THE SOCIETY FOR
EARTHQUAKE AND
CIVIL ENGINEERING
DYNAMICS

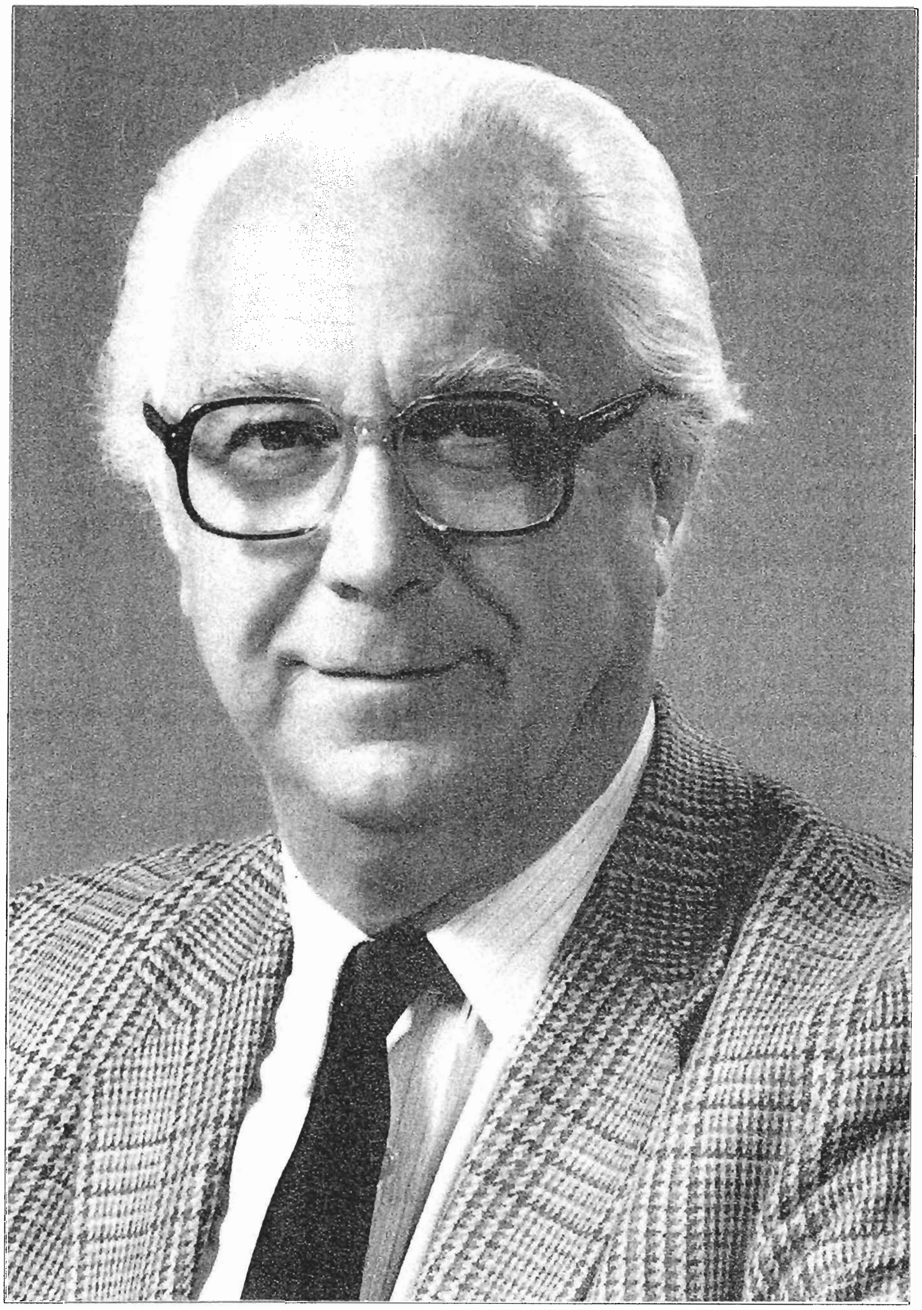
SECED NEWSLETTER

October 1992, Vol. 6, No.4

SIMPLICITY AND CONFIDENCE IN SEISMIC DESIGN

SECED's Fourth Mallet-Milne lecture will be delivered by Professor Tom Paulay on the subject Simplicity and Confidence in Seismic Design. The lecture, which is a public event and open to all, will be held on 26th May 1993 at the Institution of Civil Engineers in London.

Professor Paulay is Professor Emeritus at the University of Canterbury, Christchurch, New Zealand, and is particularly associated with the development of 'capacity design' philosophy, which now finds widespread acceptance in the international earthquake engineering community. He was elected President of the International Association of Earthquake Engineering at last July's World Conference in Madrid.


Professor Tom Paulay

Professor Paulay's address will concentrate on the translation of research findings into application in structural design. It contrasts analysis with design strategies particularly suited to overcome difficulties that stem from inevitable uncertainties in the prediction of ground motions. A deterministic design philosophy is postulated for structural systems that must be expected to respond in the inelastic domain. Although the principles of the design strategy, particularly those relevant to the establishment of strength hierarchies, are applicable to any structural system, reinforced concrete buildings are used to illustrate relevance.

Some features of the art of the detailing of critical regions of reinforced concrete structures, particularly those where severe ductility demands may be expected, are illustrated. Emphasis is placed on the quality of structural details commensurate with behaviour intended by the designer, rather than on sophistication and accuracy of analysis. This is in support of the precept that the most desirable feature of response to very severe ground shaking is tolerance of the structural system with respect to the crudeness of predicting displacement demands.

The Society for Earthquake and Civil Engineering Dynamics
Institution of Civil Engineers
Great George Street
London SW1P 3AA

BLAST VIBRATION CRITERIA - HOW SAFE SHOULD THEY BE?

by Tim Wilton
Vibrock Limited

Development within the United Kingdom is resulting in a substantial increase in the scale of mineral extraction activities and civil engineering projects in relatively close proximity to residential and other developed areas. The expansion of such activity has been matched by an increased public awareness of environmental issues and sites which rely on the use of explosives in order to facilitate rock fragmentation are not immune from this increased concern.

