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NEWSLETTER

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Field Observations of the Italian Earthquakes of September-October 1997

Following the recent series of destructive earthquakes in central Italy, a short field reconnaissance visit was carried out by the Earthquake Field Training Unit (EFTU) comprising Amr Elnashai, Julian Bommer, Alejandro Martínez and Antonio Orlando from Imperial College and Tim Allmark from EQE. The team was supported in the field by Professor Nuti and Drs. Vanzi and Biondi from the University of Pescara, Barbara Borsi from the Politecnico di Milano, Giovanni Fabrocino and Gerardo Verderame from the University of Naples, Vera Passini from GNDT and Agostino Goretti and Vittorio Bosi of SSN.

Introduction
The earthquake series struck the region between the provinces of Umbria (capital city Perugia) and Marche (capital city Ancona) in the central Appenines (Fig. 1). Several people in the region reported feeling various shocks since April of this year, but no damage was caused until the events of September and October occurred. The total death toll produced by the earthquakes is 11. The largest shocks, all of which were of shallow focus, were assigned the source characteristics listed in Table 1 by the USGS.

The epicentre of the second and largest event was located close to the town of Colfiorito (Fig. 1). The epicentre of the 14 October event was some 20 km to the south, between the towns of Triponzo and Sellano. The field visit was carried out during the period 16-19 October and hence the cumulative effect of the shocks was observed.

Tectonics and Faulting
The tectonics of this region, described by Cello *et al.*[1997], consist of thrust faults, trending N-S and dipping to the west, which were active during the Miocene-Pliocene period. This compressional regime is now overprinted by faults associated with a NE-SW extension related to crustal thinning in the Tyrrhenian-Tuscan area. The currently active fault systems are left-lateral strike-slip structures, with a N-S strike, and normal faults with a NW-SE strike, both of which show activity during the Pleistocene-Holocene. The field survey visited an exposed segment of the NW-SE trending fault that defines the southern boundary of the Colfiorito basin. This fault extends from the village of Cesi (Fig. 1) and then continues with a nearly N-S strike through the village of San Martino. The fault scarp, of up to about 4 metres, is clearly visible on a steep slope to the SE of the village of Costa for about 100 m on the boundary between limestones to the NE and debris to the SW. The strike angle is about 135° and the dip is about 65° to the SW. Along this scarp, exposure of limestone

Table 1 Source characteristics of the largest shocks in the region

Shock	Year	Month	Day	Time	Latitude	Longitude	Magnitude
1	1997	September	26	00:33:11.8	42.8°N	12.6°E	5.5 M_s
2	1997	September	26	09:40:25.3	43.0°N	12.8°E	5.9 M_s
3	1997	October	6	23:24:52.7	43.0°N	12.8°E	5.3 m_b
4	1997	October	14	15:23:09.5	42.8°N	12.9°E	5.5 M_s

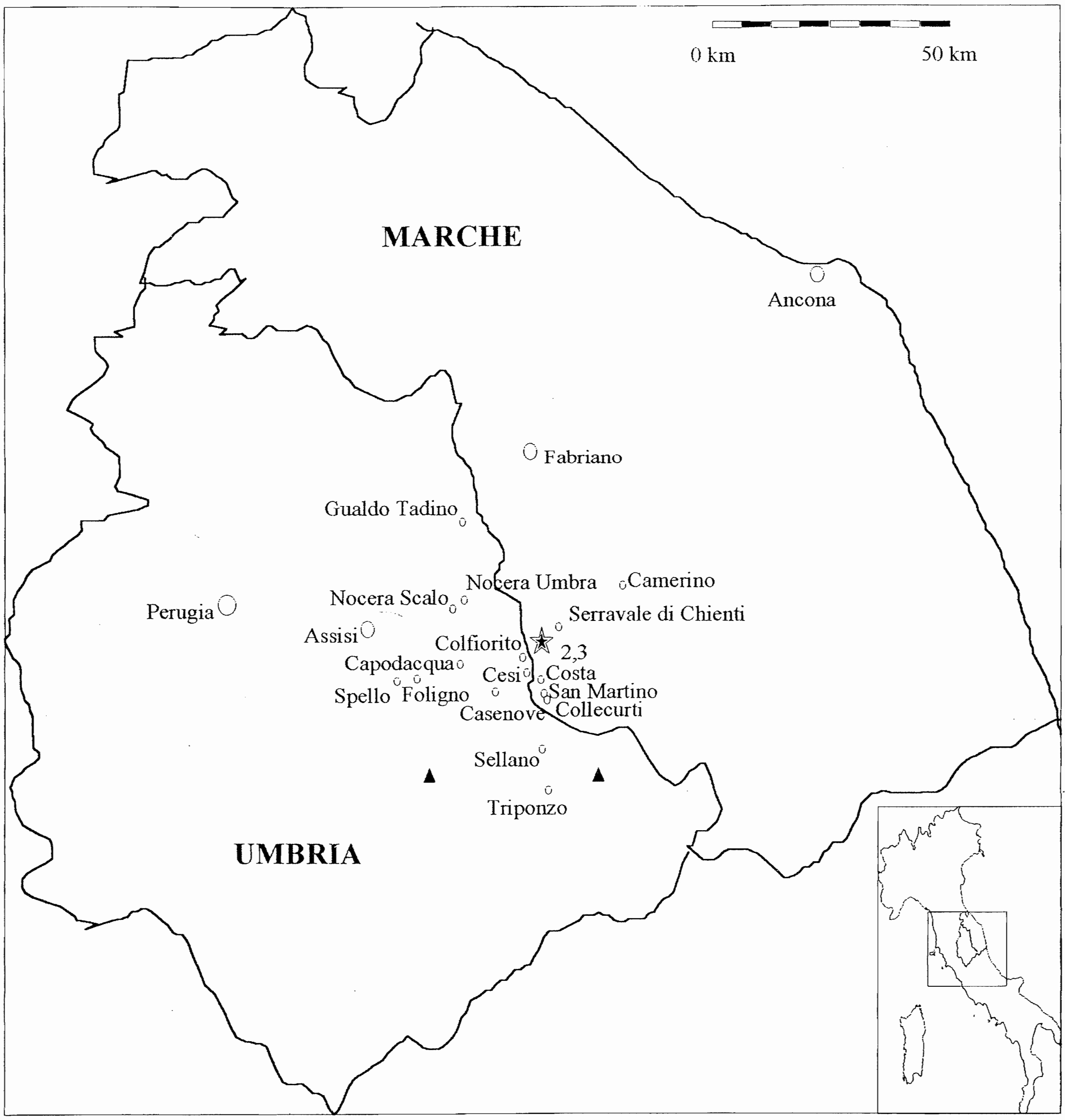

Figure 1 Location map of the affected area.

