SECED NEWSLETTER

THE SOCIETY FOR EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS

April 1992, Vol. 6, No.2

INTERNATIONAL PARTICIPATION IN POST-EARTHQUAKE FIELD INVESTIGATION

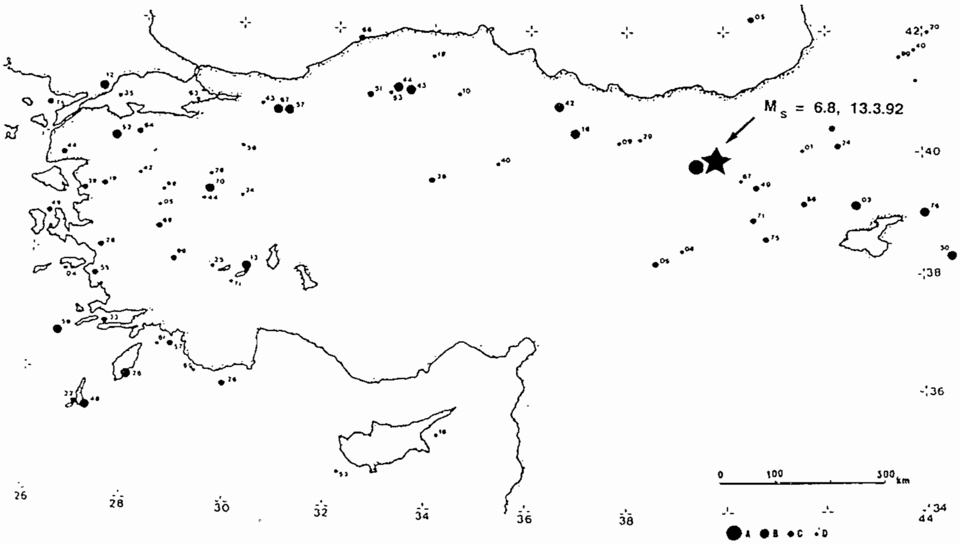
Engineers and seismologists from the UK, France, Greece, the US and Japan joined Turkish investigators in field studies to gather data on the effects of the 13th March earthquake in Erzincan, Eastern Turkey. The lessons to be learnt are undoubtedly exportable to other regions along the Mediterranean/Himalayan belt, such as Iran, Greece, Yugoslavia etc. The magnitude 6.8 earthquake which was centred on the town of Erzincan caused widespread damage to reinforced concrete frame buildings and to some industrial facilities. Further damage was caused by a magnitude 6.1 aftershock 48 hours following the main event. The UK's Earthquake Engineering Field Investigation Team (EEFIT) sent a team into the field nineteen days after the earthquake. The team comprised Antonios Pomonis (Cambridge University), Martin Williams (Oxford University), Steven Ring (Bath University) and Giovanni Vaciago (High Point Rendel). Edmund Booth (Ove Arup & Partners) who was seconded to the French AFPS team as part of a joint SECED/EEFIT initiative also joined the mission. The EEFIT team spent six days in the field collecting data and will present their findings at a joint SECED/EEFIT meeting at the Institution of Structural Engineers at 2pm Friday 5th June. An EEFIT report about the earthquake will be published later in the year, and the data gathered by EEFIT will be fed into the Cambridge University Martin Centre's database. A preliminary report of initial findings is given in this issue of the SECED newsletter.

Right: column failure in reinforced concrete frame building.

THE 13th MARCH 1992 ERZINCAN EARTHQUAKE IN EASTERN TURKEY

Demography; Building Damage; Strong Motion and Casualties

by ***Antonios Pomonis***
The Martin Centre
University of Cambridge



Above: Earthquake location. The main shock magnitude was ML=6.8, focal depth approximately 25km. A main aftershock magnitude ML=6.1 followed 48 hours after the first event.

Right: Fault system in Erzincan basin.

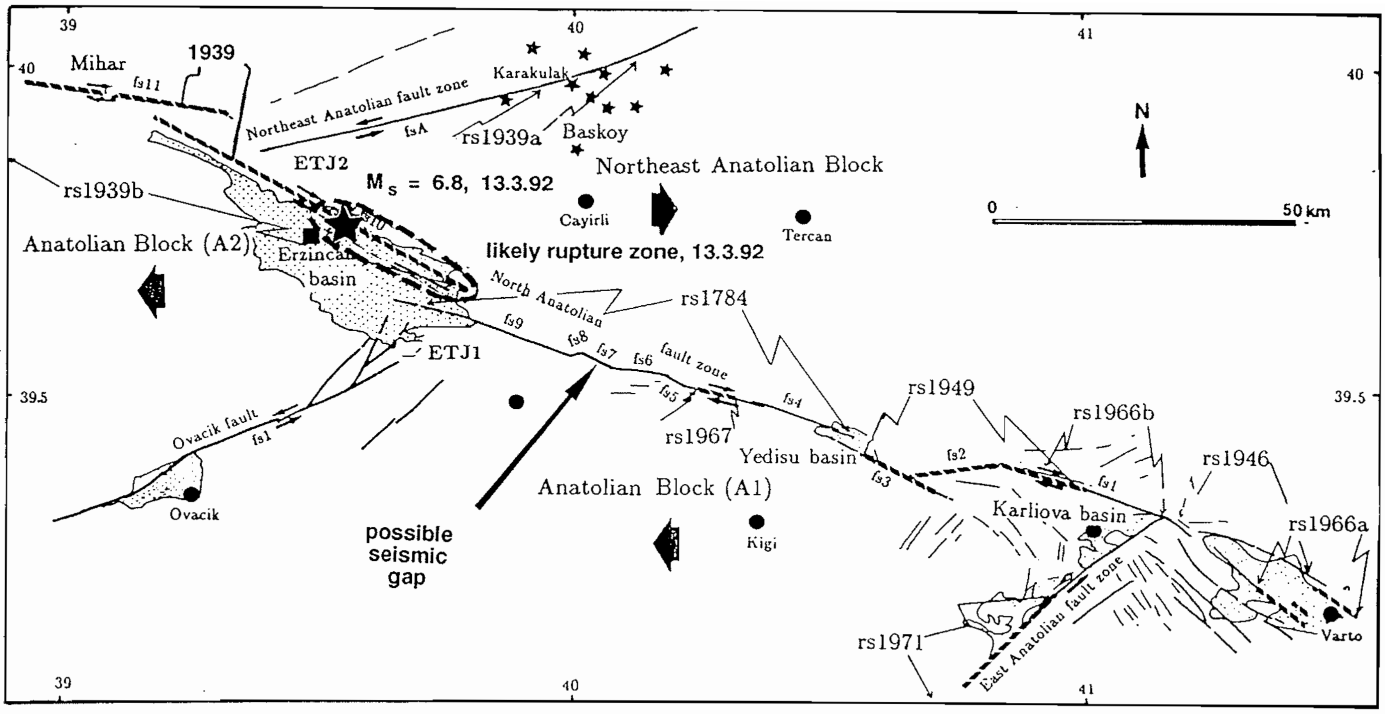
The 13th March 1992, Erzincan earthquake is the most severe earthquake in Turkey since the 30th October 1983 Horasan earthquake. The loss of life reached 550 people, about three quarters of them in the town of Erzincan that has a population of some 92,000 people. A further 2,100 were injured (688 hospitalized). About 60 reinforced concrete buildings collapsed or were damaged beyond repair in the town of Erzincan. In the surrounding villages a total loss of life of 150 persons was reported (included in the 550 total).

The loss of life could have been more severe, but fortunately many people were in mosques praying during the occurrence of the main shock. The collapse of a mosque's minaret in the village of Demirkent (just north of Erzincan) was however reported to have caused about 30 deaths. Furthermore many public buildings that collapsed were not occupied at the time of occurrence.