When an explosive detonates within a borehole the resulting stress waves cause localised distortion and cracking but outside of the immediate vicinity permanent deformation does not occur. Instead, the rapidly decaying stress waves cause the ground to exhibit elastic properties. Such vibration is always generated even by the most well designed and executed of blasts and will radiate away from the blast site attenuating with distance. Vibration is also generated within the atmosphere where the term air overpressure is used to encompass both its audible and sub-audible frequency components. Blast induced vibration has potential for both damage to property, structures and services as well as subjective concern to the local community.

Understandably, much work has been undertaken in the past and is continuing into both the damage potential and the annoyance aspect of blast induced vibration. In reviewing 'safe vibration levels' documented and applied in practice over past years, it is apparent that the more recent the limit the lower the acceptable value has become. This trend does not appear to be supported by any significant new field evidence of damage at these lower vibration levels and presumably indicates the shifting social climate rather than a change in engineering values.

Whilst operators employing explosives as a necessary tool will be only too aware of their social responsibility they also have to operate under economic considerations. The increased costs associated with these ever lowering vibration levels are significant, and in many cases, unnecessary. Strict vibration criteria cannot be divorced from the cost implications - they cannot be 'conditioned out' in Planning Applications.

The costs for careful blasting adjacent to residential or other vibration sensitive areas increase very rapidly with decreasing vibration limits. The costs depend upon many factors, the main ones of which are:

- Drilling costs - smaller diameter boreholes lead to significant increases in the amount of drilling required in order to excavate the same volume of material.
- Explosive/accessory costs - the more complex shots that are required use significantly more detonators and primers and involve a higher cost in terms of labour.
- Standing time - the greater number of blasts that are required lead to greater stand-down times.

The costs will also increase with regard to planning and control in terms of both the time expended on them and the extra matters involved, for example:

- Blast design
- Visual inspection of sensitive locations
- Test blasting involving vibration measurements to ensure compliance with limits
- Regular analysis of measurements to ensure future blast designs will comply with limits
- Extra insurance costs

Each site at which vibration limits restrict blasting will incur different cost increases depending upon the specific circumstances involved. However, as a broad guide it is seen that as vibration limits are reduced by a factor of 2, the costs will also increase by at least a similar factor.

Therefore, realistic safe blast criteria are important not only in order to safeguard property and services but also from the project cost viewpoint.

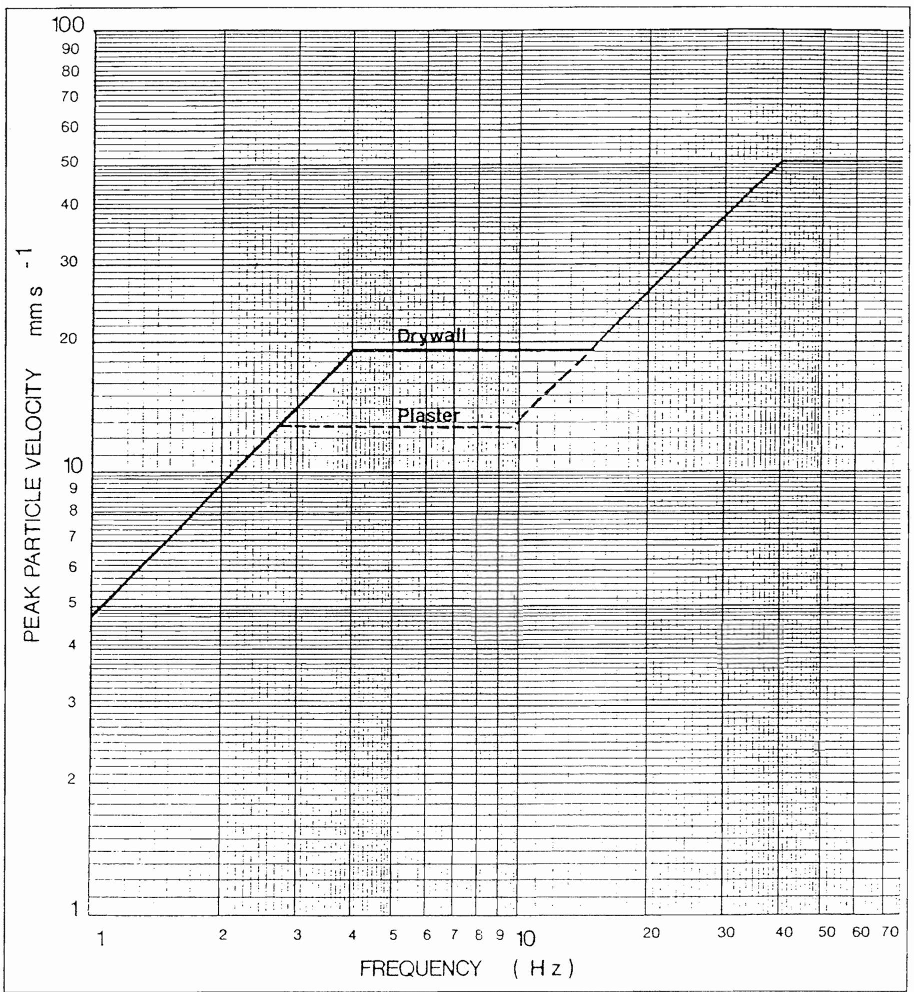
Ground vibration

Ground vibration criteria are either related to potential damage levels or to human perception. Long term blasting activities such as those involved with quarrying and opencast coal sites will invariably have their criteria considered in terms of perception, with relatively short term activities such as demolition projects, tunnelling and trenching being considered in terms of damage criteria.