without moss cover revealed normal slip of up to 7 cm. Due to the topography this movement could be attributed to gravity effects, but there is also evidence of left-lateral strike-slip of about 2 cm in some locations, confirming that this is most probably co-seismic slip on the fault rupture. The rupture mechanism implied by these observations (a rake angle of about -75°) is consistent with the known mechanism of the faults in this area [Cello *et al.*, 1997]. Evidence of surface rupture has also been reported by the Italian GNDT (National Group for Defence against Earthquakes) along a parallel strike about one kilometre to the NE of Costa and also on the Colfiorito fault which defines the northern boundary of the Colfiorito basin, passing through Monte il Castello and Monte Tolagna.

Intensity distribution

Structural damage was mainly limited to masonry buildings and few engineered structures suffered appreciable damage. Heavy damage, including a number of collapses, was observed in the towns of Nocera Scalo, Cesi, Costa, Capodacqua, Colfiorito and Casenove. Further to the south, there was also very significant damage, including collapses, in the town of Sellano. The highest intensities that could be assigned to any town or village visited on the basis of the observed structural damage, would be of the order of VIII on the MSK scale. This observation is consistent with the reports of GNDT which give a maximum intensity of IX on the MCS scale, at a single location (the village of Collecurti), which is equivalent to VII-VIII on the MSK scale. Over a wider area the maximum intensity is reported as VIII-IX on the MCS scale which corresponds to VII on the MSK scale [Reiter, 1990].

At greater distances from the epicentral area, damage was limited to a few isolated structures. In the medieval town of Spello, 20 km west of the epicentral area, a number of buildings, some of which date back as far as the twelfth century, suffered some damage although there were no cases of collapse. Nonetheless, it was reported that about 1,000 of the town's 8,100 inhabitants had been left homeless by the earthquakes. In Assisi, a few kilometres NW of Spello, it is unlikely that the intensity exceeded V or possibly VI on the MSK scale.

The earthquakes produced a number of landslides, some of which caused disruption of roads and some routes were closed to traffic as a result. There were no reports of interruptions to other lifelines such as electricity, water and gas supplies.

Strong-motion

The region affected by the earthquakes lies within the second highest hazard zone according to the official seismic classification map of Italy [Slejko & Zonno, 1993]. Italy is divided into three seismic zones and there are also parts of the country for which no seismic design requirements are imposed.

There are a number of accelerographs in this region which were previously operated by ENEA-ENEL but which are now maintained by the Servizio Sismico Nazionale (SSN). There are some 400 strong-motion recordings from the area but no information about the records has yet been released except for accelerograms of the first and second shocks obtained at Sacro Convento in Assisi, about 20

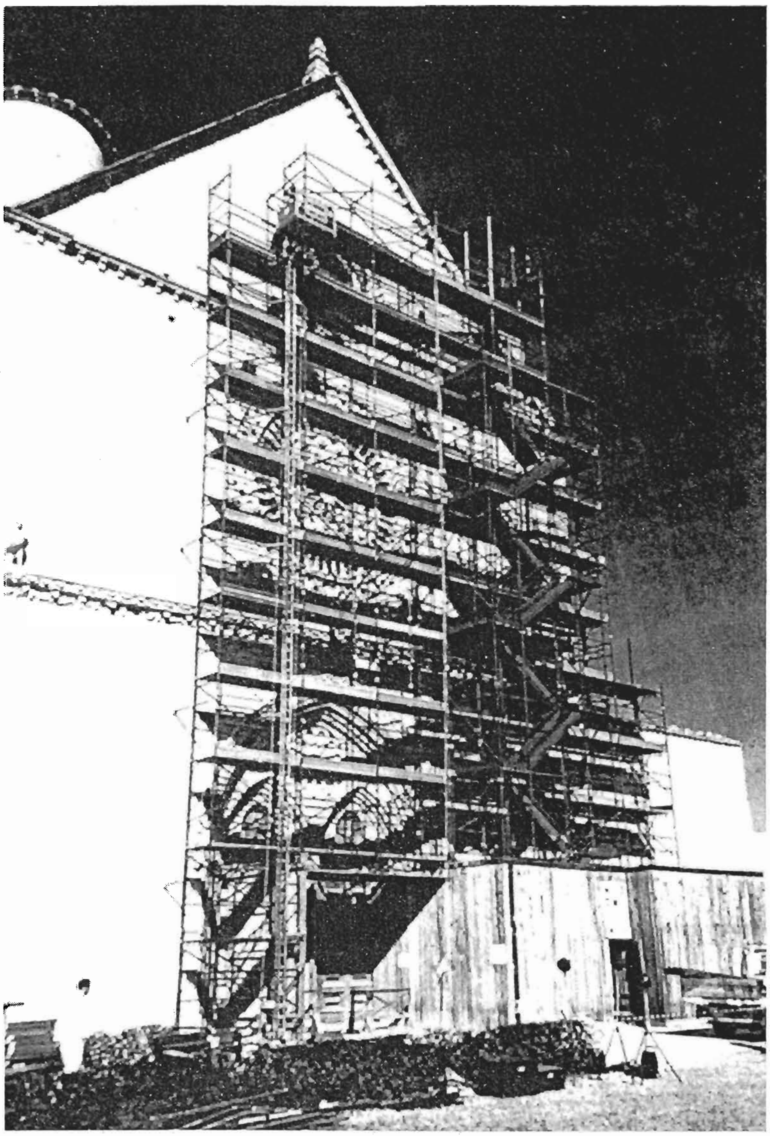

Figure 2 Basilica di San Franceso, Assisi.

Figure 3

Collapse of masonry house in lower area of Cesi.

km from the epicentre. The accelerogram from the second event has peak horizontal accelerations of almost 0.2g in both directions and 0.08g vertically. The duration of strong shaking is of the order of 5-6 seconds.

Structural Damage
From a structural damage point of view, it is difficult to make general statements at this stage, due to the scarcity of information and the rather large area affected. The comments below should therefore be seen as tentative.

