SECED NEWSLETTER

THE SOCIETY FOR EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS

January 1990. Vol. 4, No.1

## IN THIS ISSUE

We would start the new year with the hope of greater membership participation in this newsletter. Contributions are not restricted to members of the committee and contributions from members via special articles or letters are very welcome. The committee would also welcome membership proposals for topics which might provide a subject for society meetings. Please write either direct to the secretary at the ICE or to the address given below.

Members should note also the special article by committee member Ed Booth and the Society's proposed connection with the newly formed Hazard Forum.

A full programme of events progresses the 1989-90 session and although the membership has been separately advised by the Secretary, meeting dates and details are repeated under the SECED Meetings item below.

We have a further guest editorial, this time kindly submitted by Dr. Gordon Woo of Principia Mechanica. Surely Gordon's article can provide a catalyst for some form of membership response. Any members attending the recent SECED/EEFIT meeting on the Loma Prieta earthquake at Imperial College will remember that Julian Bommer's references to the rapid rise in the number of recording instruments in California prompted extended discussion regarding the impact this might have upon the future engineering definition of earthquake loading, particularly in respect of aftershock/multiple event effects. It is interesting to note that the last paragraph of Gordon's editorial also looks toward increased observational data suggesting a review of this critical design parameter.

Together with the special articles following the editorial, regular features appear as follows:



**The Editor**

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



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## CONTENTS

### Guest Editorial

### Being Conservative

With television cameras now allowed in the chamber of the House of Commons, it should be possible to see what it is to be quintessentially Conservative. Telling Conservative MP's apart from other politicians is not as easy as it once was. Two sword lengths away, on the Opposition benches, are seated squires of country estates, members of exclusive dining clubs, and dapper young barristers dressed by Comme des Garcons. Most are opponents of nuclear power - but so also is the Minister of Energy.

Support for nuclear power used to be a shibboleth of Conservatism. Scargill and Marshall formed the axis that polarised opinion: if an MP was equivocal on nuclear power, he was equivocal on black-outs. The parliamentary rakes may have been discomforted, but the night lights were kept burning; Scargill was defeated and the CEGB chairman emerged victorious and ennobled. The virtues of nuclear power, paraded patiently before the Sizewell Inquiry, were extolled by the Prime Minister, who gave her blessing to a bold programme of PWR construction. And there the PWR story might have had a happy beginning, but for the politics of privatisation and the greed of the City hawks.

Perhaps it is just as well for parliamentary democracy, that faith in the democratic ideal does not demand the same faith in the elected members, in whose hands this high ideal is entrusted. Tommy Handley was a star of the wireless, whose abilities as an entertainer are undisputed. On this slender evidence of qualification, I voted at the last election for his son, Jeremy. While Principia still occupied an office in his constituency, the Conservative member for Richmond and Barnes honoured us with a visit. I remember his good humour and attentiveness in following outlines of our earthquake engineering studies. As he left my office, he laughed uncontrollably at seeing, within my cricket book-ends, a copy of Ambraseys and Melvillle's celebrated History of Persian Earthquakes. The reader of Hansard thought it extraordinary as a title for a book; he may have thought it more appropriate for ITMAR.

If there were such a thing as an earthquake vote, no politician would be elected who did not take seismic risk seriously. At a meeting of the British Nuclear Forum, I was privileged to sit at lunch next to Richard Holt, Conservative MP for a constituency near Billingham. He seemed more concerned about the colour of the coulis de tomates than UK seismicity, which I thought to be a Principian affectation, but which I suppose is just forgivable for an MP for the North-East. Nevertheless it was a disappointment, given that an important question had been raised earlier at the meeting about the cost of increasingly onerous seismic design requirements.

With the financial pressures bearing down on the nuclear industry, it is proper that all sources of conservatism in UK seismic design should be scrutinised. The state-of-the-art in earthquake engineering is steadily moving forward to a stage where improved knowledge and understanding, founded on superior quality observational data, will enable engineers to address the key issue of seismic design conservatism.

Gordon Woo.

### Hazards Forum

Last year's president of the Institution of Civil Engineers, Alistair Paterson, took the role of engineers in hazard mitigation as one of the themes of his year of office. In order to develop this, he conceived the idea of a hazards forum, which would bring together professionals involved in dealing with both natural and man-made hazards; the majority of the people involved would be engineers of all disciplines, but some scientists would also be involved. The aim was to bring to bear on the problem of hazard mitigation a wide range of different skills, and perhaps also to raise the public's consciousness on the contribution of engineers in making the world a less dangerous place to live in.