It is important to realise that human perception levels are very much lower than even the most pessimistic of damage criteria for the weakest of structures. The average person is very sensitive to vibration and can readily feel the levels that are generated across the boundaries of virtually all quarries, coal sites and civil engineering projects. In the great majority of cases it is simply not possible to reduce vibration at source such that this is not the case.

It is also important to realise that although we are very sensitive to the onset of vibration we are very poorly equipped to differentiate between magnitudes. Our overall perception is governed by a great number of factors concerning the vibration itself and its characteristics of frequency component and duration and also concerning the human character involved and his/her activity at the instant of vibration arrival.

The fact that people are relatively sensitive to the onset of vibration is beginning to unduly influence the setting of criteria with respect to damage likelihood. The belief that '*If I can feel it so clearly it must be damaging*' used to be heard only from understandably concerned property owners adjacent to a blast site. Unfortunately, this reasoning now seems to be gaining ground elsewhere. The separation of perception and damage thresholds are, in practice,



Left: Safe blast vibration levels (RI 8507/1980)

becoming closer in peoples minds to the detriment of the extraction and civil engineering industries.

Vibration limits with respect to damage should be a function of our knowledge on the matter and whether the possibility of minor damage is acceptable or not to those concerned. It should not be a function of uninformed opinion, ignorance or 'the disaster syndrome'. By the latter I refer to the extremely low vibration limits occasionally placed upon features because of the unimaginable consequences of failure irrespective of their actual sensitivity to vibration.

In 1980 the United States Bureau of Mines published their report RI 8507 detailing safe vibration criteria for residential type properties. These criteria are for the prevention of the most cosmetic of plaster cracking of the type that must be expected to develop in all properties irrespective of blasting operations. In a more recent 1987 publication these safe criteria were reconfirmed as applicable for the worst case of structure condition and independent of the number of blasting events.

The fact that the limits are frequency related enables them to be applied to a wide variety of impulsive vibration sources from relatively high frequency civil engineering blasts to relatively low frequency coal site operations. It should be noted that no damage has ever been observed at vibration levels less than 12.7 mms^{-1}, and that these levels are recommended in order to prevent the most cosmetic of plaster cracking.

These same criteria are recommended within the Department of Transports Transport and Road Research Laboratory Research Report 53 of 1986 where it is stated that "*The 'safe' levels indicated fit British case history information well and it is suggested that these levels provide a useful basis for risk assessment.*" However, there seems to be a marked reluctance in some quarters to accept these criteria. They are very often applied with a further safety factor, typically two fold, or if they are applied as stated, it is to protect a structure or service that is clearly less vibration sensitive than brittle plaster.

So, can we trust these limits ? The answer seems to be yes! and for two basic areas of reasoning.

Firstly because of the wealth of work undertaken by the USBM to determine these levels in the first instance, and their community work to ensure that these levels are not overtaken by subsequent findings. It was 1980 that these criteria were first suggested by the USBM. All known published data was reviewed before establishing these criteria. Ten years later, a further review was undertaken by the USBM and they came to the conclusion that "*In the 10 years since their publication nothing has appeared to replace them or even significantly add to the database.*"

It is often said, however, with some justification, that typical American residences are very differently constructed to typical European or specifically typically British structures. It is undoubtedly true that many properties within the USA are one-storey and many predominantly of wooden construction. However, there are also many properties within the USA that are constructed identical to those within the UK. These USBM criteria are obviously designed to protect all residential structures not just the more common wood framed properties. They must be applicable to brick/breeze block construction that exist within the USA. Indeed, it can be argued that a significant safety factor is involved with these latter structures which clearly do not magnify the incoming vibration as much as a wooden framed structure. Magnification factors in the range 2 to 4 times are not unusual within these USA wooded framed properties - such magnification would be highly unusual within the UK housing from typical quarry/construction shots. With these criteria being applied to the input at the base of a residential structure, it can be seen that the vibration level experienced on plaster walls and ceilings within these US structures must, in general, be significantly greater than that experienced on the average British wall.

In the highly litigation conscious USA a drill and blast contractor would not last very long working to a vibration specification that safeguarded just, say, 90% of adjacent properties. He must obviously consider them all. In the USA the safe vibration criteria of RI 8507 are adopted in virtually every State i.e. the most usual vibration specifications are 1"/second and 2"/second depending upon predominant vibration frequencies.

There is a second line of reasoning that provides confidence that these levels are realistic damage limits. This is based on past experience of blasting works. Vibrock have been involved in a large number of successful civil engineering projects based upon 25 and 50 mms^{-1} to protect residential property. The company has also been involved in a significant number of quarries working to 25 mms^{-1} as the vibration limit. Such instances for both civil work and quarrying are becoming less common. For quarries, it is accepted that such limits should not be the norm. For civil engineering projects they most definitely should be the norm. It is not unusual nowadays for civil engineering projects within the UK to be based upon 12.7 mms^{-1} rather than 25 or 50 mms^{-1}. Unless blast frequencies of less than around 20 Hz are to be expected then this limit is half of the minimum level that should be considered as a limit. It will be most unusual indeed to experience 12.7 mms^{-1} as a blast induced vibration without the frequency being greater than 20 Hz.

There can seldom be justification for vibration limits less than those presented by the USBM when considering civil engineering projects. Perception simply should not be an issue. The number of events is so few in relation to open pit blasting, the direct benefits and need for blasting should be self evident to most householders. Whether the limit is 12.7 or 50 mms^{-1} blasting will still be well above the perception threshold and once this occurs, adverse comment is always possible and is poorly related to actual vibration magnitude. It is strongly related to the number of blast events and the effectiveness of any public relations exercise in explaining the phenomena of blasting as these will be perceived at neighbouring properties, together with an explanation of the need to blast.

Not only are low limits becoming commonplace for the protection of residential properties, but the USBM curve is often quoted as the source work for the protection of features which are clearly very much more robust than the brittle plaster that these curves were introduced to protect, namely, for example, concrete structures and pipelines.