This earthquake follows a recent trend observed around the world, since the mid-70's, where most of the casualties are due to the collapse of RC buildings (Bucharest 1977, Thessaloniki 1978, Mexico City 1985, Kalamata and San Salvador 1986, Luzon 1990). This is definitely the first such event of significant importance in Turkey and therefore its effects have to be studied carefully and extensively in order to draw lessons, for the improvement of future RC constructions in Turkey and elsewhere in the world. RC is one of the most common construction types in all the urban areas of Turkey and is also getting more and more common in the less remote rural areas. In the town of Erzincan there was a large number of 1-5 storey RC frame structures with masonry infill. In the surrounding rural areas there is a variety of traditional building types, covering almost the whole spectrum of traditional Turkish houses. RC houses are also increasing in number especially in the less remote villages. The area therefore lends itself for further studies, since most of the affected villages are within a 40 minute drive from Erzincan, most of them in easily accessible roads, thus making feasible a more detailed study.

DEMOGRAPHIC DATA IN THE AFFECTED REGION

Turkey's population is now estimated at around 57 million people (the population density is at present 71 people per km^2, as compared to 230 for Great Britain), and the expected annual population growth in the period 1990-2010 is 1.6% with an expected population of 76 million in the year 2010. Turkey's economy grew by 5.5% annually during the 1982-1990 period, but the actual per capita income growth was about 3.5%. Turkey's GDP is now valued at around 75 billion US$, and the per capita income is around 1350 US$ per annum. The country is continuing to suffer from high inflation rates, the average annual rate of inflation during the '80's was around 70-80%. The export industry of Turkey has made significant progress during the '80's, the total exports in 1981 were about 4 billion US$ while in 1990 they exceeded 12 billion US$. Another important source of income is the remittances of Turkish people working abroad (about 1.5 million people in Germany).



The Prefecture of Erzincan has an area of 11,903 km², and population of 300,000 (1990), thus a density of only 25 people per km². The proportion of urban population is 48% and the rural population lives in 563 villages. The prefecture is divided into 8 provinces (Erzincan; Cayirli; Ilic; Kemah; Kemaliye; Refahiye; Tercan and Uzumlu). During this earthquake the most affected provinces were those of Erzincan and Uzumulu with a total population of 179,000 people, area of 2,166 km², density of 83 people per km², urban population exceeding 60% and 116 villages (for comparison the area affected by the 1988 Armenian earthquake of similar magnitude, had a population density of 220 people per km², 25,000 lives were lost in that earthquake).

BUILDING DAMAGE

The Ministry of Public Works and Resettlement has published a first assessment of building damage in the town of Erzurum and Uzumlu as well as 15 neighboring villages. According to these a total of 3,700 buildings were destroyed due to the main shock, and a further 618 due to the main aftershock. Nevertheless this may actually be quite higher, because there are at least another 101 villages in the two affected provinces for which damage data have not been published yet. The population of these remaining villages is 61,000 people (or 34% of the total population of the two affected provinces).

The damage data for the two main towns are also available by district (21 districts in Erzincan and 5 in Uzumlu). The districts that suffered most damage in Erzincan are: Kizilay, Karaagac and Inonu in the centre, as well as Yavuz Selim in the northwest and Fatih in the East.

Detailed Damage Survey Around The Strong Motion Instrument Triggered in the Meteorology Station of Erzincan.

This research has a scope in trying to understand the nature of ground motion, its damage potential to various building types and establish a range of useful parameters and correlations between strong motion and vulnerability functions. The survey included 105 buildings in the vicinity of the Meteorology station. These were:

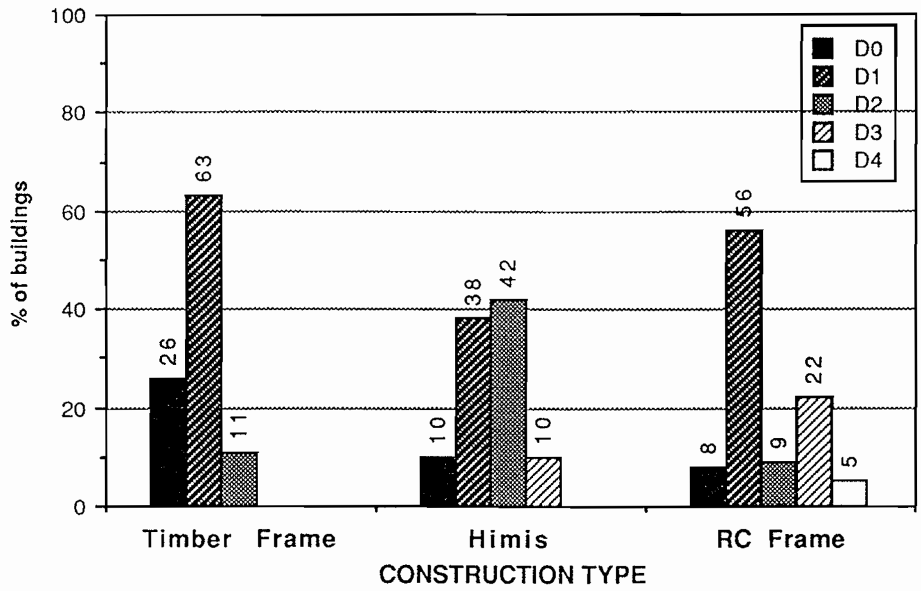
Timber Frame: 38 one-storeyed buildings made of timber frame covered by diagonal timber laths (sheathing) with a vapour barrier, a 2mm mesh and 5mm render. Usually resting on reinforced concrete and having a semi-basement for storage (wall of concrete). These houses were built during the reconstruction after the 1939 earthquake.

Himis: 29 one-storeyed timbered buildings, with unprocessed timber material, and infill of adobe bricks. They do not have a semi-basement.

Reinforced Concrete Frame: 22 structures of 2-3 storeys, with unreinforced horizontally perforated brick infill walls and varying quality of design.

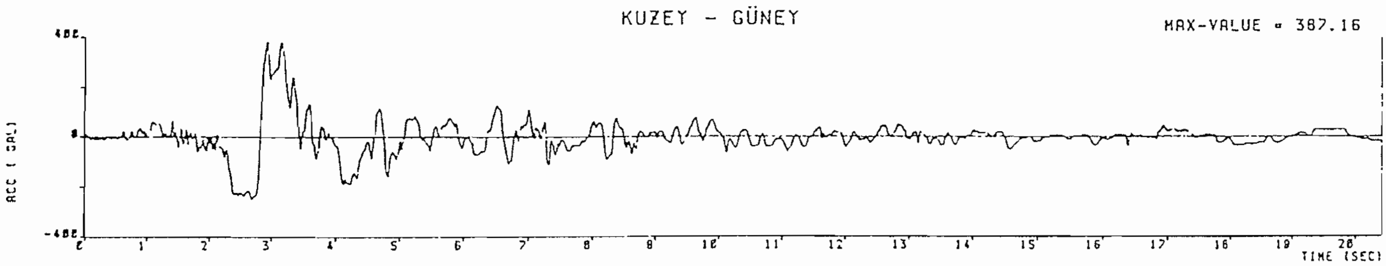
Confined Masonry: 16 houses of solid brick or concrete block masonry, with RC slab, and some form of RC frame and ring beam. Mostly one storeyed, without basement.

