



SECED NEWSLETTER

THE SOCIETY FOR
EARTHQUAKE AND
CIVIL ENGINEERING
DYNAMICS

October 1988 Vol.2 No.4

MALLET - MILNE LECTURE 1987

The text of the first Mallet - Milne Lecture, "Engineering Seismology", by Professor N.N. Ambraseys, has appeared in a special issue of Earthquake Engineering and Structural Dynamics, Volume 17, 1988. Also in that issue is a paper, "Robert Mallet and John Milne - Earthquakes Incorporated in Victorian Britain," by R. Muir Wood.

HERALDING THE INTERNATIONAL DISASTER DECADE

The second Mallet - Milne Lecture will be given by the distinguished engineer Dr George Housner at the Royal Institution on May 24 1989. The lecture which honours the memories of the great Irish engineer Sir Robert Mallet and the pioneer seismologist Professor David Milne will be given, appropriately, by the man largely responsible for enabling engineers to design structures rationally when shaken by chaotic strong earthquakes.

George Housner, Emeritus Professor of Engineering at the California Institute of Technology has had a distinguished career in academe and industry. Born in Michigan 78 years ago he alternated between consulting practice and university until, with his PhD secured, he joined the US Army Corps of Engineers and by 1944 he was Chief of Operational Analysis for the US 15th Air Force in Italy.

From Cal. Tech. he went on to reach the heights of his profession, President of the International Association of Earthquake Engineering 1969-1973, of the Earthquake Engineering Institute in 1977, and of the Seismological Society of America in 1978. His worth has been recognised in the wider engineering context and he became a member of the US National Academy of Sciences in 1972.

The provisional title of his lecture will be 'The International Decade for the Mitigation of Natural Disaster' which begins in 1990. The suggestion for an international decade mobilising scientific, engineering and planning resources on a world wide front to cope with natural disasters was first suggested by Dr Frank Press, seismologist and one time scientific advisor to US President Carter, at the Eighth World Congress on Earthquake Engineering held in San Francisco in 1984. It has since been taken up by the US National Academy of Sciences, international scientific and engineering associations and the United Nations Organisation.

The SECED Newsletter is published four times a year by the SOCIETY FOR EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS and is available to all members of the society. Articles for inclusion should be sent to The Editor, SECED Newsletter, Mr. D.A. Howells at The Institution of Civil Engineers, Great George Street, London SW1P 3AA.

Although the responsible organising centre for the UK will be based on the Royal Society it is fitting that the first public exposition in the UK of the purpose and procedures of this international decade should be under the auspices of the Society for Earthquake and Civil Engineering Dynamics, a Society of the Institution of Civil Engineers.

NINETEENTH CENTURY EXPERIMENTS IN SEISMOLOGY

What follows is a serendipitous additional outcome of an extensive search for archival material relating to earthquakes in Wales. The research is being carried out on behalf of the Central Electricity Generating Board's Seismic Hazard Working Party.

The letter is apparently in the hand of J Milne and was addressed to a Professor Ramsay who may have been with the Ordnance Survey at Marshfield near Bath at the time. Unfortunately the letter is incomplete and so we have no indication of how certain matters were concluded.

If any reader of the SECED newsletter has some knowledge of the name mentioned or not mentioned in the letter (eg of a geologist with a bullet wound in one arm?), or details of the diagrams mentioned in the letter then these would be most gratefully received by:

Alun Price Jones
Soil Mechanics Associates
Eastern Road
Bracknell
Berkshire
England RG12 2UZ

From J. Milne, Tokio. Japan

Jan 9th 1882

My dear Prof. Ramsay

Since last I wrote to you I have had a good months work at artificial earthquakes produced by exploding charges of Dynamite in deep boreholes - My first experiments, owing to at least one foot of snow, hundreds of curious visitors who continually got their legs tangled in my telegraph wires, general hurry, want of experience, and a fearful headache - instead of developing valuable scientific facts, developed wicked expressions.

The second lot of experiments were however in my own mind the best thing which has yet been done in this line. One thing I find is that the shock does not directly radiate out in circles from the center like the pictures in the Geology book, but it comes up to the surface and then turns out and radiates. If from a measured vertical and horizontal motion on the surface I calculate the depth from which the shock came (using so called angles of emergence which the text books tell us about) I get for a charge which I know exploded only 10 feet down, a depth of say 500 feet.