For pipelines, vibration limits some 10 years ago would vary from 'no blasting' up to perhaps 75 mms^{-1} depending on pipe construction and condition. But nowadays these limits would also vary very much depending upon the importance of the pipeline and those commissioning the blasting operations - two factors clearly not related to the vibration sensitivity of the pipeline. The importance of the pipeline will be related to what is being carried through the line and what possibility there is of re-routing this product should this be necessary and/or the disaster syndrome i.e. how much damage could a rupture of the line create either directly or indirectly. These factors are very important especially if you are the one responsible for the length of affected pipe. However, they do not affect sensitivity of the pipeline to vibration and, therefore, should not be overriding considerations in determining a safe vibration limit: neither should be the question of who is commissioning the blasting work. Unfortunately, this has always been and continues to be the overriding factor in most cases. If those who own or are responsible for the pipeline are commissioning the work then vibration limits are usually realistic, if not then the limit is relatively low. The most usual limit for solid welded steel pipelines is 25 mms^{-1}. Such a limit incorporates a tremendous safety factor.

Vibrock have been recently engaged in a quarry blasting project adjacent to twin 24 inch pipelines. If the quarry are unable to blast immediately adjacent to these pipelines then a considerable sum in compensation will be claimed from the pipeline owners. This has tended to concentrate their minds on the issue. The standard 25 mms^{-1} vibration limit would equate to a stand off distance of some 80 metres from the pipeline, a 50 mms^{-1} limit would reduce this to 50 metres. The minimum possible separation distance in fact will be just 8 metres. The last blast at this location was 15 metres from the closest of the two pipelines and generated 225 mms^{-1} on the ground surface immediately above the pipeline, or about 150 mms^{-1} on the pipeline. In other words, by carefully monitoring the vibration levels and associated strain gauge measurements on the pipe itself, it has been possible to blast successfully to a limit 6 times the usual maximum and vibration levels will increase further as the desired 8 metre separation distance is reached.

Concrete structures are another example of features often considered to be sensitive to vibration to the extent that the USBM plaster cracking criteria are applied. It is not unusual for massive structures such as dock walls or reinforced building foundations to be subjected to a limit of just 25 mms^{-1}. Again, past experience has indicated that working to levels well in excess of this, 150 mms^{-1} on dock walls, for example is perfectly successful. We know that in order to demolish concrete by explosive means we need to generate many thousands of millimetres per second and yet when it comes to a vibration limit for its protection we fear to set a figure higher than 25 or 50 mms^{-1}. Lewis Oriard cites many examples of relatively high vibration limits successfully applied to concrete. He generally works to an upper limit of some 500 mms^{-1} for fully cured concrete.

It should be stressed, of course, that any significant increase in vibration limits to a realistic level has to be matched by an increase in control measures. However, the cost and time implications of these measures should readily be absorbed by the cost savings in working to a less restrictive, and unnecessarily so, regime.

(see also Supplement)

Natural DISASTERS

INTERNATIONAL DECADE FOR NATURAL DISASTER REDUCTION

PROTECTING VULNERABLE COMMUNITIES

to be held at

The Royal Society
London

13 – 15 October 1993

supported by

The Royal Society

THE ROYAL ACADEMY OF ENGINEERING

The Society for Earthquake and Civil Engineering Dynamics

BNFL *Sponsored by* **British Nuclear Fuels plc**

IDNDR Conference

First Announcement and Call for Papers

Themes

Papers are invited on natural disaster reduction with emphasis on:

1 Vulnerability of communities
2 Preparation, protection and prediction before the event
3 Lessons to be learned from recovery, reconstruction planning and implementation
4 Opportunities for the future (low cost – high tech)
5 Technology and knowledge transfer

in the face of hazards posed by:

Earthquakes Floods
Volcanoes and Storms

Exhibits

There will be related exhibitions of organisations and companies involved in disaster work. Those interested should contact the conference organisers.

Abstracts

Authors wishing to present papers are invited to submit two copies of typed abstracts of up to 500 words by 1 November 1992.

Organising Committee

Dr R D Adams
International Seismological Centre

Dr C W A Browitt
British Geological Survey

Dr I Davis
Disaster Management Centre

Dr P A Merriman
(Chairman)
British Nuclear Fuels plc

D Oakley
Consultant

Prof W B Wilkinson
Institute of Hydrology

For further details please contact Rachel Coninx, Conference Office, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA.
Telephone: **071-839 9807**
Fax: **071-233 1743**

The IDNDR (International Decade for Natural Disaster Reduction) was launched through a United Nations proclamation in December 1989 for the last Decade of the Twentieth Century. Nations throughout the World are asked to give special attention to programmes and projects designed to reduce loss of life, property damage and economic and social disruption caused by natural disasters. In the past two decades alone such events have killed an estimated three million people.

In this context, the UK IDNDR Committee extends a warm invitation to all scientists, engineers and practitioners working towards the reduction of the impact of **Earthquakes, Floods, Volcanoes** and **Storms** to participate in the Conference.

THE FAYOUM EARTHQUAKE OF 12 OCTOBER 1992

First impressions
by the Imperial College
Earthquake Field Training Team

Two days after this Ms = 5.38 earthqake struck near Cairo, a three-man team was dispatched to the affected area by the Imperial College Earthquake Field Training Unit (EFTU). The team comprised Amr Elnashai, Assaad Salama and Montasser Soliman. Amr Elnashai spent one week there; Assaad Salama will be staying for some weeks and Montasser Soliman, having completed his PhD under Amr's supervision on methods of assessment of RC structures in seismic areas, has moved permanently to Egypt.

The team's first impression of the earthquake effects are that damage is relatively minor but is widespread over a very large area, including Greater Cairo (approximately 12 million inhabitants) and many smaller towns and villages. It was therefore decided that the team will not attempt to survey the damage, neither will a report be compiled. The team was therefore primarily concerned with helping to clarify the priorities for action by the authorities.

A brief note on damage

The statistics published to date are scanty and contradictory. Therefore, the numbers given below should be viewed with caution and are a first order approximation at best.

