S E C E D
SECED NEWSLETTER
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EARTHQUAKE : Natural or Man-made Hazard ?

A report of a joint meeting of SECED and The Hazard Forum in December under the Chairmanship of Alastair Paterson, Chairman, Standing Committee for Natural Disasters of the Hazards Forum

Of all natural disasters earthquakes pose a major threat and account for disproportionate deaths and economic losses in many regions of the world. Although an earthquake is a natural disaster many of the deaths and damage caused are man-made. Damage from poorly constructed buildings which collapse cause serious social and economic problems, with the poor generally suffering the most. Some casualties can be avoided if there is adequate preparedness in the community. Even disaster-prone regions have a tendency to complacency. For example, an estimated 90,000 people will die in the next major earthquake in Japan, yet the community is still reluctant to take preventative measures.

Nonetheless,it is encouraging that in many areas the importance of disaster preparedness, rather than just disaster relief has been recognised. Training local people in disaster management programmes on their own territory has provided a cost effective tool in the reduction of the scale of disasters.

However problems remain in dealing with post-disaster effects. Casualty departments of local hospitals are not always able to cope with the types of injury that occur. Small hospitals each operate emergency plans of their own which are not co-ordinated with other hospitals and do not integrate with fire and emergency services. Local doctors often lack experience of traumas and for cultural and other reasons are sometimes reluctant to amputate damaged limbs. It is not uncommon with building collapse to find patients who survive for some time, but then die as a result of the release of pressure on a crushed limb and the sudden change in blood pressure that results.

Destruction of low cost buildings in 1990 Manjil Earthquake, Iran

The period of recovery after an earthquake should be used for long-term protection. Reconstruction could and should be used to revitalise the local economy. In the reconstruction period there should be deconcentration, with a view to less damage next time. It is important to export the lessons beyond the immediate reconstruction area, as the next earthquake in the region would not be in the same place as the previous one and other areas should be set in a state of readiness.

In the long term, prevention of building collapse by design offers the best strategy for protection against the earthquake hazard. Over the past 20 years, those working in the field have identified what is needed to make buildings reasonably secure. Observations of earthquake damage and advancements in analytical techniques have added to the sum of knowledge in recent years. Low technology solutions exist which can add a significant degree of protection at least cost to low cost housing. At the high technology end of the spectrum it is now possible to have active control of a building by computer. The appropriate technology should be applied to suit the available economic resources.

The UK's main contribution has been made in education in ensuring that proper building techniques were widely known in the areas likely to be affected, so that appropriate precautions can

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BUILDING EDUCATION TARGETED IN DISASTER REDUCTION INITIATIVE

Since the mid-1970s, new community-based approaches to reconstruction after disaster have met with increasing success. Programmes to train local builders in safe construction can help to protect the population of areas prone to earthquakes, strong winds, floods and other sudden natural hazards.

Until now much of the knowledge about safer building and post-disaster reconstruction has been confined to technical specialists. To extend this knowledge to possible implementors, the **Overseas Development Administration** of the British Government has commissioned a project to develop a number of publications concerning the construction of low-cost houses in hazard-prone countries.

The project, being carried out jointly by Cambridge Architectural Research and Oxford Polytechnic Disaster Management Centre, involves reviewing recent projects of builder training and public education to provide practical guidelines on how to set up and run training and education programmes in safe building. The guidelines produced will also contain details of better construction techniques for specific building types as well as principles for the communication of technical messages to householders and local buildings. The publications will be organised so that the hard-pressed non-specialist development worker and Government official may rapidly get an overview of the issues involved in running such programmes, while also having access to resource documents which can be called upon when disaster strikes.

When the publications are available in early 1993, the key summary document will be distributed free of charge to Non-Governmental Development Organisations, Government agencies, International Organisations and others involved in training, technical dissemination or building projects. Institutions wishing to be added to the project mailing list should write to the address below. The project would particularly like to hear from anyone with any experience of building improvement projects, community-based education and training or hazard-resistant construction.

Anyone interested in receiving a free copy of the summary document or finding out more about the project should write to: The Building for Safety Project, Cambridge Architectural Research Ltd., The Oast House, Malting Lane, Cambridge CB3 9HF, United Kingdom.

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continued from page 1

be taken. The UK has strong relationships with many developing countries and strong educational resources, technology transfer and research capabilities. The UK strengths could make a great contribution to the international effort for natural disaster reduction.

Drawing together some of the main conclusions of the meeting,

- disaster prepardness is of prime importance
- to be effective in-coming rescue teams should be self-contained and self-sufficient and able to respond to the wishes of the local community.
- reconstruction should be based on local building capacity rather than centralised plans.
- there is a need to educate local builders to build earthquake-resistant houses.

Despite developments and advances of knowledge two problems still remain. What can be done about inadequate existing buildings. This is a vast problem and substantial resources would be required to make a significant impact on current vulnerabilities world wide. The second problem relates to new buildings. Unless people really know how to design them properly the same accidents are likely to re-occur. A high level of education and technology transfer is required in many regions to avoid problems in the future.

Finally, without good codes of practice and knowledge of appropriate materials, and the political will to bring about change, little will be achieved to anticipate disasters.

For notes on the topics discussed at this meeting contact,

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Topics cover,

Earthquakes, Predictions and Hazards
Dr. C. Browitt - British Geological Survey and Dr. C. Taylor - University of Bristol

Preparedness of the Community
Mr. E. Alley - President, Institute of Civil Defence and UNDRO Consultant

Medical, Psychological and Sociological Aspects
Mr. A Redmond - Director, South Manchester Accident Resue Team (SMART)

Reconstruction of the Community
Mr. A. Barber - Disaster Management Limited

The Current State of Earthquake Resistant Design
Mr. E. Booth - Ove Arup and Partners

COMMUNICATING WITH BUILDERS FOR EARTHQUAKE-RESISTANT CONSTRUCTION

Andrew Coburn, Eric Dudley, Ane Haaland *report on a Building for Safety project. Andrew Coburn and Eric Dudley are directors of Cambridge Architectural Research. Ane Haaland is a communication specialist with experience in developing educational material for less-literate communities. All are consultants currently working on the* ***Building for Safety Project.***

Since the mid-1970s, new community-based approaches to reconstruction after disaster have met with increasing success. Programmes to train local buildings in safe construction have been implemented to help to protect the population of areas prone to earthquakes, strong winds, floods and other sudden natural hazards.

To extend the experience that has been built up to possible future implementors, the Overseas Development Administration of the British Government has commissioned a project - the Building for Safety Project - to develop a number of publications concerning the construction of low-cost houses in hazard-prone countries.

The project, being carried out jointly by Cambridge Architectural Research and Oxford Polytechnic Disaster Management Centre, involves research into builder training and public education to provide practical guidelines for setting up and running training and education programmes in safe building. The guidelines produced will also contain details of better construction techniques for specific building types as well as principles for the communication of technical messages to householders and local builders.