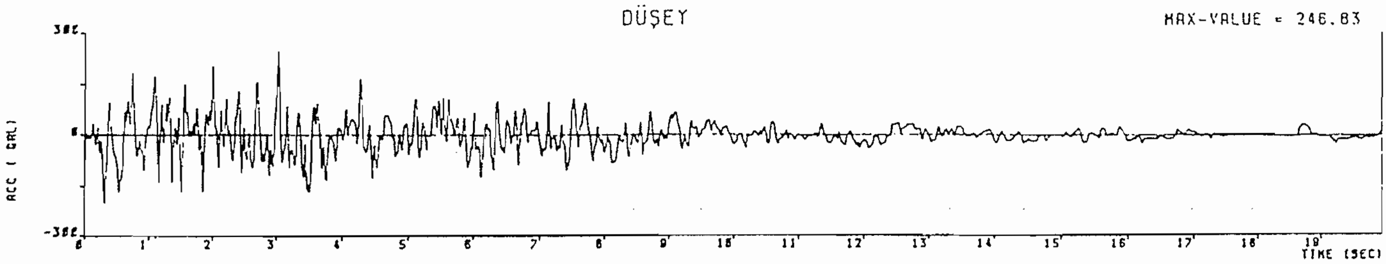
The Meteorology Station of Erzincan was very close to the earthquake epicentre. A first analysis of the ground motion record shows that all the acceleration parameters are very high. The East-West component was much stronger than the North-South component with peak horizontal accelerations 0.5g and 0.4g respectively. The peak vertical acceleration of 0.25g was not so strong, typical of a strike-slip mechanism. The significant strong motion duration (90% of energy release) was about 9 seconds. The peak horizontal velocity was significant at 108 cm/s and one of the strongest ever recorded, and is typical of the deep soil layers in the Erzincan basin. Preliminary response spectra indicate that the energy of the Erzincan record was concentrated in the 1.1 to 3.3 hertz frequency range. The amplification factor between peak acceleration and peak response at 5% damping was 2.7, which is similar to the average amplification in Californian earthquakes.

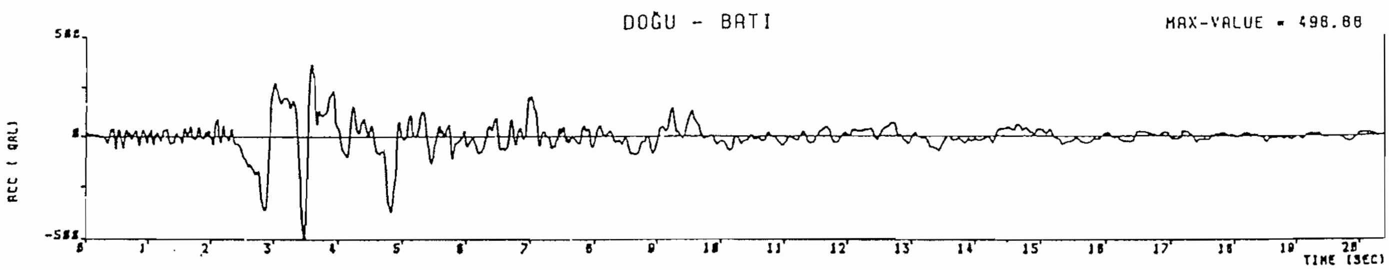


Above: Distribution of damage around the strong motion instrument.

Below: Acceleration time-history captured at the Erzincan ground response station. Range approximately 15km from the earthquake epicentre.







Traditional Turkish house, "Himis". It consists of timber frame with adobe infill. Most of them in the epicentral region were clearly shattered but still standing. Very little loss of life in such buildings but unfortunately timber is scarce at present in Turkey.

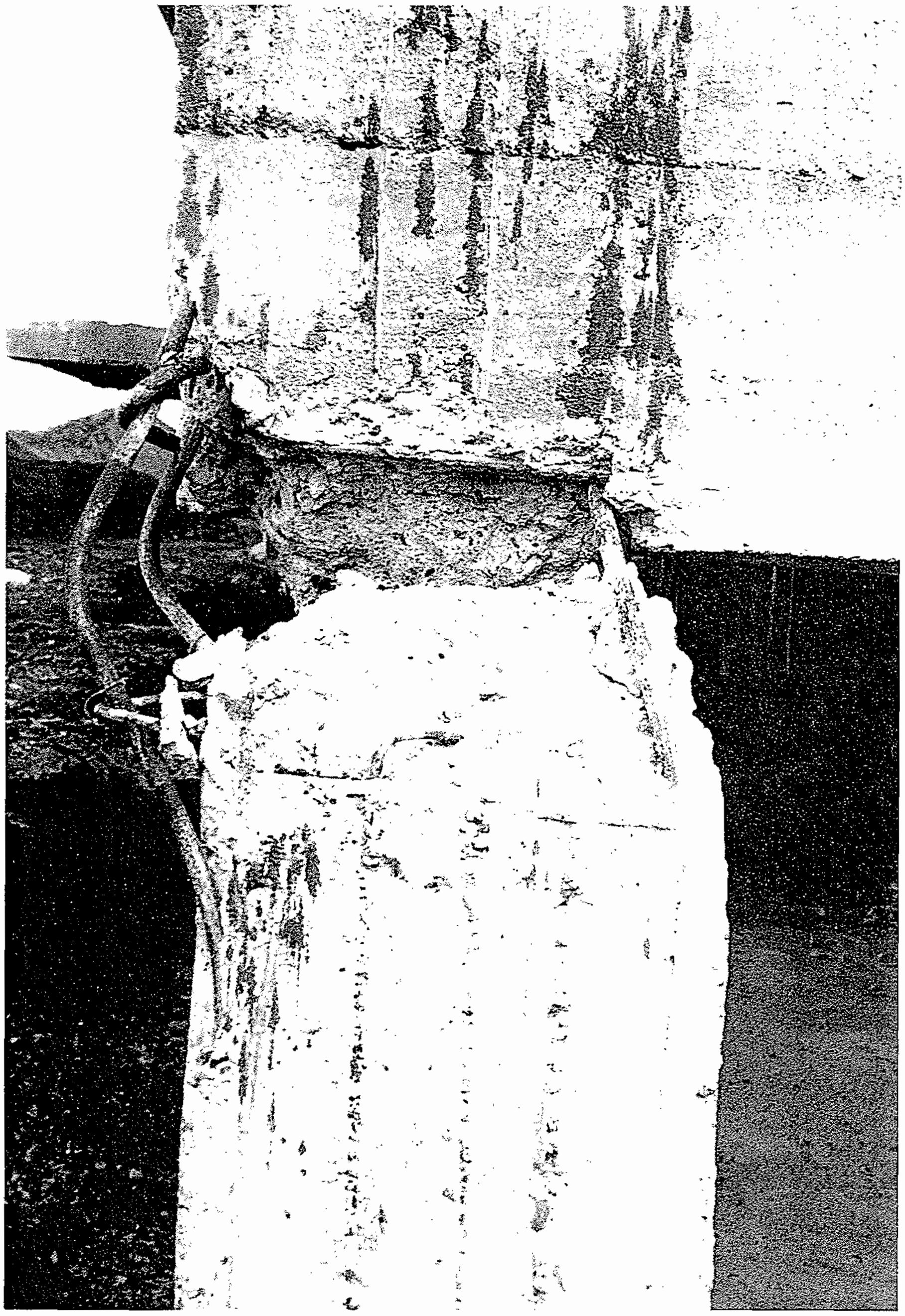
Unreinforced masonry building with reinforced concrete ring beam and floor slabs. Corner failure at ground floor level. The ring beam acts to limit scope of failure thereby protecting occupants.