Apartment Buildings

Failures (total & partial)	350
Heavy damage	1244
Light damage	8000

Schools

Heavy damage & collapse	350
Light damage	950

Monuments

Mosques & Churches affected	140
Pharonic monuments affected	24

The cost of repair to the ancient monuments affected by the earthquake is expected to be at least £30 million, and the repair of other structures is estimated to be of the order of some £200 million.

Non-structural damage was found by the team to be exensive, especially in

flat-slab reinforced concrete buildings; a system widely used in Egypt. In one case in Maach, a 12 storey structure (where Assaad Salama lives!) had cracking to at least 80% of all walls in all apartments. Also very heavily affected were the old masonry houses in the centre of Old Cairo. Even the more modern two storey wall-bearing masonry houses in villages near the epicentre were badly affected. Near Fayoum, two cases of liquefaction were reported, one of which was inspected by the team.

The historical monuments were adversely affected by the earthquake. One temple in Edfu suffered very extensive damage and partial collapse. At least one of the stones of the Khoufou pyramid in Giza rolled down the structure. Many mosques and other Islamic historical buildings were damaged. Abdeen Castle, used as the offical office of the President in Sadat's days, was heavily cracked in many locations. Wall separation and floor slab sagging was observed. The Castle is currently under repair.

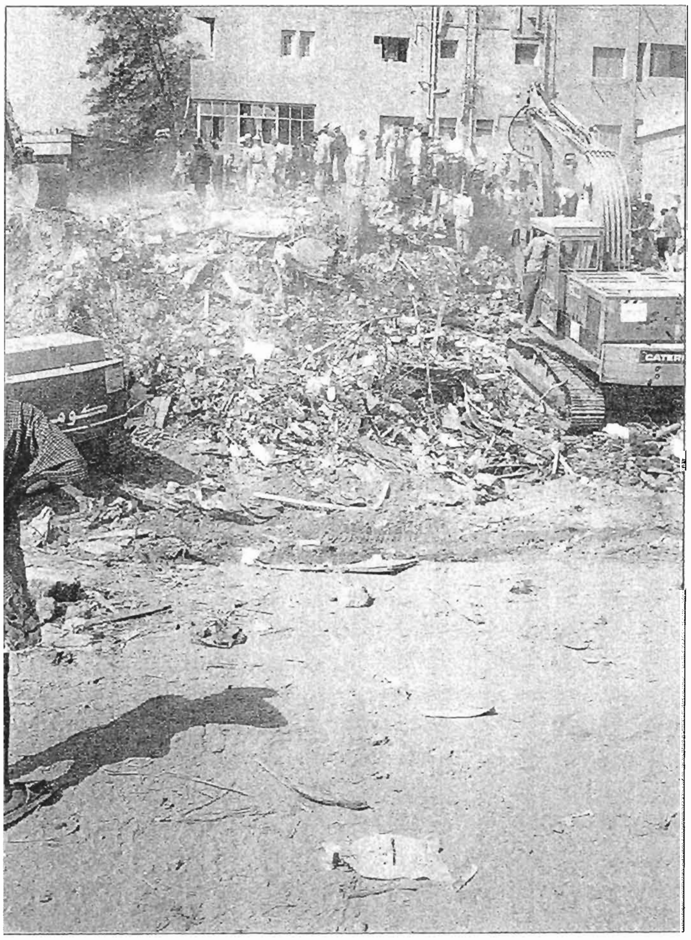
The offical death toll is about 545, with more that 6500 injuries: these figures are continuously changing, since structures still collapse either due to excessive deformations or due to minor aftershocks.

During the trip, Amr Elnashai was invited to give a lecture at the Military Technical Academy, hosted by the Egyptian Army Corp of Engineers and another at the Institution of Civil Engineers. He was also interviewed by two newspapers. He has submitted to the Minister of Construction and New Communities two proposals detailing the requirements and priorities in education and training of engineers and in assessment, repair and upgrading of structures.

The two team members in Cairo are pursuing these proposals.

For information about the availability of EFTU reports for other earthquakes contact:

Imperial College
Department of Civil Engineering
Imperial College Road
London SW17 2BU
United Kingdom



Left: Remains of a 14 storey reinforced concrete building that collapsed. Teams from Italy, Germany and France helped with the rescue operations.

Far Left: Masonry structure near Fayoum. The wholeblock lost the first floor - the rubble remains can be seen at the left bottom corner.

NAFEMS Workshop

NAFEMS DYNAMICS WORKING GROUP WORKSHOP

A report by Stephen Raynes, Lloyd's Register

The workshop was held on the second day of a three day event which also included the NAFEMS AGM and a Research Technical Session. It was held at the Lord Daresbury Hotel, near Warrington in Cheshire, which is a pleasant location and has been chosen for the NAFEMS 4th International Conference next year.

The workshop, chaired by Professor Alan Morris (CIT), was devoted to a set of industrial application case studies. These all related to structural problems requiring modelling and analysis in a dynamics regime. Methods of structural optimization were also looked at in some detail.

Six companies presented in all. Richard Bush (MSC) inspired audience participation and instigated a lively discussion on the methods of updating finite element models to match test results. M. Mendoza (ESTEC) presented a case study of the structural analysis and optimization methods used in the analysis of space station racks. John Smith (STRUCOM) presented optimization methods with particular reference to the dynamic anaylsis of a disc brake system. The presentation particularly focussed on the use of MAC and COMAC analyses in conjunction with mesh refinement. Sarah Vinson (SCICON) and Peter Bartholomew (DRA) used a Lynx Helicopter analysis as an example of analysis and correlation and Alan Humphries (GEC-MARCONI) used an interesting folding stable airborne platform as his case study example. Geoff Wright (ASSESSMENT SERVICES) discussed the design and analysis of a missile transportation frame vibration fixture and highlighted the problem of deciding how good does a good model have to be.

