SECED NEWSLETTER

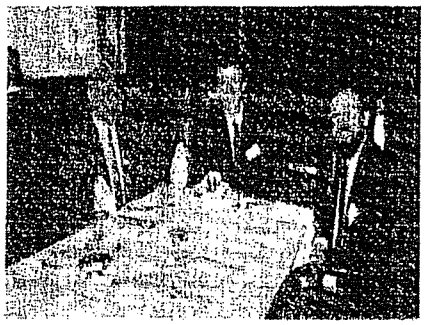
THE SOCIETY FOR EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS

October 1990. Vol. 4, No.4

9th EUROPEAN CONFERENCE ON EARTHQUAKE ENGINEERING

Editor's Note: This issue of the newsletter focuses on the 9th European Conference on Earthquake Engineering held during September in Moscow. There was strong support from the UK with over 20 papers presented by the British delegation. The abstracts of the papers are reproduced in a special conference supplement to this edition of the newsletter. The delegation was led by Dr. Bryan Skipp who gives us his personal impression of the proceedings in the article which follows.

Kypros Pilakoutas (Imperial College) with John Colloff (BNFL)



Edmund Booth & Jack Pappin (Ove Arup & Partners) with Russian counterpart

MOSCOW 1990

It was really quite an achievement to have a conference at all in the Moscow of Autumn 1990. Let me acknowledge the overwhelming friendliness of the Soviet organisers and participants and the almost intoxicating degree of openness which went a long way to make up for the deficiencies.

Most of the delegates were staying at the Cosmos Hotel, an hour's coach ride from the conference centre, and after a few hiccups the shuttle service performed adequately. The conference itself was intended to run three simultaneous sessions with distinguished lecturers giving a series of overviews. Only one session room could be blacked out and only one overhead projector was found. This was moved from room to room, keen presenters having to mount raiding parties.

As with all international gatherings the 'no shows' threw the time table into confusion. On this occasion the virtual absence of visual aids discouraged all but the most articulate from presenting their papers even though they may have been present.

There were significant compensations however; we had plenty of time to make contact with Soviet engineers, they came up and offered their CV's. There was an interesting exhibition with the UK end being kept up by Ove Arup and Partners and the Martin Centre. Booths showing Soviet instrumentation from the Institute of Physics of the Earth and heavy viscoelastic isolators from the Central Boiler and Turbine Institute, Lenningrad drew my attention.

The Proceedings appeared towards the end of the week, all sixteen volumes, which the least trusting of us lugged back. I have not yet had chance to read them.

SECED's bid for the 1994 conference fell at the first hurdle although it was acknowledged to have been the most 'serious'. After four secret ballots the run off was between the 'haves' who wanted to go to Reykjavik and the 'have nots' who could only manage the train fare to Vienna. The 'have nots' won, supported by the fence sitters and ballot switchers who noted that Austria had organised a very successful seminar in Carinthia in 1988. There was a consolation for the UK, perhaps in recognition of the quality of our conference bid, in that we retained our position on the Executive Committee of the European Association.

We had our munificent reception and an evening out to hear white Cossack songs! Ballet dominated the remainder of the entertainment. The Stanislavsky Ballet had taken over the Bolshoi for the Tchaikovsky Centenary Festival and the gala performance of Swan Lake on the last night of the conference was watched by a goodly SECED contingent. My most lasting impression will however not be the dancing and superb ensemble work but the preliminary declamation by the Director at the Government Box listing the dire straits of Soviet ballet and threatening a strike!

Bryan Skipp

SECED CONFERENCE 1991 - LATEST NEWS

The closing date for abstracts has now passed and 70 have been received. Contributions have been received from the UK, USA, USSR, Italy, Malaysia, Portugal, Greece, New Zealand, Taiwan, Canada and

China. A truly international conference is therefore guaranteed and the SECED Review Committee is carefully considering which papers should be invited. In addition, over 12 firms have expressed an interest in exhibiting and arrangements are now in hand to accommodate them. A conference programme and registration details will be published early next year - book early as places will be limited!

John Maguire
SECED 1991 Conference Chairman

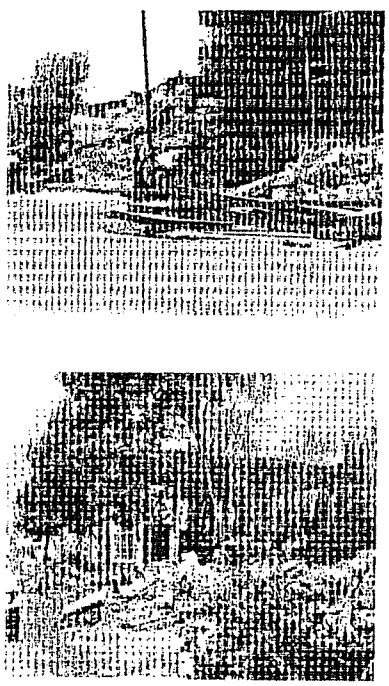
IRAN EARTHQUAKE, JUNE 1990

A contribution from the South Manchester Accident Rescue Team

The South Manchester Accident Rescue Team (SMART) was formed in 1987 to ensure that a small group of senior doctors experienced in pre-hospital care was always available to respond to a local incident, particularly where patients were trapped and crushed. Members are unpaid volunteers.

The team's first experience of a major disaster was in December 1988 at the Armenian earthquake, and 48 hours after our return at the Lockerbie air crash. Many useful lessons were learnt and incorporated into local plans for disaster management and future international disaster relief operations. The team continued to train with other branches of the emergency services.