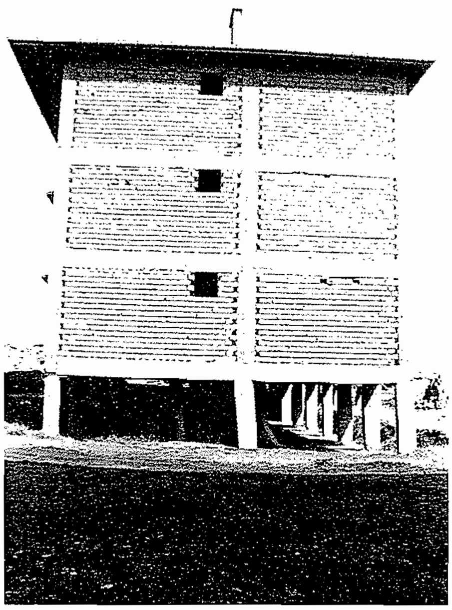
Complete collapse of a reinforced concrete frame building. Form of failure promotes high lethality potential.

Investigation into the causes and types of collapse of reinforced concrete structures in Erzincan and surrounding areas, and the way they affected their occupants.

In Erzincan itself more than 50 reinforced concrete buildings collapsed totally or partially. They were predominantly 3-5 storeyed. The EEFIT team started working in the town on the 1st of April, thus 19 days after the event. Most of the main collapsed structures were already cleared and it is difficult to comment a lot about them. Nevertheless there were other sites that were not yet cleared, and buildings under construction where a lot could be observed. In principal we can say that the behaviour of the reinforced concrete structures in Erzincan was not satisfactory, but when we take into consideration the strength of the motion, the period characteristics of the collapsed buildings and the ground conditions in the town centre of Erzincan, we may say that the conditions were also not favourable.

* Most of the collapsed structures have suffered the so-called 'pancake' type of collapse, where the failure usually starts from the ground floor, and causes the complete failure of the structure above, thus leaving very little void spaces and only a few chances of survival to its occupants. The causes for this type of collapse are usually due to a soft ground storey (either left open for parking and other use, or having shops with a very limited amount of infill walls). Studies of previous such collapses suggest that the lethality potential among the entrapped occupants is 50% or higher (depending on the number of floors). Many of the buildings that collapsed in this earthquake lost completely their first two floors, but an increasing amount of voids was observed in cases where the collapsed structure had more than two storeys.





Above: Soft storey failure in reinforced concrete frame structure.

Left: Column failure detail.

* Cases of torsional overturning were also observed, especially in corner buildings with a significant amount of openings at the street facing facades, or due to eccentric position of the staircase, or due to difference in the amount of openings from floor to floor.

* Mid-storey collapses with the bottom and top floors surviving were observed in just a few cases (mainly due to pounding between adjacent structures with different dynamic characteristics and sometimes different floor levels). The most important such case was that of the building behind the Kizilay (Red Crescent headquarters) in the town centre.

Other problems observed in severely damaged structures were:

* weak column-strong beam design

* frames distributed only in one horizontal direction, or being very weak in one of the horizontal directions

* short columns especially in buildings with semi-basement

* lack of uniformity between openings from floor to floor or from side to side of a building

* columns and beams are usually cast separately, thus reducing the bonding and shear strength of the most crucial point in frame structures

* lack of stirrups, or very few of them

* reinforcement being visible due to insufficient coverage

* lack of shear walls

* severe damage to many of the infill walls, that sometime failed out-of-plane.

Relatively few problems were observed due to an unusual plan configuration or elevation or any other architectural details. Most of the

Above: Complete collapse of a storey in a reinforced concrete frame building. The upper and ground floors remain standing.

reinforced concrete buildings tended to have a good configuration.

It would be very useful to examine in more detail the causes and type of collapse of at least the most important reinforced concrete buildings in Erzincan (collapsed to undamaged). Parameters that should be investigated are: Design details, relationship between columns and slabs, foundation type, surface area, height, self period range, location in respect to street and other buildings. Such a study could shed significant light into the behaviour of reinforced concrete frame buildings in earthquakes. Another important factor that needs further investigation is to find out what happened to the entrapped people. Collapses of concrete buildings will unfortunately occur again and the more we know the better our response can be. Types of collapse affect the way rescue operations are carried out as well as the chances of survival of the entrapped victims. It is important to find out more about the types and level of injuries of the people that were pulled out alive and their location in the building. For the same reason the location of those exctricated after their death, should be recorded. In our investigations we could only find that:

* In the Hotel Roma there were 25-30 people inside the building when it collapsed, 13 died (12 of them were in the ground floor).

* In the Nursing School (State Hospital) there were about 50-55 people inside the building when it collapsed (only in the collapsed wing) and 22 died.

* In a 3 storey reinforced concrete building in Yelnizbag village, 3 out of 5 occupants were killed (all of them were in the top floor). The survivors were reportedly lightly hurt.

Thus the lethality in these 3 buildings reached 45% of the occupants.

We think that in the case of the Nursing School and Insurance Hospital, being medical institutions, there should be a better chance to find more information about the survivors and those that were fatally injured.

Search and Rescue data are yet scarce, but a few of those are mentioned here:

* In the first 2 days (14th and 15th March) 200 to 300 injured people were puilled out of the rubble of collapsed buildings

* 80% of the casualities referred to the State Hospital arrived during the first 24 hours. About 800 injured people were sent to Erzurum, an additional 1300-1500 were treated locally

* Information about the Search and Rescue operations (casualties etc. in every site where major operation was carried) should be mentioned in the minutes of the meetings of the Erzincan Authorities.

* In the first hours after the earthquake the State Hospital treated about 300 people with water burns (overturned tea pots etc.). The majority of these were children. Nevertheless the staff reported that they were not able to respond very well to that many cases of burns, due to lack of stocks of necessary treatment.

* The State Hospital had a backup generator that could operate during the first night but it was located inside a damaged building and staff were reluctant to enter the building.

* Problems were faced also with the water in the first week. A lot of the work was carried out in the first days without proper care for sanitation.

* Foreign Rescue Teams as in previous earthquakes, arrived too many hours after the earthquake, thus being unable to make a big impact in the effort to save lives. Nevertheless their experience and way of organization was reported to have been useful to the local rescue teams and doctors. An emphasis towards more training before disaster is therefore necessary in the strategy of those teams.

* Local Search and Rescue teams tried their best, but had little experience or expertise to deal with collapsed reinforced concrete buildings, since this was the first such major event in Turkey.

Investigation of damage to the traditional buildings

Villages in the west and east of Erzincan were visited, both high on the foothills of the mountains to the north, near the North Anatolian fault, as well as on lower ground in the flat part of the basin. Our observation is that in the villages to the west, damage dimished from high ground to lower ground, while the opposite happened in the east of Erzincan.

Two detailed damage surveys were carried out in Cukurkuyu-Yalnizbag and Uzumlu.

