N.Z. GEOMECHANICS NEWS

No. 7

NOVEMBER 1973

A NEWSLETTER OF THE N.Z. GEOMECHANICS SOCIETY

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C O N T E N T S

THIS IS A RESTRICTED PUBLICATION

"N.Z. Geomechanics News" is a newsletter issued to members of the N.Z. Geomechanics Society. 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. For 1973 the annual subscription varies depending on which International Society the member wishes to be affiliated to. The basic subscription rate is $2.40 and affiliation fees to the International societies are $0.60, $2.40 and $1.60 for Soil Mechanics, Rock Mechanics and Engineering Geology respectively. Members of the Society are required to affiliate to at least one International Society.

EDITOR'S NOTES

1. The Geomechanics Lectureship

Notice is given elsewhere in this issue regarding the First Geomechanics Lecture to be sponsored by the N.Z. Geomechanics Society. Present proposals are that the lecture will be presented in March-April 1974 in Auckland, Wellington and Christchurch, in each case in conjunction with the local branch of the N.Z.I.E.

The history of the proposals for the Geomechanics Lectureship is that a substantial profit was made by the organising committee for the Fifth Australian-New Zealand Conference on Soil Mechanics and Foundation Engineering held in Auckland in 1967. Most of this money has been invested by your Management Committee to provide an annual income which can be devoted towards the promotion of geomechanics in New Zealand. A considerable amount of thought and effort was put into deciding the manner in which this income could best be spent and the final decision was that it should be put towards "The Geomechanics Lectureship" to be held approximately biennially at three different cities in New Zealand, not necessarily the same ones on each occasion.

If the lectureship is to be effective in its purpose of promoting geomechanics in New Zealand, then it is essential that all members of the Society get right behind the idea, attend themselves if at all possible and persuade many of their friends and colleagues to attend also.

It is particularly important that this be done for the inaugural lecture as this will undoubtedly "set the tone" for future lectures and determine the amount of prestige with which the lectureship is held within New Zealand.

The inaugural lecturer will be Mr J.W. Ridley M.P. Not only is Mr Ridley a well known engineer who has been involved with mining and dam design and construction, but he is also the founding chairman of the N.Z. National Society for Soil Mechanics and Foundation Engineering, and thus one of the originators of the present Society.

Your Management Committee has organised and promoted this new venture. It is up to you, the membership of the Society, to ensure that the venture gets off to a successful start.

2. Geomechanics at the N.Z.I.E. Annual Conference

The Management Committee decided at its June meeting that the Society will participate in the 1974 N.Z.I.E. Annual Conference to be held in Wellington from 18-22 February.

As notified elsewhere in this issue, a Group Technical Session will be held on Tuesday afternoon 19 February to precede the A.G.M. of the Society at 8.00 p.m. the same evening. In this way, members of the Society from outside the Wellington area who would not normally be attending the N.Z.I.E. Conference will have more incentive to travel to Wellington to be present at the A.G.M. with the thought of a stimulating technical session in the afternoon. The afternoon technical session will take the form of a workshop on lateral earth pressures followed by a discussion and review of the recently published "M.O.W. Retaining Wall Design Notes".

Participation of the Society in future N.Z.I.E. Conferences will by no means necessarily be workshops of a similar type to this one which has been organised at relatively short notice. The Management Committee now invites any member to submit a paper on any geomechanics subject at any time for consideration for presentation in a Technical Group Session at future N.Z.I.E. Conferences, and for subsequent publication in the future N.Z.I.E. "Transactions". Synopses of papers to be considered for a particular N.Z.I.E. Conference should be in the hands of the Management Secretary by 31 May of the year preceding the Conference.

By offering itself as a vehicle for presentation and publication of member's papers your Society is endeavouring to encourage the preparation of more geomechanics papers in New Zealand, and in particular to papers which relate directly to typical geomechanics problems in New Zealand. In recent years the number of geomechanics papers published in New Zealand has been dismally low.

It is not intended that Technical Group Sessions at N.Z.I.E. Conferences will supersede the symposia organised by the Society on particular themes at approximately four yearly intervals. Rather, it is hoped that these two activities will be complementary - the symposia continuing to be made up of invited papers on a particular subject and the Technical Group Sessions of papers on any subjects which are forthcoming from the membership.

How often these Technical Group Sessions are held at N.Z.I.E. Conferences and the success of this new venture will depend on you, the membership of the Society. We trust that you will rise to the challenge.

3. Contributions Still Wanted

Contributions to New Zealand Geomechanics News 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 and 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
New Zealand Geomechanics News,
C/- New Zealand Geomechanics Society,
P.O. Box 12-241,
WELLINGTON.

J.P. Blakeley,
EDITOR

THE EVOLUTION OF ENGINEERING GEOLOGY FROM "GEOLOGY FOR ENGINEERS"

L.E. Oborn

Engineering Geology has evolved from geology to meet the specific needs of engineers. A decade or so ago geologists told engineers the rocks (everything was a rock in those days) that they might encounter at a site, the location of faults, and, in simplified terms, the geological structure, age, and mode of deposition of the various deposits. It was the exception for engineers to be told what all this meant for them. Geologists were trained to interpret natural processes and the results of these; they were not qualified, nor often very interested in trying to predict the behaviour of the materials that resulted from these processes.

There was little dialogue between engineers and geologists. Engineers suspected, in many cases probably justifiably, that geologists would impart little that was constructive; if a programme of investigation was suggested, the engineer was suspicious that he was being sold a geological research programme. Geologists very often believed that they were consulted only when it was too late, and when there were no data upon which to base opinions.

The very existence and structure of this Society testifies to the significant changes that have taken place in recent years. Ten years ago there was no one in New Zealand who admitted to using the tag "engineering geologist". Today possibly 20-25 would make this admission, on appropriate occasions if not all the time. The mere changing of a tag, of course, does not necessarily change attitudes and approaches to a problem. What changes have been made; how far has dialogue progressed, and how fruitful has it been?

The N.Z. Geological Survey, for example, after what seemed to be a slow start, has progressed in the past decade or so from the dependence upon the part time efforts of a few highly respected geologists, to an effective team of about 10 full time engineering geologists. The infrequent periodic visits to distant major sites are now largely a thing of the past. The Tongariro Power Development has four engineering geologists resident on site; the Upper Waitaki Power Development has one in residence and one visiting. The effectiveness of engineering geologists to site engineers has been increased immeasurably as a result of day-to-day discussions and deeper project involvement. The barriers that once existed are being broken down, and each discipline sees the other in a more favourable perspective. A number of Government Departments and consulting engineering firms too, have recognised the need for continuing engineering geological capability, and have engineering geologists on their staff. Several private consulting geologists also offer services in engineering geology.

