multinational funding. For example forced vibration tests in Japan and elsewhere, large scale experiments at Lotung (Taiwan), vibration tests at the Heissdampfreaktor (HDR) facility in Germany and artificial earthquake studies in the USA under the Simquake program. These and others have significantly improved our knowledge of the SSI process and have led to greater insights into the development and validation of the various analytical techniques.

In the rest of the article I intend to give an overview of this work. I do not intend to present results, except in the broadest terms as they are too extensive for such a short article. However I include some references so that anyone wishing to delve deeper can do so.

<u>Forced Vibration Tests</u>

As one example of these tests which have been performed on many of the nuclear facilities in Japan and some other countries in the world, is a series carried out at the Tokai-2 plant about 100 km NE of Tokyo. This plant is a 1100 MWe Boiling Water Reactor with a reactor building about 70m by 70m by 55m above grade. The building is embedded to a depth of

about 17m below grade. On this building at a height of about 45m above grade two shakers each capable of an output of 150 tonne horizontal vibration were fixed. In the experiment the vibration was applied over frequencies up to 20Hz and horizontal displacement response times were recorded on each floor by at least one instrument.

The measurements were compared with those generated by a lumped mass model for the building and a lumped parameter model of the foundations, by frequency dependant and independant foundation impedances. As well as the above a series of eighteen parametric analyses were performed investigating such matters as variations in soil parameters, structural damping, surface vs embedded foundation models, coupled versus decoupled soil impedances.
The results showed that in all cases in the frequency range less than 10Hz the analyses were conservative compared to the experimental results. The most significant parameter was the embedment both in terms of the modifications of impedances and the coupling impedance between the horizontal and rocking modes. They also showed that the design basis seismic response based on Japanese design practice for Tokai-2 is very conservative compared with the seismic response used for building design in the US nuclear industry, (EPRI report NP 5739). Similar work has been performed in the case of the Fukushima nuclear power station when a Richter magnitude 7.4 earthquake occurred about 100km away giving rise to a basemat peak acceleration of 0.08g, and 0.6g at the top of the reactor building. Results lead to the same general conclusions as for the Tokai-2 plant.

The Simquake Series of Experiments

This series of experiments was conceived in the late 1970s early 1980s by the Electrical Power Research Insitute (ERPI) in the USA, (ERPI reports, NP-1728, NP2916, NP-5752). One of the primary aims was to generate a database of building response to simulated earthquakes and forced vibration loadings, from a variety of buildings, both surface mounted and embedded, and with a variety of shapes and a variety of scales and soil types. This database was to be used as a source of the validation of analytical techniques that include soil structure effects. The unusual aspect was the simulated earthquake technique, whereby vertical and horizontal arrays of slow explosives suitably placed relative to the structure under investigation were detonated to generate a simulated earthquake sweeping across the site. Several tonnes of explosive could be used in one test. In later tests they were also used to excite actual reactor buildings, albeit to levels well below that of the design basis earthquake. The results form a large database and give information of the effects of model scaling and different geologies. However the shock waves produced do not well represent that of genuine earthquakes for a number of reasons and in many cases inconsistant and unexpected results were obtained. It is not always clear whether such results arose because of the artificiality of the experimental configuration, or are genuine

and are simply not being accurately modelled by the analytical techniques. They are in general too numerous to detail and the interested reader is referred to the reference.

Vibration tests at the HDR facility

This facility in West Germany is a LWR research reactor with its fuel and core removed. It is housed in a concrete containment building. Because of its origin there is considerable LWR plant present inside the building allowing the results of dynamic analysis of many structures to be compared with experimental results. Very many experiments have been performed at this facility, generally by international teams.

Dynamic activation of the structure has been performed by a variety of methods, mainly by the use of explosives (as in the Simquake tests), by eccentric mass shakers mounted in the building, and by impulse loading by rocket. The use of explosives has been limited by the proximity of other buildings and the levels of excitation reached have been smaller than in the Simquake case. Nevertheless using the above techniques valuable work has been performed, both for SSI studies and for building and plant dynamic analysis.

The Lotung Experiment

To overcome the shortcomings in the Simquake series of tests, EPRI sponsored in conjunction with other organizations a seismic scale model experiment at Lotung in Taiwan (EPRI report NP-5513). This experiment uses scale models of an LWR containment building which is subjected to genuine earthquakes, and the measured response data combined with free field data to evaluate many common SSI analytical techniques such as SASSI, CLASSI, and FLUSH.

