N.Z. GEOMECHANICS NEWS

No. 3

NOVEMBER 1971

A NEWSLETTER OF THE N.Z. NATIONAL SOCIETY FOR SOIL MECHANICS
AND FOUNDATION ENGINEERING

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N.Z. GEOMECHANICS NEWS

No. 3, November 1971

A Newsletter of the N.Z. National Society for Soil Mechanics and Foundation Engineering

CONTENTS

THIS IS A RESTRICTED PUBLICATION

"N.Z. Geomechanics News" is a newsletter issued to members of the N.Z. National Society for Soil Mechanics and Foundation Engineering. It is designed to keep members in touch with recent developments. Authors must be consulted before papers are cited in other publications.

Persons interested in applying for membership of the Society are invited to complete the application form at the back of this newsletter. The annual subscription rate is at present one dollar but it is likely to increase in the near future.

EDITOR'S NOTES

1. Formation of a Geomechanics Society in New Zealand

We present in this issue a progress report on the formation of a Geomechanics Society. Members of our present Society voted on this issue in January this year and gave strong support to the move.

The report outlines in considerable detail the form the new Society will take and how it will be managed. At first glance the proposed new Society may appear to be somewhat unwieldy with three sub-committees as well as a Management Committee. However initially the engineering geology and rock mechanics sub-committees should both be small ones which will grow in size as they foster increasing interest in these disciplines in New Zealand. The Management Committee will have the task of co-ordinating and inter-relating the growth of all three "ground engineering" disciplines of soil mechanics, rock mechanics and engineering geology in New Zealand. It is a challenging task and it is hoped that the proposed Geomechanics Society will provide the right framework for progress to be made.

We trust that members will read this progress report carefully and that as many members as possible will plan to be present at the 1972 Annual General Meeting next February where it is hoped that the Geomechanics Society can be declared to be in existence.

2. Geomechanics Research in New Zealand

In this issue we also present an article on Soil Mechanics Research at the University of Canterbury which complements one published in our first issue on soil mechanics research at the University of Auckland. We hope that these two articles will be the first of a continuing series on geomechanics research work in New Zealand.

Because of its relatively small population and resources the number of research topics in any field which can be tackled in New Zealand must of necessity be rather limited and carefully selected. However once the selection of the topic has been made, there is no reason why the quality of the work carried out should not be as good or better than that carried out anywhere else in the world.

We encourage all our members to take an interest in geomechanics research work being carried out here in N.Z. Not only can this work often be of immediate practical benefit because it is locally oriented, but also there is much more opportunity for an interchange of ideas between the person carrying out the research and the potential user of the information. This interchange of ideas could be of considerable benefit to both parties.

3. Advertising in N.Z. Geomechanics News

This issue is the first one to contain advertising. The concept of advertising in N.Z. Geomechanics News was discussed at the A.G.M. of the Society in Auckland in February 1971 and met with the general approval of the members present. Not only can advertising help to keep the subscription rate of the Society down but it could also lead to a greater frequency of publication in the course of time.

We urge our members to support the advertisers in this issue and look forward to continued support from advertisers. Any enquiries regarding advertisements should be addressed to the Technical Secretary at P.O. Box 12241, Wellington.

4. Contributions Still Wanted

The response from members to requests for contributions to this newsletter have still been very limited. We feel that the success of the newsletter will be greatly increased if the variety of opinions expressed can be enlarged.

Contributions may be in the form of technical articles, notes of general interest, letters to the Editor or book reviews, and may cover any subject within the fields of soil mechanics, rock mechanics or engineering geology. Articles on site investigation or construction techniques or design methods which have been successfully used in New Zealand and which would be of help to other members would be particularly welcome.

All contributions should be sent to -

The Editor,
N.Z. Geomechanics News,
c/- N.Z. National Society for Soil
Mechanics and Foundation Engineering,
P.O. Box 12-241,
WELLINGTON.

5. Errors in Previous Issue

We regret that due to an oversight the previous issue - N.Z. Geomechanics News No. 2, June 1971 was sent out to members with the cover for the first issue attached. The correct cover is enclosed with this issue in order that members who so wish may attach this correct cover to the No. 2 issue.

Also the reference to "soil merchants" on the first page of the No. 2 issue was quite unintentional!

J.P. Blakeley
EDITOR.

PROGRESS REPORT ON THE FORMATION OF A GEOMECHANICS SOCIETY IN NEW ZEALAND

R.O. Bullen

1. Introduction

During 1970, ways of broadening the scope of the N.Z. National Society for Soil Mechanics and Foundation Engineering to include the related disciplines of Rock Mechanics and Engineering Geology were studied by your Committee. A poll of members held last January gave strong support to the move. Shortly afterwards the A.G.M. of the Society authorised the incoming National Committee to proceed with the formation of a Geomechanics Society and a sub-committee was set up to formulate the necessary amendments to the statutes. The resulting draft rules are now almost ready to be submitted to the Council of the N.Z. Institution of Engineers for approval and the following is a brief report to inform members exactly what form of organization has been devised.

