SECED

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THE SOCIETY FOR EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS

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TK HSIEH AWARD

The TK Hsieh award is made annually by the Institution of Civil Engineers, acting on the recommendation of SECED, for the best paper on civil engineering dynamics published in the ICE Proceedings, Geotechnique or proceedings of ICE conferences.

The SECED panel (Drs Skipp & Papastamatiou and Mr Booth) this year were impressed by the number and quality of the eligible papers, and any of the three shortlisted would have been very worthy winners. In the event, the 1988 award (for papers published in 1987) was given to:-

> Ambient vibration measurements of the Humber Suspension Bridge and comparison with calculated characteristics. J.M.W. BROWNJOHN, A.A. DUMANOGLU, R.T. SEVERN & C.A. TAYLOR. Proc ICE Part 2 1987, Vol 83 Sept pp561-600. Structural Engineering Group Paper 9173.

Congratulations to the authors, all of whom are SECED Members, who share a prize of £50.

VIBRATION OF FLOORS

A subject which is of increasing interest to structural engineers is that of floor vibrations. A recent conference in Canada on Serviceability of Structures attracted several papers on floor vibrations and resulted in the organising body (CIB W85 - working group on Structural serviceability) proposing the formation of a CIB ad hoc group to provide basic design criteria for floor vibrations. An ISO working group (TC98) is also preparing a standard "Vibration criteria for Serviceability of Buildings" which includes information on floor vibrations.

In Britain the question of floor vibrations is often raised in connection with long-span lightweight floors. The interest has arisen primarily because it is anticipated that problems may arise with increasing span lengths, rather than because of problems with existing floors. In this particular case, the source of excitation is normally people walking on the floor and the limiting criteria is usually one of human perception or tolerance. The difficulty which faces the engineer is to provide an accurate estimate of the fundamental frequency (which is not a simple task) and if necessary, to change the design to avoid significant human

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excitation (often taken as < 5 Hz). Alternatively he can evaluate the response of the floor to the expected loading conditions, and this will require calculations of frequency, stiffness and mode shape as well as estimation of damping for the fundamental mode.

One group which has been interested in the behaviour of composite floors is the Steel Construction Institute who have just published a design guide in association with CIRIA. The publication is entitled "Design guide on the Vibration of Floors." However, it is recognised that feedback from vibration tests is still required in order to calibrate design rules and provide a database of measurements of damping. If any reader has measured data which he would like to be used for the calibration of the various codes, the author would be pleased to relay the information to the appropriate group.

Brian Ellis
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SURVEY OF NEEDS FOR MID CAREER PROFESSIONAL TRAINING IN EARTHQUAKE ENGINEERING AND DYNAMICS

Forms for this survey were sent to all SECED members in mid 1988 by the Research and Education sub-committee. There has been a disappointing response so far, only ten replies which is not enough to draw realistic conclusions from. To those of you who have not yet responded please do make an effort to reply. We think that mid career education is greatly neglected in this field but it is extremely difficult to target new courses without some feedback from consultants, educational institutions and contractors.

Subjects identified by more than 50% of respondents so far are Earthquake Design for the Nuclear Industry, Seismic Secondary Structure Analysis and Design, and Dynamic Soil-Structure Interaction. There is interest in a ten week course with an emphasis on Structural Dynamics and Advanced Numerical Methods.

Some of the additional subjects not included in the survey which have been identified are Quality Assurance, Missile Penetration, Centrifuge Modelling, Structural Impact and Crashworthiness.

PLEASE let us have your survey forms. Additional copies will be available at SECED meetings or can be obtained from the Secretary.

Dr. David Key, University of Bristol.

THE ISOLATION OF BUILDINGS AND HEAVY STRUCTURES FROM VIBRATION, SECED Meeting, 26th October 1988

Report by Dr. David Key, University of Bristol.