The most significant adaptation has come from the geologists. Geologists now think of weak unconsolidated deposits as "soils", and enter the "rock, soft rock, soils" discussions with a vested interest. They now admit that "blue or brown Pleistocene or Holocene gravel" does not adequately define an alluvial deposit, and that a detailed petrographic and mineralogical description does not fully describe a rock. To be able to gain an adequate "picture" of a deposit indicated on a map, or to understand its likely behaviour for example, geologists now look for a description of its physical properties. They too, expect engineering properties to be adequately described in generally accepted terms.

The N.Z. Geological Survey realises that it must be able to prepare engineering geological reports and maps which provide this kind of information. Its engineering geologists think this way now, and on major projects obtain these data from Ministry of Works laboratories. Until recently, when it set up a modest geotechnical laboratory, the N.Z. Geological Survey did not have the facilities to make these kinds of investigations for its own research, engineering geological mapping, and for other applied projects with which it might be associated. This excursion into geotechnics is deliberately modest. It is not intended at this time, to determine and state index parameters with precision. Indeed to do so, especially in the regional mapping of "soils" and rocks having widely different physical properties, would suggest a degree of exactitude that would be quite unrealistic. The aim is to indicate between which well defined limits these properties lie.

A recently constructed rock shear box has extended the capability of the N.Z. Geological Survey's Engineering Geology Section to study the parameters of soft rock material and defects in hard and soft rocks, especially as these relate to slopes and excavations. At present they must rely on other laboratories, mainly Ministry of Works, to perform other tests on hard rocks, but an extension of effort into these fields in the immediate future is both essential and inevitable.

Engineering geology cannot stand in isolation. It must embrace the philosophies and adopt the techniques of related geomechanical disciplines, just as this Society in its sphere has done. Members of any team of engineering geologists, apart from being competent geologists, should be able to interpret geology in geotechnical terms; they should be able to see geotechnical problems as an engineer should, and make sound judgements based on available data; they should know how to obtain acceptable data, and be backed by a competent team of specialists. They must be able to differentiate between fact and opinion. They must be able to impart their knowledge and apply their skills for the advancement of engineering and the betterment of the environment. Engineering Geologists in New Zealand strive to achieve these aims.

HINTS ON METHODS FOR SAFEGUARDING THE STABILITY OF LAND

J.P. Blakeley

Introduction

The previous issue of "N.Z. Geomechanics News" (No. 6) contained an article on insurance against damage caused by landslip. The Editor's Notes in the same issue stated that this article would be followed up by some simple hints for methods of safeguarding stability both for individual house sections and development on a larger scale. These hints are intended to be for the general public and as such be the type of advice an engineer should give the public, either in his professional or private capacity.

Individual House Sections

You can help prevent that slip on your own or your neighbour's section by following these tips:

(a) Drain all stormwater effectively from your buildings and your section, but not on to your neighbour's property as this could cause a slip on his section. A soak pit is of little use and can be dangerous on a hillside. (Drainage and Plumbing Regulations require every homeowner to provide sufficient drains for taking stormwater from the premises to a street channel or other approved outfall).

(b) Don't excavate for a house, garage, swimming pool or driveway without competent engineering advice. Injudicious cutting into natural or graded slopes can result in disaster.

(c) Make sure all banks are properly retained whether they be in cut or fill, and see that retaining walls have adequate weep holes or drains behind the wall, and proper backfilling such as gravel or scoria.

(d) Any ground on your section which is to be covered with fill material should be stripped of vegetation and topsoil down to firm clay, before the filling is placed.

Filling should not be placed on sloping ground without considering the effects that the weight of the fill may have on the overall stability of the land. When filling is to be placed on sloping ground it will be necessary to ensure that the ground is properly benched, in addition to being stripped of all vegetation and topsoil, before the filling is placed.

All filling should be free from organic matter and adequately compacted.

(e) You can improve the stability of exposed slopes by planting suitable trees and shrubs.

(f) Don't disregard any ground surface crack or small slump on your section, as it could lead to something much bigger. Seek competent advice.

(g) Cracks opening up at the ground surface during a dry summer which have been caused by ground shrinkage should be filled in with clay as soon as they occur, if they are near the top of a bank or slope.

(h) Failure to act prudently by taking all reasonable precautions may mean the loss of your home and could also prejudice your right to landslip insurance cover.

(i) Further useful information is contained in the booklet "House Foundations" available from the Building Display and Development Centre, corner of Victoria Street West and Elliot Street, Auckland 1.

Larger Scale Development

The following notes are taken from Town and Country Planning Bulletin No 14, July 1972 produced by the Town and Country Planning Division, Ministry of Works and entitled "Town Planning and Unstable Land".

What Causes Landslides?

Gravity is the primary force operating. Movement occurs when the weight of soil and vegetation on a particular slope exceeds the resisting forces offered by the strength of the rocks, soil, and plant roots. The causes of movement can be divided into two broad classes:

(a) Natural causes, due to the inherent condition of the rock; to the degree of weathering, fracturing, layering, or deformation of rock; to movements resulting from soil development.

(b) Active or induced causes such as the removal of support at the toe of slopes, overloading, oversteepening, or the reduction of strength.

In general, movement usually takes place in inherently weak rock formations and can be triggered by any of the following factors:

Rain
Changed drainage systems (natural or induced)
Undercutting by excavations for structures, roads, etc
Undercutting by rivers and streams
Removal of vegetation
Overloading of slopes (e.g. by building, road, trees)
Earthquakes
Combinations of these

In urban developments the most important of these triggering mechanisms are the first three. For instance, a large proportion of the insurance claims paid out on landslide damage can be traced to inadequate provision for storm-water drainage.

What Kinds of Landslide are There?

Mass movements can be divided into three main groups according to the rate and character of movement and, to a lesser extent, the kind of material involved. These groups are:

Creep	(soil creep
	(scree
Slip	(soil slip
	(slump
Flow	(earthflow
	(debris avalanche

All types of mass movement can affect urban development, but movements in the slide and flow groups are more likely to be encountered. Often movements occur as a combination of these forms.

In What Kind of Rock are Landslides Most Common?

1. Weathered rocks and soil, especially in the soft, weaker siltstones and mudstones.

2. In all rocks where there are prominent layers of joints especially if they are strongly weathered. In harder rocks, zones of shattering or prominent joint planes are possible areas of weakness, particularly if they are exposed by road cuttings.

How to Recognise Unstable Areas

A safe slope is difficult to define. Bad earth movements have occurred on comparatively gentle slopes with no obvious warning signs on the surface, but in general it is wise to beware of steep slopes on soft rocks or areas where there is a high degree of soil and rock weathering, especially where rainfall can be intense. Signs of instability can include:

Hummocky ground and steep scarps
Swamps or wet ground in "perched" positions
Water seeping from the ground
Saucer-shaped surface depressions
Trees leaning downhill, or with curved trunks
Cracks in the ground surface
Crooked fences
Uneven road surfaces

Can any Effective Measures Be taken Against Landslides?

There are no completely effective measures for preventing earth movements but certian precautions can lower the risk. Where possible, the likely cause of movement should be identified and as far as practicable minimised.