2. Name, Objects and Membership

The new society will be called "The New Zealand Geomechanics Society". It will become the affiliated organisation in New Zealand of the following:

(a) The International Society for Soil Mechanics and Foundation Engineering.

(b) The International Society for Rock Mechanics.

(c) The International Association of Engineering Geology.

This will require the Institution to pay on behalf of the Society the respective annual subscription due to each International Society.

The objects of the new Society have been set down as follows:

(a) To advance the study and application of soil mechanics, rock mechanics, and engineering geology among engineers and scientists.

(b) To advance the practice and application of these disciplines in engineering.

(c) To implement the statutes of the respective international societies insofar as they are applicable in New Zealand.

Qualifications for membership are generally in the same form as at present but of course are extended to include those who are interested in rock mechanics and engineering geology. Interest in the aims of the Society has been retained as the prime criterion for membership. On election, each member must affiliate to at least one of the International Societies. All members of the present Soil Mechanics Society will be regarded as affiliated to the International Society for Soil Mechanics and Foundation Engineering.

3. Management of the New Society

It is proposed that the new society be managed by a committee to be known as the Management Committee of the N.Z. Geomechanics Society. This committee shall comprise ten members of the Society; eight shall be elected by all members of the Society and two shall be appointed by the Council of the N.Z. Institution of Engineers. It is intended that representation on the committee should be maintained as broad as possible with respect to the field of interest, occupational and regional classification. Of the ten members not less than five shall be corporate members of the N.Z.I.E.

In addition to the elected and appointed members, the Vice-President for the Australasian region of each of the respective International Societies, plus the Secretary of the N.Z.I.E. shall be ex officio members of the committee.

The Management Committee shall elect a Chairman plus three Vice-Chairmen (one for each of the disciplines of soil mechanics, rock mechanics and engineering geology) from their own number. The Management Committee shall then establish three sub-committees, each under the chairmanship of a Vice-Chairman, to promote and further the interests of each of the corresponding three disciplines. Each sub-committee shall comprise a Vice-Chairman and up to four other members of the Society plus the Chairman of the Management Committee ex-officio.

In establishing the sub-committees it is specified that the Management Committee shall first consider the field of interest and availability of its own members. At the same time it is acknowledged that not all members of the Management Committee need serve on a sub-committee and stated that none may serve on more than one. If a sub-committee is not filled from the Management Committee, the Vice Chairman for the particular discipline is given the power to co-opt other members of the Society if he so desires. It is believed that this gives a fairly flexible but appropriate arrangement allowing:

(i) the size of a sub-committee to be adjusted to the needs of the particular discipline. e.g. for rock mechanics, it might start initially as a small committee but increase later up to the maximum number as interest in the topic grows.

(ii) the sub-committee to be formed from those members most interested in and/or competent to handle and foster the affairs of that discipline.

The Management Committee shall be responsible for the policy and administration of the Society but always subject to the broad approval of the Council of the N.Z.I.E. Within these limits, the new rules give the Management Committee fairly broad powers which it may use as it thinks fit. These are as follows:

(a) arrange conferences, seminars or symposia.

(b) establish and maintain a technical library, publish bulletins or newsletters and establish and maintain a technical service for members and non-members.

(c) form branches or specialist groups.

(d) establish and maintain liaison with other organizations with similar objects.

(e) appoint any necessary staff and decide upon their remuneration.

4. Subscriptions

Each member of the Geomechanics Society shall pay an annual subscription, the amount of which shall be determined by the Management Committee. The amount shall be such that the income from subscription will cover:

(a) The annual contribution to each International Society.

(b) Other normal expenses of the Society.

(c) For each member, the capitation fee(s) for the particular International Society (or Societies) to which the member wishes to affiliate.

5. Progress to Date

The draft rules have been prepared and submitted to the three International Societies for their approval. Replies are expected shortly and providing no difficulties arise, the draft will then be submitted to the Council of the N.Z.I.E. for final approval. It should perhaps be noted that during preparation of the draft there was considerable consultation with the Secretary of the N.Z.I.E. on the contents and format of the rules.

If all approvals are obtained without delay, the N.Z. Geomechanics Society should be able to be declared to be in existence at the A.G.M. next February.

REVIEW OF THE FIRST AUSTRALIA-NEW ZEALAND GEOMECHANICS CONFERENCE

J.H.H. Galloway

The First Australia-New Zealand Geomechanics Conference held in Melbourne from 4th to 9th August last was organised by the Melbourne Group of the Australian Geomechanics Society and sponsored by the Institution of Engineers, Australia, the Australian Institute of Mining and Metallurgy, the N.Z. Institution of Engineers and the N.Z. National Society for Soil Mechanics and Foundation Engineering. The venue was the Camberwell Civic Centre which was well suited to the purpose.

There were more than 275 registrants. Quite a number were from outside the Australasian Region, many of whom had come to Australia to attend the executive committee meeting of the I.S.S.M. & F.E. which was held the previous week. Thus the region was very much on show to the world. I think a good showing was made, but I was most disappointed to count only nine New Zealanders among the registrants. For a co-sponsor this is just not good enough! We must all start planning now to attend the next regional conference in Brisbane in 1975. There should be at least 30 of us there! The number of papers from New Zealand was also disappointing, but this was by no means solely our fault.