All of the presentations provoked stimulating discussions and I think that all who attended found the day both interesting and useful. The proceedings from the session are to be published shortly by NAFEMS.

For further information contact,

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East Kilbride
Glasgow G75 0QV
United Kingdom

Telephone: 03552-72639
Fax: 03552-72749

Book Review

A FINITE ELEMENT DYNAMICS PRIMER

Edited by Dennis Hitchings with acknowledgement to the NAFEMS Dynamics Working Group. Published by NAFEMS, 1992.

A review by Stephen Raynes, Lloyd's Register

Although this book is not intended for cover to cover reading, I have done just that and now have a chance to comment on it in its entirety.

This book addresses the problems that a practising FE analyst might encounter when carrying out a vibration analysis. Rather that adopting a typical textbook approach, it sets out to give practical help and advice to the analyst both before and during an analysis. For this reason the layout is of a modular form, which easily allows the reader to dip into and gain an understanding of a relevant topic, with the minimum number of cross references having to be made.

The basic layout is in two sections. Section 1 contains chapter one consisting of brief guidelines to dynamics analysis. Section 2, the rest of the book, expands on Section 1.

Brief mathematics have been given to explain the problem under discussion. It is not complete but it is sufficient for the purposes of explanation and the simplicity which this adds to the text makes its a very much more readable book.

Section 2 covers such aspects as Solution Methods, Modelling Suggestions, Problems/Cost Reduction, Matching Test and Theory, Approximations and Output Interpretation. This section also includes information on more specialised topics.

I am pleased to be able to recommend this book to both the analyst new to the field of dynamic analysis as well as to those with some experience. It is available free of charge to NAFEMS members and at a price of £40 for non-members.

For further information contact,

Anne Creechan
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Birniehill
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Tel: 03552-72639
Fax: 03552-72749

New Publications

Earthquake Protection

Andrew Coburn and Robin Spence

Published by John Wiley & Sons

This book provides an overview of ways to reduce the impact of earthquakes worldwide on people, buildings and human settlements and describes the manner of dealing with the consequences of earthquakes when they occur. It is intended for everyone interested in understanding, organising or participating in earthquake protection. The introductory chapter discusses the global incidence of earthquakes and their causes and effects, and the remaining chapters deal with separate aspects protection.

The book covers a wide range of economic and social conditions, looking at protection strategies in Europe, USA and Japan, as well as for rural and urban communities in developing countries. A considerable amount of the material presented derives from the author's experience over thirteen years of eathquake damage investigation and reconstruction planning.

Conferences

COLLOQUIUM ON STRUCTURAL SERVICEABILITY OF BUILDINGS Göteborg 9-11 June, 1993

Objectives

The Colloquium is intended to promote the development of well-designed functional buildings. Methods for structural design and assessment aiming at assurance of building functionally are in focus.

Various phenomena which could potentially violate the serviceability should be highlighted and information on corresponding engineering parameters related to serviceability should be presented. Interpretation of structural serviceability as a measure of functional quality will emphasize the need for different engineering approaches as compared to the classical fail/safe concept applied to structural safety problems.

Scope

The Colloquium will comprise structural serviceability of buildings. The orginal functional requirements, corresponding engineering parameters and criteria, analytical models and methods of experimental verification are included. The design process aiming at serviceable structures as well as relations between functional requirements and structural properties are important.

Vibrations and deformations are the main phenomena of concern, while problems associated with acoustics (noise) and indoor climate are excluded.

Themes

The following themes are planned:

- Performance requirements for structural serviceability
- Design concepts for structural serviceability
- Service loads and load models (static and dynamic)
- Structural response to service actions
- Serviceability aspects on whole structural systems
- Floor and roof deformations
- Floor vibrations
- Special topics of structural serviceability

Further information may be obtained from,

Chalmers Conference Bureau
S-412 96 Göteborg
Sweden

Tel: +46-31 7724010
Fax: +46-31 7724011

EURODYN '93

2nd European Conference on Structural Dynamics

The Norwegian Institute of Technology
Trondheim, Norway - **June 21-23 1993**

Background and aim

Dynamic effects caused by wind, waves, earthquakes, impacts, traffic loads and machinery vibrations have become increasingly important for the serviceability and safety of engineering structures such as buildings, bridges, offshore platforms, vehicles and other structures.

Efficient analytical and numerical methods such as Finite Element and Boundary Element Methods are being developed for predicting dynamic behaviour and hence achieving a safe and economic design. At the same time there are advances in experimental techniques and system identification methods.

Following the success of the first EURODYN conference in Bochum in 1990, the aim of the second conference is to provide a forum for engineers, researchers, university teachers and other professionals for discussing recent developments in dynamics of structures. The aim is to stimulate the exchange of information between various diciplines in science and engineering and various fields of application. Moreover, it is especially hoped that this venue will contribute to a closer cooperation and harmonization of techniques, methods and rules for design in Europe.

Preliminary session topics

- Earthquake engineering
- Wind engineering
- Dynamics of bridges subjected to wind and traffic loads
- Marine structures subjected to sea loads
- Material and structural behaviour under cyclic loading
- Mechanics relating to impacts by vehicles and other objects
- Explosion mechanics
- Fluid-structure interaction
- Soil dynamics
- Soil-structure interaction
- Stochastic dynamics
- Chaos in dynamic systems
- Dynamic stability and bifurcations
- Analytical and numerical methods
- System modelling and identification
- Vibration monitoring and safety assessment
- Techniques for laboratory and in-service investigations
- Design rules for dynamic excitation