Of course I don't want to argue that their (sic) is no true vertical component due to a motion direct from the origin, for if my machine had been over the top of one of my boreholes I expect it and its owner would have found that they had acquired an angle of emergence of 90°. Humbolt Riobamba earthquake would have been nothing to it. However this is only one point out of a whole legion of points which the experiments have brought out. Unfortunately they have ended like nearly all experiments

end, by showing new lines for investigation. If it were only a matter of dropping an iron ball to get an earthquake I should not hesitate to continue, but to peril my existence with Rhum Korff coils (which alone if I may judge by the shock I got whilst fumbling about the fixings of one of these things during my experiments) are enough to knock you down, and above all with Dynamite which according to books and the labels in the cases, can't even be spoken to when it is frozen, like mine was, without exploding - I am not anxious about the undertaking.

For a week before my experiments when I brought my Dynamite home wrapped up like boots or gloves so that fellow passengers should not be alarmed, until the last explosion took place I suffered from a serious depression of spirits and felt melancholy. Everyone I shook hands with, I thought I should never see again and it was not until I had destroyed every scrap of paper in which the stuff had been wrapped that I felt happy.

I enclose you 3 diagrams of an explosion, taken at distances of about 100 ft, 300 ft, and 400 ft. The time marks on each are exactly similar being given electrically to each station by one pendulum swing through mercury.

I am sure if you had seen the wires, the batteries, the magnets the machines and the surrounding muck, you would have ordered me to Hanwell. But it all went well and every electric key caused an operation to take place at its proper time. Not a single explosion missed, and the fossils they turned up were wonderful. 3lbs of Dynamite in a 10 ft borehole, after an explosion makes a respectable well. These are my experiences in science. I will now tell you my experiences in my social relations which have also not been altogether free from explosions.

My neighbours are the geological survey people. Sometime ago the topographer made love to the geologist's wife, who in consequence dismissed her per french mail to Europe. As the Geologist had already had one duel in Tokio (when he got shot through the arm) he did not shirk seeking for a second. As I was his friend, he came to me and borrowed the old pendulums of my seismographs which he melted into bullets and practiced a little boards about the size of a man's face. When he could put about 60 out of 100, at 20 paces in quick succession into the board, he bought a horse whip. About 3 days after this he met the topographer coming from his office and after a baptism of unparliamentary German, commenced to beat him with the whip. The topographer however unexpectedly produced a revolver and shot goodness only knows how often at the geologist. However he didn't hit him. All this was outside my garden gate, and in one way the result of seismograph pendulums I am sorry to say.

Since then, the geologist has sat at home for 72 hours waiting for the challenge but the challenge has not come. What will happen...

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NEWS FROM THE EARTHQUAKE RESEARCH CENTRE AT BRISTOL UNIVERSITY

Contributed by Dr David Key

Concurrently with the SERC earthquake simulator going through its final acceptance tests a University owned company, Bristol Earthquake & Engineering Laboratory, BEELAB, has been formed to handle its commercial use for testing, as well as consultancy and other testing projects. The company expects to be in a position to undertake earthquake simulator testing by the end of 1988.

SECED members represented on the board are Professor Roy Severn, Chairman, Dr Colin Taylor, Technical Director, Dr David Key, Managing Director and Dr Tony Blakeborough. A quality Assurance system is being set up under the direction of Dr James Brownjohn which will be applied to the operations of BEELAB and the EERC.

Research work in progress includes work on the use of knee brace dampers, discrete dampers and base isolation in earthquake resistant structures. The effect of earthquakes on reservoir intake and drawdown towers is also being studied, and an earthquake simulator study of the response of suspension and cable stayed bridges has recently commenced.

Field testing work continues on dams and bridges. Studies include analytical work as well as field measurements. A team is expected to go to Turkey towards the end of the year to undertake field measurements of the dynamic response of the second Bosphorus bridge.

The chief non Bristol customer for the SERC earthquake simulator has been Kings College, London, studying the effects of torsion on building structures.

Another recent addition to the work of the EERC at Bristol is a "Teaching Company Programme" with Ove Arup and Partners. This is a joint OAP/EERC project, with staff drawn from both participants, to validate seismic response predictions by comparing computer analysis with earthquake simulator tests. As the first of its kind undertaken by the EERC it will be watched with great interest to see whether the expected benefits of collaboration between industry and the university are realised.

PROGRESS ON EC8 - SEPTEMBER 1988

1.0 The working group of the ICE on EC8 met on November 16 1987, January 29 1988 and May 3 1988. A brief report on the first two of these meetings we made to the Ground Engineering Board in February 1988.