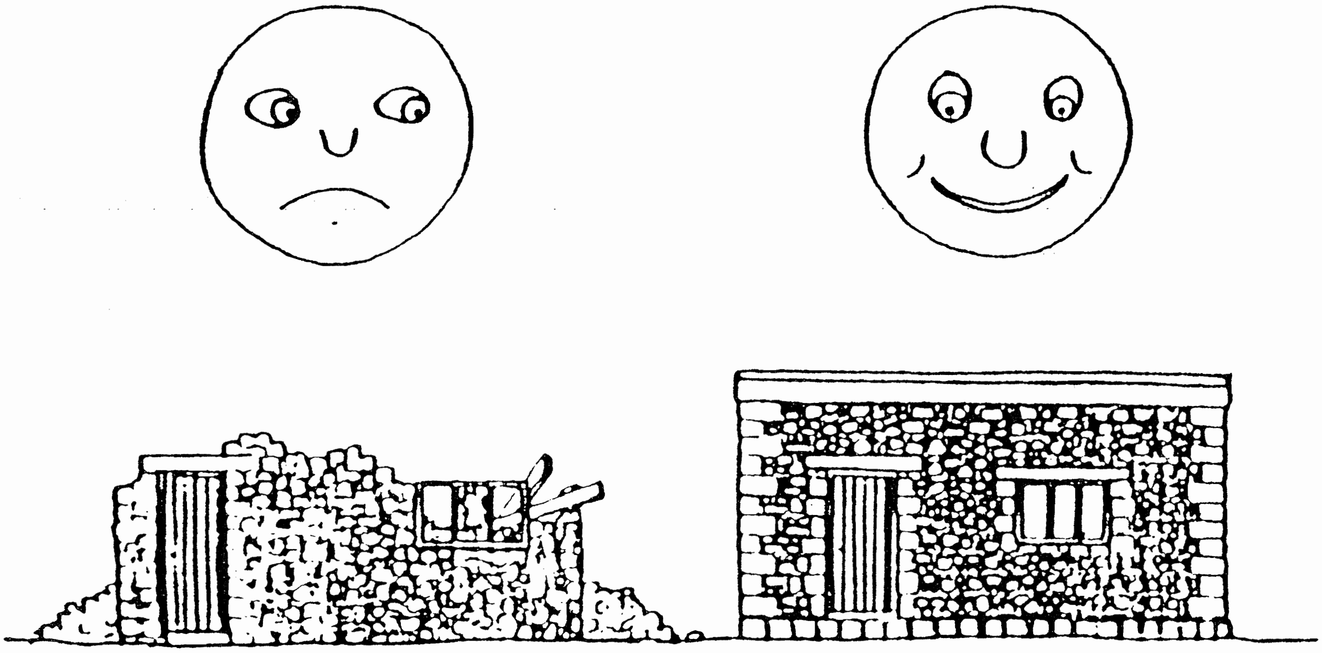
Research into Building Communication

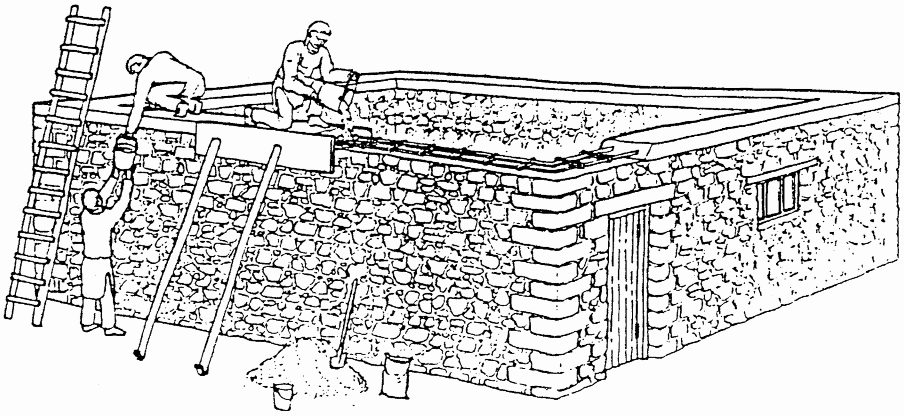
Many past building improvement programmes have used educational materials to convey information as part of the programme's activities, yet the success of materials in communicating building messages has rarely been evaluated. In other fields, notably primary health care and agricultural development, studies of the interpretation of educational materials by communities have shown that poorly designed material and particularly material that makes assumptions about the way that the target audiences read information can be completely ineffective. As part of the Building for Safety Project, a recent field study[1] explored the relevance of lessons from communication studies in primary health care to the development of educational materials for building improvement programmes.

The field work was carried out in the Northern Areas of Pakistan in collaboration with Aga Khan Health Service, both to take advantage of their extensive infrastructure and representation in rural communities across a major hazard-prone region, and to coordinate studies with their current interest in evaluating their own educational materials used for primary health care communication.

A major objective was to assess the relevance to building education material of pretesting techniques developed for health education

Depiction of primary design objective





Conveying structural concepts - the ring beam

material[2] in communities of low literacy. Pre-production testing, or pretesting, is a method which enables the designers of educational materials (graphic/ printed materials, radio programmes, videos etc.) to find out how well the material is being understood by the target audience. It also allows implementors to learn more about the perceptions, beliefs and practices of the target audience.

Building Education Materials

A range of building education material was development and revised during the field trip. 147 interviews were carried out with members of the local community in a range of locations across the study area, testing their understanding of different batches of educational material.

The educational material pretested in the field study was designed to explore the influence on comprehension of a range of issues , including picture style, graphic conventions and pictorial content. The technical content of the building education material concentrated on the single theme of building a reinforced concrete ringbeam to make a safer masonry house. Methods of conveying the concept of a ringbeam and its advantages were explored, as well as methods of communicating construction detail - the steps needed to make a ringbeam properly.[3]