Two meetings, chaired by the distinguished engineer Sir Frederick Warner, took place this year to discuss the Hazards Forum. At the meetings, the structure of the Forum was explained. It is conceived as revolving round a central committee, consisting of representatives of professional bodies (who will have to pay a subscription to the Forum), serviced by a small secretariat, and three standing committees of recognised experts. The standing committees will comprise one on man-made hazards (to be chaired by Professor Bernard Crossland, who directed the scientific enquiry into the Kings Cross disaster), a second on natural disasters (to be chaired by Alistair Paterson) and a third, as yet unconstituted, committee on public relations.

An estimated £20,000 per year is needed to run the Forum, so far, the Institutions of Civil and Mechanical Engineers have each promised £2,500. Other bodies who sent representatives to the discussion meetings have been more reluctant to come up with cash, although a large variety of institutions showed enough interest to attend the meetings, there is some doubt as to how the Forum will operate on a practical basis, and also some concern as to how the Forum would relate to individual organisations, for example to the Institution of Naval Architects in the event of a disaster like 'Herald of Free Enterprise'. One thing that was made quite clear was that the Forum would <u>not</u> act as the British National Committee for the UN Decade for Natural Hazard Reduction, and indeed in some quarters, any connection between Decade and Forum was vigorously denied, a position that the SECED representatives at the meetings were anxious to tone down.

The present position is that nominations have been invited for membership of the two standing committee on natural and on man-made hazards. The committees' initial brief will be to discuss and clarify ways and means for the Forum to operate, largely so that the doubters should be convinced that there is a role for the Forum and so lend their support, including financial support.

The SECED committee has taken the view that the development of the Forum is certainly worth following; hazard mitigation (not just of earthquakes) has long been a major concern of our society, and we have proved the fruitfulness of collaboration between scientists and engineers of many different disciplines, particularly in our earthquake work. Accordingly, Dr. Willy Aspinall, who is a member of the SECED committee, has been proposed as a member of the Standing Committee on Natural Hazards, with a particular brief to promote SECED's potential contribution to the Forum.

Future developments will be reported in the Newsletter; your own views on the Forum and how SECED should relate to it, are invited, either directly to Willy Aspinall or to the Newsletter editor, Chris Sharman.

Edmund Booth

## <u>Masonry: An Easy Prey To Earthquakes</u>

Although masonry is one of the oldest construction materials, it has always paid a heavy tribute during earthquakes. Historical evidence can be traced back to 2150 BC when the two cities of Sodom and Gomora (Genesis XIX, vs 24-25), were destroyed in the plain north of the Dead Sea. In 1250 BC the walls of Jericho (Jehosuah III and IV) collapsed, and as confirmed by recent excavations also the town. In 220 BC, a moderate seismic event hit Rhodes, destroying the Colossus, the wharf and the fortress.

According to Buniyatov, from 30,000 to 150,000 people were killed in 893 during the collapse of masonry structures in the region of the present town of Maykop in the western Caucasus. Throughout history, many houses, churches, mosques and palaces, as well as whole towns and villages, built in plain masonry, have been flattened by earthquakes, in a vast area from Lisbon to

Karachi. The death toll was always impressive, even in the era of early civilisation where the population was scattered.

Among the most destructive events around the Mediterranean and in the Middle East, one should be impressed by the following number of people killed: 70,000 in Damascus (847), 45,000 in Tunis (856), possibly 200,000 in Qumis Damghan, Iran (856), 230,000 in Ganzah, Syria (1138) 70,000 in Naples (1626), 30,000 in Tabriz, Iran (1641), 80,000 in Shemala, USSR (1667), 20,000 in Algiers (1715), 77,000 in Tabriz (1727), 40,000 in Cairo (1754), 62,000 in Lisbon (1755), 60,000 in Calabria, Italy (1783), 58,000 in Messina, Sicily (1908), 32,000 in Marsia, Italy (1915), 30,000 in Erzincan, Turkey (1939) - most of them killed due to the collapse of masonry structures. From the same cause, many more have died in India, Japan, Ecuador and Java.

It is also worthy of note, that the average death toll, during earthquakes, has increased significantly in Japan, China and India since the beginning of the century, due both too the sharp increase in population and the new trend of architecture that uses masonry material.