2.0 During 1987 E. Booth formally joined the Study Group (2nd Phase) convened by Professor Sedlacek (RWTH Aachen). He submitted a working paper 'Notes for a methodology for selecting seismic input data' drawn up in consultation with Professor N.N. Ambraseys and Dr B.O. Skipp following a meeting of the Study Group in Rome 2/3 October 1987. In March 1988 a set of substantial documents describing a variety of methodologies drawn up by experts from Germany, Greece, Italy and Portugal were received and are being reviewed by Messrs Ambraseys, Booth and Skipp.

A near final draft of Parts 1 and 2.1 was made available late in December 1987. It leaves the definition and delineation of seismic zones to each

competent national authority without as yet advising on procedures. A complete near final draft was produced in June 1988.

3.0 In the later part of 1987 three DOE sponsored study contracts, managed by the Institution were placed.

Seismic vulnerability (E. Booth)
Seismic design practice (B.O. Skipp)
Impact of UK comments on EC8 draft (J. Mills)

4.0 A Seminar on EC8 held at the University of Bristol on March 23 1988 addressed by Messrs Bartle, Skipp, Sedlacek and Tassios. Thirty four persons attended and it was regarded as a success.

5.0 At the working group meeting on May 6 1988 interim progress reports on the studies were presented.

6.0 Progress on the drafting of EC8 is understood to be the programme outlined early in 1987. A very rough draft translation from the French of section 2.2 dealing with foundation materials was received in 1987 but will not be incorporated in the latest draft.

7.0 Following a letter from the BSI to the Institution in December 1987 asking for a report on the activities of the EC8 Dr Skipp has been in contact with Mr L.A. Smith of BSI on this matter and the future constitution of B150.

8.0 Having regard to the progress of the next draft of EC8, and that of EC7, Dr Skipp and Dr Simpson have met and discussed the recent situation.

9.0 The time is fast approaching when B150 will have to be formally reactivated. The work of the Institution's EC8 study group will have ensured, mainly due to the DOE sponsored studies that the ground is well prepared for informed and helpful reaction by the UK to the new draft.

NOTES ON THE THIRD INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN STRUCTURAL DYNAMICS HELD AT THE ISVR 18 - 22 JULY 1988

1. Number of papers published 91

2. Breakdown of papers

(i)	Analytical methods	9
(ii)	Finite element methods	6
(iii)	Composites	7
(iv)	Testing Techniques and Correlation	14
(v)	Vibration Control and Damping	9
(vi)	Shock	6
(vii)	Failure and Fatigue	6
(viii)	Nonlinear Techniques	5
(ix)	Random Vibration of nonlinear systems	6
(x)	Parametric Excitation	3
(xi)	Structure/Acoustic Interaction	4
(xii)	Large Space Structures	6
(xiii)	Civil Engineering	10

3. Number of delegates 136

4. Breakdown of delegates

(i)	Academics from UK	29)
(ii)	Academics from Europe	24) 95
(iii)	Academics from US/elsewhere	42)
(iv)	USAF/NASA	8
(v)	Consultants	7
(vi)	Clients	26

5. Comments:

- a. An interesting event, although the conference seemed to be largely academically biased. There were some papers that would be of immediate interest to consultants and clients.
- b. The large number of papers necessitated 2 parallel sessions on all 5 days - a trend towards multiple parallel sessions which seems to be becoming common at large international conferences.

J.R. Maguire
July 1988
JRM/pa/146

NATIONAL AGENCY FOR FINITE ELEMENT METHODS AND STANDARDS

Extracts from the Chairman's Report on 12 September 1988 to members at Brighton.

1988 A Year of Consolidation and Growth

At last year's AGM we looked forward to a new style of organisation and management of the agency but we could not possibly have foreseen those developments now in prospect. We have operated successfully with a full-time manager and independent chairman but this year, once again, we are faced with staff changes at the same time as the future of NEL, our parent body, is itself in the balance. This will inevitably lead to some change in the relationship between the Agency and NEL which will not be clarified until the privatisation discussions at DTI are concluded. The Steering Committee has anticipated these events, so that the business of the agency continues to proceed apace. We have added two new working groups during the year and reconstituted two more; another has expanded its role. We have responded to the repeated requests of members by introducing new forms of membership for those who either cannot or who do not wish to participate fully in all our activities. Perhaps most significantly in the long run has been the emergence of a clearer policy in relation to Europe, with our eyes firmly on 1992 and the expected tightening and unification of consumer protection legislation.