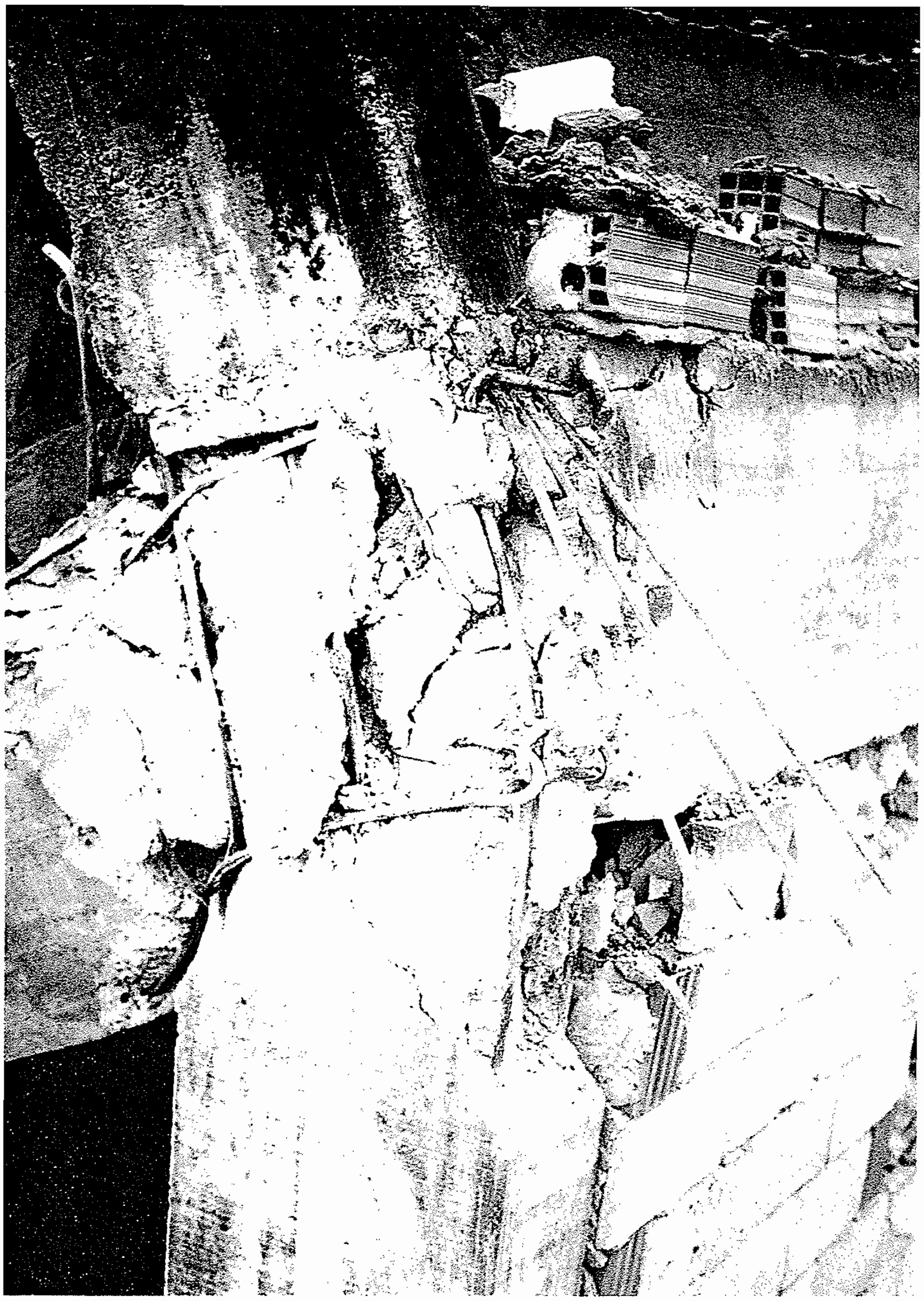
Cukurkuyu-Yalnizbag

In the first case it was possible to observe damage to reinforced concrete frame buildings in comparison to masonry houses (mostly adobe brick). The reason for this survey was that: the villages of Cukurkuyu and Yalnizbag (next to each other) suffered severe damage and they were located at the foothills of the mountains in the northern part of the Erzincan basin, thus free of any bias of soil induced amplification of ground motion. Furthermore all reinforced concrete buildings were 1-3 storey, and similar in size to the masonry buildings, therefore a more direct comparison could be done, without the bias of storey height and possible effect of motion amplification. The behaviour of most of the reinforced concrete houses was very good, with damage of D1 and D2 (fine or wide cracks in the infill). But there were also 2 completely collapsed concrete houses, illustrating the fact that these buildings can be very vulnerable if not designed properly. Overall the average damage degree for the masonry houses was 2.45 while for the reinforced concrete houses it was 1.41. Nevertheless it must be pointed out that no masonry house suffered complete collapse to the extent suffered by the 2 collapsed reinforced concrete houses.

Uzumlu

A detailed damage survey was carried out in the cooperative housing site, near the E23 highway, that was at the last stage of completion before the onset of the winter. In this housing complex there were 21 largely identical houses of load-bearing hollow brick masonry with concrete ring beam and reinforced concrete slabs superimposed at the top by a timber framed roof with clay tiles. These buildings are quite weak for Zone 1 of Turkey and suffered increasing damage as they approached the flat part of the basin. The progression from slight damage (D2) to complete collapse (D5) could be seen very clearly. The buildings that were more damaged were also more recently built, just before the onset of the winter, therefore this may be one of the reasons for their severe damage rather than any significant effect of ground condition on the seismic motion.

Generally we can say that the behaviour of load-bearing masonry buildings in the area was as expected. Masonry buildings with two timber hatils on the wall, or with a timber or concrete ring beam suffered somewhat less damage than the unreinforced ones. Himis houses were damaged, but due to the existence of the timber frame they were usually standing. Low-rise timber frame houses built after the 1939 earthquake have suffered limited damage. Rubble stone masonry houses with heavy compacted earthen roof and timber log-joists suffered more damage and were a serious threat to their occupants. The behaviour of the low-rise reinforced concrete framed buildings (up to 2 storeys) was satisfactory, but the performance was much worse for the reinforced concrete framed structures that had 3 to 5 storeys. Many of the collapsed buildings in the centre of Erzincan town were of this type, and predominantly in street corners or detached from neighbouring buildings. Generally in the affected area there have been at least 80 complete or partial collapses of reinforced concrete buildings, that is estimated they have caused about 75% of the total loss of life.



Beam-column joint failure. Note lack of confinement reinforcement and inappropriate curtailment of longitudinal steel.

Acknowledgements : The support of the Disaster Affairs Directorate of the Ministry of Public Works was excellent and greatly appreciated. Equally thanks go to Professor Cetin Yilmaz of the Middle Technical University who joined the EEFIT team during the field trip.

For information about EEFIT reports contact A Loreans, EEFIT Secretary, Institution of Structural Engineers, 11 Upper Belgrave Street, London SW1X 8BH, United Kingdom.

AID ARMENIA HOSPITAL

Three years on following the devasting earthquake of December 7th 1988 Aid Armenia's hospital was officially opened on 25th April 1992 .Aid Armenia, the UK Charity set up after the earthquake used the money raised through donations made by the British public to build a Children's Hospital in Kirovakan. The St Nareg hospital was opened by His Grace Lord Robert Runcie, former Archbishop of Canterbury. Sir Roderick Braithwaite, the British Ambassador and a number of other VIP's from Great Britain, also attended the opening ceremony. His Holiness Vazken I, Supreme Patriarch and Catholicos of all Armenians gave a blessing to the hospital. Accompanying the UK delegation attending the opening were Vahe Gulvanessian, the architect for the hospital, and Dr. Allan Mann of Allott & Lomax, seismic design consultants for the project.

The December 1988 earthquake largely destroyed Leninakan, the second largest city in Armenia, as well as the small town of Spitak, and seriously damaged the town of Kirovakan. The result was an appalling loss of life and homes. In Leninakan and Spitak few buildings survived undamaged. The majority were reduced to rubble. Of the 240,000 inhabitants of Leninakan, and the 20-25,000 inhabitants of Spitak, almost all were made homeless, as were many of the 169,000 people in Kirovokan. An estimated two-thirds of medical facilities in the stricken area were destroyed.

Aid Armenia decided to use money raised in the UK to build a paediatric hospital in Kirovokan. Unlike much construction work undertaken in Armenia after the earthquake, the St. Nareg Hospital is a permanent and not a temporary building. It is designed to

Below: Completed hospital on opening day.