For further information contact the conference secretariat,

Eurodyn '93
SEVV Conference Office
N-7034 Trondheim
Norway

NOTABLE EARTHQUAKES APRIL - JUNE 1992

Reported by British Geological Survey

YEAR	DAY	MON	LAT	LON	DEP KM	MAGNITUDE ML	MB	MS	LOCALITY
1992	26	Jul	57.485N	5.661E	15	2.8			STRATHCARRON, HIGHLAND
			Felt (III-IV MSK) at Strathcarron. Also felt at Diabaig and Torridon.						
1992	29	Jul	53.131N	4.384W	9	3.4			CAERNARFON BAY
			Felt at Caernarfon (IV MSK). Also felt at Bangor, at Llanfaelog and other parts of Anglesey and in Snowdonia.						
1992	17	Aug	58.683N	3.256W	2	2.3			BARGOED, MID GLAMORGAN
			Felt at Nelson, South Wales						
1992	19	Aug	42.096N	73.540E	24		6.8	7.5	KYRGYZSTAN
			An estimated 74 people were killed including 14 killed by landslides in Toluk. Several villages including Toluk were destroyed in the Susamyrtau Mountains and at least 8,200 dwellings were destroyed. Felt (VII MM) at Andizhan and Mamangan, Uzbekistan, and structural damage (VI MM) at Bishkek, Kyrgyzstan.						
1992	27	Aug	56.029N	6.018W	11	2.7			JURA, STRATHCLYDE
1992	28	Aug	0.868S	13.614W	10		6.5	6.9	NORTH OF ASCENSION ISLAND
1992	31	Aug	55.0477N	3.867E	24	3.5			CENTRAL NORTH SEA
1992	2	Sep	11.715N	87.406E	33		5.2	7.2	COAST OF NICARAGUA
			At least 105 people killed, 63 missing and 16,00 homeless. At least 1,143 houses and 185 fishing boats were destroyed along the west coast of Nicaragua. Some damage was also reported in Costa Rica. Most of the casualties and damage were caused by a Tsunami affecting the west coasts of Nicaragua and Costa Rica						
1992	11	Sep	6.096S	26.733E	10		6.7	6.5	ZAIRE
			Eight people killed, 37 injured and several buildings destroyed at Kabalo.						

RECENT PUBLICATIONS FROM IMPERIAL COLLEGE

Performance of Steel Concrete Composite Members under Earthquake Loading: Analytical Modelling, Parametric Studies and Design Considerations, A.Y. Elghazouli and A.S. Elnashai, ESEE Report no. 92/3, June 1992.

Testing and Analysis of Partially-Encased Composite Beam-Columns under Combined Earthquake and Axial Loading, B. Broderick and A.S. Elnashai, ESEE Report no. 92/6.

For further information contact,

Imperial College
Department of Civil Engineering
Imperial College Road
London SW7 2BU

British Geotechnical Society - Thirty Third Rankine Lecture

LIQUEFACTION AND FLOW FAILURE DURING EARTHQUAKES

Professor K Ishihara
University of Tokyo

Professor Ishihara, current Vice President (Asia) of the ASSMFE, is a world authority on seismicity and its effects on soils, and has made significant contributions to the understanding of the phenomena. His lecture will deal with the practical problems of how to predict the onset of liquefaction and flow slide conditions, drawing on case studies and the results of laboratory studies.

The following topics will be touched upon:

- Mechanisms causing liquefaction
- The factors influencing the susceptibility of ground to earthquakes
- Prediction of the onset of liquefaction and flow slides
- The consequences of liquefaction

Wednesday 24 March 1993 - 5:30pm
Main Lecture Theatre, Sherfield Building, Imperial College, London SW7

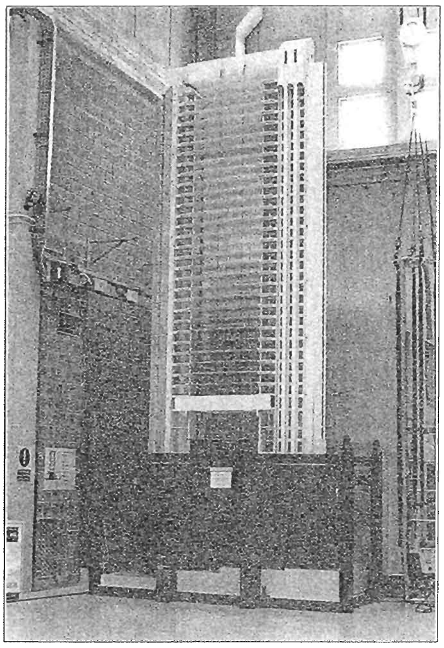
IMPERIAL COLLEGE VISIT ITALY

Continuing education in the field - the 1992 earthquake engineering field trip

In the absence of a timely and accessible earthquake, members of the Earthquake Engineering and Structural Dynamics group of Imperial College spent a week touring dynamic testing facilities in Universities and commercial testing outfits in Northern Italy. The group consisted of fifteen Master of Science students and three "consultants", each advising a group of students. Based in Milan, the group visited the Politecnico di Milano, the University of Pavia, the EEC Joint Research Centre at Ispra, and the large commercial testing outfit of ISMES in Bergamo. The students prepared informal presentations each evening, and more formal group presentations on the last day of the trip. The trip was organised by Mark Manzocchi and Amr Elnashai; the third consultant was Assaad Salama.

The first one and a half days were spent at the Politecnico di Milano where a tour of the structures laboratories was arranged. The Politecnico has an active experimental programme of cyclic and dynamic testing. Current work includes tests on energy dissipating devices and fibre reinforced composite components. A fascinating presentation on an experimental and analytical study into the behaviour of steel cantilevers under cyclic loading was also given.

Below: Multi-storey building model for shake table testing at IMES



Half a day was spent at the impressive new structural testing laboratories at the University of Pavia. Here, an extensive experimental programme concerning the behaviour of masonry structures under seismic loading is underway. Currently this involves cyclic testing of masonry panels; full scale tests on two storey masonry buildings are to be carried out in the near future. The research here is fuelled by the current concern over the vulnerability of ancient masonry buildings in Italy. The sudden collapse of a mediaeval tower in Pavia in 1991 has resulted in a monitoring and retrofitting programme by the University for the many ancient buildings in Pavia. On-site instrumentation is fitted with radio transmitters allowing 24 hour monitoring from the University's structural laboratories.