Historical monuments and buildings have been seriously affected by the earthquake sequence. Of particular interest is the Basilica di San Francesco in Assisi, where damage was inflicted on the inner ceiling frescos as well as on the outside of the main hall (Fig. 2). The response spectrum of the accelerogram obtained from the Assisi station for the first shock on 26 September (02:33 local time)

Figure 4 Severe damage to modern house in higher area of Cesi

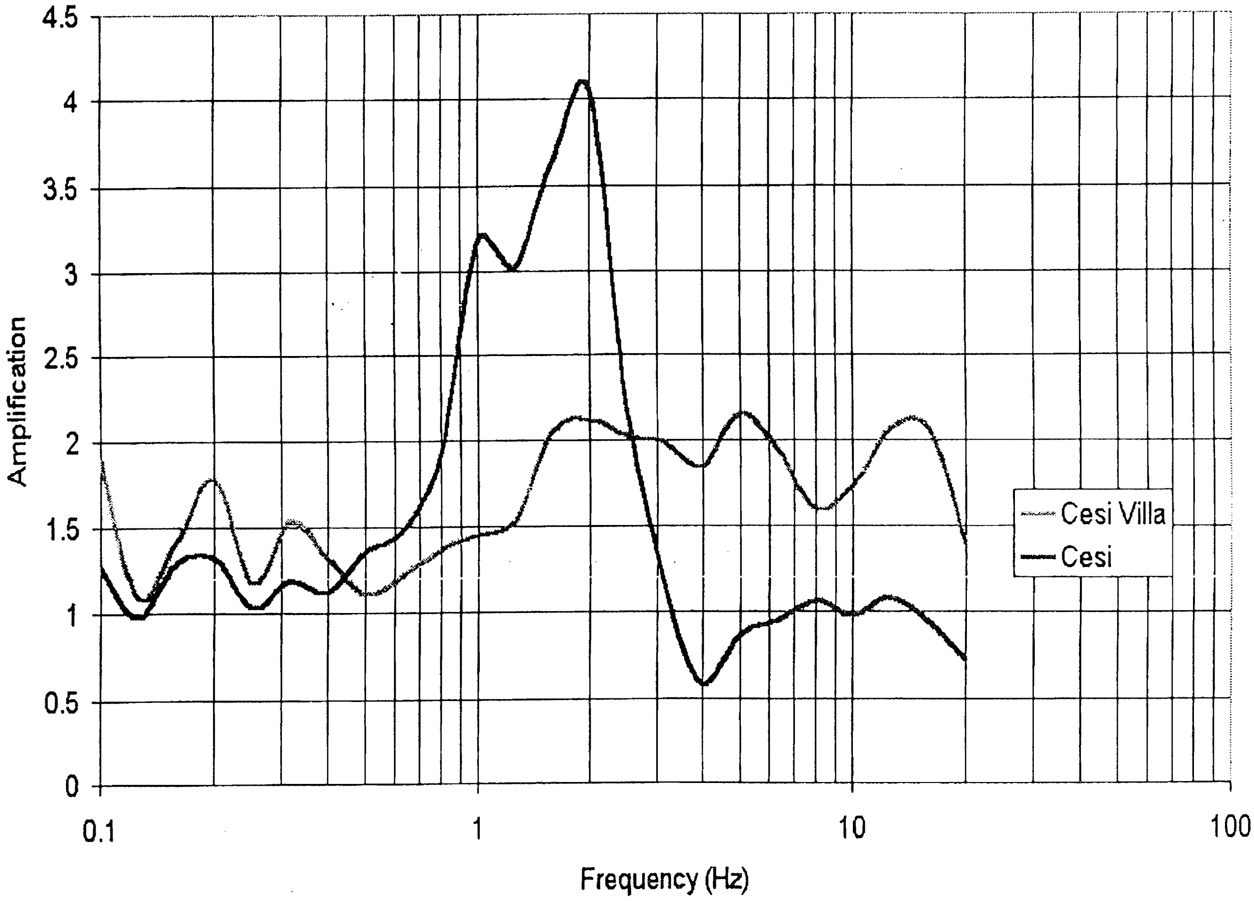

Figure 5 Nakamura ratios from aftershock measurements at the low lying parts of Cesi and from Cesi Villa which is on higher and firmer ground [Macciarelli *et al.*, 1997].

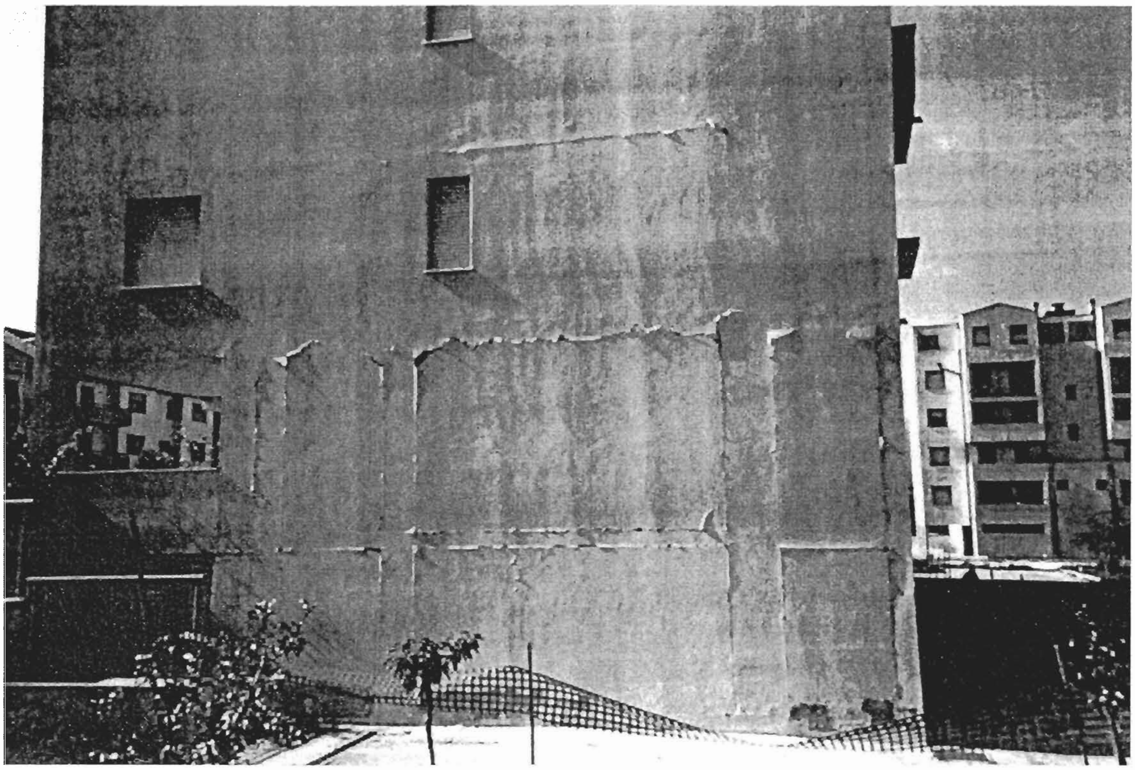

Figure 6 Non-structural damage to apartment block in Fabriano caused by excessive displacements