Of course, such a disastrous situation is not as acute in Northern Europe, simply because of its low seismicity. However, one should be aware that population density is high, and that masonry constructions are favoured by builders due to a vast range of architectural qualities and low costs, particularly in the housing sector.

Awareness of the population, as well as that of governmental authorities, to the earthquake threat fades very quickly in low seismicity areas. We must realise however, that small magnitude earthquakes do happen regularly and are capable of inflicting serious damage, in particular to masonry structures.

For the past 150 years, events in the UK, Northern France, Belgium, Holland and Germany have occurred and damaged structures, at an average rate of one every 10 years. Since the seismicity is diffuse in the region, that is, it cannot be attributed to an obvious active geological accident or fault, we should assume that any area, including major cities can be hit at any time.

For this purpose, one should recall a few earthquakes that, so far, have missed our major cities, but have still entailed damage: Colchester (1884), Derby(1903), Doncaster (1905), Swansea (1906), Cornwall (1925), Hereford (1926), Calvados (1927), North Sea - south (1931), Brussels (1932), Dixmunde (1933), Hainault (1938), Derby (1957), Liege (1983) and North Wales (1984).

In the past, the main reason for such disasters was that the behaviour of construction material was not clearly understood and, a fortiori, the very poor seismic dynamic performance of masonry in earthquake situations.

However, these days, much work has led to a better knowledge of structural response, earthquake loading process and the way in which they interact. Good results have already been obtained with reinforced concrete and steel materials, which have captured most of the research energy of this century and are properly accounted for in codes of practice, be they static or dynamic (that is earthquakes). Oddly enough, we still refuse to accept that masonry material does not react like concrete or steel.

It is unfortunate that we still consider masonry, subjected to earthquake loading, in the same way we consider it under static loading; that is a compressive only material. Since it also possesses different particularities, large mistakes may occur as a result, in particular when equivalent static procedure are used.

Masonry is a low compression strength material with negligible and non-reliable tensile strength and low ability to deform. In static conditions, designers have overcome these limitations by designing structural shapes so that no tension ever originates in the various sections. As a result structures are usually massive and extremely rigid. Even remarkable structures such as Gothic cathedrals, in which elegant solutions, such as roman ogive arcs, buttresses and ties, have been employed, showing an exceptional grasp of the laws of statics for the time, mass and rigidity are still the rule.

As such, masonry structures attract very high seismic forces. The poor tensile strength makes them inadequate to sustain cyclic actions. The low ability to deform, subjects them to a rapid and total rupture. Vertical load carrying elements, in particular, are highly vulnerable.

As dynamic strains reach yield level, no ductibility is available in plain masonry to absorb seismic energy, so that immediate rupture occurs. It is therefore extremely dangerous, when designing masonry, and where proposed design spectra apply predominantly to reinforced concrete and steel materials for which, at least some ductibility may be available, enabling the seismic forces to be reduced. This is not the case for brittle materials, such as masonry, for which the true elastic spectrum, exhibiting large dynamic amplifications, should be used. Using reduction coefficients for masonry in a similar way to that of reinforced concrete or steel, is unhealthy and this should be clearly affirmed.

It may be argued, that in areas where only small magnitude events are probable, seismic excitations are so small that most of the new constructions will sustain the actions. This ignores two fundamental factors. The first is that small events generate predominantly high frequencies, which are happily amplified by stiff structures. In addition, and to the contrary of other structures of major size, any degradation in stiffness due to crackings and loss of integrity, results in a significant increase of the dynamic amplification.

The second, oddly, is due to the good mastering of the static situation. The behaviour of masonry buildings and, in particular housing is, today, so well established that structural safety margins are reduced to their absolute minimum. Enormous economic pressures also push in this same direction.

Indeed, solutions to the poor dynamic performances of masonry do exist in the form of reinforced masonry and they are widely used in the US and in New Zealand. However, it would be unwise and uneconomical to copy this technology in Northern Europe where low seismicity does not justify the design effort nor the extra expense. Besides, if one wants to apply them seriously, such solutions require enormous power in analysis, since modelling masonry structures is a formidable task; they have complex shapes with many 3D interactions and torsional effects.