Implications of NEL Privatisation

Members will rightly wish to know where the agency stands in the light of the public announcements concerning the future of NEL. It is premature to make any definitive statement, as it is not yet certain what will be the outcome of current negotiations, despite the fact that DTI has declared its preference for the bid by YARD and NEL management. As soon as we knew for certain that privatisation bids were being sought, the Steering Committee asked for a meeting with the Chief Engineer and Scientist at DTI who is directly responsible for NEL and indirectly for NAFEMS (as one of its projects). A meeting was held in late July at which the Committee asked

for the special position of NAFEMS to be recognised and taken into account during subsequent discussions. Two main issues were addressed: the national status of NAFEMS and the future funding position. In the latter case, we were given the strongest indications possible in the circumstances of the strength of our position, as NAFEMS is seen as a model of the kind of operation which DTI wishes to support in the future. The former issue cannot yet be resolved but the Steering Committee made a strong case for DTI to retain management authority and has clearly identified the special position of NAFEMS in subsequent negotiations. Our current perception is that there will be no visible change in day-to-day operations in this financial year and that government support, via the new "NEL Ltd", will be contractually assured for a further 3 years. Our most immediate concern is that the staff, who provide such dedicated and indispensable support, should be given secure prospects for their future so that they can get on with the job which they want to do.

The Working Groups

The Dynamics Working Group has produced its free vibration benchmark tests, has placed a contract for forced vibration benchmarks and is turning attention to damping. Members' feedback is being sought in the most effective way possible, via a specialists' workshop at the conference.

NAFEMS and Europe

The Steering Committee has for some time been considering its proper role in relation to Europe. Since its original formation, many European companies have shown interest in various forms of participation and we have welcomed a significant number of European members from the outset. Several countries, notably Denmark and Holland, have been considering setting up bodies of their own with similar aims and have been seeking ways of linking these formally with NAFEMS. We have, for our own part, given serious consideration to broadening NAFEMS into a European agency as opposed to a UK national body, but for many practical reasons this course has been rejected. What we now propose is to adopt a federated approach wherein we encourage other countries to set up their own national bodies, offering the NAFEMS organisation as a role model and our standards documents as a starting point. We have previously adopted a policy of attending European conferences and seminars to promote NAFEMS as such. This year alone we were represented in the World Congress in Salzburg and at conferences in France, Holland and Denmark; in the coming year, we intend to step up our activities in this direction and make a determined effort to involve major countries like West Germany who have thus far kept their distance whilst supporting our general aims.

The major catalyst for this new approach is undoubtedly the unification of the European Market in 1992 with the attendant requirements for harmonisation of standards and consumer legislation. NAFEMS has already anticipated much of this type of legislation in the field of interest to us and is giving added emphasis to its role in setting realistic and responsible standards which will raise quality in the necessary areas without imposing undue constraints on our members. We shall if appropriate, seek EEC support for our initiatives and can look forward with confidence to a fruitful activity as European leaders in the field.

Our Future Prospects

NAFEMS has certainly established itself as a major national and international force in the field of Finite Element quality and Standards. This has been achieved, in part, by the dedicated work of the Steering Committee and Working Groups, whom I would like to thank for their invaluable

efforts, and also by the enthusiastic support of the members themselves. It is greatly encouraging to us to see the exceptionally large turnout each year for these AGM's and it is our firm intention to build on the good start made in the past five years and to develop this agency for the good of the industrial and consumer communities in the U.K. and Europe. Changes are certainly coming but we see every reason to look forward to a future in which we continue to receive government backing and to expand both the value and scope of our activities. Next year we shall hold our second International Conference which promises to be even bigger and better than the last. We welcome the prospect of greater Europeanisation in 1992 as this is already firmly established as an activity whose aims know no national boundaries; in our view, nothing but good can come from strengthening with colleagues on whom we already depend for technical support.