This meeting was held at the Department of Civil Engineering, Bristol University. There were some organisation problems due to the postal strike, and British Rail unfortunately failed on the day to deliver Graham Roberts of W.S. Atkins who was to present "An isolation system for large pulverising mills." However the meeting was well attended and produced worthwhile discussion.

Dr. Browitt, the Chairman, introduced the subject and welcomed those present. Dr. Key CEP Research, described current practice and research in relation to earthquake resistant buildings and demonstrated that base isolation was just beginning to be accepted as a practicable technology, principally in Japan. Dr. Blakeborough, Bristol University, then presented work in progress at the University Earthquake Engineering Research Centre on discrete brass dampers, including analytical work and model testing on the earthquake simulator (which was demonstrated during the tea break).

C.J. Derham, Materials Engineering Research Laboratory described the latest work on high damping, non-linear, laminated rubber bearings, followed by Keith Green from TICO Ltd who described a number of isolation projects using fabric reinforced rubber bearings used to minimise the transmission of man-made vibrations. Vince Coveney of the Malaysian Rubber Producers Research Association also described new work on laminated rubber bearings and showed a number of examples of projects.

In discussion it was pointed out that for earthquake isolation it was primarily horizontal transmission of ground movement that was of concern whilst for machine isolation it was usually vertical transmission that caused concern.

The meeting format, running from 1400 to 1800 with a tea break in the middle, seemed to be quite successful. Some samples of reinforced bearings were put on display by TICO Ltd.

THE DAMPING CAPACITY OF BRIDGES, SECED Meeting, 23rd November 1988 by Dr. G.P. Tilly (TRRL)

Report by E. Booth (Ove Arup and Partners)

Dr. Tilly, head of the structures group of the Transport and Road Research Laboratory, based his talk on work carried out by the TRRL into the dynamic characteristics of bridges. Starting in the early 1970's the work arose out of a concern that modern bridge construction, being lighter and more slender, was leading to a tendency for bridges to be more lively, with the attendant risk of discomfort to pedestrians on footbridges, and of fatigue damage in vehicular bridges caused by traffic vibration. Checks on wind response of box girder bridges under the Merrison rules also required a knowledge of inherent damping, which, at that time, was not well documented.

Dr Tilly described the various methods that TRRL had considered for testing bridges dynamically. Footbridges in the 40m to 60m span range were most at risk from pedestrian excitation, and Dr Tilly showed a film of the alarming response of a footbridge resulting from loyal members of TRRL doing a synchronised walk and then run in time with the bridge's natural period. Other methods of excitation investigated for large bridges included sudden release of a 30T weight suspended from midspan (tried, and it worked well) dropping of weights onto a bridge (used by the French) rockets (too expensive) and a curious and unreliable Hungarian device nicknamed the jumping flea. In the end, TRRL chose as its main excitation method a large mass, placed at midspan and moved up and down at a chosen frequency by hydraulic rams. Damping was measured from the logarithmic decrement of decay of the recorded accelerations, after sudden cut off of motion of the reciprocating mass.

Damping values measured from the TRRL tests and from literature surveys revealed damping ranges in steel elements and beams of δ = 0.002 to 0.005 log dec (ξ = .03% to 0.1% critical), with values for concrete elements and beams almost an order of magnitude greater. However, the difference in overall damping between concrete and steel bridges was very much less; Dr Tilly attributed this to the importance of connection and junctions in energy dissipation. The recommended values for bridge design in BS 5400, based on the TRRL work, are δ = 0.03 steel (ξ = 0.5%), 0.04 composite (0.65%) 0.05 concrete (0.8%).

Another pattern to emerge from the measurements was a sigmoidal variation of damping with amplitude, resulting in a lower plateau of damping at small excitation followed by a steeply rising portion and an upper plateau at large excitation. The BS 5400 values given above are based on the upper plateau.

