Field Testing in Engineering Geology

## Geological Society Engineering Geology Special Publications Series Editor M. G. CULSHAW

# Field Testing in Engineering Geology

Proceedings of the 24th Annual Conference of the Engineering Group of the Geological Society Sunderland Polytechnic, 4–8 September 1988

**EDITED BY** 

F. G. Bell

Department of Geology and Applied Geology University of Natal Durban, South Africa

> J. C. Cripps Department of Geology University of Sheffield UK

> > M. G. Culshaw

Engineering Geology Research Group British Geological Survey Nottingham, UK

J. R. Coffey
Department of Applied Geology
Sunderland Polytechnic
Sunderland, UK

1990 Published by The Geological Society London

#### THE GEOLOGICAL SOCIETY

**Engineering Group** 

Treasurer

Mr B. A. Leach

Mr S. Penn

Miss R. E. Allington

President

Professor D J Blundell

Dr L E Frostick

Chairman Dr J Brooks Secretary

Professor J W Murray

Foreign Secretary

Secretaries

Professor J B Dawson

Treasurer Professor B E Leake

The Geological Society of London was founded in 1807 for the purposes of 'investigating the mineral structures of the earth'. It received its Royal Charter in 1825. The Society promotes all aspects of geological science by means of meetings, special lectures and courses, discussions, specialist groups, publications and library services.

It is expected that candidates for Fellowship will be graduates in geology or another earth science, or have equivalent qualifications or experience.

Membership of the specialist groups is open to all Fellows without additional charge. Enquiries concerning Fellowship of the Society and membership of the specialist groups should be directed to the Executive Secretary, The Geological Society, Burlington House, Piccadilly, London W1V0JU.

Published by the Geological Society from: The Geological Society Publishing House Unit 7 **Brassmill Enterprise Centre** Brassmill Lane Bath Avon BA13JN UK (Orders: Tel. 0225 445046)

Typeset by KEYTEC, Bridport, Dorset Printed by Bookcraft, Midsomer Norton

First published 1990

© The Geological Society 1990. All rights reserved. No reproduction, copy or transmission of this publication may be made without written permission. No paragraph of this publication may be reproduced, copied or transmitted save with the written permission or in accordance with the provisions of the Copyright Act 1956 (as amended) or under the terms of any licence permitting limited copying issued by the Copyright Licensing Agency, 33-34 Alfred Place, London WC1E 7DP. Users registered with Copyright Clearance Center: this publication is registered with CCC, 27 Congress St., Salem, MA 01970, USA. 0267-9914/90 \$03.00.

British Library Cataloguing in Publication Data

Field testing in engineering geology.

1. Engineering geology

I. Bell, F. G. (Frederic Gladstone)

II. Culshaw, M. G. III. Cripps, J. C.

IV. Geological Society of London V. Series 624.1'51

ISBN 0-903317-51-6

# **Contents**

|                         | aw, J. C. Cripps, F. G. Bell & J. R. Coffey  | V             |
|-------------------------|--|---------------|
| 2                       | e  | vi<br>vi      |
| Session 1: Introduction |  |               |
|                         | F. G. Bell, J. C. Cripps & M. G. Culshaw: Field testing methods for engineering geological investigations  | 3             |
| Session 2: Pressureme   |  |               |
|                         | W. F. Anderson, I. C. Pyrah & L. S. Pang: Strength and deformation parameters from pressuremeter tests in clay   | 23            |
|                         | B. G. CLARKE: Consolidation characteristics of clays from self-boring pressure-  | 33            |
|                         | meter tests  A. S. O'Brien & R. L. Newman: Self-boring pressuremeter testing in London Clay  | 39            |
|                         | D. J. CORKE: Self-boring pressuremeter in situ lateral stress assessment in London Clay  | 55            |
| Discussion              |  | 63            |
| Session 3: Pressureme   | ter and dilatometer testing in rocks   |               |
|                         | M. C. STEVENSON, J. H. MARTIN & P. O. SQUIRE: Some recent in situ stress testing experience with strong clays and weak rocks in Britain  | 6°<br>7°      |
|                         | rock  A. Marsland & J. J. M. Powell: Pressuremeter tests on stiff clays and soft rocks: factors affecting measurements and their interpretation  D. H. Shields, L. Domaschuk, B. H. Kjartanson & F. Azizi: Measuring the creep properties of ice in situ | 8:<br>9<br>11 |
| Discussion              |  | 11            |
| Session 4: Penetration  | testing: the standard penetration test  M. E. Barton: The interpretation of standard penetration tests in geologically aged sands  | 12            |
|                         | G. B. CARD, D. P. ROCHE & S. M. HERBERT: Applications of continuous dynamic probing in ground investigation  | 12            |
|                         | A. R. Dawson & N. H. Thom: Field tests on pavement foundations  S. L. Huntley: Use of a dynamic penetrometer as a ground investigation and design tool in Hertfordshire  | 13            |
|                         | J. Pitts: The use of Swedish ram sounding and weight sounding in residual soils and weathered rocks  | 16            |
| Discussion              |  | 17            |
| Session 5: Penetration  | testing: static methods  |               |
|                         | J. Lewandowska: Field testing of lime sediments and the interpretation of test data  | 17            |
|                         | J. A. LITTLE & D. R. CARDER: In situ and laboratory testing of Anglian stage Pleistocene sands and gravels   | 18            |
| Discussion              |  | 193           |