The most common cause of earth movement in urban subdivisions is excess water. Here the most effective procedure is to increase strength and decrease weight by removing water. Surface or subsurface drains that will take known storm flows, and the diversion of surface flow away from the unstable area, are necessary in most cases. Soak pit drainage should never be used in areas which are hazardous.

Other methods, including the construction of physical restraining devices such as buttresses, retaining walls, and piles, are of doubtful value without effective drainage.

NEWS FROM THE MANAGEMENT SECRETARY

1. New Members

New Members elected to the Society since the last list was published in Issue number 6 are:

P.R. Barker	Petone
D.S. Brathwaite	Dunedin
D.J. Fergusson	Otahuhu
C.P. Gulliver	Auckland
M.J. Haydon	Auckland
T.J. Kayes	Auckland

2. NZIE Conference, Wellington 1974

The Society will be participating in the Group Technical Sessions on Tuesday afternoon, February 19, and the Annual General Meeting of the Society will be held at 8.00 p.m. on the same evening.

The afternoon technical sessions will take the form of a workshop on Lateral Earth Pressures. The workshop will be opened by the presentation of prepared papers by Messrs J.P. Blakeley and G.L. Evans on static and dynamic considerations of earth pressures.

An M.O.W. Officer representing the Chief Design Engineer, Civil, will then introduce and review the M.O.W. "Retaining Wall Design Notes" and will be followed by several brief prepared comments on various aspects of this publication. The remainder of these sessions will be open for general informal discussion and comment on the provisions and requirements of these design notes.

Members of the Society who are not members of the N.Z.I.E. will find registration papers enclosed with this copy of Geomechanics News. Other members will receive registration forms and other conference information direct from the Institution.

Our participation in the Group Technical Sessions of Conference and subsequent AGM, reflects the N.Z.I.E. policy of increasing Technical Group involvement in Conference activities. Your committee looks forward to a good attendance and lively participation by members at both the Technical Session and AGM.

3. International Conferences in Engineering Geology and in Rock Mechanics - 1974

The Second International Congress on Engineering Geology will be held at Sao Paulo, Brazil from 18-24 August 1974. Further details are given elsewhere in this issue. The Third International Congress of the International Society for Rock Mechanics will be held at Denver, Colorado, U.S.A., from 1-7 September 1974. Further details can be obtained from Mr G.D. Mansergh, N.Z. Geological Survey, P.O. Box 1471, Christchurch.

4. Invitation to Submit Geomechanics Papers for Review

The Management Committee decided at its June Meeting that the Society should offer itself as a vehicle through which presentation and publication of members' papers on geomechanics subjects can be arranged.

It is proposed that any paper which is submitted to the Society will be considered for presentation at Technical Group Sessions to be held at future N.Z.I.E. Conferences and for subsequent publication in the forthcoming N.Z.I.E. "Transactions".

Synopses of papers to be considered for a particular N.Z.I.E. Conference should be submitted to the Management Secretary by May 31st of the year preceding the Conference.

5. The Geomechanics Lectureship

Present proposals are that the First Geomechanics Lecture sponsored by the N.Z. Geomechanics Society will be presented in March-April 1974 in Auckland, Wellington and Christchurch. The lecturer will be Mr J.W. Ridley M.P., the foundation chairman of the N.Z. National Society for Soil Mechanics and Foundation Engineering (which later became the N.Z. Geomechanics Society). The provisional theme is "The Economics and Correct Use of Natural Materials".

If the proposed series of these Geomechanics Lectures are to be as successful as your Management Committee is hoping that they will be, it is most important that the inaugural lecture is well attended and received in all three main centres. We therefore hope that all members of the N.Z. Geomechanics Society will feel a personal obligation to attend the inaugural lecture if they possibly can do so and to invite and persuade many friends and colleagues to attend as well.

6. 8th International Conference of Soil Mechanics and Foundation Engineering

Among the matters dealt with at the Executive Committee Meeting at the above Moscow Conference in August, two matters are of general interest to members. They are:-

(a) The election of Professor P.W. Taylor of Auckland as the Australasian region Vice President for the next four years, and

(b) A significant and not unexpected rise in dues payable by affiliated societies and members. Your committee will be considering this matter at the next committee meeting.

7. 2nd Australian/New Zealand Conference On Geomechanics

The organising committee for this conference in July 1975 at Brisbane has called for papers for presentation at this conference.

Papers are invited on research, practical applications and review of the present state of knowledge in all fields of soil and rock mechanics. Topics of the sessions will depend on the papers received. It is hoped they will include:

Measurement Techniques in Soil and Rock Mechanics
Application of Computer Techniques in both Soil and Rock Mechanics
Environmental Aspects of Geomechanics Studies
Design of Earth and Rock Structures
Fracture Mechanics
Foundation Behaviour
Slope Stability
Handling non-homogeneous material
Roads and Pavements
Engineering Geology
Groundwater Hydrology

As a guide to intending authors, the present timetable is for titles of proposed papers and synopsis to be to hand not later than April 30, 1974. Papers accepted for presentation must be complete and to hand by November 30, 1974.

Intending authors should contact the Management Secretary, for further details.

8. Proceedings, Wanganui Symposium, September 1972

Copies of the Proceedings are still available for sale from the Management Secretary at a cost of $8.00 for Society members, and $10.00 for non-members.

9. Back Issues, N.Z. Geomechanics News

Copies of all back issues (1 to 6) of N.Z. Geomechanics News are available to members at a nominal cost of 50 cents per copy from the Management Secretary. Only a limited number of copies of issue 1 remain.

10. Forthcoming Conferences and Symposia

Listed below are Conferences and Symposia in the 1974-75 period which we know about. Members may be interested in either attending or obtaining proceedings. Further details can be made available on request.

1973

11-12 October	22nd Geomechanics Colloquium. Salzburg, Austria
23-24 October	International Symposium of the I.S.R.M. on Protection against Rock Fall. Katowice, Poland.
27-28 November	Fourth Symposium on Rock Mechanics in Japan. Tokyo, Japan.
13-15 December	Ninth Canadian Symposium on Rock Mechanics. Montreal, Canada.

1974

18-22 February	N.Z.I.E. Annual Conference, Wellington.
2 - 4 April	Conference on Settlement of Structures, Cambridge University, Great Britain (organised by British Geotechnical Society).
4 - 7 June	International Symposium on Genetical Basis concerning the Study of the Geotechnical Properties of Rocks. Moscow, U.S.S.R.
5 - 7 June	European Symposium on Penetration Testing. Stockholm, Sweden.
18-24 August	2nd International Congress on Engineering Geology. Sao Paulo, Brazil.
27-31 August	Geological Society of America Penrose Conference on Fracture Mechanics and Earthquake Source Mechanisms. Aspen, Colorado, U.S.A.
September	Walling and Anchors Conference. London, England. (Sponsored by the Piling Committee of the I.C.E.).
1 - 7 September	3rd International Congress of the International Society for Rock Mechanics. Denver, Colorado, U.S.A.