The Conference was organised into nine technical sessions, three of three hours each and six of one and a half hours each. Each session commenced with the technical reporters comments on the papers involved and then each author was allowed five minutes to reply. Discussion was then open to the floor. With up to seven papers in a single short session there was often very little time for this discussion and both contributors and authors were under considerable pressure to keep within stringent time limits. Even a modest increase of ten or fifteen minutes in the session time would have relieved this pressure greatly. But it is easy to be critical whatever solution to this perennial problem is adopted.

One innovation since previous conferences was that no record was taken of the oral discussion. Only discussion submitted in writing will be published in the proceedings. It will be interesting to see how this turns out. It should certainly ease the editorial work.

In addition to the official opening and closing sessions, which were suitably short and effective there was a full afternoon devoted to a symposium on the topic "Geomechanics - a Tool in National Development." This symposium was intended to help define the relatively new term "Geomechanics" in the mind of both the public and the profession and to focus attention on the role of geomechanics in developmental projects. As a contributor to the Symposium I cannot give an outside impression of its impact but I was conscious that we were too many, we spoke too long and rather above the heads of the laity and all fell into the trap of emphasising our own organisations achievements rather than explaining the central place of geomechanics in civil engineering. This feeling was so strong that I felt it necessary to cut out about a quarter of my prepared text.

Undoubtedly the technical hightlight of the Conference was the keynote address given by Professor T.W. Lambe of M.I.T. This is as it should be but few such addresses are delivered so well or so wittily. Talking to the theme "Predicted Performance of Constructed Facilities" Professor Lambe explained that prediction was the product of two things, Laws and Facts. If either, or both, were inaccurate he said it was only good luck that gave rise to good predictions. The theoreticians, he explained, often had good laws at their disposal but poor field data while the experienced engineer often had good field information but was ignorant of the natural laws involved. Thus both had little prospect of making good predictions. The "catalogue engineer" was in an even worse state as his "facts" were scrappy and mostly irrelevant while his "laws" were little more than folk tales. Even the giants of Geomechanics made some poor predictions and Professor Lambe had the courage to show how some of his own apparently brilliant predictions were the result of a fortunate combination of poor facts and poor laws. Thus we were all warned, in a most humorous fashion, of the pitfalls of prediction, encouraged to continue to improve our store of laws and facts so that we could the better predict performance, and advised that if we did not continue to predict performance and critically assess the worth of our predictions we would become catalogue engineers or technological fossils.

The change in scope from "Soil Mechanics and Foundation Engineering" to "Geomechanics" was reflected in the larger number and wider range of papers presented. A reasonable balance between disciplines was achieved and the Organising Committee are to be congratulated on this. The interaction of the three main branches of Geomechanics can do nothing but good.

MEETING OF THE EXECUTIVE COMMITTEE I.S.S.M.F.E.

SYDNEY, N.S.W. 4-5 AUGUST 1971

J.H.H. Galloway

At the invitation of the Australian Geomechanics Society the biennial meeting of the Executive Committee of the International Society for Soil Mechanics and Foundation Engineering was held in Sydney on 4th and 5th August. This was the first "between conferences" meeting under the new constitution adopted in Mexico in 1969.

The Australians had gone to great lengths to ensure the meeting went smoothly and both the Institution of Engineers (Australia) and the Sydney Group of the Australian Geomechanics Society were most lavish in their hospitality. It was just unfortunate that the New South Wales railwaymen should have chosen the two days of the meeting to hold a strike, but in spite of this handicap we were well looked after.

The first part of the meeting was essentially routine Society business - admission of new members, reports of the Vice Presidents and discussion of formal motions on the order paper. Chile was admitted as a member and Ghana and Iran provisionally admitted subject to the receipt of satisfactory draft constitutions. One item of interest to us in the Vice Presidents reports was that the Australians are starting a Geomechanics Journal to be published by the Institution of Engineers (Australia). Of the formal motions affecting the constitution and bylaws only those concerned with the preferred interpretation of official minutes and the form of voting were passed. In the former case the President is now empowered to decide as to the preferred meaning. In the latter, secret ballots will now be held sequentially with the choice receiving fewest votes at each ballot dropping out till one choice receives an absolute majority.

The Geotechnical Abstracts prepared by the German National Society were discussed at length. They are still some way from being self supporting though their quality is good. So good, in fact, that the ASCE Soil Mechanics and Foundation Division has decided to discontinue its abstracting service in favour of Geotechnical Abstracts. Rather than raise subscriptions to a break even level at present circulation it was considered more appropriate to urge all National Societies to promote sales in their own countries and a motion was passed to this effect. One confusion that existed, at least in my mind, was also cleared up. The Geotechnical Abstracts are strictly a Society enterprise while the Geodex Retrieval System is a commercial enterprise which provides a means of locating any particular reference in the Geotechnical Abstracts. Subscription to the Abstracts is quite modest ($US 35 p.a.) and provides 144 abstracts a month taken from some 500 periodicals in many languages. It provides a very convenient way of keeping in touch with world literature and is probably better value for money than a subscription to any one periodical.

