SECED NEWSLETTER

THE SOCIETY FOR EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS

January 1991. Vol. 5, No.1

INTERNATIONAL DECADE FOR NATURAL DISASTER REDUCTION

Recognising the increasing susceptibility of individuals and communities throughout the world to loss of life, property damage and social and economic disruption caused by such natural phenomena as hurricanes, earthquakes, wild fires, volcanic eruptions and floods, the United Nations General Assembly adopted a resolution in December 1987 identifying the last decade of the Twentieth Century as the International Decade for Natural Disaster Reduction (IDNDR).

The principal aim of the IDNDR is to capitalise on existing knowledge of the ways whereby the effects of these natural events can be mitigated. While much of that knowledge is available in the developed world, the risks of naturally induced disasters are chiefly to be found in Third World countries. The aim of the IDNDR is to foster the systematic transfer to, and the application of the relevant knowledge in, those countries and communities recognizably most at risk.

To develop an appropriate framework for the Decade, the UN Secretary General appointed an international ad hoc group of experts, with Dr. Frank Press (President of the US National Academy of Sciences) as Chairman. Following meetings of this group and of the UN Economic and Social Council, the UN General Assembly adopted a definitive resolution in December 1989 which inter alia called on all governments:

- to formulate national disaster mitigation programmes
- to participate in concerted international action to reduce the effects of natural disasters
- to establish, as appropriate, national committees in cooperation with relevant scientific and technological communities
- to encourage the provision of appropriate support from public and private sectors
- to take measures to increase public awareness of damage risk potential and the value of preventative and mitigation measures

The Disaster Unit of the Overseas Development Administration, a wing of the Foreign Office, is coordinating the UK response to the Decade and will form the central link in a network of relevant Government departments and agencies, channelling information on available UK expertise on hazard mitigation as well as dealing with requests for disaster relief, and providing advice and assistance with preparedness and preventative measures. The ODA will also be a focal point for harnessing and monitoring UK private and voluntary sector expertise and involvement in the Decade.

To that end, the Royal Society and the Fellowship of Engineering have agreed jointly to co-sponsor a UK Science, Technology and Engineering Committee for the IDNDR, under the chairmanship of the Foreign Secretary of the Royal Society. This Committee will provide a forum for discussion of the UK's scientific and technological input to IDNDR and a source of recommendations on the

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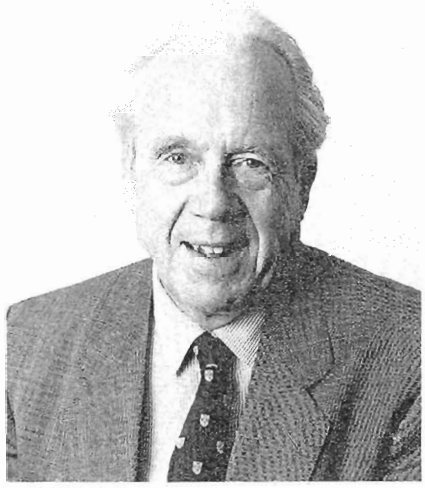

Professor Severn

SECED MEMBER BECOMES PRESIDENT OF THE INSTITUTION OF CIVIL ENGINEERS

Professor Roy Severn of the University of Bristol who was among the earliest members of SECED took over as ICE President in November 1990. With a career closely involved with earthquake engineering and structural dynamics during a period of over 40 years he will already be well known to most SECED members.

Roy Severn has a style of his own and a gently effective way of getting things done. Some years ago he asked me down to Bristol when the idea of building an earthquake simulator at a UK university was under discussion. "Was I prepared to support it", he asked. He showed me an enormous concrete pit in the earthquake laboratory which had previously housed two large compression testing machines. "That's where we propose to put it", he told me, "The pit is exactly the right size". I had to be impressed with a man who could find a pit of exactly the right size for an

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IDNDR

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the contributions that might be made after having identified UK strengths in science, technology, engineering and medicine relevant to the IDNDR.

A report from the Royal Society

Professor Severn

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earthquake simulator at exactly the right moment. If I had known him better at the time I would still have been impressed but not surprised.