1975

	February	N.Z.I.E. Annual Conference
21-25	July	Second Australia-New Zealand Geomechanics Conference. Brisbane, Australia.

11. Membership Application Form

A membership application form is included at the back of this newsletter. If you show the newsletter to any non-member who expresses interest in joining the Society please cut out this form and give it to him.

For intending members the 1973 subscription is as follows:

Basic subscription N.Z. Geomechanics Society	$2.40
Affiliation fee to I.S.S.M.F.E. (Soil Mech. and Fdn. Eng.)	$0.60
Affiliation fee to I.S.R.M. (Rock Mechanics)	$2.40
Affiliation fee to I.A.E.G. (Eng. Geology)	$1.60

All members must affiliate to at least one of the International Societies.

12. Change of Address Notification

Some members in the past have not had their address updated or amended for N.Z. Geomechanics Society correspondence, although they have notified N.Z.I.E. of the change of their address for N.Z.I.E. correspondence. In order to ensure that the Society's records can be kept up to date, a change of address form is included at the back of this issue.

P.G.M. Imrie

Management Secretary

N.Z. Geomechanics Society
P.O. Box 12-241
WELLINGTON.

AN ENGINEERING GEOLOGIST IN THAILAND

W.M. Prebble

Over the last two years I have had the opportunity of working in two distinctly different regions of the Kingdom of Thailand. Both occasions were a direct participation in Colombo Plan Aid-sponsored ENEX projects and both were studies for major new roads.

The first project is located in the vast north-eastern region of Thailand - the Khorat Plateau which is a peneplain sloping ever so gently towards the Maenam Maekhong or Meking River which separates this part of Thailand from the mountainous country of Laos. The northeast is populated largely by Lao people and we were privileged to work in an area not previously studied in any detail by foreigners. The road survey stretched across 90 kilometres of almost featureless plateau in which the only landforms were undulating rather indistinct alluvial terraces. Outcrops of rock were almost non-existent and deeply weathered and were restricted to the deep river channels of the major drainage systems such as the Maenam Chi. Some 100-200 kilometres to the south, unweathered basalt outcrops near Buriram and Surin and this material was used for basecourse and sealing coats on the N.Z. Army road project. However, as on this road, the ENEX road was designed to use local sources of material for embankment and pavement construction up to at least sub-base level and possibly also for basecourse. At this stage a fairly painstaking geological survey which entailed recognition of the ancient terraces and drainage regimes revealed substantial quantities of lateritic gravel and these were extensively sampled to assess their suitability for road construction. Generally subgrade conditions were sand and clay on the terraces and silts in the low flood plain areas.

The second project differed remarkably in that hills and hard rock were in comparative abundance and included strong, fine grained, Palaeozoic limestones and Tertiary igneous rocks. Weathering of many of the rocks was only superficial and good quality gravels and sands were common on the higher terraces and slopewash fans. The area was northern central Thailand, in the central valley of the Chao Phrya River north of the major provincial towns of Lop Buri and Sing Buri. Altogether 200 kilometres of proposed road route were investigated.

Common to both the ENEX projects was a problem of access away from existing roads. Somewhat unfortunately, both projects also took place during the hot dry season when dust and haze fill the air and the sun provides daily tormentation with relentless temperatures of around 40 degrees Celsius. During the months of February and March there are few breezes to alleviate the heat but during April and May the humidity slowly rises until afternoon thunderstorms and showers provide a welcome relief. One carries copious quantities of iced water and lemon drink and survives on a daily basis of drinking this regularly along with a lunch of local pineapples and oranges supplemented with tinned fruit.

Our transport was by Landrover in which several thousand kilometres were driven in the space of 3 to 4 months in the field. We were well served by irrepressible Thai drivers with a penchant for overcoming any physical obstacles in their path and, in many cases, with an abundance of initiative for helping out in difficult situations.

An example of this was the stopping of an express train in a local provincial station, just as the engine was pulling away. To the amazement of hundreds of Thais my driver flagged the train to a halt and somehow located one of our team members on board and whisked him off the train into a Landrover and to a rendezvous with me before anyone had guessed what was happening.

Members of our team even innocently spent several hours in jail and had to be bought out of captivity, all because of a passive involvement in a minor road accident. Such events teach great tolerance, and may even have contributed towards international understanding at the expense of considerable discomfort and humiliation on our part.

The Thai Geological Survey were of great assistance in providing geological maps, reports and much verbal comment on the regions involved in the studies.

Local quarries already operating provide excellent basecourse material and generally the study revealed an abundance of natural materials. The time consuming part of these projects is the daily travel out in the field. Whether on foot or in the Landrover, this tends to be a tiring exercise.

We operated out of small country towns and established a well equipped base in a new house rented from the local people. Food supplies were readily obtainable from Bangkok supermarkets and from the local produce markets.

Both projects finished field work in June, by which time the countryside is either naturally or deliberately flooded to provide wet paddies for the planting of rice seedlings. The countryside at this time is lush and beautifully vivid with clear blue skies and towering white clouds. In fact, this is a very pleasant time to be in Thailand and it contrasts vividly with the oppressive heat and barrenness of the dry season some months earlier.

S.I. UNITS IN GEOMECHANICS

P.W. Taylor

The following simple examples (some of which were presented at a Continuing Education Seminar on Metrication at the University of Auckland last May) serve to illustrate the use of S.I. units in Geomechanics calculations.

Density and Stress

As was mentioned in a previous article (Geomechanics News, No. 4, p.3) the S.I. unit of density is in mass per unit volume, (kg/m^3 with the symbol ρ) instead of weight per unit volume ($lbf./ft^3$) with the symbol γ) as used in the Imperial system.

Example 1

Using a balloon densometer, the density of a clay stratum, exposed by excavation is to be found from the following results -

Mass of soil excavated = 2.70 kg
Volume of hole measured = 1500 mℓ

Converting this volume to the S.I. unit
Volume = $1500 \times 10^{-6} m^3$

$\therefore$ Density of soil, $\rho = \frac{\text{mass}}{\text{volume}} = \frac{2.70}{1500} \times 10^6$

$= 1800 \text{ kg/m}^3$

(In Imperial units, the density of water is 62.4 $lbf./ft^3$.
The soil density, γ, in Imperial units is $1800 \times \frac{62.4}{1000} = 112 \text{ lbf./ft}^3$.)

Example 2

What is the vertical stress, p, at a depth of 6m beneath the surface of this uniform clay?

(Stress = force per unit area, and force = mass x acceleration)

Considering $1m^2$ plan area and with acceleration due to gravity, $g = 9.8 \text{ m/s}^2$.

The stress, $p = \rho gh = 1800 \times 9.8 \times 6$ Pa

As it is a coherent system, and we have used the SI units for each quantity (not multiples or submultiples) the answer must be in the S.I. units for stress (pascals or newtons/m^2).

Converting to the more practical multiple

$p = 106$ kPa (kilopascals)

This example shows why it is necessary to have a new symbol ρ for mass density.