The format of the next list of members was discussed and it was decided to have the list set in letterpress, to accept advertising (but not "professional cards") and to investigate ways of reducing the printing and checking costs to a minimum and the possibility of mailing copies direct to members. It was also agreed to make the list available to non-members at a price of $US 25.

Much of the meeting was devoted to discussing the report of the Conference Procedure Committee set up after the Mexico Conference and the arrangements proposed by the Russian delegates for the Moscow Conference. The main outcome of these discussions was the acceptance of the need for a Conference Advisory Committee of the I.S.S.M.F.E. to guide the Conference Organising Committee of the host country in making its arrangements. The ex-officio members of the Advisory Committee (the President, the Regional Vice President and the Secretary-General) all being present in Sydney it went to work straight away with the Russian delegates. The outcome of this work will appear in the Conference Bulletins in due course.

Three important points about this meeting are firstly it obviously fills a real need in the Society's affairs in providing a convenient forum for discussing arrangements for the next international conference. Secondly the proxy voting system by way of the Vice Presidents, which we pressed for at Mexico, fills a real need. Thirdly the Australian venue brought home to many of the delegates the difficulties remote countries face in attending meetings of the I.S.S.M.F.E. I lost no chance of stressing this difficulty.

In conclusion I must pay a personal compliment to our Secretary-General, Professor Kevin Nash. The meeting was held under "Quaker Rules" where the minutes are prepared as the meeting proceeds and are then read back and confirmed before the meeting disperses. This throws a great burden on the Secretary-General. At one point, when discussion had become a little confused Professor Nash was asked if he could read out the minute he was drafting. With an apologetic smile he replied "Well, actually, I have two draft minutes in hand, which would you like me to read? I wasn't sure which way the discussion was going". To draft one minute while answering questions on procedure and keeping ones temper must be very difficult. Two simultaneous minutes require superhuman qualities!

REVIEW OF THE CONFERENCE ON EARTHQUAKE ENGINEERING, WELLINGTON, MAY 1971

G.L. Evans

As earthquake problems are essentially related to ground motion it is perhaps not surprising that among the twenty-two papers presented at the Earthquake Engineering Conference on May 18-20, 1971 in Wellington, there were seven concerned with ground and foundation behaviour or the dynamic properties of soil materials.

A comprehensive paper by W.R. Stephenson on "Seismic Microzoning in New Zealand" first defined microzoning as the division of land areas into small regions of differing local geology for which differences in earthquake attack on structures are specified; and then described in some detail the ground mechanisms causing damage. Reference was made to the limited amount of research at present undertaken in New Zealand, but some guide lines were suggested on where this should continue from overseas work. Emphasis was placed on the important aspects of earthquake destructiveness such as shear waves and inertia attack and how these factors are affected by local geological conditions.

A paper on "The Earthquake Resistant Design of Cohesive Earth Slopes" by G.R. Martin and P.W. Taylor described the nature of slope failures with reference to the earthquake response of slopes and banks and the behaviour of saturated cohesive materials. It gave details of the dynamic triaxial tests which can be used to simulate earthquake stresses to determine the dynamic modulus of soil samples. Various design procedures were reviewed and their limitations examined. A "proof test" concept was presented, by which samples from selected positions in a slope are tested under simulated earthquake stresses. From a limited number of tests, showing whether samples fail or not, an assessment can be made of the safety of the soil structure. This procedure is outlined and some examples of its use were presented. This is a simplified and useful method which should prove valuable to soils design engineers.

"The Effect of Soil Properties on Earthquake Response" was described by I.M. Parton and R.W. Melville-Smith in a paper which presented results from a computer investigation into the effects of surface layering at the site of a motorway bridge. From dynamic tests on soil samples the dynamic moduli were determined and used in an analysis which demonstrated that for this site the soil and site characteristics determine the seismic response of the ground surface. Shear modulus and strain were found to be linear on a log/log plot and this is not in accord with overseas research on this aspect. The non-linear properties of soil give rise to complexities of analysis not yet resolved but the knowledge now available on surface layer modification is adequate to allow engineers to use the results of research as a useful guide in evaluating the influence of soil conditions on earthquake ground motion.

The use of wave velocity measurements was described in a paper on "A Field Test for Dynamic Soil Properties" by G.L. Evans. From a knowledge

of the P and S wave velocities and the density of the ground material the values of shear modulus, poissons ratio and the dynamic elastic modulus can be derived. In the test described a wave pulse is generated and timed over various distances at a site in deep loess. Tests were made on the surface and down holes 3 ft in diameter down to 20 ft. Not only did this provide velocity results but it also detected reflecting layers in the loess, which on close physical inspection were confirmed down to 30 ft. The moduli values found by this technique are those associated with the very small strains of wave motion. Therefore they would be the upper limit values which would have to be factored down for larger earthquake strains.