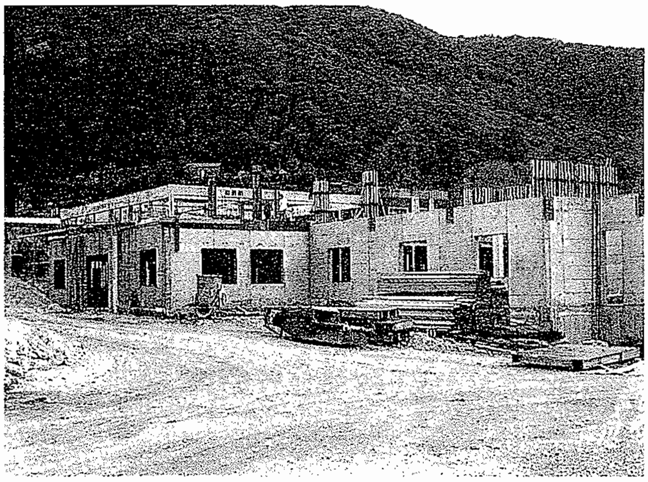
provide facilities for 60 children in a hospital equipped with an X-ray Department, Operating Theatre Suite, Accident and Emergency Suite, Pharmacy, Dispensary, Physiotherapy, Consulting and Examination Room Suites.

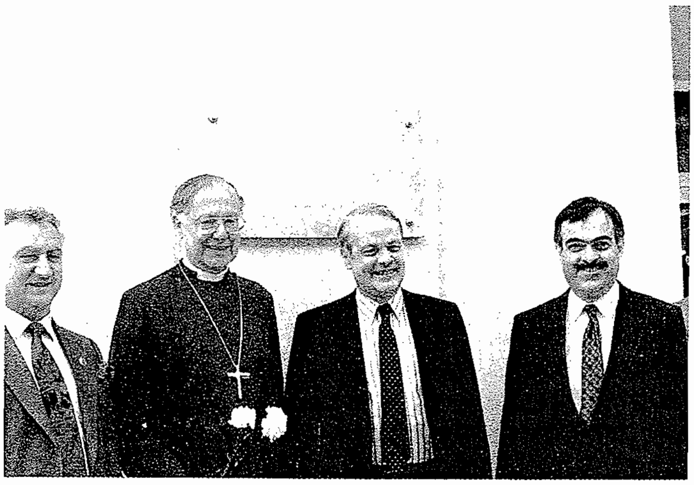
The building is of reinforced concrete shear wall construction with a lightweight timber roof. The building has been specially designed to withstand an earthquake of similar magnitude to the 1988 event. The structure has been designed not only to remain safe during such an earthquake but to be able to function immediately after it. Special care to reinforcement detailing was needed to ensure that the structure would behave as required. Bob Nichols, Allott & Lomax's supervising structural engineer for the project explained, "In practice this meant paying close attention to the amount and disposition of reinforcement needed to resist the very high shear forces that would be experienced during an earthquake." Great emphasis was placed on the quality of workmanship achieved during construction.

Design and construction of the hospital was by Viennese contractor Awstraoj Baugesellschaft MBH & Co. The building of the hospital was achieved in record time despite some setbacks due to working conditions in Armenia and shortages of materials there. The Armenians started the foundation works in August 1990 but were unable to complete the job. The Austrian contractors were called in in March 1991 to complete the foundation works and start construction of the building superstructure. The construction cost of the hospital was approximately £3.2M, which was raised entirely from money donated by the UK public.

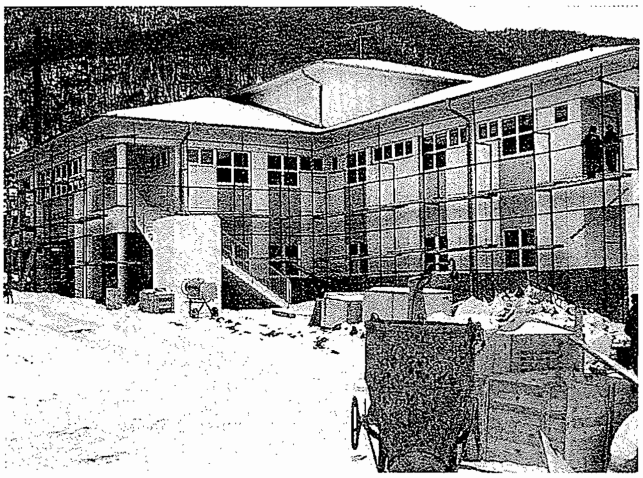
Following the opening ceremony, Allan Mann drove through the region worst affected by the earthquake and saw the very large modern cemetry by the roadside where the majority of the earthquake victims lie buried. Since the disaster, there has been some development by foreign countries; for example an Italian hospital and prefabricated housing units supplied by the Norwegian government have been built. Allan Mann noted, "these new, quality buildings contrast starkly against the general standard of the older structures which appear poorly conceived and poorly constructed. Many of the existing structures are in quite an appalling state, exposing the vulnerability of the community to future earthquakes." A vast amount of work remains to be done before the population can be considered to be adequately protected against the threat of eathquakes in the future.

Further information about the project may be obtained from Aid Armenia, 25 Cheniston Gardens, London W8





Above: Robert Runcie, Roderick Braithwaite and Vahe Gulvanessian.



Top Left: Constuction of first storey shear walls June 1991.

Left: Hospital nearing completion December 1991.

SECED Meeting Report

WORK IN THE UK RELATED TO EUROCODE 8

SECED's meeting in January presented the work undertaken with funding from the Department of the Environment and managed by the Building Research Establishment on the UK response to the draft Eurocode 8. The work was undertaken by Scott Wilson Kirkpatrick, who administered several study sub-contracts on topics found to be in need of further investigation during a preliminary study for the work. Sitting in for Bryan Skipp (Chairman of the BSI Commitee Eurocode 8), Dr David Key (CEP Research) chaired the meeting. After a brief introduction by the UK Eurocode 8 Technical Co-ordinator Dr Amr Elnashai, who summarized the current status in the UK and in Europe, Dr Key talked about the organisational aspects of the work undertaken. David Smith (Scott Wilson Kirkpatrick) summarized the main findings from the quantitative and qualitative assessments of the new Eurocode draft. The presentations were concluded with Dr Key's account of the work he has undertaken as a sub-contractor on structural interpretation of the perceived risk.

SECED AND THE UK CONTRIBUTION TO IDNDR

Position statement by the SECED Committee, March 1992

SECED offers to involve the expertise of its membership, where possible , to assist with UK contributions to the Decade. SECED (Society for Earthquake and Civil Engineering Dynamics) is the UK society for professionals in the fields of seismology, earth science, engineering and architecture with an interest in earthquake effects and other aspects of civil engineering dynamics. It brings together specialists with extensive experience of seismology and earthquake engineering in both developed and Third World countries. It publishes a regularly updated Directory of Practioners in its field. SECED is the UK national section of the International and European Associations for Earthquake Engineering.

The particular expertise represented by SECED which may be relevant to the British contribution to the Decade is as follows:

- ◆ Monitoring and recording of earthquakes and the motions they produce.
- ◆ Assessment of earthquake hazard, vulnerability and risk; seismic microzonation.
- ◆ Design of earthquake resistant facilities; codes of practice and guidance on earthquake resistant design.
- ◆ Training and education in earthquake related topics, both in the UK and abroad, particularly in developing countries.
- ◆ Improving the seismic resistance of vernacular and traditional construction.
- ◆ Through its sister organisation EEFIT, field investigations of damaging earthquakes.
- ◆ Research into short term earthquake prediction.

Following SECED's contacts with sister organisations in Europe and elsewhere, SECED considers the formation of a high level UK national committee for the Decade as essential to an effective UK contribution.

EEFIT ANNUAL REPORT

The year has been one of consolidation of our position with considerable work being devoted by the committee towards updating our "Objectives and Methods" statement including developing identity cards, publishing outstanding reports, establishing links with Europe and reconsidering aspects of the Constitution. Some of these topics are adressed below in more detail but I would like to acknowledge the help of the Committee in tackling this important work, particularly Adrian Chandler for his revision of the " Objectives and Methods" statements and Gavin Trott for his work in reviewing and revising elements of the constitution.