shows highest amplification narrowly corresponding to 0.2 seconds in both EW and NS directions. On the other hand, the shock approximately 9 hours later (11:40 local time) produced a response spectrum with high amplification in a wider period range of 0.2-0.4 seconds in the NS direction. It was this event that caused the collapse of part of the valuable ceiling, hence it may be concluded that the response period of the structure was longer than 0.2 seconds. Damage in Assisi, other than to the Basilica, was very minor.

Many historical buildings were adversely affected and considerable cracking was observed in such buildings as the municipality buildings in Spello and in Fabriano centres. However, failure was avoided due to the use of steel wall ties that prevent out of plane shedding.

Worst hit were masonry structures, with tens of cases of total collapse. One of the worst hit villages were Nocera Scalo and Cesi. In the latter village, the central part, which is low-lying, suffered most, with the majority of buildings either totally or partially collapsed (Fig. 3). Towards the mountain (on higher grounds), damage is relatively less severe. However, even well-constructed and modern structures on firm ground suffered partial collapse (Fig. 4). Evidence of the effect of site conditions on damage is still inconclusive, because there is an interaction between at least three factors, if Cesi is taken as a test case. These are as follows:

i. The strong-motion amplification on soil is in general higher than on rock, as shown by measurements during aftershock reported by Mucciarelli et al. [1997]. In the latter work, amplification factors of up to four were measured in a period range of 0.4-1.0 seconds (Fig. 5). However, it is not mentioned what magnitude event was used for this study, hence it could be that such high amplifications are realised only for small amplitude vibrations.

ii. There is a period shift on soil towards longer periods, which in general will not coincide with periods of stiff stone masonry structures typical of central village sites. This is also evident in the amplification plots of Mucciarelli et al. [1997], where the amplification on rock of about 2 is realised in a period range of 0.05-0.5 seconds. Such periods are definitely closer to the periods of vibration of stiff squat masonry houses than the period range of high amplification of soil sites, typically very low in the range 0.05-0.1 seconds.

iii. The village centres usually have the oldest vintage of buildings, as shown by comparing Fig. 3 with Fig. 4 opposite. Therefore, the lower incidence of damage on higher ground may be a consequence of the more modern construction.

Whereas brick and block masonry structures were severely hit in the extended epicentral area, due to short period excitations by the strong short duration ground motion, engineered structures further afield were affected. On the outskirts of Fabriano, the field group inspected several reinforced concrete structures with varying degrees of damage. A modern apartment block (Fig. 6) suffered external and reportedly internal non-structural damage due to excessive drifts. This is attributable to the absence of walls and the flexibility of moment frames. Two other structures suffered shear failure in short columns, an example of which is shown in Fig. 7. In this case, due to sloping ground, the columns on the facade acted in flexure, whilst the shortened columns at the back suffered shear distress in two directions. Other cases of shear failure of short columns were reported to the group for RC structures on the outskirts of Nocera Umbra. The general statement though for engineered structures is that they behaved very well and only suffered damage when well-known guidelines for earthquake-resistance were violated. A corollary of this statement is that industrial plant, which is usually of adequate design and construction standard, suffered very little damage and hence no significant disruption.

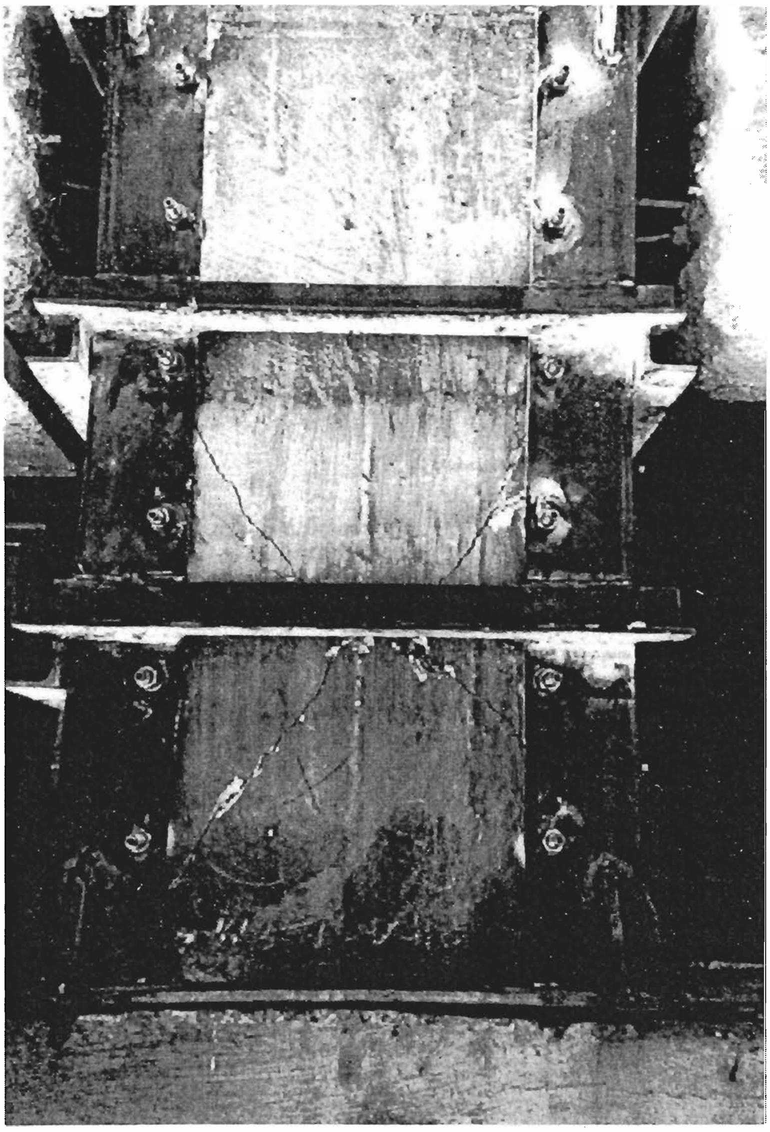

Figure 7 Repair and strengthening of short column damaged in shear in Fabriano

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SECED Meeting Announcement

The EEFIT and EFTU visits to the Italian earthquakes

28 January 1998

IStructE 5.30pm

After the recent earthquakes in Italy teams from EEFIT and EFTU went out to survey the damage. Speakers from both teams will outline their main findings and draw some conclusions from the visits.