| Sessions 6 and 7: Load                          | , vane and direct shear testing   |     |
|---|---|-----|
|   | E. MULLER, E. A. Nowatzki & J. S. DeNatale: A determination of the shear  | 107 |
|   | strength parameters of a fine-grained cemented alluvium in the U.S. Desert Southwest  | 197 |
|   | H. Nienhuis & D. G. Price: The scale effect with regard to the deformability of   |     |
|   | calcarenite   | 205 |
|   | A. Marsland: Measurements of effective strength parameters of stiff fissured  | 215 |
|   | clays using large in situ shear boxes   | 217 |
|   | J. H. Atkinson & C. A. Jessett: Measurement of relative density of saturated sand using a piezovane   | 229 |
|   | saild using a piezovane   | 223 |
| Discussion                                      |   | 235 |
| Session 8: Surface geor                         |   |     |
|   | S. G. Lee & M. H. DE Freitas: Seismic refraction surveys for predicting the intensity and depth of weathering and fracturing in granitic masses | 240 |
|   | D. M. McCann, M. G. Culshaw & K. J. Northmore: Rock mass assessment   |     |
|   | from seismic measurements   | 257 |
|   | P. W. McDowell: The determination of the dynamic elastic moduli of rock   | 267 |
|   | masses by geophysical methods   | 207 |
|   | quality by a non-intrusive method   | 275 |
|   | R. D. BARKER, D. N. LERNER & H. V. RODRIGUEZ-ESTRADA: Resistivity   |     |
|   | sounding for a landfill investigation at Bray, Berkshire  | 287 |
| Diameter  |   | 205 |
| Discussion                                      |   | 295 |
| Session 9: Downhole ge                          | conhysical testing  |     |
| Source St.                                      | G. M. PINCHES & R. P. THOMPSON: Crosshole and downhole seismic surveys in   |     |
|   | the UK Trias and Lias   | 299 |
| Discussion                                      |   | 309 |
| Sagaine 10. December 111                        | to tooking  |     |
| Session 10: Permeabilit                         | J. H. Black: Focussed packer testing: a structured approach to save time and  |     |
|   | improve results   | 313 |
|   | D. J. CORKE & A. SMITH: Developments in in situ permeability testing  | 323 |
|   | J. H. Tellam & S. F. Eyre: Estimating rates and electrical conductivities of  |     |
|   | borehole inflows using a logging/two-level pumping technique  | 335 |
|   | S. WALTHALL: Packer testing in geotechnical engineering   | 345 |
| Subject index                                   |   | 351 |
| Index of authors and contributors to discussion |   | 355 |

### **Preface**

The twenty fourth Annual Conference of the Engineering Group of the Geological Society was held at Sunderland Polytechnic from the 4th to the 8th of September 1988. The theme of the Conference was 'Field testing in engineering geology' and covered both direct and indirect methods of field testing, with particular reference to their relevance to engineering geologists. Most in situ testing techniques were addressed and geophysical methods also were considered with reference to the indirect derivation of geotechnical parameter values.

Most of the papers presented to the Conference are included in these Proceedings, together with both verbal and written discussion contributions. An editorial introductory paper which briefly reviews the main themes covered during the Conference also is included.

Once again, the Conference was well attended by delegates from engineering consultants and contractors, local and central government organizations and academia. The Conference was enhanced by the large trade exhibition and a lively social programme which enabled delegates to meet informally in a convivial atmosphere. It has always been the policy of the Engineering Group that the Conference should act as an eagerly anticipated meeting point for the various professionals with an interest in engineering geology. That this objective was met, was largely due to the efforts of the local organizers and other staff at Sunderland Polytechnic. They, and all those who contributed in the technical sessions, at the trade exhibition and on the field visits, are thanked for making the Conference a success.

M. G. Culshaw J. C. Cripps F. G. Bell J. R. Coffey

Nottingham, 1989

# Organizing committee

Chairman R. K. Taylor/B. A. Leach

Local Secretary
Preprints/proceedings Editors
J. R. Coffey
F. G. Bell
J. C. Cripps
M. G. Culshaw

Trade Exhibition W. Scott
Field Visits M. Money

## Acknowledgements

The editors gratefully acknowledge the work of David Ogden (Geological Society Publishing House) in preparing this volume and also the assistance of Dinah Bridger (British Geological Survey) in the production of the pre-prints and preparation of these Proceedings.

We also should like to thank all the authors and discussion participants for their lively participation in the Conference and their contributions which make up this volume.

The Engineering Group of the Geological Society is grateful to Sunderland Polytechnic, and Ralph Coffey in particular, for their provision of facilities, and the local organization that made the Conference enjoyable and successful.