A descriptive paper by R.I. Skinner outlined "Design Lessons from Recent Destructive Earthquakes". Naturally much of the paper dealt with buildings, but evidence was presented of the microzone effects in several earthquakes and the extent to which depth of alluvium affected damage to different types of buildings. The lesson here for the foundation engineer was that in moderate earthquakes the microzone effects can be greater than in severe earthquakes, hence for certain local conditions even a moderate earthquake might be destructive.

A brief but useful paper presented by J. Hollings on behalf of the absent author, B.K. Ellison, on "Earthquake Damage to Roads and Bridges in Madang, November 1970" summarised damage to eight bridges with a large selection of photographs. Some very good lessons to bridge designers and foundation engineers are apparent in this report. No interpretation or recommendations were made in the paper, but it enlivened considerable discussion.

The complex problem of dynamic behaviour of foundation materials was elucidated in a paper by A.J. Carr and P.J. Moss on "Elastic Soil-Structure Interaction". This paper presented a refined method of finite element analysis for two dimensional plane stress and plane strain structures with particular emphasis on the solution of problems involving soil structure interaction under earthquake. It is pointed out how neglect of the foundation material behaviour can lead to erroneous assumptions regarding the input of earthquake motion at the base of a structure. The need to take into account the ground material behaviour is particularly relevant for relatively soft soil overlying rock.

The proposed finite element method illustrated in the paper treats the soil and the structure as a combined system. Examples are given of a large bridge site and a building frame on a shallow foundation. This method should prove to be an extremely powerful technique in this field of analysis.

The papers of this conference have all been published in The Bulletin of the New Zealand Society for Earthquake Engineering (vol. 4, Nos. 1 & 2).

NEWS FROM THE TECHNICAL SECRETARY

1. ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society will be held in February 1972. The time and place will be confirmed in a notice to members which will be sent out in January. It is expected that the meeting will be held in Christchurch during the Annual Conference of the N.Z. Institution of Engineers. The probable time is the afternoon of Wednesday, 9 February 1972.

It is hoped that as many members as possible will plan to be present at the A.G.M. It will be a particularly important meeting as it is hoped to officially form the N.Z. Geomechanics Society as discussed elsewhere in this issue.

2. FOUNDATION INDEX.

Since the list of addresses at which cards are held in the various centres was published in the previous issue of "N.Z. Geomechanic News" some further information has come to hand.

First, the completed cards for the Auckland area are no longer held by the Geology Dept, University of Auckland. They have been moved to the Engineering Library of the University of Auckland which is located in the School of Engineering, Symonds St.

Second, in Christchurch the completed cards are being held by the Buildings Engineer, Christchurch City Council.

3. PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING.

The Proceedings of the first International Conference held at Cambridge, Massachusetts in 1936 are to be reprinted. The expected cost of the three volumes is $40.00 (U.S.)

Anyone interested should write to -

Dr S.J. Poulos,
Geotechnical Engineers,
934 Main St.,
Winchester,
MASSACHUSETTS 01890, U.S.A.

Initially an order but no money should be sent.

4. PROCEEDINGS OF THE SECOND AUSTRALIA-NEW ZEALAND CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING (CHRISTCHURCH 1956).

To complete its records, the International Society for Soil Members and foundation Engineering requires a copy of the above Proceedings. Will

anybody who has a copy they can spare, no matter what its condition, please let the Technical Secretary know so that he can arrange for this request to be met.

5. ADDRESSES OF MEMBERS.

Some members have complained that their copies of "N.Z. Geomechanics News" are not being sent to the right address. A short note to the Secretary of the N.Z.I.E, P.O. Box 12-241, Wellington will put the matter right.

6. COPIES OF SOIL MECHANICS PAPERS PUBLISHED IN "N.Z. ENGINEERING".

It has previously been the policy of the National Committee to have copies of papers on soil mechanics topics which are published in "N.Z. Engineering" printed and sent to members of the Society who are not also members of the N.Z.I.E. This has been done because these particular members would not normally receive "N.Z. Engineering".

However at the National Committee meeting on 23rd July the following motion was passed.

"That in view of the increasing cost of reprints of papers on soil mechanics topics published in N.Z. Engineering the policy of circulating non N.Z.I.E. members of the Society with these reprints be discontinued and that titles of papers in any other publications on geomechanics topics by N.Z. authors or related to N.Z. be promulgated in N.Z. Geomechanics News".

Accordingly the next issue of N.Z. Geomechanics News to be published early in 1972 will contain a list of papers on geomechanics topics by N.Z. authors published in the three years 1969 to 71. It is hoped that this list will become an annual one thereafter. Members will be able to peruse this list and obtain copies of papers which interest them from their nearest engineering library.

M.J. Pender
TECHNICAL SECRETARY

P.O. Box 12-241
Wellington.

STOP PRESS.

Subscription for 1972

The National Committee met on Friday 19th November and decided to raise the subscription to the Society for 1972 to $3.00. This is in line with the proposal set out in the Chairman's Report for 1970. It covers the application fee to the ISSMFE and a capitation fee of 60¢ for each member plus the local costs of running the Society.