Two scale models to 1/4 and 1/12 scale were constructed at Lotung where a University of California 2D strong motion array was disposed. Two down hole arrays to a depth of 150ft was also present. The site itself is relatively soft and a strong SSI results. The 1/12 scale model was the same as the one deployed in the Simquake series of experiments so as to allow actual earthquake induced data to be compared with the simulated earthquake response data.

The large scale model allowed a mock up of reactor components to be placed inside which gave further results of an LWR primary circuit response. Strong motion instruments were

installed at numerous places all over the model and internals.

Many earthquakes with Richter magnitude 5.0 have been recorded giving rise to peak accelerations well within and well above the values typically used in the design basis events for nuclear power plants.

Further work carried out has involved the effects of soil properties on SSI, has ascertained and the dependability of laboratory testing and in-situ testing of material properties. Analysis is being carried out by a number of organizations internationally.

Conclusions

Considerable experimental work has been performed mainly with international collaboration in order to increase the understanding of SSI effects, and to validate analytical techniques. This is not to suggest that the small scale laboratory experiments are not of use, they can give great insight into the science of the phenomena. However scaling phenomena are very important and the large scale field experiments are the surest way of overcoming this factor. This article has highlighted some of the more important large scale experiments.

CONFERENCE CALENDAR

Dynamics of Civil Structures 1989
Date unknown as yet
Stavebni ustav CVUT, Solinova 7,
16608 Praha 6 Czechoslovakia

10th international conference on
structural mechanics in reactor
technology
14-18 August 1989 Anaheim, Ca, USA
Asadour H. Hadjian, General Chairman,

SMIRT 10, Bechtel Western Power Company,
P.O. Box 60860 - Terminal Annex, Los Angeles,
California 90060, USA

IASPEI-CSMS Workshop/Symposium on
Estimation of Site Specific Ground
Motions for Large Earthquakes

August 22-30 1989 Istanbul
Prof. M. Erdik, Dept. of Civil Engineering,
Bogazici Uiv., 80815 Bebek, Istanbul, Turkey

Symposium on "Durabilite des Constructions"
to be held by IABSE (AIPC = Association
Internationale des Ponts et Charpentes)
6-8 September 1989 Lisbonne, Portugal
Secretariat de L'AIPC, ETH-Honggerberg,
CH-8093 Zurich, Suisse

15th Regional Seminar on Earthquake Engineering
September 1989 near Milan
Prof. A. Giuffre, Dipartimento di Ingegneria
Strutturale e Geotecnica, Universita di Roma
"Las Sapienza", Via A. Gramsci 53, 00197 Roma,
Italia

International Conference on Reinforced and
Prestressed Prefabricated Concrete Structures
in Seismic Areas
September 1989 Romania
Prof. A. Negoita, Polytechnical Institute,
Bd. Karl Marx 38, 6600 Lasi, Romania

IUTAM Symposium on Nonlinear Dynamics in
Engineering Systems
1989
University of Stuttgart, Pfaffenwaldring 9,
D-7000 Stuttgart 80, Germany FR

Ninth European Conference on Earthquake
Engineering
September 1990 Moscow
Dr. B.E. Denisov, Secretary-General
Organising Committee of the 9th ECEE, USSR
Societ Committee on Earthquake Engineering
Gosstrey of the USSR 26, Pushkinskaya Street
103828 Moscow, USSR

International Conference on Vibration
Problems in Engineering
6-9 June 1990 Nanjing, China
Prof. Zhm Dem 90, Chinese Society for
Vibration Engineering, Nanjing
Aeronautical Institute, 29 Yudao Street,
Nanjing, China (Telex 34155)

European Conference on Structural Dynamics
(EURODYN 90) Bochum Germany June 5-7
1990. Further details can be obtained from:-

EURODYN' 90 Organising Commitee
Ruhr - Universitat Bochum
Lehrstuhl fur Static und Dynamik
c.o. B. Garstka
Universitatsstrabe 150
D-4630 Bochum
Tel (0234) 700-6137 FAX 7002001 Telex 825 860

Unfortunately summaries of proposed papers were due in to the organising committee by 1st July 1989 and so this newsletter has not been able to give advance notice for intending participants.

University of Missouri-Rolla
Second International Conference on
Recent Advances in Geotechnical Earthquake
Engineering and Soil Dynamics.
March 11-15 1991.

There has been a first call for papers, submission of a 500 word abstract to be forwarded before November 1989. Further details from:

Shamshar Prakesh
Conference Chairman
Dept. of Civil Engineering
University of Missouri-Rolla
Rolla, Mo 65401 USA
Tel (314) 341 - 4489 or 341 4461
Telephone (314) 341-4729

The 6th NAFEMS Annual General Meeting and Workshops,

Will be held at the Grand Hotel, Brighton on 4-6 September 1989.