This year John Mills, Adrian Chandler, Jack Pappin and myself complete our terms of office. Dr Chandler, Dr Pappin and I (together with John Bethell) have been nominated to stand for re-election. Dr Mills, due to other commitments, is not seeking election and we acknowledge his contribution over the years towards EEFIT.

Publications: Our publications list is steadily growing and over the past year the Newcastle (Australia), Phillipines and Manjil (Iran) Earthquake reports have all been published. ***Contact the secratary for a full list of available publications.***

Slide Sets: This year saw the completion of slide sets on the Newcastle and Iran earthquakes. These will be held at the IStructE and will be available on loan to members. It is hoped to expand this new service to cover the other earthquakes for which EEFIT has reports.

European Links: The past year has also seen the establishment of links with our equivilant societies in France and Germany. Discussions are ongoing concerning the nature and form of a joint European initiative. These discussions are still at an early stage, however, and input from the membership would be welcome.

Conclusion: 1991/92 has seen considerable efforts by the Management Commitee to place EEFIT on a firm footing for its second decade of operations. Much credit is due to the individual members of the Committee who have worked towards this goal. We look forward with your support, to the coming year.

Dr R S Steedman
Chairman, EEFIT

SECED FORGE LINKS IN EUROPE

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Britain's links with the continent are becoming increasingly important, and the earthquake engineering community is no exception to this trend. SECED has always played its part in the European Association for Earthquake Engineering and this will continue. As a supplementary activity, the SECED committee has decided to seek bilateral links with its sister societies across the Channel. The first such link has been forged with the very active French society, AFPS. Recently, Edmund Booth attended one of their committee meetings in Paris and Pierre Sollogoub of AFPS reciprocated with a visit to London. One outcome was an agreement to hold an occasional series of joint seminars on topics of mutual interest. The first such seminar will take place in Paris next year on 22/23rd April on the theme 'Dynamic Testing Facilities in the UK and France'. AFPS also agreed to accept a seconded member of EEFIT on the French post earthquake reconnaissance mission to Erzincan, Turkey. Another outcome was that one of France's most distinguished earthquake engineers, M. Despeyroux, will be coming to London next autumn to address a SECED evening meeting. Finally, AFPS has been asked to contribute - in French - a note about their society which will be carried by this Newsletter.

SECED has also been corresponding with the German earthquake society, and we hope to develop joint activities with them in future. EEFIT has been talking to its European counterparts, too, and hopes to set up some form of pan-European earthquake reconnaissance group.

Brtitain's days of isolation from Europe (if they ever existed) are certainly over, and we hope that our continental links will continue to strengthen.

S E C E D

afps
ASSOCIATION FRANÇAISE DU GENIE PARASISMIQUE

IOWCEE

Experts from all around the world are expected to attend the tenth world conference on Earthquake Engineering, July 19 - 24, 1992 in Madrid, Spain. The purpose of the conference is to provide worldwide specialists with an opportunity to get together in an international forum where they may exchange ideas and information. The technical sessions of the conference will cover a wide range of topics.

For information contact:

IOWCEE Secretariat
TILESA
Princesa 81
28008 Madrid
Spain

EEFIT TEAM INVESTIGATES APRIL 13 ROERMOND EARTHQUAKE

Ove Arup's Jack Pappin and Andrew Coburn of Cambridge Architectural Research Limited travelled to the Dutch-German border to investigate the effects of the 13th April Roermond earthquake. They were joined by Chris Pratt from Allott & Lomax's Essen office in a three day investigation to gather data from the field.

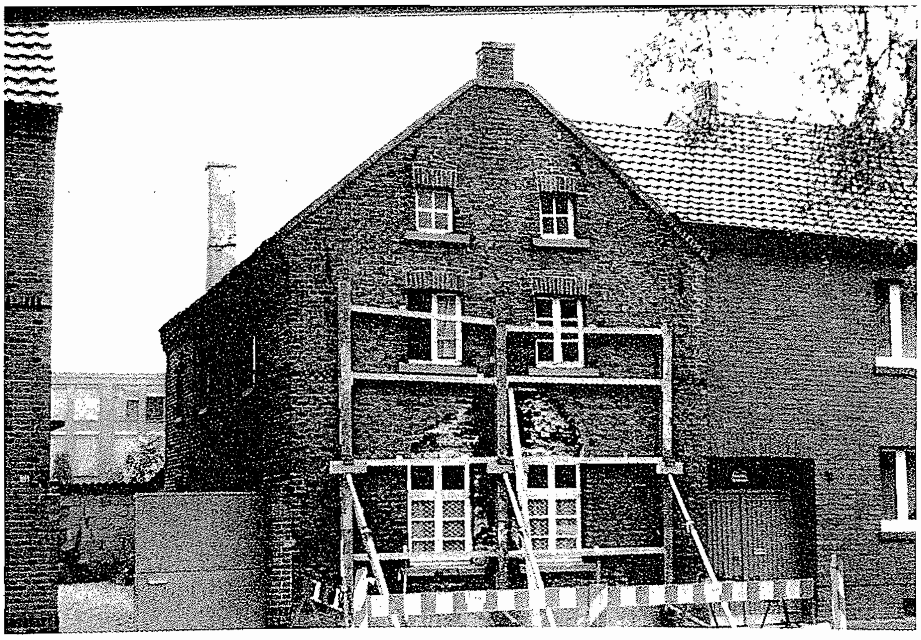
The earthquake was centred near the Dutch town of Roermond although the most severe damage occurred in Oberbruch, a German village 20km from the earthquake epicentre. Masonry buildings in the older part of the village were mainly affected with damage ranging from superficial cracks to dislodgement of chimneys and parts of wall panels.

The earthquake which registered 5.6 on the Richter scale caused alarm over a wide area when it struck at 3.20 in the morning. Allott & Lomax's structural engineer Chris Pratt was woken in his apartment 100km from the earthquake epicentre. "The noise woke us," he said, "several people in the area ran into the street in their pyjamas."

The earthquake originated in an area of faulting which runs north west along the Mass River on the Dutch-German border. The area is earthquake zone 3 according to German Standard DIN 4149. The last earthquake of a similar magnitude occurred in the region about 200 years ago (18 Feb 1756; Magnitude 6.2; Maximum Intensity = 8 MSK; Felt Area about 360,000 sq km).

The EEFIT team will present a report of their findings at a joint SECED/ EEFIT afternoon meeting at the Institution of Structural Engineers in London on Friday 5th June.

Out-of-plane failure of unrestrained wall panel in older masonry building in Heinsburgh



NOTABLE EARTHQUAKES JANUARY - MARCH 1992

Reported by British Geological Society

YEAR	DAY	MON	LAT	LON	DEPTH km	MAGNITUDE ML	MB	MS	LOCALITY
1992	10	Jan	61.597N	3.321E	13	3.4			**NORTHERN NORTH SEA**
1992	27	Jan	50.662N	1.880E	7	3.0			**BOULOGNE, FRANCE**
1992	17	Feb	52.488N	0.207E	11	3.4			**SE OF PETERBOROUGH CAMBRIDGESHIRE**
			Felt in the Peterborough, Stanford and Corby areas. Intensities were IV - V MSK in the epicentral area. Some cases of very minor damage were reported.						
1992	27	Feb	55.211N	3.413W	3	2.7			**JOHNSTONEBRIDGE, DUMFRIES AND GALLOWAY**
			Felt in the Johnstonebridge area of Annandale (III - IV MSK) and at Eskdalemuir.						
1992	02	Mar	52.864N	160.012E	43		6.4	6.7	**KAMCHATKA**
			Felt (IV MM) at Petropavlovsk-Kamchatskiy.						
1992	07	Mar	10.183N	84.375W	73		6.3		**COSTA RICA**
			One person died of a heart attack, a few slightly injured and slight damage in the SonJose area. Felt throughout most of Costa Rica..						
1992	13	Mar	39.705N	39.549E	28		6.1	6.9	**EASTERN TURKEY**
			479 people were confirmed to have died, over 2,000 were injured and thousands were made homeless. There was extensive damage in the Erzincan area with landslides and avalanches blocking a number of roads. Felt strongly in many parts of north eastern Turkey.						
1992	15	Mar	39.503N	39.804E	24		5.4	5.8	**EASTERN TURKEY**
			Aftershock of the 13 March event, Additional damage in the Erzincan area. Felt strongly in the epicentral area						

CONFERENCES

14th - 16th June 1993
Bath

6th International Conference on Soil Dynamics and Earthquake Engineering.