Finally, Dr Tilly gave an account of the devices developed by TRRL to reduce dynamic response by increasing damping. Friction dampers on movement joints in handrails and at abutments on a 40m span footbridge had increased damping from δ = 0.003 to 0.6 (ξ = 0.05% to 1%) and had been very effective in reducing response. Of more general application are the tuned mass dampers that TRRL have developed. These comprise a simple spring/mass/oil dashpot assembly which are tuned to the first vertical bending mode of the bridge. They have been used effectively on a range of bridges from footbridges to major river and estuarial crossings. The mass in the tuned damper has to be at least 2% of the generalised mass, or ½% of the total mass of the deck, which results in feasible designs. After a few early teething problems, the TRRL dampers have proved very reliable in operation. The attraction is that they can easily be retrofitted if dynamic problems occur, though Dr Tilly stressed that they should never be relied on for preventing major wind instability problems. Dampers are also useful in preventing minor wind induced oscillations in the cables of cable stayed bridges; such oscillations, if not prevented, can lead to corrosion/ fatigue problems.

In conclusion, Dr Tilly said that, in practice, dynamic amplification of traffic vibrations was a rare problem in bridges. Of much more concern were wind induced oscillations in major bridges and pedestrian excitation of long span footbridges. The latter not only caused discomfort and dismay but made the bridges vulnerable to vandals determined to bounce the decks off their bearings - a real possibility given the very low damping levels which can easily apply.

Bibliography

Proceedings of symposium on dynamic behaviour of bridges. TRRL Supplementary Report SR 275, Department of Transport, Crowthorne 1977.

G.P. Tilly, D.W. Cullington and R. Eyre. Dynamic behaviour of footbridges, IABSE Survey, 1984.

Dynamic behaviour of concrete structures. Report of RILEM 65 MDB Committee, Ed G.P. Tilly, Elsevier 1987.

BOOKS

SIZEWELL B An Anatomy of the Inquiry by Timothy O'Riordan, Ray Kemp and Michael Purdue, Macmillan Press Ltd, London, 1988. £45.00.

Reviewed by Gordon Woo

The remote venue was the concert hall at the Snape Maltings. During the Aldeburgh Festival, the inquest into the death of Peter Grimes' apprentice might have been enacted. Instead, an Inquiry was staged into the birth of a nuclear power station: Sizewell B. In listing 'the main dramatis personae' at the opening of their anatomy of the Inquiry, the authors from the University of East Anglia introduce a Thespian motif that threads throughout the book. The principal players are the silks: Sir Frank Layfield as the Inspector, Henry Brooke as the Counsel to the Inquiry, and the fastidious Lord Silsoe as Counsel to the CEGB. With such legal stars, the Inquiry 'broke all the superlatives for this class of public examination.' No wonder the show enjoyed such a long run.

Any engineer or scientist submitting evidence for a Public Inquiry would do well to read this book. Any technical witness expecting to be cross-examined would gain from the humbling experience of a presumed expert on crack propagation who was forced to admit 'Well, I work alone in an attic in Warrington and I do the best I can.' Henry Brooke QC admitted to not being an engineer, scientist or statistician, yet he was capable often of summing up technical evidence better than the experts themselves. Technical jargon is no barrier to sharpness of intellect and quickness of mind.

Earthquake engineers may be disappointed to find little mention in this book of seismic issues, but will be keen to read the chapter on Safety and Public Trust. The discussion of probabilistic risk analysis is particularly interesting as a lively contribution to the ongoing debate. For the Inquiry to be full, fair and thorough, as the Secretary of State for Energy had mandated, an adversarial approach was adopted to maintain impartiality. Engineers may question whether this is indeed a better way for safety matters to be disputed than an inquisitorial style of procedure. So much seems to depend on the match of legal representation.