Professor Severn graduated from Imperial College in 1949 and was awarded a PhD in 1952. After lecturing there and spending two years on National Service in the army he joined the University of Bristol in 1956, advancing to Reader in Structural Analysis in 1965 and Professor of Civil Engineering in 1968. He retired as head of the Civil Engineering Department in 1989 but retains his chair as Professor of Civil Engineering and is active in the affairs of the Department and Earthquake Engineering Research Centre (EERC).

His career has been strongly orientated towards research and he has published work on foundation rafts, composite action between slabs and beams, the dynamic behaviour of arch, rockfill, gravity and buttress dams and suspension bridges, finite elements, fluid-structure interaction, asynchronous base excitation, field dynamic testing and engineering education. Under his guidance the EERC at Bristol has grown into a widely recognised centre of excellence with its six degree of freedom earthquake simulator and unique skills and resources in field measurement of the dynamic behaviour of structures and subsequent processing of the data. He has acted as Chairman of the Board of the Bristol Earthquake and Engineering Laboratory, which is a University owned company carrying out commercial testing on the earthquake simulator since its formation in 1988.

In his Presidential address Professor Severn made a strong appeal for continuing support for Civil Engineering research in the UK and showed how government policy was shifting responsibility for research funding from government to private industry. He strongly favoured the setting up of 'research clubs' of industrial companies who share common interests in specific types of problem, and suggested that these needed to be done under the umbrella of organisations such as CIRIA.

SECED members will wish him well in his year of office.

David Key

UK SEISMIC HAZARD AND RISK

A Preliminary Study for the Department of the Environment

A study is currently being undertaken by Ove Arup and Partners in association with Delta Pi, Cambridge Architectural Research Ltd. and Geomatrix Consultants, San Francisco.

The scope of the project includes a review of seismic hazard in the UK, assessment of the vulnerability of the built environment to earthquake ground motions, and estimation of the overall seismic risk in the UK. This is seen as a necessary step in the research programme of information for planning and development decisions.

For the purposes of the study the following definitions have been used:

- SEISMIC HAZARD: The level of ground motion due to seismic activity at any particular location which may be exceeded within a given time period or which may arise due to a specific earthquake.
- SEISMIC VULNERABILITY: The damage level to a specific structure arising from a given level of ground motion.
- SEISMIC RISK: The level of damage due to seismic activity within a given time period or due to a specific earthquake.

$$\text{RISK} = \int \text{HAZARD} \times \text{VULNERABILITY}$$

SEISMIC HAZARD IN THE UK

The review of UK seismic hazard is based on the historical macroseismic data and recent instrumental records presented in studies carried out by Prof. N. Ambraseys; Dr. C. Melville; Soil Mechanics Ltd. Principia Mechanica Ltd. (carried out for Nuclear Electric plc, formerly the Central Electricity Generating Board) and the British Geological Survey during the 1980's. Figure 1 shows the distribution of earthquake epicentres (surface wave magnitude, $M_s > 4.0$) for the period 1800-1990. The collated earthquake catalogue is estimated to be spatially and temporally complete for the periods 1800-1990 and 1980-1990 respectively. The seismic hazard levels have been assessed using two methods:

- MSK INTENSITY RECURRENCE: Based on the digitised isoseismal maps the MSK intensity recurrence has been directly estimated from the macroseismic data. Figure 2 shows the results for observed