The Annual General Meeting will be held at 2 p.m. on Monday, 4th September. The workshops will be held on Tuesday and Wednesday 5 & 6 September. To participate in any of these meetings write to Anne Greechan at NAFEMS at the address below.

Book early as space is limited on some workshops.

NAFEMS National Engineering Laboratory
East Kilbride
Glasgow G75 OQU.

PUBLICATIONS

(*SECED and related)

1. *"Directory of Practitioners in Earthquake Engineering and Civil Engineering Dynamics" (Issue No. 2, April 1988).
Price : £15.00 (Summer 1988) from Chris Sharman, Allott and Lomax.

2. *"Earthquakes & Earthquake Engineering in Britain"
(1st SECED Conference, 18-19 April 1985, University of East Anglia)
Price: £30.00 (Spring 1988) from Thomas Telford Limited

3. *"Civil Engineering Dynamics"
(2nd SECED Conference, 24-25 March 1988, University of Bristol)
Price: £30.00-pub. due Spring 1989 from Thomas Telford Limited.

4. *"The Mexican Earthquake of 19 September 1985"
(A field report by EEFIT)
Price : £25.00 (Autumn 1988) from Thomas Telford Limited

5. *"The San Salvador Earthquake of 10th October 1986"
(A field report by EEFIT)
Price : £10.00 (1987) from RPT or Julian Bommer, Imperial College

6. *"The Chilean Earthquake of 3rd March 1985"
(A field report by EEFIT)
£25.00 (Autumn 1988) from Thomas Telford

7. *"EEFIT Constitution and Aims and Methods" booklet
Price : Free Order from Secretary, SECED

8. "Earthquake Design Practice for Buildings"
(ICE Design Series - author David E. Key)
Price : £35.00 (Spring 1988) from Thomas Telford Limited

9. "Dams and Earthquake"
(A conference held at the ICE 1-2 October 1980)
Price: £35.00 (Spring 1988) from Thomas Telford Limited

10. "Earthquakes" (Bibliography 87/1)
(Books, pamphlets & serial publications of interest to earthquake engineers)
Price : £8.00 (Spring 1988, to ICE members) from Thomas Telford Limited.