SOIL MECHANICS RESEARCH AT THE UNIVERSITY OF CANTERBURY

T.A.H. Dodd

INTRODUCTION

This article complements the one published in the No. 1 issue of "N.Z. Geomechanics News", November 1970, on research activities in soil mechanics at the University of Auckland.

A total of four theses were submitted for the degree of B.E.(Hons) at Canterbury in the period 1948 to 1952; in 1955 the Master of Engineering degree was instituted, and five theses were submitted for this degree between 1956 and 1964. In the last four years, six Ph.D. candidates and two M.E. candidates have enrolled. This upsurge in research interest is due at least in part to the readiness with which both the Ministry of Works and the National Roads Board have contributed financial support for students and for their research equipment. Projects currently underway, or recently completed, are outlined, grouped under major topic headings as shown below.

A. Shear Strength of Soils

"The Stress-Deformation Behaviour of a Compacted Clay"
by M.J. Pender (Ph.D. thesis, 1971, supervised by T.A.H. Dodd)

A form of rheological model (the Critical State concept) has been used to predict the stress-strain-time behaviour of a compacted clay. The model was formulated in terms of effective stress, and the concepts of the plasticity theory were used to study the yielding and apparent work-hardening of the soil. A mathematical approach was evolved from the principles of the theory of plasticity, whereby integration of an expression for the instantaneous direction of the experimental plastic strain increment vectors led to a new expression which would accurately predict the main features of the clay's deformation. Testing was done in triaxial compression apparatus specially designed for the project; the compacted soil specimens were saturated by application of back-pressure, and most were tested undrained.

"The Ultimate Resistance of Deadman Anchors Subject to Inclined Load" by M.D. Gillon (M.E. Thesis, 1970, supervised by T.A.H. Dodd)

This project stemmed from the need for inclined guy wires for tall structures such as transmission towers, masts, poles, etc. The plane strain resistance of deadman anchors was investigated experimentally both in the field and in laboratory model tests on sand. From observation of the model test failures, a theoretical failure mechanism was formulated, based on Kötter's equation, and when appropriate corrections were included for end effects on the anchors, good agreement was found between the ultimate loads calculated using this theoretical approach and the failure loads from the field tests. Observation of the modes of failure in the model tests were made by a form of time-lapse photography developed for the purpose.

B. Tests on Piles

"The Elastic Behaviour of a Laterally Loaded Pile" by C.D. Matthewson (Ph.D. Thesis 1970, supervised by D.G. Elms)

The resistance of piles to lateral forces has been computed from the consideration of a flexible pile in an elastic soil, assumed continuous. The soils may be layered, and may have properties varying with depth within any layer, and piles with various properties have been considered. It has been found that for a depth of driving greater than a "characteristic length", no further benefit to the fixity is obtained. Computer-produced tables are given of approximate ground-level deflections for a pile in a soil of constant elastic properties. The theoretical analysis has been verified by using both photo-elastic tests and full-scale pile tests.

"Laterally-Loaded Piles" (Current Ph.D. study by G. Mullenger, supervised by D.G. Elms)

Currently an investigation is being made into the behaviour of a laterally-loaded pile in a granular soil. A theoretical appraoch to the problem is being considered in two parts: firstly in the specification of a constitutive relationship for a granular material, and secondly in the method for solving the field problem. At the same time an experimental technique, involving the use of x-rays, is being used to measure displacements of lead shot embedded within the body of a granular material in the vicinity of a model pile which is being translated laterally through it.

C. Road Research

"The Rational Design of Flexible Pavements" (Completed Ph.D. study by D. Niven (1967) supervised by A. Williman).

This project was an attempt to determine by experimental means the empirical factors which are used in the design of flexible pavements. Experimental sections of carefully under-designed pavement were laid on the approaches to the Christchurch-Lyttelton Road Tunnel, using various types and depths of base course overlying a carefully-controlled subgrade layer. The density and loading of the heavy vehicles using the road were obtained from the toll facility of the Tunnel Road Authority, and routine measurements of the behaviour of the various experimental sections of pavement were obtained until they failed. These measurements were correlated with traffic, weather and soil conditions.

"The Shrinkage Characteristics of Soil Cement"
by R.J. Dunlop (current Ph.D. study, supervised by T.A.H. Dodd)

A feature of almost all soil cement bases laid to date, for both roads and airport runways, has been the regular pattern of shrinkage cracks induced by shrinkage stresses. These cracks admit surface water into the subgrade, which consequently becomes soft locally, and the base fails by breaking up under the edge effects induced by traffic loading. Tests have been made using two widely-differing types of material - loess from the Cashmere Hills and sandy pumice from Hamilton. Shrinkage is due to loss of water from the soil, either by evaporation or by hydration of the cement; it can be minimised by reducing the cement content, the mixing water content, and/or the early evaporation of water during curing. The shrinkage stresses are relieved to some extent by creep, which is a more complex function of age, stress level, curing conditions, and rate of drying. Studies of this are continuing. Much of the specimen-drying has been done at constant room temperature in controlled low-humidity conditions, from which movements of moisture in the vapour phase within the specimens can be studied and predicted. When this is extended to full-scale pavements it is expected that the development of shrinkage stress, and consequent cracking, may become predictable.