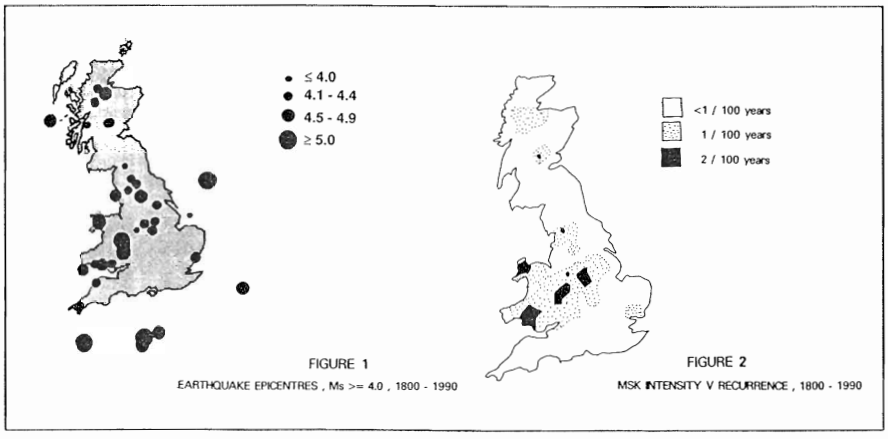


FIGURE 1
EARTHQUAKE EPICENTRES , Ms >= 4.0 , 1800 - 1990

FIGURE 2
MSK INTENSITY V RECURRENCE , 1800 - 1990

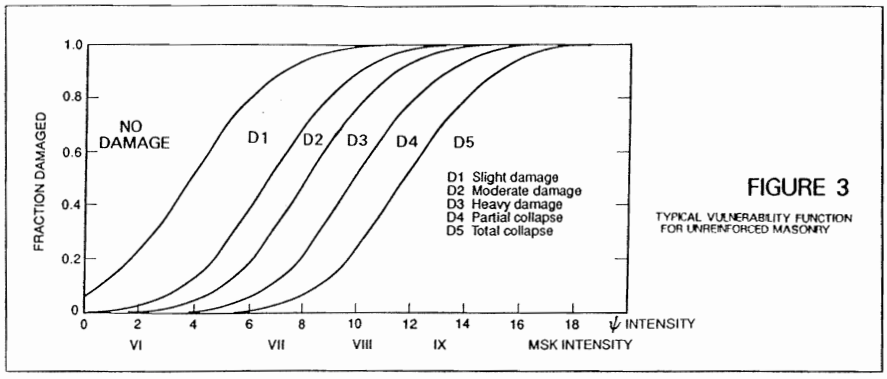


FIGURE 3

TYPICAL VULNERABILITY FUNCTION FOR UNREINFORCED MASONRY

recurrence of MSK intensity V.

- PROBABILISTIC SEISMIC HAZARD ANALYSIS: Using the Cornell approach ground motion acceleration and pseudo spectral velocity have been calculated for annual frequencies of exceedence in the range 1×10^{-2} to 1×10^{-6}. Various seismic source zonations, source parameters and attenuation relationships have been incorporated into the analyses through the "logic-tree" methodology. Uniform hazard bedrock spectra have also been calculated for annual frequencies of exceedence of 2×10^{-3} and 1×10^{-4}, and compared with corresponding spectra developed for Eastern and Western North America.

Secondary hazards such as slope stability, site response effects, liquefaction and mining induced seismicity have also been studied and are being assessed through the microzoning studies.

VULNERABILITY OF THE BUILT ENVIRONMENT

95% of the built environment in the UK consists of domestic buildings such as houses and flats. The vulnerability of these unreinforced masonry structures has been assessed through the vulnerability functions developed by Cambridge Architectural Research, see Figure 3.

The vulnerability of engineering structures is being estimated by calculating the lateral force capacity, assessing the behaviour of structures in the recent earthquakes such as Bishop's Castle - UK and Newcastle - Australia. ATC-13 "Earthquake Damage Evaluation Data for California" is currently being studied to assess its applicability, if any, to UK structures. Industrial tanks have been selected as a case study for industrial structures.

ASSESSMENT OF SEISMIC RISK

The assessment of seismic risk is being carried for two 400 km² microzoning areas in the UK to determine damage levels and estimate final losses. For each microzoning area the following data has been collated in digitised form and has been plotted graphically:

- building distribution (types and age distribution)
- population density
- bedrock geology and superficial deposits
- infrastructure

The seismic risk has been estimated using two methods:

- SPECIFIC EVENT - a typical earthquake is specified in terms of magnitude, position and depth. Using a bedrock attenuation relationship, soil response modifiers and the microzoning data, the hazard levels and financial costs to the built environment can be calculated at any location. The distribution of ground motion and cost of damage to housing arising from a magnitude 5.5 earthquake, 10km deep, are shown in Figures 4 and 5 respectively.