One day was spent at the Ispra site of the EEC Joint Research Centre. Here construction of a massive reaction wall and strong floor facility intended for large scale pseudo dynamic testing of structures has recently been completed. The reaction wall is of 4 metre thick prestressed concrete box construction, 16m high and 21m long. It can resist a total base shear of 20 MN distributed over its length. For pseudo dynamic testing, hydraulic actuators will be used, each with a maximum capacity of 1 MN. In the near future multi degree of freedom pseudo dynamic tests on full scale steel structures are planned. The facility may also be used for real time dynamic testing of lighter models such as pipework components.

The last two days of the trip were spent at ISMES near Bergamo. A tour of the dynamics and geotechnical laboratories was arranged, and various presentations on the activities of ISMES were given. The dynamic testing facilities include no less than six shake tables ranging from a six degree of freedom table maximum payload of 30 tonnes, to a high frequency table for component testing at frequencies up to 2000 Hz. The range of experience and expertise is vast; current work includes shake table tests on two storey masonry buildings, shake table tests on a scale model of a 120m high multistorey building, and testing of base isolation systems. This latter work included an in-situ free vibration test on a building fitted with base isolation.

The trip not only stimulated discussions on various issues in earthquake response and design, but also strengthened links with earthquake research centres in Italy. The group was hosted by the following, to whom we are grateful: Profs Ballio and Castiglioni (Politecnico di Milano), Profs Macci and Calvi (University of Pavia), Drs Donea, Jones, Pinto and Negro (J.R.C. Ispra) and Dr. Casirati (ISMES).

Mark Manzocchi
Research Assistant, Imperial College.

WHAT'S ON

September - October 1992

5th - 9th October 1992
International Conference on Risk Assessment
London

7th October 1992
Institution of Mechanical Engineers
Seismic and Environmental Qualification
Institution of Mechanical Engineers, London

5th November 1992
Joint SECED/WES Meeting
Hazard Assessment - Seismological and Wind Comparisons
Institution of Civil Engineers

17th November 1992
Institution of Structural Engineers
Demolition and Explosives
Institution of Structural Engineers, London

25th November 1992
Joint SECED/AFPS Meeting
Presentation from the French Association of Earthquake Engineering
Institution of Civil Engineers

FORTHCOMING EVENTS

20th - 22nd January 1992
Royal Netherlands Meteorological Institute
The Roermond Earthquake of April 13 1992: Seismotectonics and Seismic Hazard in the Rhine Graben System
Veldhoven, The Netherlands

27th January 1993
SECED Meeting
Seismic Resistance of Steel Frames with Semi-Rigid Connections
Institution of Civil Engineers

24th February 1993
Joint SECED/OES Meeting
Analysis and Design of Offshore Structures under Blast Loading
Institution of Civil Engineers

24th March 1993
British Geotechnical Society
Thirty Third Rankine Lecture
Liquefaction and Flow Failure During Earthquakes
Professor K Ishihara
Imperial College, London

31st March 1993
Joint SECED/EEFIT/EFTU Meeting
EEFIT/EFTU Field Reports
Institution of Civil Engineers
+ EEFIT AGM

22nd - 23rd April 1993
Joint SECED/AFPS Seminar
Dynamic Testing Facilities in the UK and France
Paris, France

28th April 1993
SECED Half Day Meeting
Conservatism in the Design of Industrial Facilities
Risley, Warrington
+ SECED AGM

26th May 1993
4th Mallet-Milne Lecture
Simplicity and Confidence in Seismic Design
Professor T Paulay
London

9th - 11th June 1993
International Colloquium on Structural Servicability of Buildings
Göteborg, Sweden

14th - 16th June 1993
6th International Conference on Soil Dynamics and Earthquake Engineering
Bath, UK

21st - 23rd June 1993
ERODYN '93
2nd European Conference on Structural Dynamics
Trondheim, Norway

7th - 9th July 1993
DTA & NAFEMS
International Conference on Structural Dynamic Modelling - Test, Analysis and Correlation
Cranfield, UK

6th - 13th August 1993
Association Chilena de Sismologia e Ingenieria Autisismica & Universidad de Chile
6th Chilean Conference on Seismology & Earthquake Engineering
Santiago, Chile

9th - 13th August 1993
ICOSSAR '93
6th International Conference on Structural Safety & Reliability
Innsbruck, Austria

15th - 20th August 1993
SMIRT 12
Stuttgart, Germany

13th - 15th October 1993
IDNDR Conference
Natural Disasters: Protecting Vulnerable Communities
The Royal Society, London

10th - 14th July 1994
Earthquake Engineering Research Institute
5th US National Conference on Earthquake Engineering
Chicago, USA

28th August - 2nd September 1994
European Association of Earthquake Engineering
10th European Conference on Earthquake Engineering
Vienna, Austria

SECED

SECED, The Society for Earthquake and Civil Engineering Dynamics is the British national section of the International and European Associations for Earthquake Engineering and is an affiliated society of the Institution of Civil Engineers. It is also sponsored by the Institution of Mechanical Engineers, the Institution of Structural Engineers, and the Geological Society. The Society is also closely associated with EEFIT, the UK Earthquake Engineering Field Investigation Team. The objective of the Society is to promote cooperation in the advancement of knowledge in the fields of earthquake engineering and civil engineering dynamics including blast, impact and other vibration problems.

For further informationabout SECED contact The Secretary, Institution of Civil Engineers, Great George Street, London SW1P 3AA, United Kingdom.

SECED NEWSLETTER

The SECED Newsletter is published four times a year by the SOCIETY FOR EARTHQUAKE 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 a 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 wherever possible. Diagrams and photographs are only returned to authors upon request. Articles should be sent to Nigel Hinings, Editor, SECED Newsletter, Allott & Lomax, Fairbairn House, Ashton Lane, Sale, Manchester, M33 1WP, United Kingdom (Tel. 061 962 1214; Fax 061 969 5131).

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