On 21st June 1990, a massive earthquake struck northern Iran, killing thousands of people instantly and injuring many thousands more. The Red Crescent Organisation rapidly evacuated the most seriously injured by air to hospitals in Tehran, each area to a specific hospital. They provided food, fresh water, clothing and tents to those remaining in that desolate area. There had been broadcasts for supplies and not medical help, but the Iranians were pleased to accept assistance from a specialist surgical team, SMART. The invitation was received via the United Nations Disaster Relief Organisation (UNDRO) as the absence of diplomatic relations prevented direct communications between Britain and Iraq.



Total collapse of masonry buildings - the principal cause of the high fatality rate in the June 1990 earthquake

A team comprising three accident and emergency specialists, a general surgeon, a plastic surgeon, an intensivist, an anaesthetist and three nurses arrived five days after the first major "shock". We were sent to the Air Force Hospital, which did not have a plastic surgery department. After a warm welcome from the general in charge of the hospital we were taken to the wards to commence care of some of the injured.

One of the first was a six year old girl who had lost all her immediate family and had been trapped, alone, by pressure of building debris on her head and legs for 36 hours. She was very ill and required urgent surgery. An operating theatre and two senior theatre nurses were immediately made available to us. Thus began a week of intense work. While some of the team worked in a surgical environment, the others visited each of the wards in turn, examining wounds and providing new dressings, advising surgery where necessary and discussing with the Iranian doctors whether they wished us to carry this out. Advice was also given on the treatment of some of the more seriously ill patients on the Intensive Care Unit. There seemed to be a shortage of dressings and intravenous fluids and they were grateful for our supplies. We were told that all eight operating theatres had been working continuously throughout the night of the earthquake. The human impact of the disaster was encountered at each bedside with repeated stories of suffering, disability and fragmentation of families.

While there is an obvious need for immediate medical help following a disaster, the team has demonstrated that the need for specialist medical expertise continues well after hope of finding survivors has been lost.

CONTINUING AIMS OF SMART

To establish a national centre for the co-ordination of the medical response to disasters.

To establish an equipment bank which would enable a small team to respond rapidly to any type of disaster, in any location.

To establish a training programme for doctors and nurses involved in disaster management.

Marion Waters
Accident & Emergency Surgeon
& SMART Team Member

EEFIT FIELD INVESTIGATION OF THE PHILIPPINES EARTHQUAKE, JULY 1990

At 1626 hours local time on 16th July 1990, a major earthquake (Ms = 7.8) struck the island of Luzon in the Philippines. 1600 people are known to have died, a further 1000 are reported missing and 3000 were injured. 90,000 people were rendered homeless and billions of dollars of damage resulted.

15 days after the earthquake, a three engineer team from EEFIT, the UK post earthquake field investigation team, arrived in the Philippines and spent 9 days in country. The team consisted of Edmund Booth

(Ove Arup & Partners, London), Adrian Chandler (University College, London) and Philip Wong (Ove Arup & Partners, Hong Kong). Chandler's expenses were met by the SERC, while Booth and Chandler were funded by their employers.

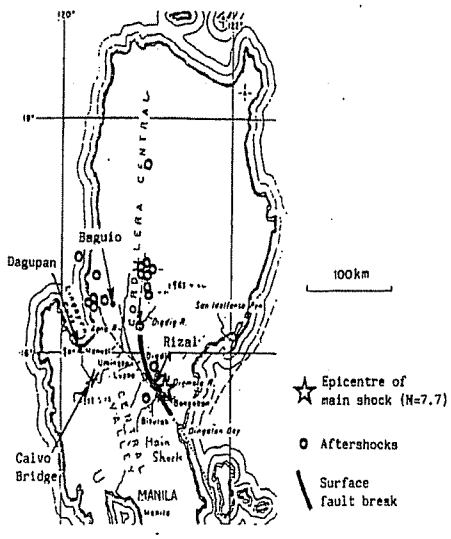
During the visit the team had fruitful discussions with a large number of local and foreign investigators of the earthquake, including the Philippines Institute of Volcanology and Seismology, the US Geological Survey and the New Zealand National Society for Earthquake Engineering. The team also received very generous logistic support from a number of Filipino companies, particularly First Pacific Land Inc. and the Ayala Corporation.

The earthquake was significant for a number of reasons,

It caused the collapse of a large number of medium rise reinforced concrete buildings in the mountain resort of Baguio. They were generally less than 20 years old and were nominally designed to US codes. The collapsed buildings, which were mainly hotel and educational establishments, were founded on weathered rock, often on steep slopes. The percentage of low rise buildings affected was much lower. Baguio was at least 20 km from the main fault break, although it may have been closer to the source of secondary earthquakes. It appears that amplification of low frequency motions may have taken place, an unusual feature on a rock site.

A surface fault break about 100km long was observed, on which horizontal movements of up to 6m were recorded. The fault break passed through the middle of a small town called Rizal and the relative movement caused the collapse of a number of buildings and a concrete bridge straddling the fault. Significantly, however, the damage to bridge and building structures in Rizal adjacent to, but not spanning, the fault was much less than expected.

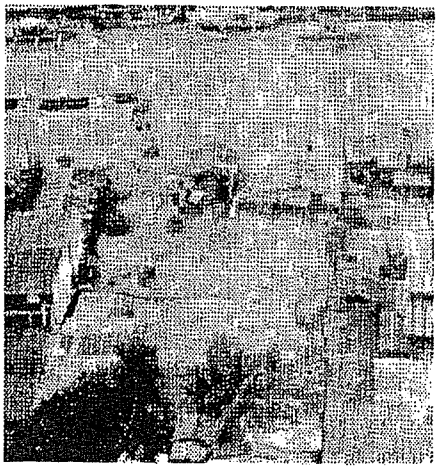
Liquefaction was experienced over a wide region, up to 70km from the fault break, causing gross foundation movements and collapse in a num-



Map of epicentral area

Tilted building, Dagupan

Bridge at Rizal, torn apart by fault break



Area of liquefaction induced settlement

Calvo Bridge, abutment has moved several metres

Hilltop Hotel, Baguio, one of the main medium rise concrete buildings that collapsed

ber of building and major bridge structures.