- ANNUAL RISK - calculated by directly integrating the seismic hazard curve and vulnerability functions to obtain an annual risk.

The project is due to be completed in May 1991. Further details about the study can be obtained from Tim Paul/ Jack Pappin, Ove Arup and Partners (071 636 1531).

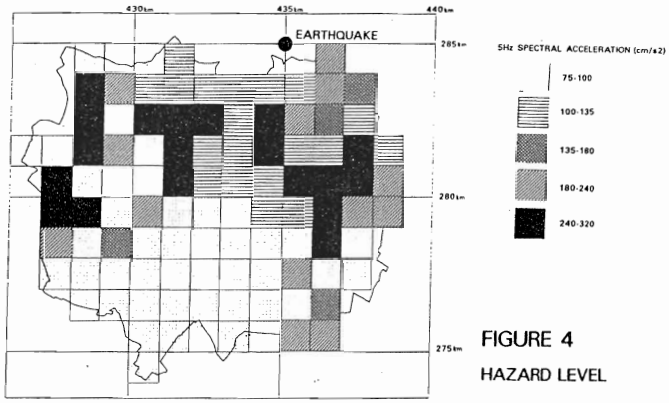


FIGURE 4

HAZARD LEVEL

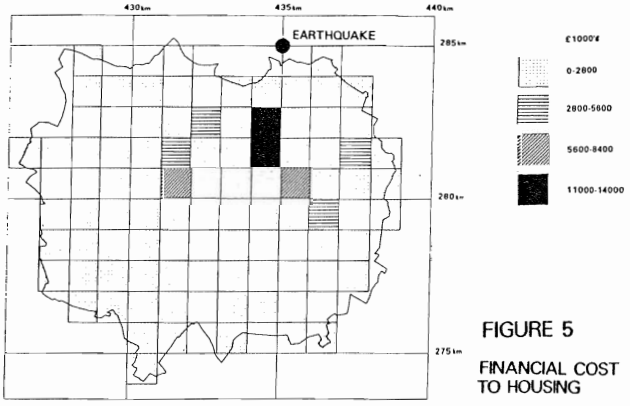


FIGURE 5

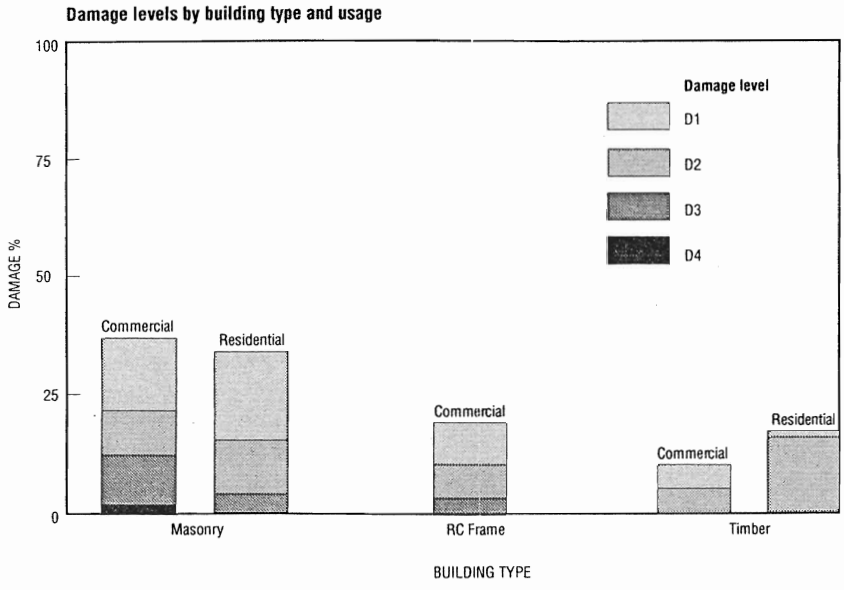
FINANCIAL COST TO HOUSING

NEWCASTLE EARTHQUAKE

A detailed account of the work carried out by the UK Earthquake Engineering Field Investigation Team (EEFIT) on the Newcastle, Australia earthquake of December 29, 1989 was presented at a SECED Seminar on 21st November by Dr. Adrian Chandler of University College London. The team which visited the affected area for six days in early January 1990 consisted of Dr. Jack Pappin of Ove Arup and Partners and Dr. Adrian Chandler, who was funded by the Science and Engineering Research Council. The article below outlines the talk presented at the seminar.