Instead, I believe that it will be fruitful to gather simple observations of the most common types of masonry failure encountered in Northern Europe, and to extract simple philosophy for constructive rules. We should realise from them, that a greater efficiency could be obtained, without any calculation, by simply emphasising fundamental rules relating to topography, foundation conditions, shapes, symmetry, bracing, ties, floor and timber stiffness, or by limiting complex shapes and overhangs.

A simple construction guide, designed for architects and builders, not relying heavily on dynamic concepts, but on common sense, will no doubt be more efficient than expensive designs and drawings and will fill the gap created by advanced seismic codes, such as Eurocode 8. It is crucial that we should recognise that, at least for low rise constructions, when basic principles are satisfied, computations are hardly needed, since sound behaviour will follow automatically.

Dr. J.M. Menu

## SECED MEETINGS

Reports on two past meetings are included. The first by John Maguire on the NAFEMS meeting of the 22nd November 1989, the second by Brian Ellis on the Integrity Monitoring meeting held on 25th October 1989.

### The NAFEMS Dynamics Benchmarks

### Meetings held at ICE, Wednesday, 22nd November 1989

Speaker: Prof. Alan Morris,
Cranfield Institute of Technology
Reported by: Dr. John Maguire

NAFEMS (The National Agency for Finite Element Methods and Standards) is a national agency owned, controlled and funded by NEL on behalf of the DTI. Since its foundation in 1983 it has grown in size and currently comprises a secretariat, steering committee and nine working groups, carrying out various studies for the benefit of its membership and industry. One of NAFEMS most important publications is a set of benchmark tests for finite element systems covering linear statics, dynamics, thermal, fatigue, fracture and non-linear problems. In this talk Prof. Morris introduced the static, dynamic and non-linear benchmarks which are of particular interest to Civil and Structural engineers. He also introduced two NAFEMS publications, firstly the GUIDELINES (a compendium of good practice, advice on modelling, rules for executing an analysis and how to present results) and secondly the PRIMER, which gives general advice (and theory) relating to aspects of static, dynamic and non-linear analysis.

The question of accreditation of finite element (f.e.) users was raised. It is foreseen that companies engaged in f.e. analysis, wishing certification to BS5750 Part 1/ISO9001, will be assessed against a "Quality System Supplement" relating specifically to f.e. practice. The NAFEMS benchmarks may, in these instances, be useful in demonstrating technical competence of users and systems, thereby reducing the possibility of negligence claims in cases of disasters or accidents where f.e.. analysis was involved. The educational value of the benchmarks was also emphasised.

### Integrity Monitoring

### Meeting held at Heriot-Watt University, Wednesday, 25th October 1989

### Reported by Dr. Brian Ellis

On 25th October an evening meeting was held at Heriot-Watt University to discuss Integrity Monitoring. Four speakers, who were involved with monitoring different types of structures or structural elements, each gave a 20 minute presentation.

The first speaker was Iain McGregor from W.A. Fairhurst and Partners and his topic was Monitoring of Offshore Structures. With offshore structures where there is a large degree of uncertainty in design assumptions and a large cost of failure, the idea of monitoring the structure in order to provide feedback on structural behaviour and environmental conditions has many merits. A steel jacket structure was given as one example of an offshore structure which had been instrumented using accelerometers, strain gauges, pressure sensors, settlement gauges and instruments to monitor the environment (wave height, temperature etc.). Formerly data were recorded on the rig and returned to the office to be analysed. More recently, the installation of a computer has enabled data analysis on the rig as well as logging the raw data on tape. The gain from the monitoring was that mathematical models could be compared with measurements thus providing more confidence in calculations, leading to larger acceptable work loads; and knowledge of the observed sea states led to much improved estimates of fatigue damage and resulted in a longer estimated fatigue life.

David Cullington from TRRL then spoke about Monitoring of Bridges. TRRL had undertaken a series of ad-hoc experiments to see whether Non-Destructive Tests would provide information to help in assessing the condition of bridges. An engineer inspecting a bridge can gain most information from a visual inspection, but a method of assessing damage in an existing bridge e.g. in the event of problems like ASR, would provide a substantial aid in routine inspections. The problem is whether a NDT test will provide information relating to damage. NDT tests using vibration measurements can provide good measurements of the frequencies of modes of vibration of bridges. Damage to bridges sometimes results in a reduction in stiffness and hence a change in frequency, but frequencies also vary considerably with temperature and it is very difficult to separate real effects from spurious ones,, especially when the spurious effects cannot be predicted accurately. Data from a number of experiments were given to illustrate these points. Also damage may not necessarily lead to a change in stiffness, hence although NDTs may yield information useful for serviceability assessments they do not provide answers when assessing damage in bridges.