An initial debriefing to EEFIT members was held at the Institution of Structural Engineers on 21st August. The team is currently working on a full report and is preparing a set of annotated slides of the earthquake.

Edmund Booth, Adrian Chandler

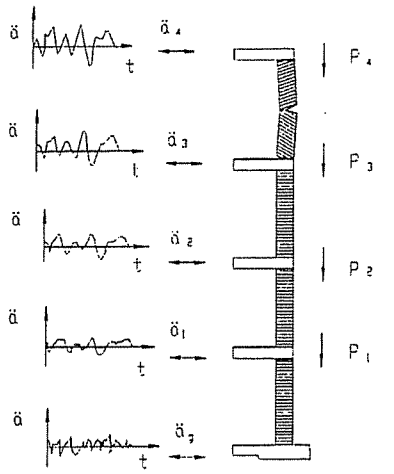
SEISMIC RESISTANCE OF MASONRY

A well attended meeting at the Institution of Mechanical Engineers on 26th September heard Dr. Robin Spence of the Martin Centre, Cambridge University and Dr. Jean Menu of Seismotech Ltd. present an excellent paper on the seismic resistance of masonry. Robin Spence introduced the subject by reviewing the experience of masonry construction in earthquakes and explaining the reasons for poor performance. Deriving from these observations the requirements for satisfactory performance were identified. Investigation of mechanical properties and testing has improved understanding and provided a basis for developing improvements in the form and detailing of masonry construction. The limitations of the material have also been quantified. Jean Menu examined the factors which influence seismic design and a brief summary of his talk is given below.

SEISMIC DESIGN OF MASONRY

Although masonry is one of the oldest construction materials, it has always paid a heavy tribute during earthquakes. The main reason for these disasters is that, due to its reluctance to be described by theoretical models, the mechanical behaviour of masonry material was poorly understood and therefore little specific seismic solution was brought into the design.

Recent research in New Zealand and in North America has helped tremendously in developing a fair comprehension of masonry subjected to seismic actions. The material differs from other construction materials



Out - of - plane failure of masonry panels

used in seismic areas by several important aspects.

Masonry is a low strength material which produces massive and heavy structures. As a result high seismic forces are generated on the construction. Low period structures are also the rule.

The material degrades quickly in strength and stiffness as soon as the peak strength strain is reached. In the low period range, this results in an increase of the applied seismic forces.

Its limited ability to deform prevents large dissipation of seismic energy precipitating collapse.

Despite these insufficiencies, seismic design solutions exist and economical masonry constructions may reliably be erected.

In low seismicity areas, and for low-rise constructions good detailing is capable of achieving efficient protection against low and moderate events. Numerous field observations relating to topography, foundation conditions, symmetry, bracing, ties, floor stiffness, shapes are now available and simple rules could easily be implemented.

In moderate to high seismicity areas and for high rise buildings one should resort to reinforced masonry. Buildings using this technology and reaching 25 storeys are now commonly constructed in high seismic countries such as California in the United States and New Zealand. The introduction of a low percentage of reinforcement allows a significant increase in the available ductility in the flexural modes and large amounts of energy can be dissipated in plastic hinge zones. Due to the limited ductility available in shear, the rapid degradation and instability at high strain, shear failure modes should, however, be avoided at all costs.

Thanks to the development of this modern technology, one can expect changes in attitudes amongst architects and engineers regarding the masonry material, even in non-seismic countries. Structural masonry is no longer limited to low-rise ing medium-rise ones with a material widely appreciated for its architectural and economical qualities.

Dr. J.M. Menu, Seismic Consultant, Seismotec Ltd.

A Technical Note TN-016/E about the seismic design of masonry is obtainable from the author free of charge upon request.

NOTTINGHAM UNIVERSITY - SOIL DYNAMICS SEMINAR

A recent soil dynamics seminar held in the Department of Civil Engineering, University of Nottingham was attended by 25 researchers from various universities around the UK. The general theme of the seminar was the laboratory determination of the dynamic properties of soils and their numerical analysis.

The seminar was chaired by Professor Chandler, SERC co-ordinator who presided over seven contributions.

Dr. Vaughan Griffiths, who was on study leave in the US, presented the results of a dynamic analysis of the Long Valley Dam, California. He showed predictions of vertical and horizontal crest movement on 2D and 3D models.

Professor John Atkinson described

NOTABLE EARTHQUAKES JULY - SEPTEMBER 1990

Reported by British Geological Survey

YEAR	DAY	MON	LAT	LON	DEP KM	MAGNITUDE ML	MB	MS	LOCALITY
1990	10	JUL	52.699N	2.761W	8	2.1			SHREWSBURY, SALOP
			Felt at Shrewsbury, Telford and Clun (Io = IV MSK)						
1990	16	JUL	15.658N	121.227E	25		6.6	7.8	LUZON, PHILIPPINES
			At least 1,621 people killed, more than 3,000 injured and 90,000 homeless. Severe damage and landslides in the Dagupan - Caba natuan - Baguio area. Some damage in Bataan Province and at Manila						
1990	03	AUG	47.949N	84.958E	19		6.1	6.1	KAZAKH-XINJIANG BORDER REGION
			Eight people injured and about 500 buildings destroted in the Akkol area, USSR (Intensity VII MSK)						

some of the static and dynamic work being carried out at City University.