MEMBERSHIP NOTES

Committee 1988-89

Elected Members

Dr. W.P. Aspinall - Mass Data Systems

Dr. C.W.A. Browitt - British Geological Survey

Dr. J.R. Maguire - WS Atkins Engineering Sciences

Dr. P. Merriman - BNFL

C.R. Sharman - Allott and Lomax

Dr. R.J. Stubbs - Health & Safety Executive

Representatives

Institution of Civil Engineers

Professor H.A. Buchholdt - Polytechnic of Central London

Institution of Mechanical Engineers

Professor G.B. Warburton - University of Nottingham

Institution of Structural Engineers

Dr. D.K. Key - CEP Research

Geological Society

Dr. D.M. McCann - British Geological Survey

Immediate Past Chairman

Dr. R.R. Kunar - BEQE

Co-Options

Dr. R.D. Adams - International Seismological Centre

E. Booth - Ove Arup & Partners

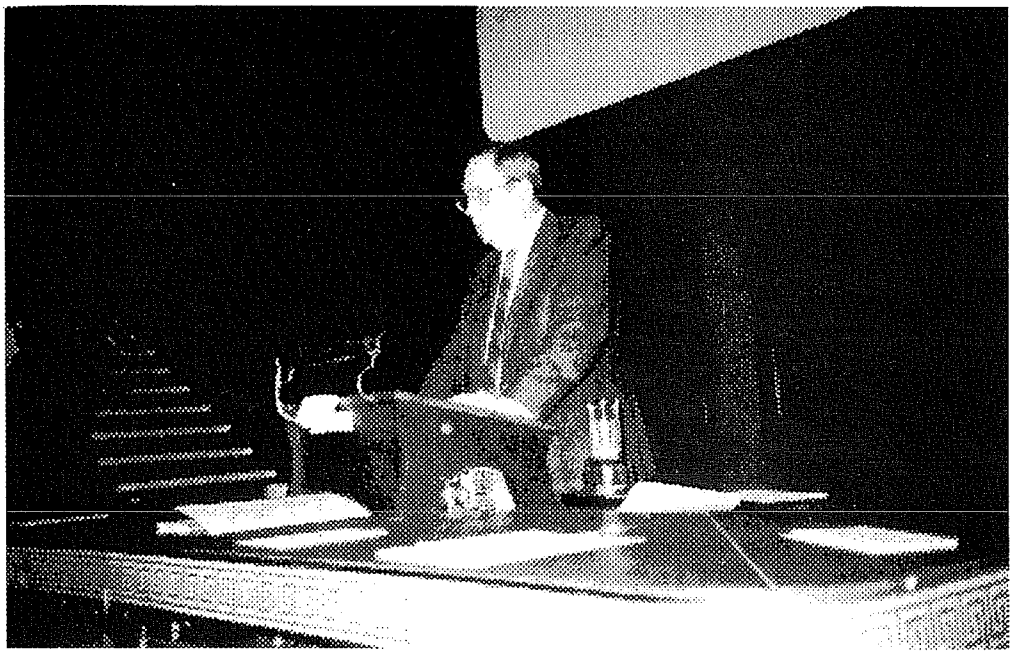
Dr. A.S. Elnashai - Imperial College

D.J. Mallard - CEGB

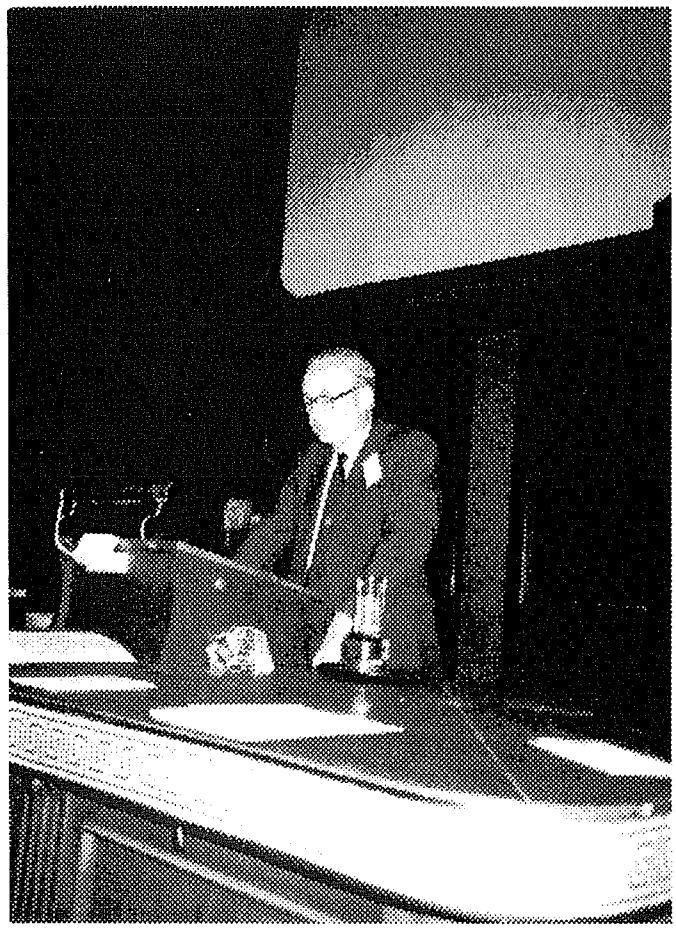
Dr. B.O. Skip - Soil Mechanics Limited

Dr. B.R. Ellis - Building Research Establishment

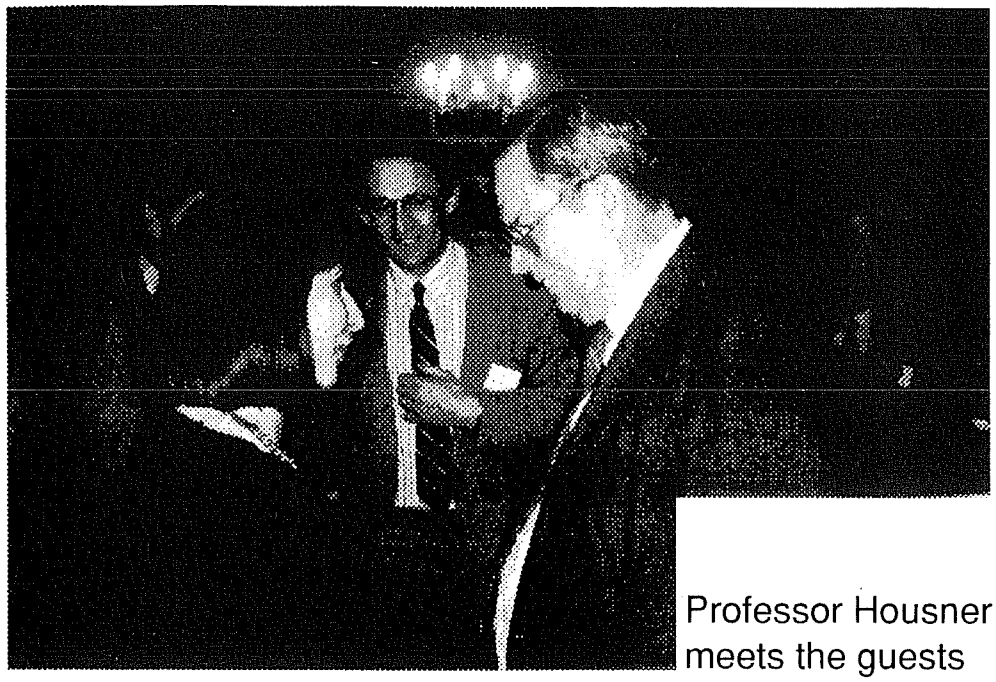
Second Mallet Milne Lecture at the Royal Institution