D. Earthquake Engineering

Following a vigorous pursuit of research by the Structural Engineering section of the Civil Engineering Department into the seismic properties of buildings, bridges, etc., the seismic properties of the foundation soils are being investigated in an effort to correlate the soil-structure interactions.

"A Study of Building - Ground Interaction Under Earthquake Conditions"
(Current Ph.D. study by J.H. Travers, supervised by R. Shepherd)

The transmission of vibrations through layers of seismically soft material overyling bedrock is being studied.

Two theories are being developed. One traces the propagation of horizontal shear waves as they are transmitted and reflected at seismic discontinuities. The other idealises the system into a number of discrete masses connected by springs.

In order to assess the validity of these theories simultaneous records on the ground surface and at depth have been obtained of earthquake and microtremor waves. Results show that for microtremors the wave propagation analysis gives good results. For larger amplitude earthquake waves where internal energy absorption becomes significant the behaviour is best represented by the lumped mass approach.

"Investigation into the Dynamic Behaviour of Embankments and Foundations under Earthquake Conditions" (Current M.E. study by G.L. Evans, supervised by H.J. Hopkins)

Evidence from many earthquakes has shown that high dynamic earth pressure occurs on earth retaining structures. Before this problem can be solved adequately it is necessary to have a relatively easy method of finding the dynamic "elastic" moduli of soil materials. A simple field test has been developed at Canterbury University in this research work. This method employs the principles of seismic surveys using a small wave pulse of the type of wave required; i.e. shear wave or percussion wave, with velocities being measured over relatively short distances (10 ft. to 100 ft.).

The method has been quite successful in finding moduli values for a variety of materials, clay, silt, sand and gravel, and at one site the values found have been used in pressure analyses.

E. Compaction of Clays

An automatic kneading compaction machine has been built in this Department, and a project has been initiated to study the strength and other relevant properties of clay soils compacted in the laboratory by various compaction methods.

"Structure of Compacted Clay Soils"
(Current research project - T.A.H. Dodd).

MEASUREMENT OF IN-SITU SOIL DENSITY
(No. 2 of a Series)

J.H.H. Galloway

2. SAND REPLACEMENT

The last article discussed the general principle of the sand replacement method of measuring field density and the possibility of using natural organic materials (seeds) as calibrated sand. This article deals with the techniques of the sand replacement method.

The usual technique is to pour the sand into the test hole from a standard container fitted with a valve and conical mouthpiece which sits over the test hole. The container is weighed before and after pouring to determine the gross amount of sand used and the net amount is found by deducting the known (constant) amount needed to fill the conical mouthpiece. Many designs of these sand containers (often called "sand bottles" or "sand cones") exist. One of the neatest of these is of American origin. (Regrettably I cannot now trace the exact source, but I will refer to it as the "symmetrical type"). In this particular design identical cones are used above and below the valve. This means that identical pouring conditions exist whether the sand bottle is being filled or emptied. Thus the sand is automatically calibrated every time the bottle is filled. The net weight of sand in the bottle is a direct measure of its standard unit weight and any variation in sand quality or calibration is immediately apparent.

The amount of sand needed to fill the cone (often called the "cone constant") is usually determined by setting the sand bottle on a level surface (with the usual "digging plate" interposed). This technique is perfectly legitimate but implies that, in the field a similar level surface must be prepared to receive the digging plate. Any lack of care in doing this leads to errors in the measured volume of the test hole. These errors become large if the test hole is shallow or the material contains more than a few percent of gravel sizes. In material containing about one third of gravel sizes holes need to be at least six inches average depth if one hopes to keep these errors below one percent. In such materials errors will be substantially reduced by carefully filling the surface of the ground with fine grained material. Almost any cohesive material will do (free running sands should be avoided as they tend to fall from under the digging plate) as its unit weight will be much nearer that of the soil being tested than the air which would otherwise be included. However one must be sensible about the use of such bedding materials and only the minimum amount should be used.

If the prepared test surface is not level a change in the pouring conditions of the calibrated sand will occur. The errors introduced will be slight for errors of a few degrees when a good sand is used. It is much more important to have the test surface plane.

Sometimes it is not possible to use a sand bottle and the sand is poured directly from a bag or placed carefully from a scoop. A really good calibrated sand (e.g. clover seed) will cope with these conditions but most will give variable results. Careful surface preparation of the test site is as necessary as ever and remember to allow for the digging plate if one is used. This method should be regarded as a makeshift only.

When large test holes have to be measured economy in the use of sand and improved accuracy can be achieved by the use of wood filler blocks. These are accurately made in a variety of convenient sizes and shapes and surface sealed. In use they are bedded on a layer of sand and surrounded with further sand. Then further blocks and sand are carefully added till the hole is filled. With holes of several cubic feet up to two thirds of the volume can be blocks so that the percentage error introduced by non standard pouring conditions for the sand is much reduced.