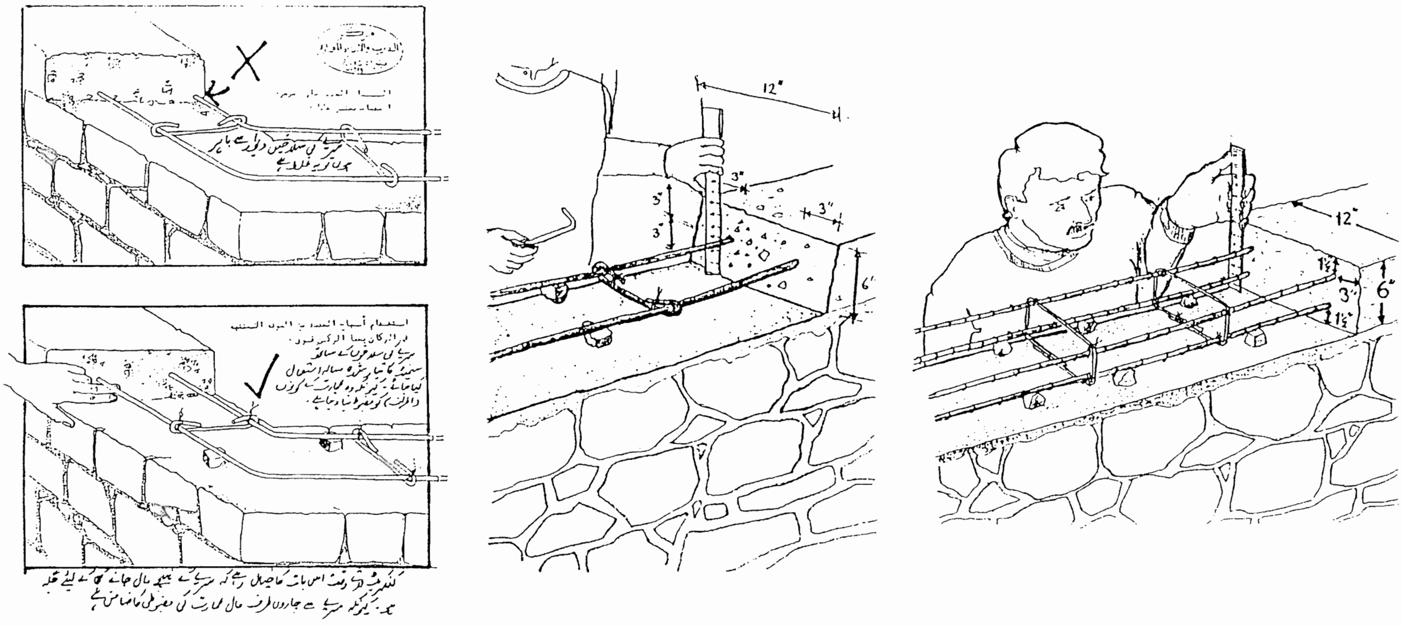
The tests included examining the complexity and simplicity of images. It appears that although extraneous detail can confuse a drawing, relevant detail may enhance understanding. Simply because people are unused to reading drawings does not necessarily imply that the drawings used with them should be simple and crude. Fine detail may be correctly interpreted if placed in an understandable context. The size of the drawing may also be important in determining how much detail can be comprehended by the viewer.

A range of symbolic graphics (arrows, borders, boxes, movement lines) were included in pretested material. These in most cases tended to be seen first as physical, literal objects. Lines of borders separating two building images were commonly read as walls. Boxes were rooms or objects. In some cases, for example arrows, the symbolic convention was broadly understood and it was recognised as a non-physical arrow, but the deduction of what the arrow was attempting to convey - the next layer of interpretation - appeared difficult. Tests were carried out to explore the comprehension of a number of other common conventions of builder training material, including positive and negative, changes of scale, emphasis of parts of a drawing, movement and direction and sequence of images. Many of the graphic conventions that literate people take for granted - for example seeing the same object at different moments in time on the same page - are not understood by people with less familiarity with graphic materials. A common device of builder training material is to use cartoons and anthropomorphic houses to depict messages. Cartoon material was tested in the field trials. Where the respondent was familiar with cartoon conventions, a higher level of interest was registered, but to those who were unfamiliar with the cartoon conventions, it was also evident that it was completely unintelligible and alienating. Anthropomorphic houses were seen as either houses or people but rarely as a synthesis of the two. Those who saw the drawings as buildings described the legs as columns and the eyes as, for instance, electricity meters.

Conceptual messages - the reason why a building should be built stronger - were the most difficult to convey through educational material. Metaphorical images were much less understood than literal depictions of the message. Pictures with meaning on a non-literal level appear to need considerable explanation if they are to be used in educational programmes. In general, the field study showed that the designers of graphic material for education may make many unconscious assumptions about the way the recipient community interprets pictures that reduce the comprehensibility of the material. In communities with low levels of literacy and poor familiarity with graphic images, most drawings are interpreted very literally. The tests showed that successful pictures do not have to be simple, but the most comprehensible images present realist and representational scenes with information content.

The Project continues ...

The project continues with research into the organisation and technical content of building improvement programmes. Examples and experiences of builder training from all over the world are currently being sought by the research team. A number of detailed case studies of past building



Development of pictorial building instructions - the right hand drawing proved the most successful in field trials

improvement projects in different countries and different situations are being documented. The project will result in the preparation of several sets of guidelines for the successful establishment and running of building improvement programmes in hazard-prone areas, including:

- Technical principles and details of low-cost hazard-resistant construction.
- Guidelines for methods of communicating technical information to local buildings and householders.
- Guidelines for setting up and running programmes, including the organisation of training programmes and financial options.
- An annotated compendium of information about building improvement programmes.
- Case studies of previous building training programmes.

When the publications are available in early 1993, the key summary document will be distributed free of charge to Non-Governmental Development Organisations, Government agencies, International Organisations and others involved in training, technical dissemination or building projects. Institutions wishing to be added to the project mailing list should write to the address below. The project would particularly like to hear from anyone with any experience of building improvement projects, community-based education and training or hazard-resistant construction.

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The Building for Safety Project,
Cambridge Architectural
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The Oast House,
Malting Lane,
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CB3 9HF,
United Kingdom.

References

1. Coburn, A.W., Dudley, E., Haaland, A., 1991, Communication for Building Safety, Report of a Field Study in Northern Pakistan 17 October to 8 November 1991, Working Report for Building for Safety Project, ODA R4773, Development of Guidelines for Buildings Improvement Programmes in Hazard-Prone Areas.

2. Haaland, A. and Fussell, D., 1976, Communicating with Pictures in Nepal, UNICEF.

3. Leslie, J.D.L. and Coburn, A.W., 1985, Dhamar Building Education Project, Yemen Arab Republic, Project Assessment for OXFAM and Executive Office of the Supreme Council for Reconstruction of the Earthquake Damaged Areas, Yemen Arab Republic.

Structural Dynamics at BRE

A review of current activities by **Brian Ellis**

The purpose of this article is to provide a brief view of the research work on structural dynamics being conducted at the Building Research Establishment (BRE). BRE is an Executive Agency within the DoE, and the majority of its work is undertaken for the Government. The Structural Performance Division is composed of several sections, including the Dynamics Section, and most of its work is ultimately concerned with the Building Regulations and Codes of Practice. BRE is also required to undertake a small amount of consultancy work, and as far as dynamics is concerned, our aim is to undertake work which will complement our research programme, eg tests to measure the dynamic characteristics of Grandstand roofs (see Building 26 July).