Matthew Raybould, Nottingham University, described the cyclic triaxial test facility developed at Nottingham University following the SERC earthquake initiative and presented some results of a project investigating the behaviour of clay contaminated silt subject to cyclic loading. Francis Chan discussed the need for studying the rotation of principal stress and development of the University of Nottingham hollow cylinder apparatus.

Dr. Adrian Hyde, Bradford University, presented models developed to predict the development of plastic strain and permanent pore water pressure for the highly plastic Japanese Ariake clay.

Steven Ring described the development of a triaxial testing facility for large size particulate media at Bath University and suggested areas for study when completed.

Dr. Andrew Chan defined the general principal behind modelling dynamic behaviour, programs that he has been involved with, and his proposal for areas of future work at Glasgow University.

Xiu Zeng, Cambridge University, presented the results of centrifuge tests on an anchored quay wall, highlighting the phase shift between the acceleration of the soil deposits and the quay wall as liquefaction sets in.

The seminar also included a visit to the research facilities at the University of Nottingham to see the Hollow Cylinder Apparatus and the digitally controlled Cyclic Triaxial Test Facility.

The discussion centred on the need for accurate laboratory determination of dynamic parameters, accepting that there are limitations of local strain measurement techniques. Maximum stiffnesses are best determined using geophysical techniques although local strain devices are invaluable for mid range values, for control purposes, and investigating soil behaviour in individual stress-strain cycles.
It is intended to hold a similar seminar in 1991. If anyone is interested in attending or contributing research or industrial presentations please contact Matthew Raybould at the University of Nottingham, Department of Civil Engineering, University Park, Nottingham, NG7 2RD.

Matthew Raybould.

BOOK REVIEW

"NUMERICAL METHODS AND SOFTWARE FOR DYNAMIC ANALYSIS OF PLATES AND SHELLS" by E. Hinton, Univ. Coll. of Swansea, UK (Pineridge Press, Swansea, UK, 1988)

This book, a sequel to "Finite Element Software for Plates and Shells" (Hinton, Owen et al 1984), deals with the dynamic analysis of plates and shells using closed form, finite strip and finite element methods. Theory, software and applications are presented in detail and six FORTRAN programs are listed and documented.

Chapter 1 describes in detail some closed form solutions for dynamic analysis of simply supported rectangular Mindlin plates which rest on elastic Winkler foundations. Pulse (patch) loadings are applied and solutions given for free vibration, buckling and forced response.

Chapter 2 presents a finite strip formulation for the free vibration analysis of plates of curved or rectangular planform and with two opposite ends simply supported. Software for a two-noded plate bending strip with reduced integration is given in which the stiffness and mass matrices and load vectors are given explicitly.

Chapter 3 presents the finite element free vibration and buckling analysis of initially stressed Mindlin plates. A "nearly ideal" 9-noded Lagrangian Mindlin plate element with enhanced shear interpolation has been used.

Chapter 4 presents various parametric studies using the element described in the previous chapter. Square plates with a variety of boundary conditions (simply supported, clamped, free) are studied, providing useful benchmark results.

Chapter 5 extends the subject of Chapter 3 by presenting the forced response of initially stressed plates. Sample solutions are given.

Chapter 6 presents a finite element formulation for the evaluation of the axisymmetric and asymmetric modes of vibration of complete solids of revolution. Examples are given for circular and annular plates.

Chapter 7 (by far the largest in the book) is concerned with three-dimensional, non-linear, transient dynamic analysis with special emphasis on plate and shell structures. Two types of structural material are considered: steel and reinforced concrete. Eight and twenty-noded, hexahedral, isoparametric finite elements are used in the spatial discretisation.

Additional notes, followed by an Author Index and Subject Index, complete the book.

This book has much to recommend it to experts and academics. Although probably not suitable for the "average" engineer, it will be of interest to those with a structural dynamics background. It is structured as a collection of related papers rather than as a textbook. There is a concise theory section in each chapter, many practical examples are given, and complete program listings are given (also available from the author on magnetic tape or floppy disc). As a source of benchmarks it is useful, and the chapter on non-linear transient dynamic analysis of steel/reinforced concrete is particularly worth reading as an overview.

John Maguire

LETTER FROM AMERICA

At the University of Missouri-Rolla Department of Civil Engineering we are developing a method for designing retaining walls under earthquake loadings, allowing for displacements that result from both sliding and rocking. We would like to test our analytical method using performance records of walls during actual earthquakes. Such performance data is very limited in published literature.

We are, therefore, soliciting information on actual measured or monitored displacements of rigid retaining walls, caused by both sliding and rocking induced by earthquakes. The following information is also needed for each case:

Type of soil (boring log at or near site). If any soils investigation report is available, it will be welcome.

Recorded ground motion at or near site.

Cross-section of the retaining wall.

Measured displacements at the base, top and any other points along the wall.

This information is needed to compare the computed sliding and tilting displacements of the wall with the observed displacements.

As a token of appreciation for the above information, we will make available our complete report, together with the computer program used to compute the displacements.

Please contact:

Dr. Shamsher Prakash,
Professor
Civil Engineering Department,
University of Missouri-Rolla,
Rolla, Mo. 65401 USA.