PUBLICATIONS

HARVARD SOIL MECHANICS SERIES

INTRODUCTION.

Since the beginning of the Harvard University Soil Mechanics Department in the early 1930's, many papers and reports have been written by staff and students of that department. These were published in a variety of publications but in parallel, many were also published in the Harvard Soil Mechanics Series. This series, which also contains a few items which were not published elsewhere, brings together in one set a fairly unique collection of publications. Included are many important contributions to modern soil mechanics and foundation engineering.

The series is not well known or commonly available in New Zealand. Several of the numbers are out of print now but between copies held by Ministry of Works library and personal copies held in various forms by R.O. Bullen (Head Office, Ministry of Works, Wellington), an almost complete set is available in the country. It is not known if any copies are available elsewhere in New Zealand so Mr Bullen has offered to help individual members who wish to refer to these publications and cannot obtain access any other way. A complete list of the series is given below together with the form in which they are known to be available in New Zealand. Otherwise any members wishing to purchase copies for themselves should write to the following address:

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APPLICATION FOR MEMBERSHIP

of

New Zealand National Society for Soil Mechanics
and Foundation Engineering

A TECHNICAL GROUP OF THE NEW ZEALAND INSTITUTION OF ENGINEERS

THE SECRETARY,
N.Z. INSTITUTION OF ENGINEERS,
P.O. BOX 12241,
WELLINGTON.

I hereby apply for membership of the New Zealand National Society for Soil Mechanics and Foundation Engineering and supply the following details:

NAME _____
(to be set out in full in block letters, surname last)

PERMANENT ADDRESS _____

_____

QUALIFICATIONS AND EXPERIENCE _____

_____

_____

NAME OF PRESENT EMPLOYER _____

_____

NATURE OF DUTIES _____

_____

_____

I have enclosed cash/a cheque for one dollar to cover my first annual subscription to the Society.

SIGNATURE OF APPLICANT _____

DATE _____ 19____

Complete subsurface data at less cost with the Terra-Scout® portable refraction seismograph.

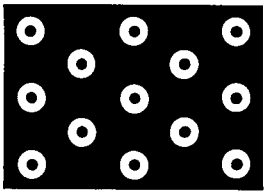

FIG. 1

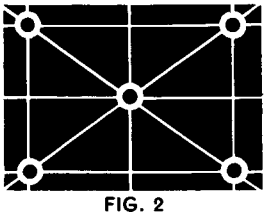

FIG. 2

Fig. 1 shows the large number of core samples needed for good survey coverage of a given area. Fig. 2 illustrates use of the Terra-Scout seismograph to survey the same area. A smaller number of borings (white circles) are supplemented with seismic traverses (black lines). Result: more meaningful data at less cost than with test borings alone.

You can greatly reduce the number of sample borings needed by supplementing them with seismic surveying.

A combined boring and seismic program is usually less costly than a conventional sampling program. On some projects, experience has shown savings of up to 50%. Additional savings are provided because you don't need to overdesign against uncertain conditions; and you'll avoid costly surprises during construction. In fact, the Soiltest Terra-Scout seismograph will usually pay for itself on its first big job.

The Terra-Scout is especially designed for shallow seismology. You can get meaningful data to depths of 100 feet without explosives. All readings are taken from the surface of the ground. Seismic surveying provides a means of interpolating between core drilling points to determine types of materials and strata depths.

The Terra-Scout consists of three main parts; the instrument itself, a tamper, and a geophone. It's simple to use. Only two men are required to operate the Terra-Scout seismograph. One strikes the ground with the tamper to set up shock waves, and the other operates the instrument to determine the wave delay between the tamper and geophone. The Terra-Scout circuitry and visual readout eliminates erroneous readings.

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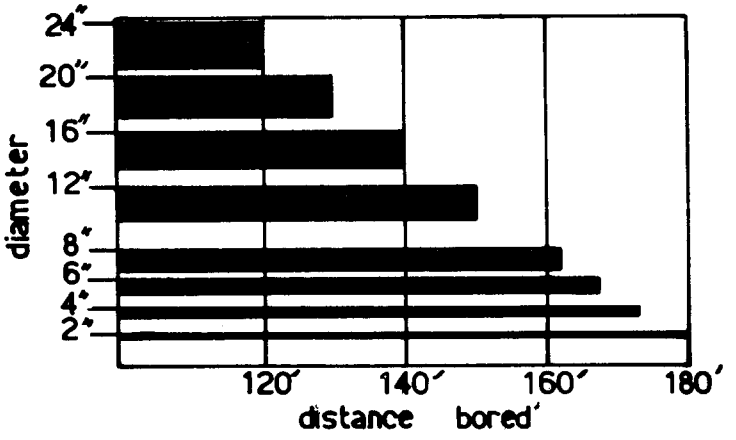
WE DRILL HORIZONTALLY

Under Roads, Runways and Buildings

IN FACT WE CAN DRILL ON ANY ANGLE

THRU' 360° ON ANY PLANE



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