The Dynamics Section was formed in 1976 although work on vibrations had been undertaken before that date notably by R J Steffens. It was soon realised that there was a need for good quality experimental data from real structures in order to check existing numerical procedures; hence prototype testing became the main research vehicle for the section. This resulted in the construction of a range of vibration generators and the development of forced vibration test procedures as well as spectral analysis techniques. The largest of the vibration generators were used for evaluating the fundamental dynamic characteristics of a number of buildings and dams. Although these 'shakers' are still maintained today, they are used only as part of more extensive projects.

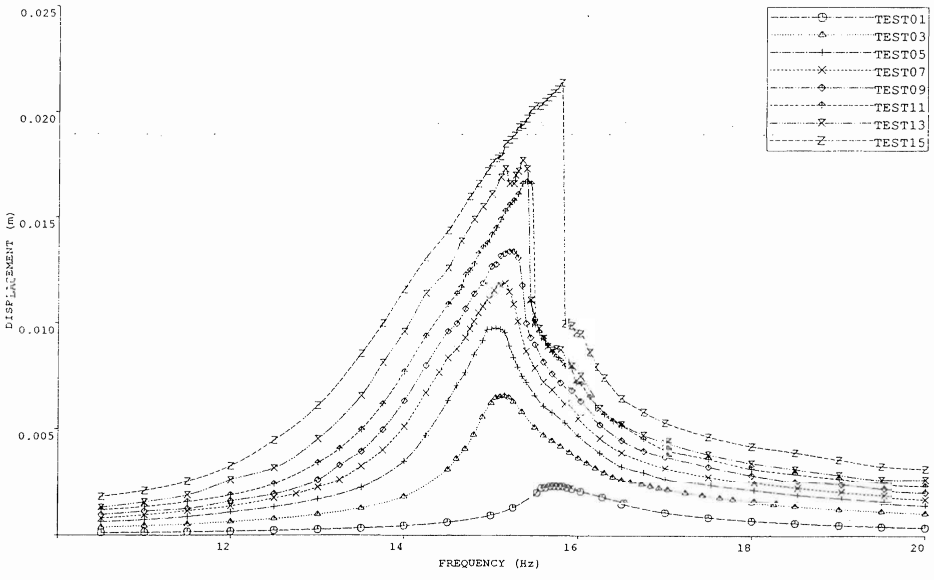
One of the early interests was to obtain data on the response of tall buildings to wind loading, and this was developed over a number of years until the Hume Point project finally produced data of sufficiently good quality and reliability to enable codes to be calibrated. This project was the subject of SECED's October meeting and a resume is given in a this edition of the Newsletter, see page 8.

BRE also receives a large number of enquiries from consultants and from the public, and the largest number of enquiries on vibration are concerned with potential damage to structures from ground-borne vibration. For subjects such as this, which are not yet covered by codes, BRE needs to maintain a good understanding of the current state-of-the-art. In this area we do not undertake routine measurements, instead we refer enquiries to consultants, usually on the basis of the nearest appropriate company found in the SECED Directory. We do however, do more than maintain a watching brief and some recent work has been involved with subjecting panels to increasing amplitudes of vibration to see how their characteristics change as they approach failure. The graph shows the response of a glass panel at a range of amplitudes of vibration, the lowest curve showing a classic visco-elastic response, whereas the highest response curve shows a significant instability zone. It is an interesting contrast to see a glass panel vibrating at a steady state of over 2m/s, and yet find values of the order of 25mm/s being suggested as the threshold for damage in structures.

One of our current topics of interest is that of floor vibrations produced by people. This has two main aspects, first, for long-span lightweight floors, vibrations produced by people walking on the floor can prove annoying to other users of the floor. Although this is a serviceability problem it may be a limiting design criteria and hence can be significant. Secondly, loads from dancing or organised keep-fit exercises can be significant and if sufficient energy is available at the fundamental frequency of the floor it could lead to excessive movements of the floor and hence a resulting safety problem. The fact that the loads from dancing are not covered by British Standards and may in the future be specified from ISO via CEN gives increased impetus to our work, which is concerned not only with actual site measurements for checking codes and calculation procedures but also with developing analytical methods for calculating response. A related problem is that of crowd loads in grand stands and this is an area where we are having to focus attention.

Another topic which has received some publicity lately is the response of buildings to gas explosions. This work is primarily in support of the disproportionate collapse rules in the Building Regulations and British

Response of a glass panel to forced vibrations for a range of applied loads



Codes. A large amount of work, primarily measuring pressure time histories for various types of explosion has been conducted in experimental rigs at Cardington. This work has been undertaken by some colleagues at the Fire Research Station (also part of BRE), and joint research has been undertaken to consider structural response to these explosions, both using the explosion rigs and site tests on real housing. One recent series of tests has been concerned with monitoring how a number of panels fail under gas explosions, the objective being to provide basic data for calibrating numerical codes. An example of a brickwork panel failing is shown in the photographs. The numerical analysis for this project has been undertaken at Heriot Watt University, initially through a CASE award. Throughout our work we see links with Universities as being important as a vehicle for extending our research effort, and one which is hopefully of equal benefit to the University.

One subject where we have no research projects is earthquake engineering, our interests in this subject being confined primarily to EC8 and how it will affect the UK. However, our Geotechnics Division have been involved with studies of the effects of earthquakes on dams within the UK. They also have considerable experience in the area of geophysics with field measurements being an important part of their work.

The dynamics section's main experience has been obtained through prototype testing and feedback from tests is still considered to be of prime importance for improving design. Often there is a large difference between measurement and calculation and for the future our task is to try to close this gap and to ensure that the those drafting codes are made aware of the likely accuracy of the calculation methods proposed. Maintenance of our testing capabilities is considered important and has been enhanced by the recent purchase of a LASER Doppler interferometer which now provides an ability to take remote measurements on site. Add to this our developing numerical analysis facilities and you should have a reasonable idea of the dynamics research work at BRE.