Tel: (314)341 4489
Telefax: (314)341 4729

CALL FOR PAPERS

Institution of Civil Engineers
International Conference

CIVIL ENGINEERING IN THE NUCLEAR INDUSTRY

Low Wood Hotel, Windermere, UK
20-22 March 1991

Contact:

Institution of Civil Engineers
1-7 Great George Street,
London. SW1P 3AA,
UK

FOURTH INTERNATIONAL CONFERENCE ON SEISMIC ZONATION
for Safer Construction and Reduction of Life and
Property Losses from Future Earthquakes
August 26-29, 1991
San Fransisco Bay Region, California, USA

Contact:

John A. Blume
Earthquake Engineering Center,
Department of Civil Engineering,
Stanford University,
Stanford,
California 94305-4020

COURSES

University of Bristol Earthquake Engineering Research Centre

EARTHQUAKE ENGINEERING COURSE

A residential course will be held at the Holly Royde Conference Centre, University of Manchester, from 7-9th January 1991. The provisional programme will be:

Monday

0900-0930 Registration and coffee
0930-1100 Earthquake damage and lessons learned, followed by discussion
1130-1245 Earthquake hazard assessment
1400-1500 Ground motion modelling
1530-1700 Theory of structural dynamics

Tuesday

0900-1000 Response spectrum methods of dynamic analysis
100-1100 Other methods of dynamic analysis and sub system analysis
1130-1245 Equipment qualification using an earthquake simulator
1400-1515 Seismic design codes, lateral force and capacity design methods

1545-1700 Foundations and soil dynamics. Soil-structure interaction

Wednesday

0900-1030 Reinforced concrete design
1100-12145 Structural steel design
1400-1515 Masonry design
1545-1700 Panel question and answer session

For further information please contact:

Dr. Roger Moses,
Engineering Continuing Education,
Faculty of Engineering,
University of Bristol,
Bristol. BS8 1TR.

Tel: (0272) 303030 Ext. 4630
Fax: (0272) 251154

WHAT'S ON

Wednesday, 31st October
SECED Meeting

Introduction to Non-linear Transient Dynamics

Dr. R. Keene

5 for 5.30 pm, Institution of Civil Engineers

Wednesday, 28th November
SECED Meeting

Assessment of Seismic Hazard and Risk in the UK

Dr. J.W. Pappin

5 for 5.30 pm, Institution of Mechanical Engineers

FORTHCOMING EVENTS

Wednesday, 30th January 1991
SECED Meeting

Earthquake Protection Planning in Mexico City

Dr. A. Coburn

5 for 5.30 pm, Institution of Civil Engineers

Wednesday, 27th February 1991
Joint EEFIT/EFTU Meeting

Reports from the Field on Recent Earthquakes in Algeria

Several speakers

5 for 5.30 pm, Institution of Civil Engineers

Monday, 11th March 1991
University of Missouri

Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics

St. Louis, USA.

Wednesday - Friday, 20th-22nd March 1991
ICE International Conference

Civil Engineering in the Nuclear Industry

Low Wood Hotel, Windermere

Wednesday, 27th March 1991
SECED Meeting

Understanding Earthquake Source Processes and their Implications for Engineers

Prof. B. Bolt

2 for 2.30 pm, Institution of Civil Engineers

Wednesday-Friday, 17th-19th April 1991
Joint Inst. Struct. E./BRE Three Day International Seminar

Structural Design for Hazardous Loads - The Role of Physical Testing

Convener: Dr. F.K. Garas

The Old Ship Hotel, Brighton

Wednesday, 24th April 1991
SECED ½-day Workshop

Soil-Structure Interaction

Introduced by Dr. B.O. Skipp

2 for 2.30 pm, Warrington

Wednesday, 29th May 1991
Mallet Milne Lecture

Reduction of Vibrations

Prof. G. Warburton

5 for 5.30 pm, Institution of Civil Engineers

Thursday-Friday, 22nd-23rd August 1991
American Society of Civil Engineers

The 3rd US Conference on Lifeline Earthquake Engineering

Contact Dr. M. Cassaro, Louisville, USA.

Monday-Thursday, 26th-29th August 1991
Fourth International Conference on Seismic Zonation

John Blume Earthquake Engineering Center, Stanford, California, USA.

Monday-Saturday, 26th-31st August 1991
NZ Nat. Soc. Earthq. Eng.

Pacific Conference on Earthquake Engineering

Auckland, New Zealand.

Wednesday-Friday, 18th-20th September 1991
3rd SECED Conference

Earthquake, Blast and Impact Measurement and Effects of Vibration

Organising Chairman, Dr. J. Maguire.
UMIST, Manchester.

RECENT PUBLICATIONS

"Directory of Practitioners in Earthquake Engineering and Civil Engineering Dynamics", Issue No. 2, April 1988.

"Earthquakes and Earthquake Engineering in Britain", 1st SECED Conference, 18-19 April 1985, University of East Anglia.

"Civil Engineering Dynamics", 2nd SECED Conferences, 24th-25th March 1988, University of Bristol.

"The Mexican Earthquake of 19th September 1985", A field report by EEFIT, 1988.

"The San Salvador Earthquake of 10th October 1986", A field report by EEFIT, 1987.

"The Chilean Earthquake of 3rd March 1985", A field report by EEFIT, 1988.

"EEFIT Constitution and Aims and Methods", booklet.

"Earthquake Design Practice for Buildings", David Key, 1988.

"Dams and Earthquake", A conference held at the ICE 1st-2nd October 1980.

"Earthquakes", Books, pamphlets and serial publications of interest to earthquake engineers, Thomas Telford Ltd.

1987 Mallet-Milne Lecture, "Engineering Seismology", by Prof. N.N. Ambraseys. Volume 17 of Earthquake Engineering and Structural Dynamics (Special Issue)

1989 Mallet-Milne Lecture, "Coping with Natural Disasters", by Prof. G.W. Housner

The Loma Prieta Earthquake (Santa Cruz, California) of 17th October 1989; Seismological, Geotechnical and Structural Field Observations. A report from Imperial College, London.

COMMITTEE

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International Seismological Centre

ORGANISATION OF SUB-COMMITTEES

Steering Committee
Mr. Booth, Dr. Elnashai, Dr. Browitt, Mr. Mallard and Dr. Ellis

Mallett-Milne
As Steering Committee, helped by Drs. Skipp and Kunar as necessary.