Old system	New system
$p = \gamma h$	$p = \rho gh$

As an alternative to replacing γ by ρg in all formulas, we can calculate the weight density in newtons per m^3.

Thus $\rho = 1800$

$\gamma = \rho g = 1800 \times 9.8$

$= 17600 \text{ N/m}^3$ (or 17.6 kN/m^3)

Strength, Bearing Capacity and Earth Pressure

The unconfined compression test machine incorporates a spring or a proving ring to determine the force on the sample in newtons, at failure. Dividing this force by the cross-sectional area of the sample gives the compressive strength. The most convenient unit is the kilopascal.

Suppose the compressive strength $q = 84$ kPa (about 12 lb./sq.in.)

Assuming $\phi = 0$ the cohesion $c = q/2$

$c = \frac{84}{2} = 42$ kPa for the same clay.

Example 3 - Bearing Capacity

The safe gross bearing capacity is given by

$$q_s = \frac{c\,N_c}{F} + \rho g D \quad (\gamma \text{ has been replaced by } \rho g)$$

where N_c is the bearing capacity factor
F^c is the load factor.

For a footing at 0.5m depth, taking $N_c = 6$ and $F = 3$ ($c = 42$ kPa)

$$q_s = \frac{42 \times 6}{3} + \frac{1800 \times 9.8 \times 0.5}{1000} \text{ kPa}$$

$= 93$ kPa (about 0.88 tons/sq.ft.)

Example 4 - Retaining Wall

Determine the bending moment at the base of a retaining wall 6m high, with dry sand backfill, density 1950 kg/m^3 such that the coefficient of active earth pressure is 0.34.

The active pressure at depth h is

$$p_a = K_a \rho g h$$

where K_a is the coefficient of active earth pressure,

at 6m depth, $p_a = 0.34 \times 1950 \times 9.8 \times 6$ Pa

$= 39$ kPa

The overturning force, P, per metre length of wall (the area of the stress triangle)

$P = \frac{1}{2} \times 39 \times 6$

$= 117$ kN per metre length of wall

The force acts at one third of the height, so the bending moment

$$m = 117 \times \frac{6}{3} \text{ kN m}$$

$$= 234 \text{ kN m} \qquad \text{per metre length of wall}$$

Consolidation and Settlement

Example 5

A 2m layer of compacted filling, of density, 1800 kg/m^3, is to be placed over a wide area on a 3m thick stratum of soft clay which overlies dense sand. The clay is normally-loaded and has the following average properties.

Initial void ratio 1.90; density 1500 kg/m^3; compression index 0.40; coefficient of consolidation 0.085 mm^2/s. Assuming the filling to have high permeability, and the water table to be at the surface of the clay, determine -

(a) The total eventual settlement.
(b) The time for 90% settlement.
(c) The settlement after three months.

(a) At mid-height of clay stratum; the original vertical effective stress,

$p_o = 1.5 \times 9.8 (1500 - 1000)$ Pa

$= 1.5 \times 9.8 \times 0.5$ kPa $= 7.35$ kPa

$\Delta p = 2 \times 9.8 \times 1800 \times 10^{-3}$ kPa $= 36.3$ kPa

$\therefore$ p_1 (= final vertical effective stress) $= 43.65$ kPa

Now $H = 3$m, $e_o = 1.9$ and $C_c = 0.4$

$$S = \frac{H}{1 + e_o} C_c \log_{10} \frac{p_1}{p_o}$$

$$= \frac{3}{1 + 1.9} 0.4 \log \frac{43.65}{7.35}$$

$= 0.32$m Eventual Settlement $= 320$ mm

(b) $T_{90} = 0.848$; $d = 1.5$m; $c_v = 0.085$ mm^2/s $= 0.085 \times 10^{-6}$ m^2/s

$$t_{90} = \frac{T_{90} d^2}{c_v}$$

$$= \frac{0.848 \times (1.5)^2 \times 10^6}{0.085}$$

$$= 22.4 \times 10^6 \text{s}$$

$$= \frac{22.4 \times 10^6}{24 \times 3600} \text{ days} \qquad t_{90} = 260 \text{ days}$$

(c) $t_x = 3$ months $\doteqdot 30 \times 3 \times 24 \times 3600$ s

$$T_x = \frac{t_x c_v}{d^2}$$

$$= \frac{30 \times 3 \times 24 \times 3600 \times 0.085}{(1.5)^2 \times 10^6} = 0.295$$

From the U-T relationship, U = 0.61

At three months the settlement is 0.61 x 320 = 195mm

The calculations for rate of settlement may be simplified by expressing the coefficient of consolidation in terms of m^2/year.

Conversion: Multiply mm^2/s by 31.6 to obtain m^2/year
Repeating (b) and (c) above,

$c_v = 0.085\ mm^2/s$

$= 0.085 \times 31.6 = 2.68\ m^2/year$

$t_{90} = \frac{.848 \times (1.5)^2}{2.69}$ years

$= 0.71$ years (= 260 days)

$t_x = 0.25$ year. $\quad T_x = \frac{t_x c_v}{d^2}$

$= \frac{0.25 \times 2.68}{(1.5)^2}$

$= 0.295$ (as before)

Permeability

In determining the coefficient of permeability from the results of a consolidation test, mistakes are easily made with Imperial units, as the calculation typically uses inches (for sample height), tons/sq.ft. (for stress) and cm./sec. (for permeability). This is greatly simplified in the SI system.

Example 6

During a consolidation test on a clay, a stress increase from 100 to 200 kPa caused a decrease in sample thickness from 18.8 to 17.4 mm and the time for 90% consolidation was found to be 16 minutes. Determine the coefficient of consolidation (c_v) and the coefficient of permeability (k)

$c_v = \frac{Td^2}{t}$ ($t_{90} = 16 \times 60 = 960s$ $d = \frac{18.8}{2} = 9.4mm$ $T_{90} = 0.848$)

$= \frac{0.848 \times (9.4)^2}{960}\ mm^2/s$

$c_v = 0.078\ mm^2/s$

Now, $c_v = \frac{k}{\rho_w g m_v}$ where $m_v = \frac{\Delta e}{(1 + e_o)\ \Delta p}$

ρ_w is the density of water
e is the void ratio
Δp is the change in stress

Also, in terms of sample height (h)

$$\frac{\Delta e}{1+e_o} = \frac{\Delta h}{h_o}$$

$h_o = 18.8$ mm
$\Delta h = 18.8-17.4 = 1.4$mm
$\Delta p = 200-100 = 100$ kPa

Thus

$$k = \frac{c_v \rho_w g}{\Delta p} \frac{\Delta h}{h_o}$$

$$= \frac{0.078 \times 10^{-6} \times 1000 \times 9.8}{100 \times 10^3} \times \frac{1.4}{18.8}$$

$$= 5.69 \times 10^{-10} \text{ m/s}$$

For simplicity, initial sample height has been used here, rather than average height. See Hawley (Geomechanics News, No. 6, p.17) for discussion on this point.