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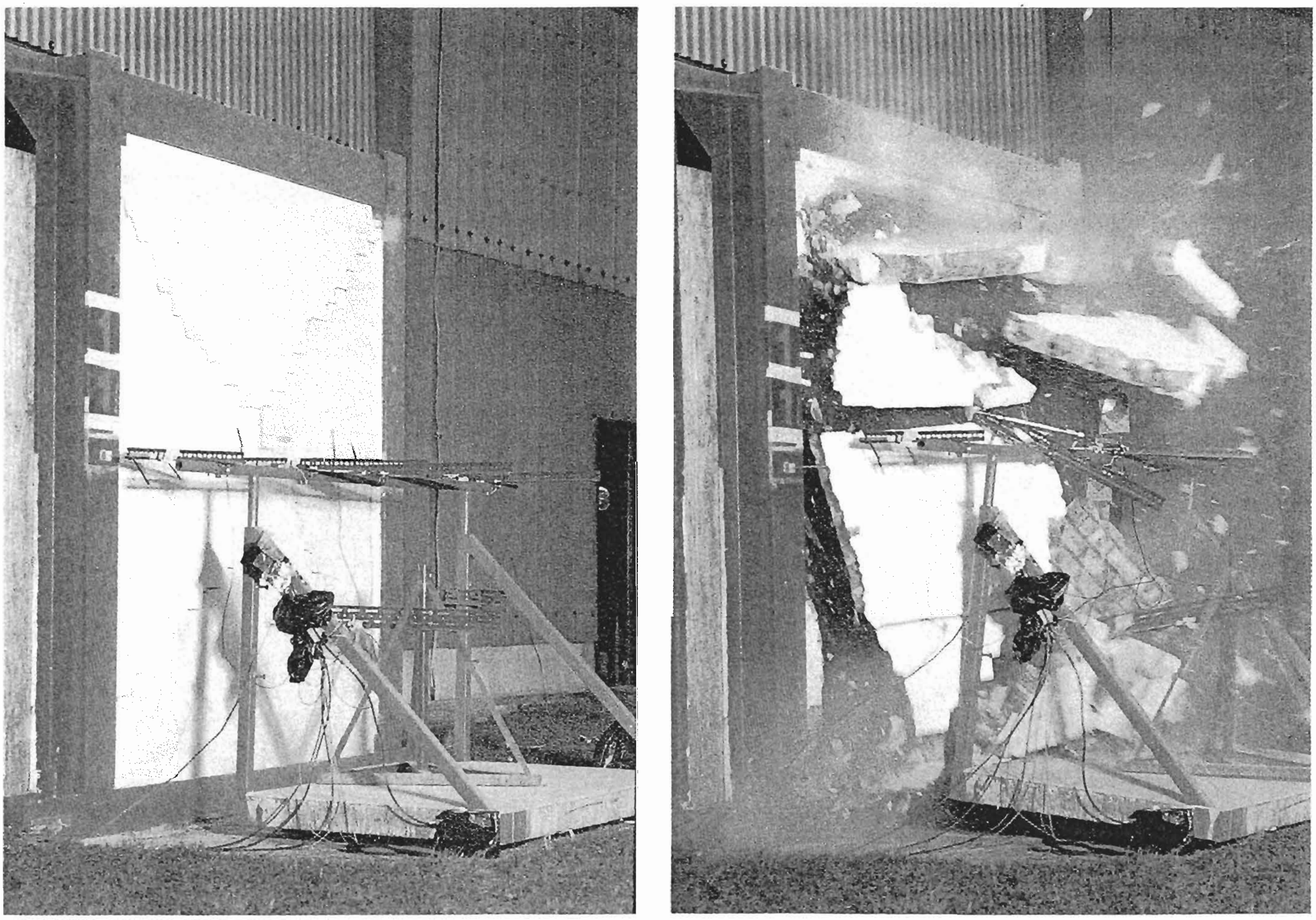
Failure of a brick panel caused by a gas explosion



SECED Meeting Report

MEASURING THE RESPONSE OF TALL BUILDINGS TO WIND LOADING

Several methods have been developed for calculating the response of tall buildings to wind loading. However, until now, none of these have been calibrated against reliable data from actual buildings. There is also a continuing trend towards lighter structures which is pushing structures nearer to the limit where they become dynamically sensitive. Although previous attempts have been made to make full-scale measurements of the response of tall buildings to wind loading, none of them have obtained data of sufficient accuracy to enable the validity of prediction models to be assessed. Furthermore, a comparison of trial calculations using several methods (ref. 1) produced a range of results, suggesting inconsistencies between the various methods.

Therefore there is a strong case for measuring the actual response of a real tall building and comparing it with that predicted by various methods. There have been many relatively short duration tests in which the response of a tall building has been measured during the passage of a storm. For example the rms and peak accelerations that occurred during a ten minute period with specified mean wind speed and direction may be quoted. However, the wind is a random process and so if the same mean wind speed and direction occur in the next or any other 10 minute period, it does not mean that the response will be the same. It is only by taking many samples, each having the same mean wind speed and direction, and then averaging them together, that a response level can be obtained which is sufficiently accurate for calibrating a predictive method.

Sufficient data to enable a meaningful calibration exercise to be carried out has only been collected from three buildings. However, there have been major problems with the data from two of these buildings (ref. 2) so that only the data from the most recent test are reliable enough to be used in calibration.

In modern methods of finding the dynamic response of a tall building to a given wind, the response of the building is calculated in its different modes of vibration, and these are summed in various ways to find the overall response. If these methods are to be calibrated, then it is necessary to measure the response of a full-scale building in terms of these different modes of vibration, and this involves some form of spectral analysis.

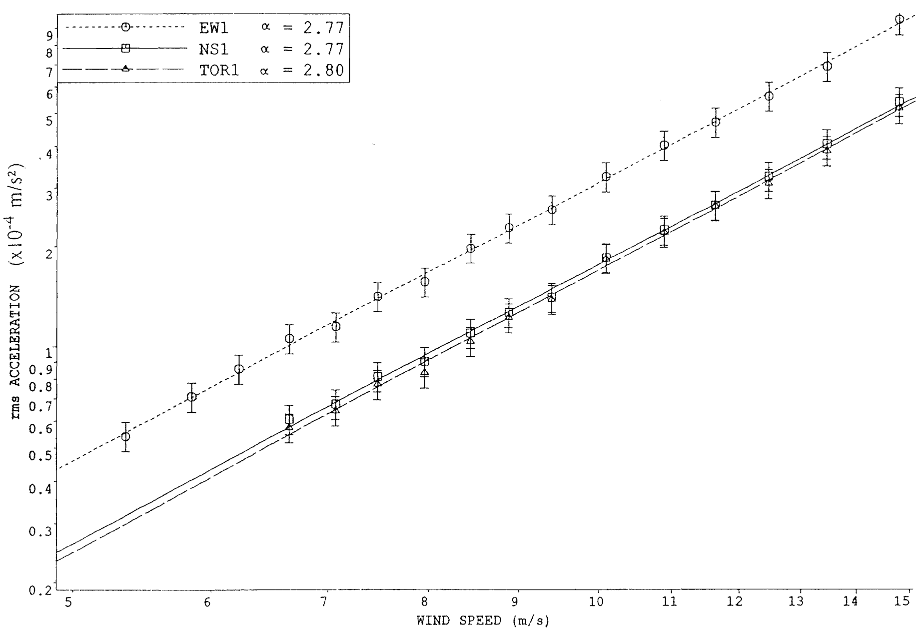
Individual record lengths of ten minutes or more need to be used to overcome the inevitable errors that occur when any spectral analysis is carried out and so that each record is within the "spectral gap" in the wind spectrum. One hundred records, each obtained during similar wind conditions, need to be averaged together in order to find the response of the building to ±10% for these conditions.