In covering the legal niceties so clearly and thoroughly, the authors, (one of whom is a lecturer in law), explain for beginners the basic mechanics of Inquiries. Advanced students can move on to the section on the tactics of the Sizewell B Inquiry. The authors are to be commended for writing a definitive book on an extraordinary event in British planning history that extended two and a quarter years from January 1983. On the last day of the Snape Maltings hearings, Sir Walter Marshall reminded a press conference that, in 1956, the Inquiry into the building of a nuclear power station at Bradwell, 70 kms from Sizewell, took just two and a half hours. Those were the days when concert halls were used for concerts.

EARTHQUAKE RESISTANT DESIGN FOR ENGINEERS AND ARCHITECTS by David Dowrick, 2nd ed., John Wiley & Sons, 1987, Chichester, 519pp, £28.50 ISBN 0 471 91503 3.

This second edition of a book which has proved useful to large numbers of engineers and architects since it was first published in 1977 has been substantially revised and enlarged, particularly in the treatment of

seismotechnics, hazard analysis, design earthquakes, design philosophy, base isolation and geotechnical engineering. The book is international in outlook, with examples taken throughout the world and notable for the unified approach the author has brought to a large and often disparate field.

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SECED CONFERENCE CALENDAR

TITLE	DATE	FURTHER DETAILS FROM
Dynamics of Civil Structures 1989	Date unknown as yet	Stavebni ustav CVUT, Solinova 7, 166 08 Praha 6 Czechoslovakia.
Symposium on the Seismicity, Seismotectonic and Seismic Risk of the Ibero-Maghrebian Region	April 13-14 1989 Madrid	Prof. A. Udlas, Catedra de Geofisica, Ciudad Universitaria, 28040 Madrid, Spain
Engineering Seismology	16th May 1989	D.M. McCann, Regional Geophysical Research Group, British Geological Survey, Keyworth, Nottingham, NG12 5GG (Tel: 06077 - 6111 ext. 3356)
10th International conference on structural mechanics in reactor technology	14-18 August 1989 Anaheim, CA, USA	Asadour H. Hadjian, General Chairman, SMIRT 10, Bechtel Western Power Company, PO Box 60860 - Terminal Annex, Los Angeles, California 90060, USA
International Conference on Reinforced and Prestressed Prefabricated Concrete Structures in Seismic Areas	September 1989 Romania	Prof. A. Negoita, Polytechnical Institute, Bd. Karl Marx 38, 6600 Lasi, Romania
IUTAM Symposium on Nonlinear Dynamics in Engineering Systems	1989	University of Stuttgart, Pfaffenwaldring 9, D-7000 Stuttgart 80, Germany FR
Ninth European Conference on Earthquake Engineering	September 1990 Moscow	Dr. B.E. Denisov, Secretary-General Organising Committee of the 9th ECEE, USSR Societ Committee on Earthquake Engineering, Gosstroy of the USSR 26, Pushkinskaya St., 103828 Moscow, USSR

Earthquake Eng. & Struct Dynamics Publication List (* = SECED and related)

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

Price : £15.00 (Summer 1988)
Order from : Chris Sharman, Allott & Lomax Tel: 061-962-1214

* 2. "Earthquakes & Earthquake Engineering in Britain"
(1st SECED Conference, 18-19 April 1985, University of East Anglia)

Price : £30.00 (Spring 1988)
Order from : Thomas Telford Limited

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

Price : £30.00 - publication due Autumn 1988
Order from : Thomas Telford Limited

* 4. "The Mexican Earthquake of 19 September 1985"
(A field report by EEFIT)

Price : £25.00 (Spring 1988)
Order from : Thomas Telford Limited

* 5. "The San Salvador Earthquake of 10th October 1986
(A field report by EEFIT)

Price : £10.00 (1987)
Order from : RPT or Julian Bommer, Imperial College

* 6. "The Chilean Earthquake of 3rd March 1985"
(A field report by EEFIT)

Price : £25.00
Order from : Thomas Telford

* 7. "EEFIT Constitution and Aims and Methods" booklet

Price : Free
Order from : Secretary, SECED