The talk focused on the findings of the EEFIT investigation and subsequent follow-up studies in relation to the extent of the various types of building damage, and the damage distribution within the City of Newcastle and the surrounding urban area. The studies were greatly assisted by Cambridge Architectural Research, who set up a detailed database of the structural damage which has been a valuable resource in assessing the significance of similar sized earthquakes in the context of the UK.

The results of the analyses carried out as part of the EEFIT investigation have been based on both detailed street surveys and general damage surveys, the former carried out in two areas, namely the heavily damaged suburban district of Hamilton (3 km west of the City centre), and the Newcastle central business district. The findings of these surveys have provided valuable information on the vulnerability of building stock of types common to other parts of Australia, the UK and elsewhere, and hence form an important database for the accurate assessment of seismic risk to buildings in regions of low seismicity. This information will assist the development of realistic, economical seismic code provisions for building design and construction in low-risk areas.



Damage Degree	Definition for load bearing masonry	Definition for reinforced concrete frame buildings
D0 Undamaged	No visible damage	No visible damage
D1 Slight Damage	Hairline cracks	Infill panels damaged
D2 Moderate Damage	Cracks 5-20mm	Cracks <10mm in structure
D3 Heavy Damage	Cracks <20mm or wall material dislodged	Heavy damage to structural members, loss of concrete
D4 Partial Destruction	Complete collapse of individual wall or individual roof support	Complete collapse of individual structural member or major deflection to frame
D5 Collapse	More than one wall collapsed or more than half of roof	Failure of structural members to allow fall of roof or slab

Level of damage caused by ML = 5.5 Newcastle Earthquake

The presentation highlighted an important feature arising from the surveys and subsequent analytical studies of site response in the heavily damaged districts within the Hunter River alluvial basin. That is, contrary to reports by the Australian Institution of Engineers, amongst others, the areas of deep alluvial soil and fill do not correlate strongly with the more heavily damaged districts determined from post-earthquake assessments. Hence, suggestions that this form of site amplification effect played a major part in the distribution and extent of heavy damage in this earthquake are misleading for the future development of planning and design regulations, and furthermore contradict the results of careful site response analysis, as carried out by Dr. Pappin, which show that it is the shallower soils near the border of the alluvial basin which tend to amplify bedrock ground motions of the type generated by this earthquake.

The EEFIT team also concluded that the comparison of damage distribution with the perimeters of the extensive coal mining activity in the Newcastle area showed a degree of correlation which should be recognised as a significant feature of the earthquake damage pattern. This may be

connected with historical and sociological urban development since the mine perimeters tend to be aligned along major roads, which is also where the most vulnerable buildings are situated, such as older, commercial brick masonry building stock.

Adrian Chandler

The EEFIT report on the earthquake is shortly to be published - details on availability and cost will be notified in due course. Further information on this and other matters related to the investigation can be obtained by contacting either Dr. Adrian Chandler (071 387 7050 Ext. 2707) or Dr. Jack Pappin (071 465 3205).

SEISMED IN LONDON

On 29th November at the ICE a hurriedly assembled body of SECED members, divided somewhat arbitrarily into 'experts' and 'non-experts', cantered in four hours through much of the SEISMED Workshop No. 2 documents entitled Vulnerability and Risk Assessment.

The SEISMED project, funded largely from Italy with UNDRO support, held its first workshop on Seismic Hazard in May 1990, at St. Marguerita on the Liguran coast. The second workshop was to be held in the second week of December and SECED was fortunate in having access to the preparatory documents for that workshop, Bryan Skipp having taken part in the first workshop.