Neil Casey from NEL then spoke about Acoustic Emission in Wire Ropes. NEL have been involved in research work determining the fatigue behaviour of large steel wire ropes (dia > 14mm) to provide an experimental data base and improve fatigue life assessment. The fatigue loading was applied to specimens in the laboratory until failure occurred and the tests were monitored to provide information on stiffness, hysteresis, elongation and temperature. Damage occurs in the form of wire strands breaking, most of which cannot be seen although they can be monitored. The comparison between measured changing characteristics and acoustic emission yields several distinct relationships, e.g. with 70mm dia ropes a distinct increase in acoustic activity marks the last 10-20% of their life. Examples were given for various sizes of rope, and correlations between property changes and acoustic emission and how these measurements can be successfully used to predict the fatigue life of the ropes.

Finally John McCarther of Heriot-Watt University spoke about his work on the Condition Monitoring of Concrete. Work on measuring the electrical properties of concrete has been undertaken since the 1930's initially measuring resistivity. A concrete specimen can also be represented as a parallel capacitor and resistance and if these parameters are measured as a function of time and frequency much more information can be obtained e.g. at high frequencies there is a sharp peak in the dielectric constant (related to capacitance). These properties, which are measured up to 24 hours after the specimen has been cast, vary between different concretes and can be used to study the behaviour of additives e.g. retarders, and provide a diagnostic technique for monitoring the setting and hardening properties. This provides a potentially useful means for quality control in concrete. Other uses of electrical measurements in hardened concrete were mentioned including the effects of cyclic wetting and drying, evaluating the quality of concrete cover and monitoring the motion of water through the concrete. This was the first SECED meeting in Scotland for a number of years and it is a pity that only 20 people were present to hear four interesting presentations. The help and facilities provided by Heriot-Watt University were excellent and the SECED committee are very grateful to the Department of Civil Engineering and especially John McCarther for sorting out the arrangements at the University.

<u>**Future SECED Meetings are as noted below:**</u>

| | |
|---|---|
| Tuesday<br>16th January<br>**NB AT**<br>**Risley, Lancashire** | **Design Criteria For Nuclear Structures**<br>One day seminar joint with the<br>Institution of Structural Engineers |

| | |
|---|---|
| Wednesday<br>14.00<br>24th January<br>**NB AT**<br>**BRE, Garston,**<br>**Watford.** | **Blast and Impact Analysis in Civil Engineering**<br>Impact Testing and Analysis at Winfrith;<br>Vapour Cloud Explosions;<br>Birdstrike on Aircraft: Computer Simulation. |
| Wednesday<br>28th February<br>2.30-5.30 pm<br>**NB AT**<br>**Inst. of Struct. Eng.** 11 Upper Belgrave St., SW1 | **Eurocode 8 (Structures in Seismic Regions): The UK Response.**<br>The UK comment on final draft of EC8 has to be made by August 1990; this meeting provides an opportunity for members to express their opinions on the draft. |
| Wednesday<br>21st March<br>5.00 for 5.30 pm<br>**NB AT**<br>**Imperial College.** | **The Work of the NCEER, at Buffalo and its Relevance to the UK.**<br>S. Brown, D. Muir Wood, C. Taylor, A. Elnashai, E. Booth. |
| Wednesday<br>25th April<br>10.30 am<br>**AT ICE**<br>17.30 | Full day meeting on SHWP work.<br>Further details to be announced.<br>Followed by Annual General Meeting. |
| Wednesday<br>30th May<br>5.00 for 5.30 pm<br>at ICE. | Joint Meeting with EEFIT<br>Further Details to be Announced.<br>(will include EEFIT AGM) |

## CONFERENCE CALENDAR

Of immediate interest are the following three dates for members' diaries:

### 2nd February 1990 at Institution of Structural Engineers London

EEFIT have sent a team to the recent earthquake in Newcastle, Australia and an open meeting has been arranged at the above venue. It is considered that space is likely to be limited. Therefore if any members are interested in attending this meeting, please make prior contact with the Institution or with Steve Ledbetter at University of Bath.