In 1986, BRE decided to initiate a long-term test to measure the response of one tall building to a high degree of accuracy. The dynamic characteristics of Hume Point, the building selected for the long-term testing, were found by forced vibration testing at a number of amplitude levels (ref. 3). The results from this testing were used to calculate suitable recording parameters for the acquisition and analysis of data. Hume Point is a 23 storey unoccupied building one mile north of the River Thames in East London. The building is a large precast panel structure with plan dimensions of 23.7m by 17.9m and an overall height of 66.9m. It is over 300m away from the seven other similar blocks built on the same estate.

Hume Point

An important part of the experiment was the accurate measurement of wind speed and direction. The wind speed was measured by three Gill propeller anemometers mounted on a 20m mast on the roof of the building. The dynamic response of the building was measured by up to fourteen accelerometers; two tracking lasers were used to observe the motion of a plumb line suspended in the building and so determine the building's quasi-static response. Thermistors were used to measure the temperature of all four faces of the building. In the final year of the experiment 32 data channels were recorded, each channel being sampled 16 times a second for 1024 seconds giving over half a million readings for each record. The raw data were recorded on an optical disc each one of which could hold up to 2 gigabytes of information. A controlling computer handled the data acquisition, storage, and initial analysis. Although the computer was installed at Hume Point it could also be accessed at BRE by a modem link which enabled a daily check to be made on data collection without having to visit the site.

Recording was triggered whenever the wind speed exceeded 5 m/s. Over 2,250 hours of data were obtained in almost 8,000 records each 1024 seconds long. Response spectra calculated from records obtained under similar wind conditions were averaged together. Using this selective ensemble averaging technique, the rms acceleration of Hume Point was obtained to an accuracy of ±10% for a range of wind speeds and directions. The results of the selective ensemble averaging for one 15° wind sectors shown in the figure above. The response in all three fundamental modes is greatest for winds blowing



rms acceleration against wind speed for records with mean wind direction 225^0 to 255^0 linear regression using points > 0.5 x 10 -4 m/s^2 + 10% error bar included for all points

onto the broad west face of the building, and ignoring the response to easterly winds (where few records were obtained), is symmetrical about both the east-west and north-south axes.

The measured full-scale response of Hume Point was compared with that predicted by the current ESDU calculation methods for both along-wind and across-wind response of tall buildings to turbulence buffeting. Values of building characteristics measured in the forced vibration tests, full-scale measured wind profiles and the data from the selective ensemble averaging were used in the calculation method. The predicted rms resonant acceleration underestimated the actually measured response by 20% for southerly winds and by 25 to 45% (depending upon the turbulence intensity chosen) for westerly winds.

While this is a creditable result it should be remembered that it has been obtained by putting measured values into the calculation. Some of these values, particularly those for the dynamic characteristics of the building, are notoriously difficult to predict at the design stage, and they have a large influence on the calculated response. In particular, the calculated tip acceleration is inversely proportional to the square root of the damping, is inversely proportional to the mass of the building, and is inversely proportional to the natural frequency to the power 1.35. It should be noted that all other calculation methods for predicting the dynamic response of tall buildings will be equally susceptible to errors in the input data. Given these results, one question which could well be asked is: "until improvements in the estimation of input parameters are made, shouldn't refinements to the prediction methods be limited to ones which simplify the calculation method?"

As well as looking at the calculated response of Hume Point a 1:200 scale model of the building was tested in the BRE boundary layer wind tunnel. Three distinct terrain simulations were used to model the actual terrain around Hume Point. Using this simulation, and the measured values of mass, natural frequency and damping, the wind tunnel tests were able to predict the along-wind response of Hume Point to within about 30% of the actually measured values, the across-wind response to within a factor of 2, and the torsional response to within a factor of 5.

Further details of the tests on Hume Point are given in reference 4. Having looked at the ESDU predictive methods, the next step is to compare the response predicted by various national wind loading codes (including the new Eurocode) with that actually measured at Hume Point.

John Littler

References:

1. Lee, B.E. and Ng, W.K. "Comparisons of estimated dynamic along-wind response" Journal of Wind Engineering and Industrial Aerodynamics, 30 (1988) pp 153 - 162.

2. Littler, J.D. and Ellis, B.R. "Interim findings from full-scale measurements at Hume Point" Jounal of Wind Engineering and Industrial Aerodynamics, 36 (1990) pp 1181 - 1190.

3. Ellis, B.R. and Littler, J.D. "Dynamics response of nine similar tower blocks" Journal of Wind Engineering and Industrial Aerodynamics, 28 (1988) pp 339 - 349.

4. Littler, J.D. and Ellis, B.R. "Full-scale measurements to determine the response of Hume Point to wind loading" 8th International Conference on Wind Engineering, London, Ontario, July 1991.

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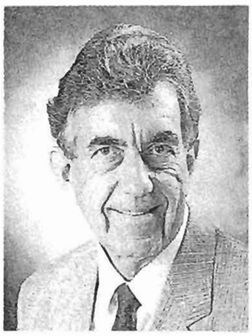
NOTABLE EARTHQUAKES OCTOBER-DECEMBER 1991

Reported by British Geological Survey

YEAR	DAY	MON	LAT	LON	DEP	MAGNITUDE			LOCALITY
					KM	ML	MB	MS	
1991	14	Oct	9.051S	158.490E	33		6.2	7.1	SOLOMON ISLANDS
			Felt strongly throughout the Solomon Islands						
1991	19	Oct	30.738N	78.792E	19		6.5	7.1	NORTHERN INDIA
			Over 2000 people killed, more than 1,800 injured and 18,000 buildings destroyed in the Chamoli and Uttarkashi areas. Some damage also occurred at Chandigarh and New Delhi. Felt throughout northern India, western Nepal and northeastern Pakistan. Landslides and deep fissuring occurred in the epicentral area						
1991	18	Nov	58.656N	1.091E	16	3.7			CENTRAL NORTH SEA
			South Viking Graben area, south of the South Brae oil and gas field						
1991	19	Nov	4.557N	77.485W	21		6.5	7.0	WESTERN COLOMBIA
			Two people were killed and 28 houses damaged in Choco Department. Minor damage (VI MM) in Buenaventura and Cali. Felt throughout western Colombia and in parts of Equador						
1991	02	Dec	45.486N	21.129E	10		5.0	5.6	WESTERN ROMANIA
			Considerable damage (VIII MM) in the Voiteg area and some damage in the Deta-Ceacova area, Romania. Slight damage in the Belgrade area, Yogoslavia. Felt in many parts of western Romania, northeastern Yogoslavia and southern Hungary. Remarkable damage from a shallow, magnitude 5 Mb earthquake in a European area						
1991	14	Dec	50.652N	1.820E	1	3.6			NEAR BOULOGNE, FRANCE
1991	22	Dec	45.367N	151.009E	33		6.3	7.4	KURIL ISLANDS
			Felt in the Kuril Islands. This event follows strong earthquake swarm activity in the same general area which started with a magnitude 6.5 MS event on 13 December 1991						
1991	27	Dec	56.395S	25.629W	33			7.1	SOUTH SANDWICH ISLANDS