GEOMECHANICS ACTIVITIES IN AUCKLAND

J.P. Blakeley

The N.Z.I.E. Auckland Branch Geomechanics Technical Group continues with a number of activities under the chairmanship of Mr R. Gilmour.

During the past year a second edition of the booklet "House Foundations" has been produced with various amendments and additions. The booklet is available from the Building Display and Development Centre in Auckland and is written for the benefit of the general public, giving sound advice on selecting a section and precautions to be taken in building a house on various types of site. Although written specifically for the Auckland area and for problems encountered here, much of the advice given in this booklet would have a general application to most of New Zealand and beyond. Along with the updating of this booklet, the House Foundations Exhibition has been remounted and many of the diagrams redrawn, and the exhibition is now reinstalled in the Building Display and Development Centre.

The Group also overseas and encourages the building up of the card index system of borehole information, and as the records are received, the borehole locations with relevant information are being plotted on overlay maps being prepared by the N.Z. Geological Survey office at Otara. The information being provided by the cards is being made use of, where relevant, on new Industrial Series geological maps of the Auckland area being produced on a 1:25000 scale. It is hoped that these maps will be available early in 1974.

A new innovation over the last eighteen months has been the holding of geomechanics group meetings for all people interested in geomechanics in the Auckland area. The meetings are publicised in the N.Z.I.E. Auckland Branch Bulletin, and notices of the meetings are sent individually to all members of the N.Z. Geomechanics Society with Auckland addresses recorded on the membership list. The meetings are held at the Auckland University School of Engineering and generally commence at 5 p.m. with refreshments in the staff common room, followed by the meeting in a lecture room from 5.30 - 7.00 p.m. The use of the University facilities is gratefully acknowledged.

Subjects discussed to date are as follows:-

September 1972	"The Register of Borehole Information for the Auckland Area" (combined meeting with Geological Society of N.Z., Auckland branch). Discussion led by L.O. Kermode
November 1972	"Some Anomalies in the Assessment of Pile Loadings" Discussion led by B.C. Hadfield
March 1973	"Metrication in Geomechanics" Discussion led by Prof. P.W. Taylor
July 1973	"The Utilisation of Water-Borne Geophysics in Sub-surface Investigation of the Auckland Harbour" Discussion led by D.K. Taylor and Prof. A. Kibblewhite.
October 1973	"The Use of Field Instrumentation and Measurements on Pile Foundations and a Sheet Pile Retaining Wall" Discussion led by C.F. Mead

The meetings have generally all been well attended, 20 or more people being present and have served a most useful function as a meeting place for people interested in geomechanics in the Auckland area.

It is hoped that the publication of this article may inspire some enthusiasts in other centres to set up local groups to foster geomechanics activities in their area.

SECOND INTERNATIONAL CONGRESS OF ENGINEERING GEOLOGY

Sao Paulo, Brazil, 18-24 August 1974

L.E. Oborn

Papers are invited from New Zealand on any of the seven Congress Themes.

Theme I - Teaching and Training in Engineering Geology

Theme II - Seismic Phenomena and Engineering Geology

Theme III - Engineering Geology Related to Urban and Country Planning

Theme IV - Engineering Properties and Classification of Natural Materials of Construction

Theme V - Mass Movements

Theme VI - Engineering Geology Related to Dam Foundations

Theme VII - Engineering Geology and Underground Construction

For notes on the scope of these various themes see N.Z. Geomechanics News No. 6 (June 1973).

Manuscripts should be submitted to the N.Z. Geomechanics Society which, as the National Group, will select and forward papers for acceptance by the Congress Organisers. All the papers that are accepted will be published in the Congress proceedings, and will be distributed at the Congress.

Papers should be limited to a total of 10 pages of single space text and diagrams. The photographic process used requires that a specified layout and paper size be used. Details of these have been published in the Second Circular, and are available from the Engineering Geology Subcommittee of the N.Z. Geomechanics Society.

Manuscripts must be with the N.Z. Geomechanics Society by 31 January 1974.

NEWS FROM THE I.A.E.G.

L.E. Oborn

1. Bulletin of the I.A.E.G. - Reduced Rates to Members

The Bulletin is the official organ of the I.A.E.G.

It is published twice yearly, presenting papers (in either English or French) on a wide range of topics, including:

(i) Scientific and technical communications pertaining to Engineering Geology in general. Articles selected are original although translations of articles may also be included in they were initially published in periodicals of limited circulation. The authors may be members or non-members of the Association.

(ii) Information about the International Association, national groups, and news of professional concern.

(iii) Bibliographical analyses and book reviews.

A correspondence and discussion column is open to all readers.

Members of the N.Z. Geomechanics Society who have elected to affiliate with the I.A.E.G. qualify for a 50% reduction in the subscription rate, from about $8 to about $4 per year.

It is necessary for those wishing to subscribe to the Bulletin to advise the Secretary of the Society as soon as possible.

2. International Conference (in association with I.A.E.G.)

An international conference entitled "Genetic Principles of Engineering - Geological Study of Soil and Rocks" is to be held in Moscow from 4-7 June 1974.

The topics to be discussed will include:

(i) Present-day knowledge in the formation of engineering-geological properties of rocks and soils.

(ii) Role of physico-chemical and thermodynamical conditions in the process of formation and composition, structure and properties of rocks and soils.

(iii) Formation of properties of sedimentary rocks and soils in the process of lithogenesis.

(iv) Formation of properties of magnetic and metamorphic rocks.

(v) Influence of tectonic factors on state and properties of rocks and soils.

(vi) Changing of properties of rocks and soils under the influence of weathering.

Further details are available from the Engineering Geology Subcommittee of the N.Z. Geomechanics Society.

RECENT N.Z. GEOMECHANICS PUBLICATIONS

J.P. Blakeley

1. House Foundations (2nd Edition)

This useful booklet is written for the benefit of the general public, and gives sound advice on selecting a section and precautions to be taken in building a house on various types of site. It has recently been produced as a second edition with various amendments and additions, and is available from the Building Display and Development Centre, corner of Victoria Street West and Elliot Street, Auckland 1. Although written specifically for the Auckland area, most of the advice given has a much wider application.

2. N.Z.S. 4431 P : 1973 Code of Practice for Earth Fill for Residential Development

This Code of Practice has been available for purchase from the Standards Association of N.Z., Private Bag, Wellington since September of this year. It has been discussed in previous issues of N.Z. Geomechanics News and is published in metric units. As a provisional standard it is to be reviewed within 12 months of publication and users are invited to send suggestions for the final document to the Director of the Standards Association of N.Z.

3. N.Z.S. 4204 P : 1973 and 4205 P : 1973 Codes of Practice for the Design of Foundations for Buildings

The November 1973 issue of "Standards Association Newsletter" has just announced the availability of these documents from the Standards Association of N.Z., Private Bag, Wellington. N.Z.S. 4204 P is for buildings not requiring specific design whereas N.Z.S. 4205 P is for buildings which do require specific design. Both are published in Imperial units and metric handbooks are available, designated MP 420400 : 1973 and MP 420500 : 1973

These codes of practice are published as provisional standards for review within 12 months of publication and users are invited to send suggestions to the Director of the Standards Association of N.Z.