Although the UK is not participating in SEISMED, it is restricted to countries on the Mediterranean littoral, the documentation, prepared by Walter Hays of the USGS, was seen as a challenge to our expertise.

So about twenty persons arrived at the resplendent new Godfrey Mitchell lecture theatre at Great George Street and with Bryan Skipp in the Chair tried to tackle in the afternoon what had been allocated a whole week of deliberations by UNDRO. By a process of self-organisation an 'expert' panel was formed consisting of Edmund Booth, Robin Spence, David Key, Jack Pappin, Peter Merriman and Scott Steedman, which left some formidable 'non experts' to ask awkward questions on the justification of judgement.

As usual in exercises of this nature the basic premises were quickly brought into question and the discussion was in danger of being side tracked into a deep consideration of the definitions of hazard, vulnerability, risk and exposure. Order was restored and after a somewhat contentious consensual completion of the self evaluation of the state of the game in the UK, the panel were able to exercise their judgement in diagnosing the causes of the failures illustrated by the illuminating set of photographs which accompanied the exercise. Then onto the exercises on the philosophy of design, simplicity and regularity, asymmetry in elevation; all of which was dealt with with noisy, even seasonal good spirit. It was clear that Christmas was not far away.

An exercise on the characteristics of ground shaking exemplified by the time histories, response spectra and energy/duration plots of the Taft, Kern County, 1952 and Bear Valley Melendy Ranch Barn 1972 records and their likely effects on one, three and five storey structures and a pipeline, used up the rest of the afternoon. There was no time to cover the exercises on the simplicity, regularity and symmetry of floor plan nor loss estimation, but the meeting had covered a lot of ground in lively and informative disputation. The completed exercises will be sent back to Walter Hays.

Bryan Skipp

For information about the availability of SEISMED workshop documents contact James Dawson (071 222 7500)

AN INTRODUCTION TO NON-LINEAR TRANSIENT DYNAMICS

A report of a SECED meeting held in October.

The field of dynamic finite element analysis has developed rapidly in recent years, particularly in the area of non-linear, transient dynamics. MacNeal-Schwendler develop and market a number of dynamic analysis codes, including MSC/NASTRAN, MSC/DYNA and MSC/PISCES, which between them cover a wide range of dynamic events.

The object of the talk was to show how different modelling techniques can be used to analyse the range of events from static structural loading to high rate transient explosive loading. A large number of slides were shown to illustrate the various problems.

Different types of problem can often best be thought of in terms of three variables - time, deformation and material.

The time variable is that which expresses the degree of 'transience' of the event under analysis. If it is a quasi-static problem then the time variable is relatively unimportant, whilst for a highly transient event such as ballistic impact the analysis may need to resolve the behaviour of the components at times as short as fractions of a millisecond.

The material variable determines the degree of non-linearity of the materials under analysis. The simplest material response would be a linear elastic material in which the stress is linearly dependent on the strain. As the material becomes more complex we might wish to include yielding, plastic flow, visco-elastic behaviour, failure and even change of phase.

The deformation variable describes the amount of material deformation that occurs during the event. Classical infinitesimal strain theory can be used for very small strains, whilst some problems may require simulation of plasticity, flow and crushing with the required constitutive laws.

The reasons reference is made to these different problem variables is that the capabilities of the available codes vary and some codes are more suited to certain problems than others.