1991 SECED Conference
Dr. Maguire (Chairman),, Mr. Barr and Drs. Kunar, Steedman, Browitt (Treasurer), Merriman and Elnashai

1994 EAEE Conference
Mr. Booth and Drs. Elnashai and Skipp

Newsletter
Mr. Hinings (Editor) and Dr. Aspinall

IDNDR
Drs. Adams, Aspinall and Browitt (Brief to monitor and promote SECED's interest and support for the IDNDR)

Membership
Dr. Elnashai and Mr. Raybould

Research & Education
Mr. Booth and Drs. Key and Elnashai

SECED NEWSLETTER

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 Nigel Hinings, Editor, SECED Newsletter, Allott & Lomax, Fairbairn House, Ashton Lane, Sale, Manchester. M33 1WP.

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SECED NEWSLETTER

THE SOCIETY FOR EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS

October 1990. Vol. 4, No.4

9ECEE SUPPLEMENT

PAPERS PRESENTED BY THE UK DELAGATION

Over twenty papers covering the topics of engineering seismology, seismic hazard assessment, structural and soil dynamics and structural design and testing were presented at the 9th European Conference of Earthquake Engineering by representatives from UK universities and industry. The abstracts of the papers are reproduced in this special supplement to the October edition of the SECED Newsletter. The papers can of course be found in entirety in the conference proceedings.

UNIFORM MAGNITUDE RE-EVALUATION OF EUROPEAN EARTHQUAKES ASSOCIATED WITH STRONG MOTION RECORDS

The paper presents uniformly calculated surface-wave magnitudes of earthquakes in the European area and adjacent regions associated with strong-motion recordings. Seismic moments and body wave magnitudes are also estimated, that may be used in the derivation of attenuation laws. Using a more complete set of data the attenuation law derived for western North American earthquakes is modified for surface-wave magnitudes.

Professor Ambraseys, Imperial College London

ATTENUATION OF DESIGN ACCELERATION FROM INTENSITY DATA

The paper presents a practical technique to define a regional attenuation law expressed in terms of effective or design acceleration derived from local macro-seismic intensity data. A possible definition for an effective peak acceleration if given. Examples of such derived formulae are given for regions of different expected focal depths.

Jean Menu, Seismotec Ltd.

DURATION OF STRONG MOTION IN EARTHQUAKES

Duration of strong motion plays an important part in causing damage during earthquakes. From the investigation of strong motion records, it appears that the duration of pulses along with their number follow a pattern. The duration of pulses as well as their number above a given acceleration level follow exponential relationships. Statistical investigation relating the duration with magnitude and distance of the source shows no conclusive correlation even though analytical formulation shows that duration should be more or less independent of the distance and at far source, duration decreases slowly with distance. Statistical investigation merely shows the inadequacy of the data.

Sarada Sarma, Imperial College London
Brian Casey, Peter Fraenkel & Partners

ON THE USE OF MICROEARTHQUAKE NETWORKS IN SEISMIC HAZARD ASSESSMENT IN BRITAIN

Microtremor networks have been operated around the potential sites of British PWR nuclear reactors at Hinkley Point in Somerset, Dungeness in Kent and at two locations in North Wales as part of a programme for the assessment of seismic hazard. Critical attention has been paid to the quality of the data obtained and advantage has been taken of recent software to explore the confidence which can be attached to the findings of the networks. During the periods of operation of the networks, eight microearthquakes have been recorded within 60 km of Hinkley Point, twenty-two close to the North Wales sites, but none within 60 km of Dungeness. Magnitudes range from 2.9ML down to -0.5ML. Well-constrained hypocentre locations indicate that mid- and lower crustal depths of origin are most common in the first two areas. Focal mechanism solutions for these events suggest that "mixed mode faulting" characterises current tectonic behaviour in both areas. These findings are exemplified by results from the Hinkley Point network. The direct and indirect implications for hazard evaluation procedures are discussed and the extent to which short term deployments of microearthquake networks may illuminate local seismicity is considered.

Bryan Skipp, Soil Mechanics Associates
Willy Aspinall, Aspinall and Associates
David Mallard, Nuclear Electric
Maureen Ritchie, British Geological Survey

THE USE OF INTENSITY IN EARTHQUAKE VULNERABILITY ASSESSMENT

The paper presents a historical development of intensity scales and development of damage descriptions of the MSK scale. The use of inten-

sity in vulnerability assessment is discussed and error assessment examined. Alternatives to intensity are considered.

Andrew Coburn, Cambridge University

THE NEED FOR FIELD STUDIES OF ENGINEERED STRUCTURES FOLLOWING DAMAGING EARTHQUAKES

The paper describes the work of the Earthquake Engineering Field Investigation Team, EEFIT, which has studied and reported on nine recent earthquakes. The aims and the methodology used for field work, dissemination of results and further research are considered. The case for greater European cooperation in this field is made using EEFIT's experience.

Stephen Ledbetter, University of Bath

INFLUENCE OF SITE RESPONSE ON SEISMIC GROUND MOTION IN REGIONS OF LOW SEISMICITY

The effects of site response has been studied for four different sites in the UK. The results are in the form of spectral accelerations and ratios. They indicate that significant amplifications can be expected at soil sites especially for low intensity excitation. All types of soil sites show amplification effects especially when the structure period matches the site period.