RECENT APPOINTMENTS

Dr Amr Elnashai has been appointed reader in Earthquake Engineering at Imperial College London. Amr is currently Vice-Chairman of the Society for Earthquake and Civil Engineering Dynamics, UK Technical Coordinator and National Technical Contact of the BSI Committee on European seismic design codes and UK delegate to the European Committees in seismic design of steel and reinforced concrete structures. He is also Visiting Professor at the University of Southern California, Los Angeles.



Dr David Key who is the Institution of Structural Engineers representative on the SECED committee and past chairman, has been appointed Visiting Industrial Professor to the Department of Civil Engineering at Bristol University. He is a partner in CEP Research, consulting engineers, and has been associated with the Earthquake Engineering Research Centre at Bristol since 1986.

9TH JAPAN PRIZE

The Science and Technology Foundation of Japan announce that one of the two categories for the ninth Japan Prize is to be awarded in the field of "Safety Engineering and Disaster Mitigation." The prize will be awarded for outstanding achievements relating to safety promotion and disaster mitigation in such research fields as : risk assessment in technical systems, engineering research on accidents and hazards, technical contributions to mitigate natural disasters, engineering developments to reduce the effects of disasters on cities and civil structures, scientific research on the planning of evacuation methods and disaster mitigation and further comprhensive and international research activities on the implementation in actual projects of the results of basic research.

Contact ICE for further information.

BOOKS

VIBRATION PROBLEMS IN STRUCTURES - PRACTICAL GUIDELINES

Published by 'CEB, EPF Lausanne, Case Postale 88, CH 1015 Lausanne, Switzerland', August 1991.

A review by Brian Ellis.

Recently I received a copy of the above document which I think is both interesting and useful. As it is likely to be of interest to some of the readers of this newsletter I 'volunteered' to write a few comments.

The first question that will probably arise is what is CEB? The straight forward answer is that CEB stands for Comité Euro-International du Béton and the organisation is based in Lausanne, Switzerland. The organisation has been in existence for a number of decades and attracts groups of voluntary technical people to produce state-of-the-art reports. The organisation appears to have grown from an initial French group dealing primarily with concrete into an international organisation concerned with all aspects of civil engineering. Although I think that CEB has no official status, the work of the organisation appears to be highly regarded and a draft CEB document was used by the European Community as an example Eurocode. CEB members also produced the first international code for the design of concrete structures.

Unlike most texts on structural dynamics, the document does not start off with single degree-of-freedom system, (although basic vibration theory is covered in an appendix), instead it concentrates on the main problem areas. It contains four chapters which deal with vibration produced by people, machines, wind and ground-borne vibration. Each chapter is split into sub- chapters to describe a specific topic (eg floors for sport or dance activities), and each sub-chapter has a similar format describing the problem, the loads produced, how to calculate the structural response and/or provide remedial measures. This layout makes the document easy to use, and judging by the sections which deal with topics with which I am familiar, it is both comprehensive and up to date. The introduction states that the document is aimed at engineers who are not specialists in dynamics and the appendices cover the fundamentals of vibration theory, but the document provides a comprehensive guide equally useful to the specialist. The first four chapters take up 151 A4 pages and the 10 appendices a further 97 pages, so it can not be termed a lightweight document in any sense, however the document does fill a niche not covered by other books, hence is likely to prove a useful addition to anyones reference collection.

I would also recommend CEB Report 187, 'Concrete Structures under Impact and Impulsive Loading.'

COURSES

The Disaster Management Centre of Oxford Polytechnic has devised a new twelve week study programme in Disaster Management for 1992, which will occur in two parts. Part 1 will involve a seven week programme of directed individual study. For Part 2, participants will join the Disaster Management Workshop, which is an intensive five week training programme. The purpose of the individual study programme is to enable participants to work specifically on those issues of disaster planning and management that are closely related to their work and needs. While the workshop can be taken by itself, the individual study programme can only be taken together with the workshop.

All those wishing to apply for the full twelve week Disaster Management Study Programme should write to the following address, giving details of special interests in the field of disaster management:

The Secretary
Disaster Management Centre
Oxford Polytechnic, Headington,
Oxford OX3 0PB, United Kingdom

WHAT'S ON
January - March 1992

15th January 1992
SECED Meeting
UK Work Related to Eurocode 8
Chairman: Dr. B. Skipp
Institution of Civil Engineers
5.00 p.m. for 5.30 p.m.

22nd January 1992
Hazards Forum Seminar
Earthquakes, Hurricanes and Floods
Institution of Civil Engineers
9.30 a.m. - 5.00 p.m.

27th January 1992
Joint SECED/British Dam Society Meeting
Seismicity: UK & Overseas Dams
Institution of Civil Engineers
2.00 p.m. - 5.00 p.m.

26th February 1992
SECED Meeting
Blast Vibration Criteria - How safe should they be?
T.J. Wilton
University of Nottingham
5.00 p.m. for 5.30 p.m.

11th March 1992
Hazards Forum Meeting
Piper Alpha: the Disaster, the Inquiry, and the Lessons
Professor Frank Lees
Institution of Civil Engineers
5.30 p.m. - 7.30 p.m.

25th March 1992
Joint SECED/EEFIT/EFTU Meeting
Reports from the Field of Recent Earthquakes
Institution of Civil Engineers
also EEFIT AGM
5.00 p.m. for 5.30 p.m.

31st March - 2nd April 1992
National Engineering Laboratory
Conference on Structural Integrity Assessment
University of Manchester

FORTHCOMING EVENTS

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

6th-10th April 1992
Third International Conference on Computational Plasticity, Fundamentals and Applications
Barcelona, Spain.

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

18th-21st May 1992
CENAPRED - Mexico, Japan International Co-operation Agency, Centre for Regional Development of the United Nations
International Symposium on Earthquake Disaster Prevention
Mexico City

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

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

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

8th - 10th September 1992
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
21st Short Course in Noise and Vibration
ISVR, Southampton

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

RECENT PUBLICATIONS

"The SECED Directory - A Directory of Practitioners in Earthquake Engineering and Civil Engineering Dynamics", Issue No. 3, September 1991.

"Engineering Aspects of the Manjil (Iran) Earthquake of 20 June 1990", A Field Report by EEFIT.