Transformation of Parts of ENV 1998 (Eurocode 8) into EN 1998.

Two years after publication by CEN of the following European Prestandards (ENVs), the CEN/CS has launched the Enquiry to members for comments and consideration to determine future action, in particular to decide on the suitability of each ENV for conversion into a full European Standard. Comments are welcomed, particularly those based on practical use of comparative studies, but must be received by **23 January 1988** to be considered by the relevant BSI committee. Comments on specific clauses should be clearly referenced and proposed redrafting included. In addition, general comments on technical quality, consequences for UK design practices, usability and economic considerations will be welcomed

Eurocode 8 Part 1-1	General Rules - Seismic actions and general requirements for structures.
Eurocode 8 Part 1-2	General Rules - General Rules for buildings.
Eurocode 8 Part 1-3	General Rules - Specific rules for various materials and elements.
Eurocode 8 Part 5	Foundations, retaining structures and geotechnical aspects.

Comments on these codes should be addressed to Mr A R Mears at BSI Head Office, 389 Chiswick High Road, London W4 4AL

Meeting Report: 29 October 1997

RECENT DEVELOPMENTS IN SHAKING TABLE CONTROL AND TESTING

This afternoon meeting, held at Bristol University, described some of the ongoing research in the Earthquake Engineering Research Centre (EERC) into the control and use of shaking tables. The meeting attracted over 35 people from various universities and other organisations to hear about some significant advances that are being made in the field of shaking table testing at Bristol.

The first speaker, Dr Colin Taylor started the afternoon by outlining some recent research projects at Bristol University which utilised shaking table testing and highlighted many of the important issues in the design and execution of such tests. Particular reference was made to the importance of achieving appropriate scale properties for the model being testing and the difficulty of achieving this, especially in the case of very small scale models. The presentation also highlighted the importance of achieving accurate control of the table motion for such small and often delicate models.

The next speaker, Mr Adam Crewe described how in 1991, as part of a European research programme, the EERC started to investigate the relative performance of the four shaking table facilities in the Laboratory for Earthquake Engineering, National Technical University of Athens, in the Earthquake Engineering Research Centre, Bristol University (Fig. 1), in the Structural Dynamic Testing Laboratory, ISMES spa., Bergamo, Italy and in the National Laboratory for Civil Engineering (LNEC), Lisbon, Portugal. This work was essential in order to allow an extensive programme of European research to proceed. This research programme planned to use the results from many different tests in several shaking table laboratories. In order to compare results from each of the facilities the relative dynamic performance of the facilities had to be assessed, along with the ability of each table to accurately reproduce the same required motions. The main results of the performance tests in the "Standardisation of Shaking Tables" project, which for the first time gave a detailed comparison of several shaking tables, were presented along with many of the key lessons learnt during the testing. Several of the solutions that were developed under this research programme to cope with problems associated with shaking table testing were also described. Mr Crewe finished by outlining how these tests identified weaknesses in the control methodology of shaking tables and the need for improved testing techniques which could cope with the testing of specimens that have significant dynamic interaction with a shaking table.

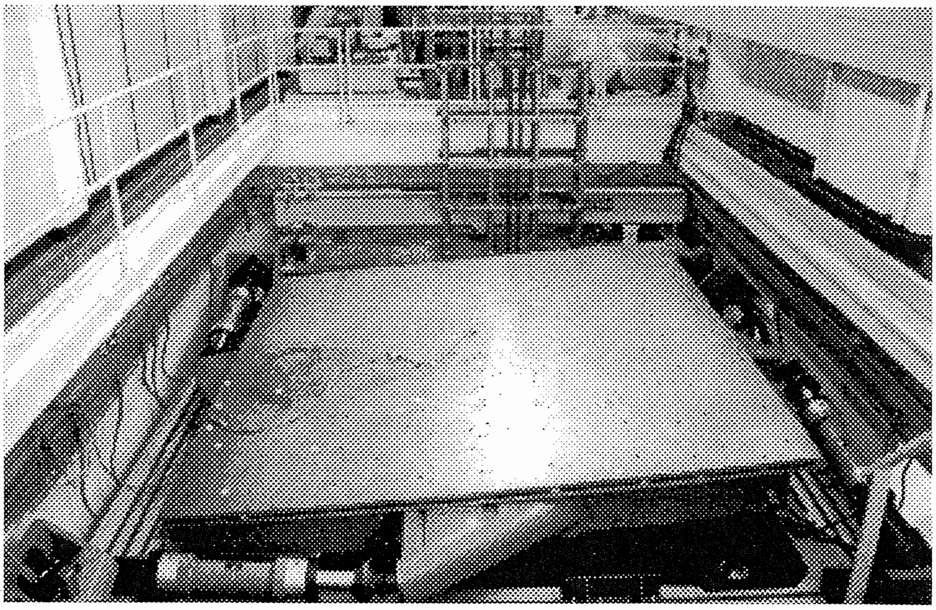

Figure 1 The shaking table at Bristol University

This led on to the final speaker, Prof David Stoten who described in detail a current programme of work leading to much finer control of shaking table motion. The history behind the development of the MCS (Minimal Controller Synthesis) adaptive controller was presented along with a brief description of the theory behind the controller. In essence, the algorithm works by modifying the various feedback parameters in the control loops in real time. This is equivalent to a real-time modification of the driving signal sent to the table compensating for any changing or unknown dynamic characteristics in the whole table/specimen system. Typical results from a series of tests on the Bristol and ISMES shaking tables were presented which showed how the new control system could cope with real-time control of shaking tables and with non-linear specimen response during a test. These results were followed by a live demonstration of the new MCS control algorithm accurately controlling a very non-linear system.