Jack Pappin, Ove Arup & Partners
Art Heidebrecht)
Paul Henderson) McMaster
Nove Naumoski) University

CODE PROVISIONS FOR ENGINEERED BUILDING STRUCTURES IN AREAS OF LOW SEISMICITY

An investigation is reported of the adequacy of current UK code provisions for providing resistance to earthquake effects in engineered building structures, allowing for the low level of seismicity applicable to the UK. A methodology is reported for defining appropriate design seismic loadings to provide a 'target level' of reliability against life threatening collapse due to earthquakes, commensurate with that implied by current UK wind strength requirements and by earthquake provisions elsewhere in the world. Current UK practice for engineered building structures is found to impart a considerable degree of earthquake resistance for areas of low seismicity, but some suggestions are made for possible additional strength, robustness and detailing requirements.

Edmund Booth, Ove Arup & Partners
Michael Baker, Imperial College London

THE PROPAGATION OF UNCERTAINTY IN SEISMIC DESIGN

Seismic design involves the coordination of technical contributions covering a wide variety of scientific and engineering disciplines. Unless carefully controlled, allowance for the inherent uncertainty associated with each task may lead to spiralling levels of conservatism, especially in areas of low seismicity where design levels of critical facilities inevitably are extrapolated from actual experience. The propagation of uncertainty has been investigated within the context of seismic design in Britain, particularly in regard to reprocessing plant.

Gordan Woo, Yard Ltd.
John Colloff, British Nuclear Fuels

REGIONAL VARIATIONS IN ASEISMIC DESIGN REQUIREMENTS FOR TORSIONALLY COUPLED BUILDINGS

The paper presents the results of a parametric study of torsional coupling effects in the response of asymmetric buildings to a series of strong-motion European and Western US earthquakes. The period dependency of the key response parameters is studied, and the regional variations in the torsional design provisions of the relevant aseismic building codes (ATC3 and Eurocode 8) are highlighted. It is concluded that torsional coupling is more pronounced in stiff, short period structures, particularly when the uncoupled torsional and lateral frequencies of the building are close. The results of analyses presented in this study using localised earthquake records give no justification for the significant differences in the earthquake-resistant design provisions of the two codes considered. Regional variations of torsional coupling effects have been found to be relatively small when compared with the influence of other parameters such as the static eccentricity ratio, uncoupled torsional to lateral frequency ratio, uncoupled lateral period and plan aspect ratio. A further detailed parametric study of these effects is currently in preparation.

Graham Hutchinson, University of Melbourne
Adrian Chandler, University College London

TORSIONAL EARTHQUAKE RESPONSE OF FRAME BUILDINGS TO EUROCODE 8 SPECTRUM-COMPATIBLE DESIGN MOTION

A set of tests are described in which idealised regular 4-storey frame models were subjected to an earthquake base input developed from the elastic design provisions of Eurocode 8. The tests were carried out on the SERC earthquake simulator at Bristol University, UK. The measured response of key asymmetric model configurations to the design earthquake are compared to calculated values based on dynamic modal analysis and codified equivalent static design procedures. It is concluded that both approaches are over-conservative for design of members on the edge of the building which is affected adversely by torsional coupling, but for the side where torsional coupling is beneficial to member forces the theory and code over-estimate the load reduction for highly asymmetric structures and hence seriously underestimate member design forces.

Richard Bassett, University College London
Mahmoud Maheri, W.S. Atkins
Adrian Chandler, University College London

TORSIONAL COUPLING EFFECTS IN THE INELASTIC SEISMIC RESPONSE OF STRUCTURES IN EUROPE

The paper presents results from parametric studies of the inelastic response of asymmetric structures designed in accordance with the base shear and torsional provisions of Eurocode 8. These structures are excited by three European strong-motion earthquake records having high, intermediate and low peak ground acceleration to velocity ratios. Evaluation of the torsional provisions of Eurocode 8 reveals some inadequacies in their application in the form of an eccentrically placed base shear. Recommendations for modifying the torsional provisions of Eurocode 8 in the light of this research have been given.

Xiaonian Duan) University
Adrian Chandler)College London

EARTHQUAKE INDUCED DISPLACEMENTS ON PRE-EXISTING SHEAR SURFACES IN COHESIVE SOILS

The paper is concerned with the earthquake induced displacements on pre-existing shear surfaces in cohesive soils. Results from ring shear tests have shown that during fast shearing the strength of such surfaces depends on the displacement and the rate of shearing. The results have been applied to the evaluation of the displacement of a sliding block model subjected to an earthquake. The analysis shows that the displacement of a soil mass sliding on pre-existing shear surface is influenced significantly by the behaviour of soil under earthquake loading conditions.

Theodora Tika, Ove Arup & Partners
Sarada Sarma) Imperial College
Professor Ambraseys) London

REFINED LARGE DISPLACEMENT NON-LINEAR DYNAMIC ANALYSIS OF STEEL STRUCTURES

A highly structured and efficient adaptive mesh refinement dynamic analysis program is described. The large displacement response is modelled by a newly-developed 'quartic' beam-column formulation, combined with realistic constitutive relationships for the non-linear response simulation. By starting the analysis with one element per physical member, and re-meshing where and when necessary, an accurate and optimally efficient dynamic response is achieved. Comparison with fixed-mesh analysis using traditional 'cubic' formulation demonstrates the potential of the developed approach.

B.A. Izzuddin) Imperial College
Amr Elnashai) London

SEISMIC RESPONSE OF EARTH DAMS ON ELASTIC FOUNDATIONS

The response of any structure, subjected to earthquakes, depends on the foundation on which it stands. Whether the foundation is rock or soil, it is never rigid. Depending on the relative rigidity of the foundation with that of the dam, some vibrational energy is lost through the foundation which is termed the radiation damping. In the past, this was usually taken care of by increasing the viscous damping factor in the structure but still considering the structure to be on a rigid base. However, there is some difference between radiation damping and viscous damping and how they affect the response. A radiation boundary condition is developed in two dimensions which is applied on a lumped mass model of dams and the results show the influence of the radiation damping which is of a different kind. The other parameters which affects the response and behaviour of a dam is also discussed in this paper.