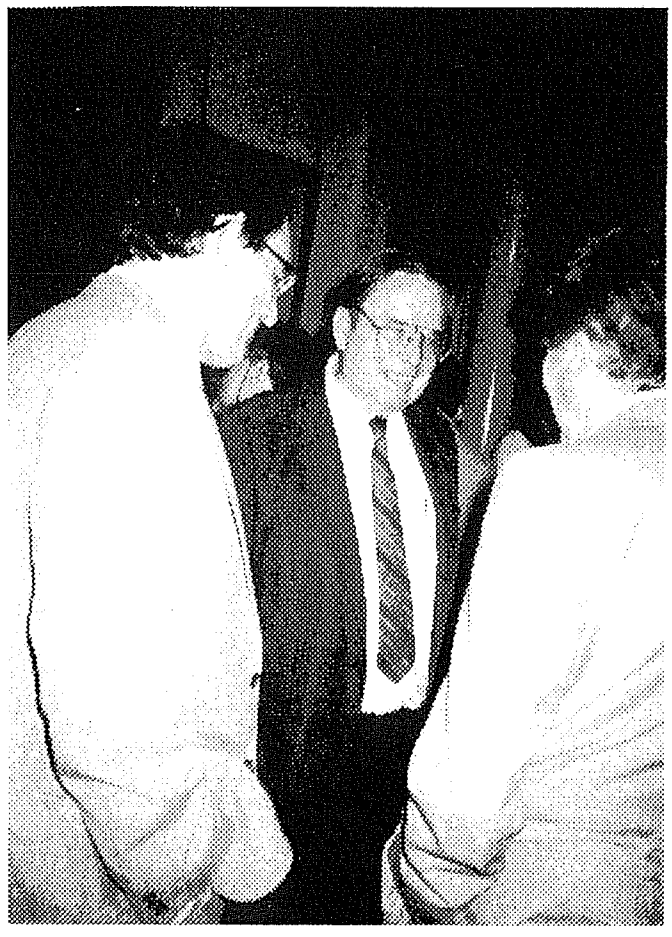
Professor Housner



Professor Warburton



Professor Housner
meets the guests



Dr. C. Browitt & Dr. R Kunar
present and past SECED Chairmen.

SECED MEMBERSHIP APPLICATION FORM

Name (block capitals please) : _____
Home Address (block capitals please) : _____

_____

_____ Telephone : _____
Name & Address of organisation with whom employed (block capitals please) :

_____

Decorations, Degrees, Diplomas, Membership of Professional Bodies :

_____

Date of birth : _____

CORPORATE SUBSCRIBER

Name of Organisation (block capitals please) : _____
Address (block capitals please) : _____

_____

_____

_____ Telephone : _____

We, being Corporate Subscribers, do hereby nominate the three undermentioned individuals to be our Nominated Representatives under the Constitution.

Name (block capitals please) : _____
Home Address (block capitals please) : _____

_____

_____ Telephone : _____
Name (block capitals please) : _____
Home Address (block capitals please) : _____

_____

_____ Telephone : _____
Name (block capitals please) : _____
Home Address (block capitals please) : _____

_____

_____ Telephone : _____

STUDENT MEMBER

Name (block capitals please) : _____
Home Address (block capitals please) : _____

_____

_____ Telephone : _____
Confirmation of student status : (To be signed by tutor or supervisor)
I confirm that this applicant is currently a full-time student
Date _____ Signature _____
Institution and position _____

Current Rates (1988-89)

Individual :	**£10**
Corporate :	**£50**
Student:	**Free**

Please return form to :

The Secretary
SECED
Institution of Civil Engineers
1-7 Great George Street
London SW1P 3AA
(01-630-0726)