The meeting concluded with a tour of the Earthquake Engineering Research Centre laboratory and demonstrations of the Shaking Table in action which gave a graphic demonstration of the differences in size and frequency composition of typical US and UK earthquakes. The demonstrations also highlighted the significant differences between earthquakes generated to UK hard rock spectra and to the typical UK design spectra used in many safety critical installations.

Adam Crewe

GROUND DYNAMICS AND MAN-MADE PROCESSES (PREDICTION, DESIGN, MEASUREMENT)

A Conference held at the Institution of Civil Engineers, 20 November 1997

This one day conference was attended by well over 50 delegates from the UK, France, Italy, Germany, Norway, Sweden, Switzerland and the USA. It featured 14 papers and an associated exhibition. In order of presentation, the papers are briefly summarised below - they are due to be published by Thomas Telford Limited in due course.

1. **Vibration on Impact**
(P J Eldred/B O Skipp)
This paper presented experience of monitoring the demolition of cooling towers and chimneys and the resulting vibrations. The development of predictive methods for vibration were outlined, as well as highlighting the predominant frequencies of ground vibration following impact.

2. **Ground Vibration - Codes and Standards**
(B O Skipp)
A review of ground vibration standards producing bodies was carried out, broken down into international, national, regional and other bodies. This was a useful lead in to the "jungle" and also addressed constraints and future developments. The principal relevant ISO Committee is TC108/SC2.

3. **A Numerical Ground Model for Railway-induced Vibration**
(C Madhus et al)
New high speed trains north of Oslo will pass very close to urban areas, and the main line will pass over soft soils. This paper discussed vibration prediction and counter measures, concentrating on analytical approaches such as the impedance method, using the commercial program SASSI.

4. **Vibration Transmission in a Layered Ground with a Wave Impedance Block**
(A Peplow, C Jones and M Petyt)
Wave impedance blocks (WIB) were proposed as a method of reducing low frequency ground vibration from trains. A model, which used the boundary element method, was described which was implemented for the analysis of WIB's.

5. **Effect of Layered Ground on Ground Vibrations Generated by High-speed Trains**
(V Krylov)
The question was posed - how does train speed affect train generated vibrations? The answer was - dramatically when the ground Rayleigh wave velocity is approached! The idea of a critical train track velocity was advanced.

6. **Vehicle Generated Ground-borne Vibration alongside Speed Control Cushions and Road Humps**
(G Watts)
Report on recent research arising from complaints from residents alongside modern traffic calming measures. Frequencies of interest were 40 - 125 Hz for airborne effects and 8 - 16 Hz for ground-borne effects, the latter being predominantly Rayleigh surface wave phenomena.

7. **The Impact Fragmentation of Rock Bodies in a Soil Matrix**
(R Bennett et al)
This paper addressed a problem and possible solution from the microtunnelling industry, namely an impact-based method of fragmenting small boulders which may be encountered in soils such as glacial clays. A typical application area is sewer installation in a no-dig environment.

8. **Computation of the Transmission of Waves from Pile Driving**
(C Ramshaw, A Selby & P Bettess)
Studies into the relation between pile drivers and ground waves were reported. Spherically expanding P waves, S waves and Rayleigh waves were discussed, and computational solutions using ABAQUS described, with particular reference to the combination of finite and infinite elements.

9. **Measurement and prediction of ground-borne vibration due to construction operations**
(G Crabb, D Hiller & P Wilson)
Aim - to increase understanding of energy transmission into, and propagation through, the ground due to plant operations, leading to reliable prediction methods. This was an interim report of experience

gained as a result of Highways Agency funding.

10. **Vibration Assessment of High Speed Dynamic Compaction**
(R Neilson et al)
This paper described some site testing of prototype high speed dynamic compactor. Results from a number of tests were presented.

11. **The interaction between a submarine pipeline and its soil support when impacted by a dropped object**
(K Oliver, A Rodger & J Farrell)
The results from an EPSRC funded programme were presented. Accidental impact of pipelines is a surprisingly common occurrence and has a safety-critical aspect. The main project aim was to include soil support effects into analytical predictions.

12. **Impedance Models for Machine Foundation Analyses**
(A Kaynia et al)
The paper presented a unified technique for the calculation of foundation impedance for various foundation models, based on the experience of Norwegian/Swedish/Canadian/UK joint projects over a number of years.

13. **Surface Ground Vibrations near a Rectangular Load: a Parametric Study**
(D Jones, D Le Houedec & M Petyt)
This work was prompted by concern about vibrations caused by rail and road transport. Theoretical models were presented that could be used in optimising the application of defensive measures such as trenches or vibration absorbing materials.

14. **Dynamic Absorbers for a Large Machine Foundation**
(B Skipp and P Grootenhuis)
The final paper related to the dynamics of a foundation block for a compressor at a chemical plant in Pakistan, when excessive vibrations were occurring. The rationale for the use of dynamic absorbers, their design, installation and performance was described.

In conclusion a most useful and enjoyable conference!

John Maguire

Seismic Design of Buildings after Kobe and Northridge

Professor Michael Burdekin, FEng, FICE, FIStructE, FIMechE, FWeldI
UMIST, Manchester, UK

The proceedings of this seminar, jointly organised by SECED and the Institution of Structural Engineers, have now been published at a price of £12 (SECED/ISE members) or £20 (non-members). The proceedings can be obtained from the Institution of Structural Engineers and an order form has been sent to members with this Newsletter. Professor Burdekin's Introduction to the set of five papers is reproduced below.

For several years the perceived wisdom amongst conventional structural engineers about design of buildings to withstand earthquakes has been that the best solution is to use steel framed buildings with moment carrying connections between beams and columns. This is not to preclude the use of other solutions, including use of damping or control systems to try to limit the loadings actually experienced by the structure and use of other materials such as reinforced concrete or composite designs.

Of course, any structure will fail or be damaged if loadings are applied to it which are greater than its design capacity. Past experience of earthquake damage has been that extensive damage has occurred in severe earthquakes to the types of structure which were not designed for such eventualities, particularly in developing countries. In the industrialised countries, however, much has been done to learn from experiences of earthquake damage and much research has been carried out to give recommendations of the principles for design of buildings. It came as a tremendous shock to the 'earthquake structural design community' when extensive damage was found to have occurred in the earthquakes at Northridge, in California, in January 1994 and at Kobe, in Japan, in January 1995 to steel framed buildings which had been designed as earthquake resistant. Although no collapses of major buildings occurred, it was found that extensive damage had occurred with fractures in the steelwork and welds at beam to column connections and on some occasions in the columns themselves. Major programmes of research have been instigated to try to establish the reasons for these fractures and to make recommendations both for new construction in the future and for repair/retrofitting existing structures.