Sarada Sarma. Imperial College London

THE APPLICATION OF DYNAMIC GEOTECHNICAL CENTRIFUGE MODEL TEST DATA TO DESIGN

Geotechnical centrifuge model tests have shown clearly that realistic data of the response of soil-structure systems to earthquake loading can be achieved and used to assess design approaches. In particular, it has been possible to explore the transition from an initial 'rigid' condition to a full collapse. Model tests of the response of anchored quay walls and of piled structures to earthquake loading have shown that degradation of soil-stiffness is a critical parameter governing the response of the system and determining whether or not a full dynamic failure condition is reached. These studies provide important guidance for designers seeking to understand the limits of application of their calculations.

Scott Steedman)
X. Zeng) Cambridge
A. Maheetharan) University

NON-LINEAR DYNAMIC ANALYSIS OF THIN WALLED STRUCTURES USING A GENERAL 48 D.O.F. SHELL ELEMENT

A multipurpose non-linear dynamic procedure for the solution of incremental finite element equations along with the associated description of a new 48 d.o.f. thin and curved shell element are presented and evaluated. Both geometric and material non-linearities are considered in the implementation. Important aspects of the proposed software such as, robustness, versatility and fast computation efficiency are assessed with respect to the most up-to-date published solutions. A variety of thin shell structures subjected to dynamic loading conditions is provided to highlight the overall validation and specific improvements of the present non-linear analysis.

Karim Chelghoum) Imperial College
Patrick Dowling) London
H.A. Moghaddam Sharif University, Tehran

A TWO DIMENSIONAL RADIATING BOUNDARY CONDITION FOR SEISMIC RESPONSE OF LARGE STRUCTURES

The response of any structure, subjected to earthquakes, depends on the foundation on which it stands. Whether the foundation is rock or soil, it is never rigid. Depending on the relative rigidity of the foundation with that of the structure, some vibrational energy is lost through the foundation which is termed the radiation damping. In the past, this was usually taken care of by increasing the viscous damping factor in the structure but still considering the structure to be on a rigid base. However, there is some difference between radiation damping and viscous damping and how they affect the response. Also, radiation boundary conditions exist in the literature which are either applicable in one dimensional vibration or in frequency domain solutions. A two dimensional radiation boundary condition is developed which can be applied in time domain solutions. This is applied on a lumped mass model of an earth dam and the results show the influence of the radiation damping which is of a different kind.

Sarada Sarma. Imperial College London

ON-LINE COMPUTER CONTROLLED DYNAMIC TESTING OF STEEL FLEXURAL MEMBERS

Further development of seismic codes based on capacity design concepts and behaviour factors calls for the use of verifiably accurate dynamic testing procedures. The paper describes a new on-line computer controlled testing facility that has been recently developed at Imperial College. Preliminary results from testing of two steel cantilevers are given. It is shown that careful selection of appropriate hardware and software results in a stable closed-loop control system with no detectable error accumulation. Comparison with analytical results in the linear range give excellent agreement. Discrepancies observed between experimental measurements and analysis in the non-linear range are attributable to inadequacies in the definition of the multi-surface plasticity model parameters.

Amr Elnashai)
Ahmed El-Ghazouli)Imperial College
Patrick Dowling)London

VERTICAL VIBRATION TESTS ON A SMALL-SCALE MODEL OF A CABLE-STAYED BRIDGE

A small scale dynamic model with artificial mass simulation of the specific cable-stayed bridge has been designed and built. Hammer, sinusoidal and random signal tests have been used to determine the vertical dynamic characteristics and damping of the model. In order to study the influence of the cables upon the damping characteristics of the bridge, two different models have been created. By using the shaking table at Bristol University two types of vertical seismic excitation were applied and the corresponding accelerations, displacements and moments in the critical sections were obtained. A comparison of the tests results with those obtained from the mathematical model of the prototype has also been made, to verify the mathematical model.

Mihail Garevsksi, Skopje, Yugoslavia
Professor Severn, Bristol University

EXPERIMENTAL OBSERVATIONS ON THE BEHAVIOUR OF REINFORCED CONCRETE WALLS UNDER CYCLIC AND EARTHQUAKE LOADING

Observations on the behaviour of model reinforced concrete (RC) walls subjected to cyclic and earthquake loading are given. The models, of scale 1:5 and 1:2.5 were tested using displacement-controlled cyclic loading and the Imperial College earthquake simulator. The results show that significant enhancements in the flexural strength can be achieved by re-arrangement of the longitudinal reinforcement, without compromising the shear capacity. It is also indicated that results from monotonic testing, or cyclic under a small number of cycles, are inadequate for the assured safety of RC walls subjected to strong ground motion. Conceptual design recommendations are highlighted.

Kypros Pilakoutas)
Amr Elnashai) Imperial College
Professor Ambraseys)

BEHAVIOUR OF REINFORCED CONCRETE WALLS SUBJECTED TO HIGH CYCLIC SHEAR

Presented in this paper are the first results from an experimental program on reinforced concrete structural walls of low shear ratio, subjected to high cyclic shear. A novel set-up is used to impose realistic loading and boundary conditions, thus representing the bottom part of a wall in a multi-storey building. The results presented indicate a behavioural pattern significantly different to that observed in previous investigations where a heavy loading beam was used at the top of the model. The data also points towards possible moderation of the stringent conditions imposed on the design in the plastic hinge zone, without significant loss in stiffness, strength or ductility.

Mario Lopes) Imperial College
Amr Elnashai) London