A three day conference organised by Wessex Institute of Technology and sponsored by Princeton University.

Conference topics focus on the dynamic properties of soils and engineering seismology. For further information contact:

SDEE 93
Wessex Institute of Technology
Ashurst Lodge
Ashurst
Southampton SO4 2AA
United Kingdom

7th - 9th July 1993
Cranfield

International Conference on Structural Dynamics Modelling Test, Analysis and Correlation.

A three day conference organised by the Dynamic Testing Agency (DTA) and the National Agency for Finite Element Methods and Standards (NAFEMS).

The overall theme of the conference is the development of validated models for use in structural dynamic analysis. The specific topics to be included are: construction of finite element models (for structural dynamic analysis), modal testing and model correlation and updating methods.

The conference aims to bring together practitioners in the two major activities which comprise structural dynamics modelling: finite element modelling and modal testing. Further it seeks to combine the expertise in both areas by introducing the various correlation techniques currently being developed for comparing and reconciling the results obtained by these two approaches and for correcting (or updating) structural dynamic model.

For further information contact:

Neil Harwood
DTA Conference Office
NEL
East Kilbride
Glasgow G75 OQU
United Kingdom

COURSES

7th April 1992
Loughborough University

Vibration Measurement Using Laser Technology

A one day course to give engineers a basic understanding of laser based techniques for the measurement and control of noise and vibration.

The ability of modern laser based techniques to make non-contacting measurements in hostile environments is now providing engineers with valuable data which not only influences the design of everyday products such as loudspeakers and automotive vehicles but aids understanding of important new techniques such as ultrasonic fabrication. In future the ease and speed at which large quantities of data can be collected in this way is certain to result in the routine use of this technology in more conventional situations.

Engineers working in a number of departments within the Institute of Optical Engineering at Loughborough University have a long research history in laser metrology. With the invention of Electronic Speckle Pattern Interferometry (ESPI) the department of Mechanical Engineering was able to demonstrate for the first time a high accuracy vibration mapping technique. This together with the department's research excellence in Laser Vibrometry gives Loughborough an unsurpassed standing in both the theoretical and practical usage of this technology.

The course is intended for all industrial scientists and engineers who have an interest in the field of vibration measurement. The speakers will be Professor Neil Halliwell and Dr John Tyrer from the Department of Mechanical Engineering, Loughborough University.

For further information contact:

Jackie Basely
Dept of Mechanical Engineering
Loughborough University
Loughborough
Leicestershire LE11 3TU

6th - 9th July 1992
University of Cambridge

Earthquake Risk Engineering - A four day advanced short course

Earthquake risk assessment for cities requires not only detailed knowledge of the performance of building structures but also an understanding of the dramatic influence of local ground conditions on lifeline performance and the potential for fire following an earthquake. Successive earthquakes have shown that our cities and communities worldwide remain surprisingly vulnerable to these disasters and that future catastrophes are to be expected. Recent research has therefore concentrated on integrating the different aspects of earthquake hazard, risk and mitigation to provide an overall picture of the seismic threat.

This advanced short course will provide a broad overview of the latest advances in earthquake engineering and will aim to address problems, particularly the prediction of damage and the assessment of risk, which lie at or beyond the limits of established practice. The course will seek to identify areas of difficulty and to recommend appropriate solutions. Topics will include:

- Seismic hazard and microzonation
- Fire following earthquake
- Performance of lifelines
- Geotechnical aspects: soil behaviour, softening, modelling
- Use of experience data from recent earthquakes
- Risk assessment for buildings
- Retrofit: strengthening of buildings

The lecturers will include Dr R S Steedman, Dr R J Spence, Professor R V Whitman, Dr C Scawthorn, Dr M D Bolton, Dr C P Melville, Dr R Muir Wood and Dr G Woo.

For further information contact:

Caroline Goodwin
University of Cambridge Programme for Industry
Department of Engineering
Trumpington Street
Cambridge CB2 1PZ
United Kingdom

WHAT'S ON

April - June 1992

6th - 8th April 1992
Institute of Sound and Vibration Research
Instrumentation and Measurement Techniques for Noise Control
ISVR, University of Southampton

30th April 1992
SECED Meeting
Structural Dynamic Testing in Earthquake Engineering
Institute of Civil Engineers
also SECED AGM and Society Dinner

20th May 1992
SECED Meeting
Earthquake Modelling for Geotechnical Applications
Dr R S Steedman et al
Cambridge University

4th June 1992
SECED/EEFIT Meeting
13th March Erzincan Earthquake EEFIT Debriefing & 13th April Roermond Earthquake
Several speakers
Institution of Structural Engineers

16th - 18th June 1992
SUSI 92
2nd International Conference on Structures Under Shock and Impact
Computational Mechanics Institute, Southampton

NEW JOURNAL

A new journal is available entitled Disaster Pevention and Management, an International Journal, published by MCB University Press in association with the University of Bradford's Disaster Prevention and Limitation Unit, (DPLU). Editor in Chief is Dr Alf Keller, DPLU Director, University of Bradford.

For further information contact:

Julie Wilson
Customer Services Executive
MCB University Press Limited
62 Toller Lane
Bradford BD8 9BY
United Kingdom

FORTHCOMING EVENTS

14th July 1992
NSF/NCEER
International Symposium Centrifuge Modelling for Geotechnical and Earthquake Engineering Applications
New York, USA

19th - 25th July 1992
Tenth World Conference on Earthquake Engineering
Madrid, Spain

20th - 23rd July 1992
Institution of Civil Engineers
International Conference on Retaining Structures
Cambridge

19th - 20th August 1992
ASCE Structural Division
Symposium on Dynamic Analysis and Design Considerations for High-Level Nuclear Waste Depositories
San Francisco, California

7th - 12th September 1992
XXIII General Assembly of the European Seismological Commission
Prague, Czechoslavakia

8th - 10th September
The Japan Society of Mechanical Engineers
First International Conference on Motion and Vibration Control
Tokyo, Japan

14th - 16th September 1992
International Association for Bridge and Structural Engineering (IABSE)
International conference on Structural Eurocodes
Dubrovnik, Yugoslavia

14th - 18th September 1992
Institute of Acoustics
Euronoise '92 - Co-operation in Noise Control
Imperial College, London

21st - 25th September 1992
Ninth European Conference on Fracture Reliability and Structural Integrity of Advanced Materials
Belgrade, Yugoslavia

22nd - 26th September 1992
Asian Disaster Preparedness Center
7th International Seminar on Earthquake Prognostics
Bangkok, Thailand.

30th September 1992
SECED Meeting
Ground Borne Vibrations and Structural Damage - Presentation of New British Standards
Institution of Civil Engineers

28th October 1992
Joint SECED/WES Meeting
Hazard Assessment - Seismological and Wind Comparisons
Institution of Civil Engineers

25th November 1992
Joint SECED/AFPS Meeting
Subject to be announced
Institution of Civil Engineers

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

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

26th May 1993
5th Mallet-Milne Lecture
Professor T Paulay
London

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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