We are fortunate at this meeting to have presentations from leading experts with direct involvement in the investigations following the Northridge and Kobe earthquakes and involved in research and making recommendations for the future.

The papers by Michael Engelhardt and by Akira Wada and Yi Hua Huang describe the nature of the damage to steel framed buildings in the Northridge and Kobe earthquakes respectively. In the case of the Northridge earthquake contributory factors were the design, workmanship and choice of materials for the beam to column connections whilst in the Kobe earthquake the magnitude of the ground movement spectra is reported to have been significantly greater than that required for design conditions. Both papers describe steps taken since the earthquakes to implement lessons learned.

The paper by Amr Elnashai takes a wider view of loading aspects for earthquake design and the requirements this imposes on structures as well as reporting on recent research in the field at Imperial College, whilst that by David Smith reviews different types of damage to structures from earthquakes over the past twenty years, providing useful insight into overall performance of steel structures. The paper by Simon Cardwell concentrates on the fact that the failures in the major steel structures at Northridge and Kobe were brittle fracture failures and that the structures had not been designed with this mode of failure in mind so that more consideration should be given to material selection and use of fracture mechanics to avoid future failure of this kind.

Clearly there are many valuable lessons to be learned from the damage experienced in the Northridge and Kobe earthquakes. The views expressed in the papers presented here do not always agree on the emphasis to be placed on the different contributory factors and it is likely to be the case that more than one solution may be adopted to improve resistance to earthquake loading. It is certainly the case, however, that if earthquake loading leads to movements of structures which are resisted by moment connections then these connections will experience tension loading. With hindsight, it is entirely predictable that there would be serious risks of brittle fracture failures in such connections if the loading reached yield stress levels and there were significant welding defects present and no attention had been paid to material fracture toughness. The solutions to avoid this may in principle be found either in reducing the stress levels experienced, or by eliminating the weld defects or by using higher toughness steels or by combinations of these measures. Reductions in stress levels could be achieved by control of the response of the structure or by attention to the detailed design of connections. All of these aspects are addressed in the papers presented in these proceedings.

This collection of papers will form a valuable reference set for all structural engineers concerned with design of buildings for earthquake conditions.

The Sixth SECED conference : "Seismic design practice into the next century"

University of Oxford, 26th-27th March 1998

How will earthquake engineers, and their colleagues in the earth sciences, be conducting their business of improving seismic safety in the first decades of the next century? If any doubt exists that seismic practice will continue to change substantially, the 60 excellent papers (all subjected to rigorous peer review) to be presented at SECED's conference next March will quickly remove it. The papers contain discussions of quite radical innovations in material technology, design philosophy, experimental techniques and analytical approaches. It is of course personally gratifying that all of these issues are touched on in papers by SECED members, but there are many contributions from outside the United Kingdom and the conference is a truly international one. The previous SECED conference was based on the theme of European seismic design practice; this was fitting, given that the ambitious and long running project of producing a comprehensive European seismic code had at that time all but achieved completion, at least of its first stage. Now, with far reaching reviews of seismic codes currently taking place in the United States, Japan and elsewhere, and the chance to review and possibly make improvements to the seismic Eurocode, it is equally fitting that this present conference should broaden its horizons to include not just Europe but the rest of the world. 45% of the principal authors of these papers are from outside the United Kingdom, and though Continental Europe predominates, 11 countries outside the European Union are also represented. There is a good spirit of international co-operation, too; 10 papers contain authors from at least 2 different countries. Clear, even strong, differences between national approaches to detailed issues are sometimes evident, in one case even within the same paper, but this has not prevented equally clear common conclusions from being reached and broad consensus from being gained. We should welcome lively debate, as long as it is conducted in a constructive spirit, and SECED conferences have always provided the friendly platform for this to be achieved.

As proved the case last time, a notable feature of this conference promises to be the eight keynote addresses by leading earthquake engineers from UK, France, USA, Japan and Turkey. Four are leading academics. Professor Elnashai of Imperial College starts the conference with a report of the findings of a major research programme into the use of high strength concrete in seismic design. Professor Muir Wood of Bristol University discusses the current state on the modelling of soils under seismic loading, a field with which he is particularly associated. Professor Erdik of Bogazici University (Istanbul), a leading authority on the seismic vulnerability of megacities, gives an authoritative and in many ways alarming report on the subject. Professor Kanda of Tokyo University presents his conclusions from Kobe on optimum seismic design loadings to achieve both safety and economy.

The other four keynote lecturers are from industry. Dr Mohammadioun of the French Atomic Energy Authority (CEA) gives a state of the art report on the rapidly developing field of choosing ground motions for design. Dr Key, visiting Professor at Bristol and partner in CEP Research, presents some ideas on design and analysis for irregularity. Loring Wyllie, Chairman of the leading Californian consultancy Degenkolb and a very influential figure in US code development, gives an up-to-date summary on the many changes either recently implemented or imminent in US seismic codes. To close the conference, Dr Amir-Mazaheri, a director of the Parisian consultancy SEEE-Ingerop gives a very wide ranging review of earthquake engineering and the need for European co-operation in this field, for which he proposes what he calls a 'Solvay meeting', after a famous assembly of physicists earlier this century.