"Engineering Aspects of the Newcastle, Australia Earthquake of 28 December 1989", A Field Report by EEFIT.

"The Luzon, Philippines Earthquake of 1990", A Field Report by EEFIT.

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 associated 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 EFFIT, 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 information about 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).

Production by Allott & Lomax, Manchester.

SECED NEWSLETTER

THE SOCIETY FOR
EARTHQUAKE AND
CIVIL ENGINEERING
DYNAMICS

January 1992, Vol. 6, No.1

EDUCATION SUB-COMMITTEE SUPPLEMENT

THE TEACHING OF STRUCTURAL DYNAMICS IN UNIVERSITY DEGREE COURSES

The Structural and Building Board of the ICE proposes to recommend the teaching of structural dynamics in graduate courses. Professor H. Buchholdt has prepared a draft syllabus for the Board and has asked for SECED's views on it. The Research and Education Sub-committee has examined the proposed syllabus and prepared its comments, and these have been accepted by the SECED committee. However it was felt that the opportunity should be given to members to express their views by publishing both the draft syllabus and comments in the Newsletter. Member's comments should be submitted in writing to the Secretary by 31st March 1992 and these will be taken into account in submitting a final report to the Structural and Building Board.

The proposed syllabus is as follows:

INTRODUCTION

1. Structural Vibration - Causes and Effects

1.1 Dynamically sensitive structures and structures for which dynamic behaviour and exposure to vibration need to be considered: tall buildings and floors, bridges, masts and towers, cable and cable-stayed roofs, membrane and pneumatic structures, off-shore structures, transmission lines, structures under erection and structures and structural elements subjected to man made induced vibration.

1.2 The concepts of natural frequencies, resonance and damping.

1.3 The basic characteristics and effects of: wind, earthquakes, waves, explosions, traffic, currents, machines and cable ruptures. Examples of failures due to the aforementioned forms of excitation.

1.4 Fatigue: examples of partial and total failures.

1.5 Review of relevant guides and codes of practice.

THEORY

2. Linear One Degree of Freedom Systems - ODOFS

2.1 Equivalent ODOFS: numerical modelling of structures as one degree of freedom mass-spring systems; methods for determining the equivalent mass, spring stiffness and viscous damper - shape functions.

2.2 The equation of motion for undamped ODOFS. Determination of the natural frequency and response to harmonic and impulse loading. Condition for resonance.

2.3 The equation of motion for damped ODOFS. Response to harmonic excitation. Damping and critical damping. Determination of the logarithmic decrement of damping from decay functions, and determination of damping ratios from response functions and ratios of static and dynamic response at resonance. The relationships between the logarithmic decrement of damping, damping ratio, damping coefficient and critical damping coefficient. The relationship between damped and undamped natural frequency. Examples of damping levels in different types of structures.

2.4 Response to vibrating machines and ground motion - transmissibility. Response analysis using wind and earthquake spectra.

2.5 Response to random excitation - fundamentals of time domain analysis. Formulation of the incremental equation of motion in terms of: (a) the linear acceleration equations, (b) the Newmark-Beta equations and (c) the Wilson Theta equations

3. Soil-structure Interaction

3.1 The stiffness and damping characteristics of different types of soil. Simple modelling of soil stiffness and damping.

4. Linear Multi-Degree of Freedom Systems - MDOFS

4.1 Matrix formulation of the equations of motion for damped and undamped systems. Numerical modelling by: lumped and consistent mass matrices, stiffness and damping matrices. Determination of natural frequencies and mode shapes by solution of the eigenvalue equation. Use of the Raleigh Quotient and matrix iteration schemes for determination of the lowest natural frequency. Determination of instability through eigenvalue analysis. Methods and effect of matrix condensation.

4.2 Solution of the equations of motion by mode superposition. Conditions for the uncoupling of the damping matrix. Response to harmonic and impulse loads, and response analysis using wind and earthquake spectra.

4.3 Response to random excitation: formulation of the incremental equations of motion in terms of (a) the linear acceleration equations, (b) the Newmark-Beta equations and the Wilson-Theta equations. Size of time step: accuracy and numerical stability.

DYNAMIC TESTING

5. Equipment

Use of accelerometers, displacement transducers, penrecorders, stroboscopes, variable speed electric motors with eccentric masses and shakers.

6. Structures

Dynamic testing of such structures and structural elements as single and multi-span beams and plates, columns, portal frames and structural models.

7. **Measurements**

Determination of natural frequencies and amplitudes of response. Measurements of logarithmic decrements of damping and damping ratios from decay and response functions, and from static and dynamic amplitude ratios. Causes and effects of beating.

Comments

Experience has shown that the greatest difficulty in teaching dynamics to civil engineers in both undergraduate and postgraduate courses is caused by lack in mathematical skills, and that correlation in teaching the relevant topics in mathematics, theory of structures, structural dynamics and computation is of the greatest importance. Experience has also shown that to obtain a feeling for the subject students need to undertake suitable tests, in which response and damping can be measured in a number of modes.

Time Required

Lectures, laboratory work and a limited amount of tutorials: approximately 60 hrs.

The comments agreed by the committee are:

1. Professor Buchholdt proposes a 60 hour optional module for dynamics teaching. The subcommittee felt that Sections 1 and 2 should be part of the core syllabus and the remainder should be a 60 hour module.
2. Section 1 should not comprise more than 2 lectures.
3. Sections 2 and 4 should incorporate linear and non-linear response spectrum methods of analysis.
4. Sections 2 and 4 should also include random vibration analytical methods with particular application to dealing with wind forces.
5. Section 3 should be omitted but the subject should be introduced in Section 1.
6. Sections 5, 6 and 7 should be omitted and replaced with project work and design examples, including some computing.
7. It was felt very strongly that there was a need for the teaching of dynamics in civil/structural engineering graduate courses.

The preceding comments derive primarily from the perceived needs of industry but also take into account experience with the teaching of dynamics at Imperial College.

Members comments should be sent to,

The Secretary
SECED
The Institution of Civil Engineers
Great George Street
Westminster
London
SW1P 3AA

APPLICATION FOR MEMBERSHIP
OF
THE SOCIETY FOR EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS

INDIVIDUAL MEMBERSHIP

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Membership of Professional Bodies: ______________________________

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3. Name: ______________________________
Home Address: ______________________________
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Telephone: ______________

STUDENT MEMBER

Name: ______________________________
Address: ______________________________
____
Telephone: ______________

Confirmation of student status: (To be signed by tutor or supervisor)

I confirm that this applicant is currently a full-time student
Date: ______________ Signature: ______________
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Annual Subscription :	Individual:	£15
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Please return to : The Secretary, SECED,
Institution of Civil Engineers,
1-7 Great George Street, London, SW1P 3AA