(Contact with NAFEMS may be made at National Engineering Laboratory, East Kilbride, Glasgow G75 0QU)

SECED CONFERENCE CALENDAR

<u>TITLE</u>	<u>DATE</u>	<u>FURTHER DETAILS FROM</u>
Fourth International Conference on Tall Buildings	April/May 1988: Hong Kong & Shanghai	Mr. P.K.K. Lee, Conference Secretary, Fourth International Conference on Tall Buildings, c/o Department of Civil and Structural Engineering, University of Hong Kong, Hong Kong
Third International Conference on Recent Advances in Structural Dynamics	18-22 July 1988: Southampton, UK	Dr. M. Petyt, ISVR, The University, Southampton SO9 5NH, UK, Tel. 0703-559122, ext. 2344/2310
9th World conference on earthquake engineering	2-9 August 1988 Tokyo-Kyoto, Japan	The Steering Committee, 9WCEE, c/o Japan Convention Services, Inc., Nippon Press Center Bldg., 2-1, 2-chome, Uchisaiwai-cho, Chiyoda-ku, Tokyo 100, Japan.
IUTAM 17th international congress of theoretical and applied mechanics	21-27 August 1988 Grenoble, France	Pr. D. Caillerie, Secretary ICTAM 1988, Institut de Mecanique de Grenoble, Domain Universitaire, B.P. 68, 38402 Saint-Marting-d' Heres Cedex, France
SOWAS '88: international symposium on modelling soil-water-structure interactions	29 August-2 Sept. 1988 Delft, The Netherlands	SOWAS '88 c/o Klvl, PO Box 30424, 2500 GK The Hague, The Netherlands
Ocean structural dynamics symposium '88	13-15 September 1988 Corvallis, Oregon, USA	Chairman, OSDS '88, Dept of Civil Engineering, Oregon State University, Corvallis, OR 97331-2302, USA
FEMCAD-88: Structural analysis, CAD/CAM and computer graphics	17-19 October 1988 Paris, France	Dr A. Niku-Lari, IITT-International, 40, Promenade Marx-Dormoy, F-93460 Gournay-sur-Marne, France
Seminar on the Prediction of Earthquakes	14-18 November 1988 Lisbon, Portugal	Executive Secretary, Economic Commission for Europe, Geneva, Switzerland

Dynamics of Civil Structures 1989	Date unknown as yet	Stavebni ustav CVUT, Solinova 7, 166 08 Praha 6 Czechoslovakia.
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

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EARTHQUAKE AND CIVIL ENGINEERING DYNAMICS

Publications 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. "Earthquake & 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 : £22.50 (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 : £22.50 (£16.50 to SECED members in UK)
Order from : Thomas Telford Limited
- * 7. "EEFIT Constitution and Aims and Methods" booklet
Price : Free
Order from : Secretary, SECED
- * 8. "Earthquake Design Practice for Buildings" (ICE Design Series - author David E Key)
Price : £35.00 (Spring 1988)
Order from : Thomas Telford Limited
- 9. "Dams and Earthquake" (A conference held at the ICE 1-2 October 1980)
Price : £35.00 (Spring 1988)
Order from : Thomas Telford Limited

10. "Earthquakes" (Bibliography 87/1)
(Books, pamphlets & serial publications of interest
to earthquake engineers)

Price : £8.00 (Spring 1988, to ICE members)
Order from : Thomas Telford Limited

11. Mallett-Milne lecture (1987) published in
Earthquake Engineering and Structural Dynamics Journal
(details to follow)

NOTE

It is planned to expand this list - contributions invited!

BOOKS (Publishers' Information)

Vibrations in Structures - induced by man and machines, by H. Bachmann and W. Ammann, International Association for Bridge and Structural Engineering, Zurich, 1988. Price 78 Swiss Francs.

Vibrations in Structures concentrates on vibrations in structures as excited by human motion or machine operation. *Man-induced* vibrations may arise from walking, running, skipping, dancing, etc. They occur mostly in pedestrian structures, office buildings, gymnasias and sports halls, dancing and concert halls, stadia, etc. Existing publications treat by and large some isolated aspects of the problem; the present one attempts, for the first time, a systematic survey of man-induced vibrations. *Machine-induced* vibrations occur during the operation of all sorts of machinery and tools with rotating, oscillating or thrusting parts. The study concentrates rather on small and medium size machinery placed on floors of industrial buildings and creating a potential source of undesirable vibrations. The associated questions have rarely been tackled to date; they entail problems similar to those of man-induced vibrations.

The book is consciously intended *to serve the practising structural engineer* and not primarily the dynamic specialist. It should be noted that its aim is not to provide directions on how to perform comprehensive dynamic computations. Instead, it attempts the following:

1. to show where dynamic problems could occur and where a word of caution is good advice;
2. to further the understanding of the phenomena encountered as well as of the underlying principles;
3. to impart the basic knowledge for assessing the dynamic behaviour of the structures or structural elements.
4. to describe suitable measures, both preventive to be applied in the design stage and remedial in the case of rehabilitation.