MEASUREMENT OF IN-SITU SOIL DENSITY

(Final in a Series of 6)

J.H.H. Galloway

6. SUMMARY

This article compares the various methods of measuring in-situ unit weight of soils previously discussed in this series and emphasises some important points which, I feel, are often overlooked by those specifying, planning or carrying out a field testing programme or in assessing its results.

Important points to remember are:-

(a) The original ground surface forms one boundary of the test volume and must match its assumed shape.

(b) The digging plate is the datum of the whole measuring system and must be handled accordingly.

(c) Significant moisture losses can occur during hole digging.

(d) It is often more important to have many tests of moderate accuracy than a few tests of high accuracy.

(e) Random errors are tolerable biased results are not.

I would assess the various test methods as follows:-

(i) Sand Replacement

A reliable method of moderate accuracy which can be used by relatively unskilled personnel. There are relatively few causes of gross error. The precision of the method can be improved by the use of the symmetrical type sand cone and in many cases, by the use of Suckling clover seed as a calibrated "sand". The method can be used in permeable soils but not where pore sizes exceed the grain size of the calibrated sand. This is particularly the case where clover seed is used.

The method is recommended when only intermittent testing is done and no body of well trained operators exists.

(ii) Oil Replacement

Potentially a little more accurate than sand replacement but more subject to operator errors. The method can only be used in oil impermeable materials and tends to be messy. It has proved acceptable on well established jobs where a large volume of testing permits a well trained gang to be formed. It is not recommended for occasional use.

(iii) N.Z. Densometer

A sophisticated method which in the hands of well trained and intelligent operators gives excellent results. The method is, however, quite subject to operator error and should not be used by untrained personnel. Well operated it demonstrates when errors are incipient. It can provide continuous unit weight profiles to any desired depth in

almost any material, the limitation being ones ability to dig the test hole. In particular it will cope with open textured materials where neither oil nor sand replacement is possible.

Other types of balloon apparatus should be regarded with a good deal of suspicion.

(iv) Nuclear Methods

My experience with these has been limited and unfortunate. The method appears to have considerable potential, but after 15 years of development the potential still remains potential.

(v) Drawings

Drawings of the symmetrical type sand cone and the N.Z. Densometer Mark IV are available to organisations on request from

The Laboratory Services Engineer,
Central Laboratories,
Ministry of Works,
P.O. Box 30325,
LOWER HUTT.

as well as operating instructions for the densometer.

PROCEEDINGS OF SOIL MECHANICS AND FOUNDATION ENGINEERING CONFERENCES

These Tables are published to indicate the current availability of the various Proceedings of International and Regional Conferences on Soil Mechanics and Foundation Engineering.

KEY TO LIBRARIES

A	Ministry of Works Head Office
B	Soil Bureau, D.S.I.R., Lower Hutt
C	Auckland University School of Engineering
D	Canterbury University School of Engineering
E	Otago University
F	N.Z. Electricity Department Library, Wellington
G	Municipal Reference Library, Auckland City Council
H	Ernest and Marion Davis Library, Auckland Hospital

INTERNATIONAL CONFERENCES

Location	Publishers	Cost	Libraries
1st Harvard, 1936	Geotechnical Engineers Inc. 934 Main Street Winchester, Mass. 01890 U.S.A.	U.S. $40.00 (bound reprint)	A B E
2nd Rotterdam, 1948		Out of print	A D B F C
3rd Zurich, 1953	Societe Suisse de Mecanique des Sols et des Travaux de Foundations, Case Postale 8022, Zurich, Switzerland	U.S. $70.00	A D B E C F
4th London, 1957		Out of print	A D B G C
5th Paris, 1961	Comite Francais de la Mecanique des Sols et des Foundations, 31 rue Henri-Rochefort Paris 17e, France	F.F. 213.79	A D B G C
6th Montreal, 1965	University of Toronto Press University of Toronto Toronto 5, Canada	Can. $100.00	A D B C
7th Mexico City, 1969	Sociedad Mexicana De Mecanica de Suelos A.C. Apartado Postal 8200 Mexico 1, D.F. Mexico	U.S. $40.00	A C D
8th Moscow, 1973	Secretary, VIII ISSMFE Gosstroy USSR Marx Prospect 12 Moscow K-9, USSR		

REGIONAL CONFERENCES

I - AFRICAN

Location	Publishers	Cost	Libraries
1st Pretoria 1955	-	Not available	
Proceedings were published in Trans. S.A. Inst. of Civil Engrs V, 263-322, 406-478, 1955			
2nd Lourenco Marques, 1959	-	Out of print	B
3rd Salisbury, 1963	-	Out of print	A B
4th Cape Town, 1967	Messrs A.A. Balkema 93 Keerom Street Cape Town, South Africa	S.A. R.20.00	A B C
5th Luanda, 1971	The Secretary, 5th RCASMFE Caixa Postale 6500 Luanda, Angola	U.S. $40.00	

II - ASIAN

Location	Publishers	Cost	Libraries
1st New Delhi, 1960	-	Out of print	
2nd Tokyo, 1963	Japanese Society of Soil Mechanics and Foundation Engineering Toa Bekkan Building 13-5, 1-chome, Nishi-Shinbashi Minato-ku, Tokyo, Japan	U.S. $20.00	B
3rd Haifa, 1967	-	Out of print	A D B
4th Bangkok, 1971	Asian Institute of Technology P.O. Box 2754, Bangkok, Thailand	U.S. $30	

REGIONAL CONFERENCES

III - AUSTRALIA-NEW ZEALAND

Location	Publishers	Cost	Libraries
1st Melbourne, 1952	-	Out of print	A D C
2nd Christchurch, 1956	-	Out of print	A C B D
3rd Sydney, 1960	-	Out of print	A D C
4th Adelaide, 1963	Institution of Engineers, Australia, Science House, 157 Gloucester Street, Sydney, N.S.W. 2000, Australia.	Aus. $18.50 plus postage	A C B D
5th Auckland, 1967	Institution of Engineers, Australia, Science House, 157 Gloucester Street, Sydney, N.S.W. 2000, Australia.	Aus. $25.00 plus postage	B E C G D
6th Melbourne, 1971 (1st Geomechanics)	Institution of Engineers, Australia, Science House, 157 Gloucester Street, Sydney, N.S.W. 2000, Australia.	Aus. $40.00 plus postage	