The talk centred on the progression

NOTABLE EARTHQUAKES OCTOBER - DECEMBER 1990

Reported by British Geological Survey

YEAR	DAY	MON	LAT	LON	DEP KM	MAGNITUDE ML	MB	MS	LOCALITY
1990	19	OCT	054.750N	005.847W	0	2.5			CARRICKFERGUS, ANTRIM
			This event was associated with a collapse in an abandoned salt mine in Eden, Carrickfergus. A depression about 200m in diameter and 7m deep was produced by the subsidence and old minehead buildings were damaged. Earlier events on 2 September and 5 October were felt locally and may also have been associated.						
1990	25	OCT	035.190N	070.740E	6	6.1	4.8		HINDU KUSH REGION
			Eleven people killed, more than 100 injured and damage in the Chitral - Mardan - Malakand area of Pakistan						
1990	01	NOV	053.585N	001.337W	1	1.8			GRIMETHORPE, S.YORKS
			One of a series of events affecting the Grimethorpe area near Barnsley and causing concern. The event was strongly felt locally but was not damaging. The epicentre is in a coalmining area and the seismic waveform is consistent with a mining-induced cause.						
1990	06	NOV	028.234N	055.455E	25	6.2	6.8		SOUTHERN IRAN
			At least 22 people killed, 100 injured and 21,000 homeless and 18 villages severely damaged in the Darab area.						
1990	06	NOV	053.468N	169.929E	32	6.4	7.0		KOMANDORSKY ISLANDS
			Felt IV MM on Attu and Shemya						
1990	13	DEC	037.201N	015.436E	10	5.1			SICILY
			At least 15 people killed, about 200 injured, 800 homeless and severe damage (VII MM) in the Carlentini area. Damage also occurred at Augusta, Lentini, Noto and Cafalu.						
1990	21	DEC	040.999N	022.339E	10	5.9	6.0		NORTHERN GREECE
			One person killed, at least 60 injured and damage in the Edhessa - Kilkis area. Some injuries and damage in the Gevgalija - Strumica area, Yugoslavia.						
1990	30	DEC	004.989S	150.973E	187	6.7			NEW BRITAIN REGION
			Some damage in the Hoskins area						

from linear, quasi-static analyses through to highly non-linear, rapid, dynamic events.

A general purpose finite element code such as MSC/NASTRAN is ideally suited to modelling linear material behaviour under static or quasi-static loading conditions or where there is only a small degree of transience. Examples include structural response of motor vehicles, aircraft or buildings. The implicit solution technique enables these types of analyses together with vibrational response and frequency analyses to be carried out very efficiently. It is possible to analyse materials with a degree of non-linearity in material behaviour, such as yielding, but difficulties arise when using such a code for highly non-linear analyses with large deformations.

As the problem becomes more transient and more non-linear an explicit code such as MSC/DYNA is more effective. The mathematical basis of the explicit technique makes the codes highly efficient for short time events, though they can be very unwieldy for long duration or quasi-static analyses. The relatively straightforward mathematical approach enables complex constitutive laws to be implemented, thus allowing material behaviour such as yielding, full plastic flow, fracture or crushing to be modelled. Thus automotive crash, aircraft birdstrike and containment problems can be modelled with regard for large amounts of plastic straining, material breakage and strain rate dependent behaviour.

The explicit formulation can readily cope with short duration events but as the type of problem becomes more extreme the modelling technique must be changed again. The common form of finite element mesh is the Lagrangian type where the mesh is fixed to pieces of material and as the material deforms so the mesh changes shape. If the deformation is large the mesh can become too distorted and the model degenerates, reducing the accuracy and the efficiency of the solution. At this point an Euler processor is more

effective. An Euler mesh remains fixed in space whilst deforming material moves from one part of the mesh to another. This technique is particularly suited to problems of large deformation, such as impact and penetration, and can also cope readily with materials which change state, such as explosives which detonate. The Euler-Lagrange coupled code MSC/PISCES employs both types of processor and is frequently used in the defence industry to analyse highly transient events with large amounts of deformation.

During the talk it was emphasised that problems can be solved by a number of different codes using different numerical techniques. Which code is the most suitable for a given problem will depend on the degree of non-linearity in the materials, the amount of deformation expected, and the time domain in which the problem occurs.

Given this information it is possible to select a code to analyse anything from creep in metal structures to the formation of high energy shaped charge warheads.

Dr. Alan Prior,
MacNeal-Schwendler Co. Ltd.

EEFIT NEWS

EEFIT starts the year with a field investigation of the December 13 ML = 5.3 earthquake in Sicily. A team of four will visit Sicily for four days in early January to undertake a survey of structural damage. The team comprises Richard Hughes and Tim Paul (Ove Arup and Partners), Bob Nichols (Allott & Lomax) and John Riding (British Nuclear Fuels). The team will present an initial summary of findings at a joint EEFIT/EFTU Meeting at the Institution of Civil Engineers on 27th February.