An innovation at the conference will be a 'Work-in-Progress' poster session, where delegates will be able to present the current state of innovative design or research projects which have not necessarily reached a final conclusion. The session will, it is hoped, add to the immediacy of the conference, although these papers will not appear in the Proceedings, which will be issued to delegates at the start of the conference. If you wish to have a paper considered for the 'Work-in-Progress' poster session, please submit an abstract on two sides of A4 paper to Alison Bullen, by e-mail on bullen_a@ice.org.uk or by post to: SECED, Institution of Civil Engineers, One Great George Street, London SW1P 3AA, UK.
Phone on +44 (0)171 665 2238
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The conference itself takes place on Thursday and Friday 26th and 27th March 1998, but there are two events which should prove of great interest on the previous Wednesday 25th March. At 11.00am on that day, there will be a tour of Oxford's newly opened Structural Dynamics Laboratory. This is set up to perform pseudo-dynamic tests on structural components conducted at real earthquake frequencies, rather than (as is usually the case for such testing) at very low frequency. A sandwich lunch will be provided for those booking in advance. At 3.00pm on the same day, there will be a public debate entitled 'Eurocode 8 - a case for major overhaul or minor revision?'. It will be chaired by David Lazenby, chairman of the main Eurocode committee TC250, and the speakers are the four UK engineers expected to serve on the Working Groups set up to convert Eurocode 8 from draft ENV status into a full Euronorm. There will be ample opportunity for contributions from the floor and it would be helpful if people wishing to make presentations (of not longer than 5 minutes) could contact SECED in advance. This will be an excellent opportunity to have a real influence on the final version of Eurocode 8 and to give your views on the adequacy of its provisions and its user-friendliness. Both the Dynamics Laboratory tour and the Eurocode 8 debate are free of charge and are open to both delegates and non-delegates; for further details and pre-booking, contact Alison Bullen of SECED at the Institution of Civil Engineers (details are at the end of the previous paragraph).

Conferences to be successful should also be enjoyable, and your conference committee has not been neglectful of this aspect. There can be few more beautiful or inspiring settings than the University of Oxford, with many places to visit both in the city and its immediate neighbourhood. Stratford-upon-Avon and the Cotswolds, for example, are within easy reach. The conference banquet takes place in the sumptuous setting of Magdalen College's dining hall; Paul Back, visiting professor of civil engineering design, is the guest of honour, and there will be musical entertainment, as well as excellent food and wines, during the meal. Magdalen is also providing bed and breakfast accommodation from £37 a night for delegates who book early enough; staying at such a magnificent location is likely to prove one of the most memorable aspects of the 1998 conference.

All SECED members will receive with this Newsletter the full conference programme and details are also available via the SECED (**http://www.bham.ac.uk/CivEng/seced/**) and Thomas Telford (**http://www.t-telford.co.uk/co/conflist.html**) websites. On behalf of the organising committee, I extend a warm invitation to take part in what promises to be a very notable 3 days, and I hope to meet as many of you as possible in Oxford next March.

Edmund Booth

Selected extracts from previous SECED Newsletters can be found on the World Wide Web at the Institution of Civil Engineers.

http://www.ice.org.uk/ice/public/pubindex.html

Comments are welcomed and should be sent to: A.J.Crewe@bristol.ac.uk

NOTABLE EARTHQUAKES JULY - SEPTEMBER 1997

Reported by British Geological Survey

YEAR	DAY	MON	TIME UTC	LAT	LON	DEP KM	MAGNITUDES ML	MB	MS	LOCATION
1997	02	JUL	06:48	53.03N	1.29W	1	0.7			LINBY, NOTTS
				Felt throughout Linby, Nottinghamshire with intensities of at least 2 EMS.						
1997	09	JUL	19:24	10.60N	63.47W	20		6.2	6.8	VENEZUELA
				At least 81 people killed, 522 injured and 3,000 people left homeless as a result of this earthquake.						
1997	30	JUL	08:34	56.25N	3.75W	5	2.5			BLACKFORD, TAYSIDE
				Felt throughout the Blackford area of Tayside with intensities of at least 4 EMS.						
1997	12	AUG	03:05	53.07N	0.99W	1	1.8			SOUTHWELL, NOTTS
				Felt throughout the Southwell and Oxton areas of Nottinghamshire, felt reports described "we were woken up and frightened", indicating an intensity of at least 4 EMS.						
1997	12	AUG	08:14	59.76N	6.30E	15	3.0			NORWEGIAN COAST
1997	22	AUG	19:31	53.06N	1.20W	2	1.0			LINBY, NOTTS
				Felt by residents in the village of Linby Nottinghamshire.						
1997	26	AUG	19:57	56.19N	4.09W	4	2.4			DOUNE, CENTRAL
				Felt throughout Doune, Stirling and the Callendar areas of Central Scotland where felt effects described "like a lorry had crashed into the side of the house" and "we were very frightened", indicating an intensity of at least 4 EMS.						
1997	02	SEP	12:13	3.85N	75.75W	199		6.5		COLOMBIA
				Felt throughout Bogota, Cali, Manizales, Medellin and many other parts of central and western Colombia.						
1997	16	SEP	00:39	56.25N	3.75W	5	2.2			BLACKFORD, TAYSIDE
				Felt throughout the Blackford and Doune areas.						
1997	26	SEP	00:33	43.03N	12.89E	10		5.5	5.5	CENTRAL ITALY
				At least six people killed, many injured and damage occurred throughout the Assisi-Perugia area.						
1997	26	SEP	09:40	43.06N	12.85E	10		5.7	5.9	CENTRAL ITALY
				Latest reports indicate that at least four people have been killed, many injured and at least 80,000 homes have been damaged.						

Issued by Bennett Simpson, British Geological Survey, October 1997

Forthcoming Events

28 January 1998
The EEFIT and EFTU visits to the Italian earthquakes. *IStructE 5.30pm*

11 February 1998
Effects of the Montserrat volcano.
(to be confirmed)

25 February 1998
Base Isolation of Large Tanks - a LNG case study. *ICE 5.30pm*

25 March 1998
EC8 - a case for minor change or major overhaul. *Oxford University*

26 to 27 March 1998
The Sixth SECED Conference: Seismic design practice into the next century. *Oxford University*

29 April 1998
Accidental Explosions. *ICE (proceeded by AGM at 5pm including the 1998 earthquake prediction competition)*

27 May 1998
Are vertical earthquake ground motions important? *ICE*

Contents

SECED Newsletter

The SECED Newsletter is published quarterly. Contributions are welcome and manuscripts should be sent on a PC compatible disk. Copy typed on one side of the paper only is also acceptable.

Diagrams should be sharply defined and prepared in a form suitable for direct reproduction. Photographs should be high quality (black and white prints are preferred). Diagrams and photographs are only returned to the authors on request.

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SECED

SECED, The Society for Earthquake and Civil Engineering Dynamics, is the UK 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 Geophysical Society. The Society is also closely associated with the UK Earthquake Engineering Field Investigation Team. The objective of the Society is to promote co-operation in the advancement of knowledge in the fields of earthquake engineering and civil engineering dynamics including blast, impact and other vibration problems.

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