### 7th February 1990 at the Queen Elizabeth II Conference Centre London

A one day conference is being organised by the British Consultants Bureau on "Disaster Relief and Mitigation". Cost of the conference £95 plus £14.25 VAT for BCB Members and £185 plus £27.75 VAT for Non-members. Further details should be obtained from the British Consultants Bureau, 1 Westminster Palace Gardens, 1-7 Artillery Row, London SW1P 1RJ (Tel. 01-222-3651).

### 15th February 1990 at the ICE, London

The Appropriate Technology Panel of the ICE is holding a half day meeting, starting at 2.00 pm entitled 'Reconstruction after disaster'. The meeting will be addressed by speakers from EEFIT, Engineers for Disaster Relief (REDR) and representatives of aid and UN agencies. Admission is free and open to all.

Conferences for later in the year of which we have details are as follows:

| TITLE | DATE | LOCATION | ORGANISER |
|---|---|---|---|
| Structures - Today and beyond 200 | 9.5.90 - 11.5.90 | Glasgow | I.Struct.E |
| European Conference on Structural Dynamics (EURODYN 90) | 5.6.90 - 7.6.90 | Germany | Ruhr-Universitat Bochum |
| International Conference on Vibration Problems in Engineering | 6.6.90 - 9.6.90 | China | Chinese Soc for Vibration Engineering |
| 9th European Conference on Earthquake Engineering | Sept. 1990 | Moscow | Soviet Comm. on Earthquake Engineering |
| 2nd International Conference on recent advances Geotechnical Earthquake Engineering and Soil Dynamics | 11.3.91 - 15.3.91 | St. Louis USA | University of Missouri - in Rolla |
| Measurement and Effects of Vibration (3rd SECED Conference) | Nov. 1991 | To be announced | SECED |

## 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 and Earthquake Engineering in Britain"
   (1st SECED Conference, 18-19 April 1985, University of East Anglia)
   Price: £30.00 (Spring 1988) from Thomas Telford Ltd.

3. *"Civil Engineering Dynamics"
   (2nd SECED Conferences, 24-25 March 1988, University of Bristol)
   Price: £30.00 pub. Due beginning 1990 from Thomas Telford Ltd.

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

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 Ltd.

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

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

11. *"1987 Mallet-Milne Lecture"
"Engineering Seismology" by N.N. Ambraseys. Volume 17 of Earthquake Engineering and Structural Dynamics (Special Issue).
Price £15.00 (Earthquake Engineering Subscribers, IAEE members, ICE members)
£25.00 Institutions, £15.00 Personal. Send order to Dept. AC, John Wiley & Sons Ltd., Baffins Lane, Chichester.

12. *"1989 Mallet-Milne Lecture"
"Coping with Natural Disasters" by G.W. Housner
Price: £10.50 to personal callers at Telford International Bookshop, ICE or direct from The Secretary, SECED, Institute of Civil Engineers, 25 Eccleston Square, London, SW1V 1NX. (Cheques payable to "Institution of Civil Engineers". Post free UK, plus 50p Europe, plus £1.00 elsewhere).

13. The Loma Prieta Earthquake (Santa Cruz, California) of 17th October 1989; Seismological, Geotechnical and Structural Field Observations. A report from Imperial College, London.
Price: £25.00
Contact: Dr. Elnashai at Imperial.

## 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 - Lloyds Register

Dr. P. Merriman - BNFL

C.R. Sharman - Allott and Lomax

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

**Representatives**

**Institute 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. Skipp - Soil Mechanics Limited

Dr. B.R. Ellis - Building Research Establishment

**Working Groups**

Engineering Seismology - Dr. D.M. McCann

Soils and Foundation Dynamics - Dr. B.O. Skipp

Structural and Civil Engineering Dynamics - Dr. B.R. Ellis

**Sub-Committees**

| | |
|---|---|
| Steering Committee: | Dr. Browitt, Dr. Kunar, E. Booth and D. Mallard |
| Mallet-Milne Lecture: | As Steering Committee |

| | |
|---|---|
| Newsletter: | C.R. Sharman, Dr. Aspinall and<br>Dr. J. Maguire |
| Membership: | Dr. Elnashai and Dr. McCann |
| Conference: | Dr. Kunar (Chairman),<br>Dr. Stubbs (Treasurer),<br>Dr. Maguire (Co-ordinator),<br>C.R. Sharman (Technical) |

## 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 :

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## 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 :

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## 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

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| 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)**