IV - EUROPEAN

Location	Publishers	Cost	Libraries
1st Stockholm, 1954	Swedish Geotechnical Society Banergatan 16 115 26 Stockholm, Sweden.		
Only Vol. III available, at S.Kr. 26.00. Also reprinted in Geotechnique, V, 1-226, 1955.			
2nd Brussels, 1958	-	Out of print	
3rd Wiesbaden, 1963	Deutsche Gesellschaft fur Erd- und Grundbau e.V. 43 ESSEN, Kronprinzenstrasse 35a, Germany.	Vol. 1 only available at DM. 50	
4th Oslo, 1967	Norwegian Geotechnical Institute, Forskningsveien 1, Oslo 3, Norway	N. Kr. 210	
5th Madrid, 1972	Sociedad Espanola de Mecanica del Suelo y Cimentaciones Laboratorio del Transporte y Mecanica del Suelo, Alfonso XII No. 3, Madrid 7, Spain.	U.S. $36.00	

REGIONAL CONFERENCES

V - PANAMERICAN

Location	Publishers	Cost	Libraries
1st Mexico City 1960	Sociedad Mexicana de Mecanica de Suelos, A.C. Apartado Postal 8200 Mexico, D.F. Mexico	U.S. $30.00	B
2nd Sao Paulo, 1963	Associacao Brasileira de Mecanica dos Solos, Rua Joaquim Nabuco, 254 - ap. 201, Rio de Janeiro, Guanabara ZC-37, Brazil.	U.S. $30.00	B H
3rd Caracas 1967	Sociedad Venezolana de Mecanica del Suelo e Ingenieria de Fundaciones, Apartado 4074 - Este Caracas, Venezuela.	U.S. $30.00	B H
4th Puerto Rico, 1971	American Society of Civil Engineers, 347 E. 47th Street, New York, N.Y. 10017, U.S.A.	U.S. $20.00	

APPLICATION FOR MEMBERSHIP

of

New Zealand Geomechanics Society

A TECHNICAL GROUP OF THE NEW ZEALAND INSTITUTION OF ENGINEERS

The Secretary,
N.Z. Institution of Engineers,
P.O. Box 12-241,
WELLINGTON.

I believe myself to be a proper person to be a member of the N.Z. Geomechanics Society and do hereby promise that, in the event of my admission, I will be governed by the Rules of the Society for the time being in force or as they may hereafter be amended and that I will promote the objects of the Society as far as may be in my power.

I hereby apply for membership of the New Zealand Geomechanics Society 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 _____

_____

_____

Affiliation to International Societies: (All members are required to be affiliated to at least one Society, and applicants are to indicate below the society (ies) to which they wish to affiliate).

I wish to affiliate to:

International Society for Soil Mechanics and Foundation Engineering (ISSMFE) Yes/No

International Society for Rock Mechanics (ISRM) Yes/No

International Association of Engineering Geology (IAEG) Yes/No

Signature of Applicant _____

Date _____ 19____

NEW ZEALAND GEOMECHANICS SOCIETY

NOTIFICATION OF CHANGE OF ADDRESS

The Secretary,
N.Z. Institution of Engineers,
P.O. Box 12-241,
WELLINGTON.

Dear Sir,

CHANGE OF ADDRESS

Could you please record my address for all New Zealand Geomechanics Society correspondence as follows:

_____

_____

_____

Name: _____

Address to which present correspondence is being sent:

_____

_____

_____

Signature _____

Date _____

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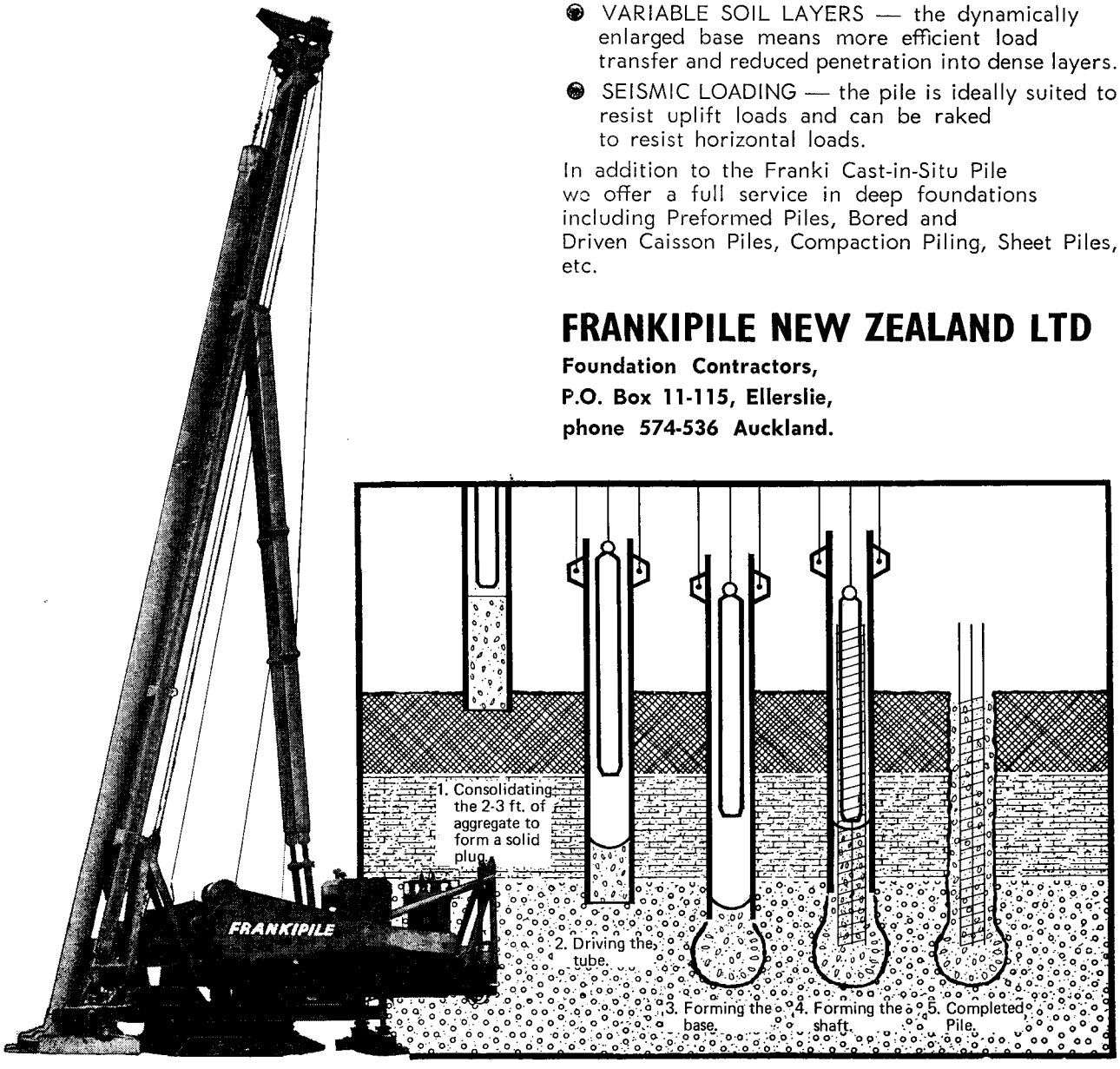

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