Soil-Structure-Interaction Analysis in Time Domain by John P. Wolf: Prentice-Hall, Englewood Cliffs, 1988.

This is the first comprehensive work on state-of-the-art methods for performing Soil-Structure-Interaction Analysis directly in the Time Domain.

A structure excited by dynamic loads such as seismic excitation, explosions and machine vibrations will interact with the surrounding soil, which modifies the response significantly.

Here is a unified approach for the dynamic analysis of soil-structure interaction which works in the time domain. It serves both as a tutorial and a state-of-the-art compilation of these time-domain procedures. Rigorous procedures based on the boundary-element method in the time domain and approximate models which still capture the essential features of the unbounded soil are discussed. The approximate models can be used in everyday analyses and in preliminary calculations for more complicated cases.

Soil-Structure-Interaction Analysis in Time Domain by John P. Wolf features, besides a discussion of the direct method, a detailed description

of methods using frequency-domain procedures for local nonlinearities; rigorous derivation of the substructure equation based on the boundary-element method working in the time domain; and approximate lumped-parameter models which capture the essential features of wave propagation in the unbounded soil.

All concepts are developed and illustrated using the same two simple one-dimensional examples, which readers can follow step by step. The examples are characteristic of the two limiting sites. Applications occurring in practice (e.g., the partial uplift of the basemat) are solved for different levels of sophistication by applying the various methods. The book includes examples from actual practice, chapter summaries, problems with detailed solutions, and references. An abundance of clearly described algorithms enables readers to write their own computer code for special-purpose applications.

This book can be regarded as Volume 2 of "Dynamic Soil-Structure Interaction" with only a minimal overlap or as an independent stand-alone text describing the time-domain analysis of (non-linear) soil-structure interaction.

Table of Contents

1. Introduction - Statement of Problem; Significant Features; Substructure and Direct Methods; Free-Field Response of Site.
2. Approximate Dynamic Model of Embedded Foundation - Dynamic-Stiffness Coefficient in Frequency Domain; Standard Lumped-Parameter Model; Spherical Cavity with Symmetric Waves; Basic Discrete Model; Disk Foundation; Embedded Cylindrical Foundation; Embedded Prism Foundation; Strip Foundation; Square Foundation on Layered Half-Space; Material Damping; Disk with Mass on Half-Space; Hammer Foundation with Partial Uplift of Anvil; Complex Modal Analysis; Partial Uplift of Basemat.
3. Direct Method - One Dimensional Wave Propagation; Semi-Infinite Rod on Elastic Foundation; Superposition Boundary; Fictitious Material Damping; Viscous Damper; Doubly Asymptotic Approximation; Paraxial Boundary; Extrapolation Algorithm; Location of Artificial Boundary; Free-Field Loading; Structures with Elasto-Plastic Base Isolation Permitting Uplift and Slipping.
4. Summary of Substructure Method in Frequency Domain - Basic Equation of Motion; Dynamic Stiffness of Site; Free-Field Response of Site; Dynamic Stiffness of Embedded Foundation; Scattered Motion.
5. Hybrid Frequency-Time Domain Analysis - Formulation; Mass Connected by Nonlinear Spring to Semi-Infinite Rod; Stability Criterion for Harmonic Excitation: Properties of Convergence for Iterative Scheme Working with Segments of Time Interval; Stability Criterion for Transient Excitation.
6. Substructure Method Using Dynamic Stiffness of Soil - Basic Equation of Motion; Dynamic-Stiffness Coefficient in Time Domain; High-Frequency Behavior of Waves from Vibrating Source; Dynamic-Flexibility Coefficient in Time Domain; Hysteretic Damping; Computational Procedure; Structure with Base Isolation; Recursive Evaluation of

Convolution Integral in Frequency Domain; Recursive Evaluation of Convolution Integral In Time Domain.

7. Substructure Method Using Green's Function of Soil - Green's Function; Time-Dependent Boundary-Integral Equation in Elastodynamics; Spatial and Temporal Discretization of Boundary-Integral Equation; Loaded Spherical Cavity with Symmetric Waves; Flexibility of Rigid Circular Disk; Structure with Partial Basemat Uplift; Embedded Foundation with Separation of Sidewall and Uplift of Basemat.

DRAWINGS

Line drawings, diagrams and graphs can be reproduced well in the Newsletter and will be of interest to members. Contributions, perhaps with a short explanatory paragraph, will be welcome. Photographs cannot be reproduced very well.

The Society for Earthquake and Civil Engineering Dynamics

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