For information about EEFIT contact Dr R S Steedman at The Institution of Structural Engineers, 11 Upper Belgrave Street, London SW1X 8BH.

EARTHQUAKES : IMPACT ON THE COMMUNITY

A half day public meeting on this subject is being organised jointly by SECED and the ICE Hazards Forum. It will take place on

Wednesday, 4th December 1991
2.00 pm to 5.00 pm
at the Institution of Civil Engineers, Great George Street, London

The meeting will be chaired by Dr. Alistair Paterson, a past president of the Institution of Civil Engineers who instigated the idea of the Hazards Forum during his term of office. A very broad review of earthquake impact is planned and distinguished contributors from seismic areas overseas will be invited to speak, as well as UK practitioners. It is hoped that conclusions will emerge on how to improve the UK contribution to reducing earthquake impact in this, the UN's International Decade for Natural Disaster Reduction.

The topics to be covered are:

- Earthquakes, prediction and hazard
- Preparedness of the community
- Search and rescue after earthquake
- Medical, psychological and sociological aspects
- Reconstruction of the community
- Disaster management
- Current state of earthquake resistant design.

WHAT'S ON

January - March 1991

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, 20th February 1991
Joint ICE/ISE/CS Meeting
Earthquake Engineering - Hidden Aspects
J. H. Mills, C. P. Rogers
6 for 6.30 pm, UMIST, Manchester

Wednesday, 27th February 1991
Joint EEFIT/EFTU Meeting
Reports from the Field on Recent Earthquakes
Several speakers
5 for 5.30 pm, Institution of Civil Engineers

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

FORTHCOMING EVENTS

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

Monday-Wednesday, 27th-29th May 1991
First International Conference on Seismology and Earthquake Engineering
Tehran, Iran

Wednesday, 29th May 1991
Mallet Milne Lecture
Reduction of Vibrations
Prof. G. Warburton
5 for 5.30 pm, Institution of Civil Engineers

Wednesday - Friday, 12th-14th June 1991
McMaster University/University of Toronto
The Sixth Canadian Conference on Earthquake Engineering
University of Toronto, Ontario, Canada

Thursday - Friday, 13th-14th June 1991.
International Conference on Building with Load Bearing Concrete Walls in Seismic Zones.
Paris, France.

Tuesday - Friday, 25th-28th June 1991.
Workshop on Non-linear Seismic Analysis of Reinforced Concrete Buildings.
Slovenia, Yugoslavia.

Sunday - Friday, 18th-23rd August 1991
SMIRT 11
11th International Conference on Structural Mechanics in Reactor Technology
Tokyo, Japan.

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.

Monday-Thursday, 23rd-26th September 1991
Fifth International Conference on Soil Dynamics and Earthquake Engineering.
University of Karlsruhe
Karlsruhe, Germany

DIARY NOTE

July 1992
Tenth World Conference on Earthquake Engineering, Madrid, Spain.

RECENT PUBLICATIONS

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

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.

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

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

"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.

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

"EEFIT Constitution and Aims and Methods", EEFIT 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.

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

SECED NEWSLETTER

The SECED Newsletter is published four times a year by the SOCIETY FOR EARTHQUAKES AND CIVIL ENGINEERING DYNAMICS. The Newsletter is issued in January, April, July and October and contributors are asked to submit articles as early as possible in the month preceding the date of publication. Manuscripts should be sent typed on one side of the paper only, and a copy on an IBM PC compatible disk would be appreciated. Diagrams should be sharply defined and prepared in a form suitable for direct reproduction. Photographs should be high quality and black and white prints are preferred. Diagrams and photographs are only returned to authors upon request. Articles should be sent to Nigel Hinings, Editor, SECED Newsletter, Allott & Lomax, Ashton Lane, Sale, Manchester. M33 1WP. (Tel 061 962 1214 ; Fax 061 969 5131).

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