N.Z. GEOMECHANICS NEWS

No. 4

JUNE 1972

A NEWSLETTER OF THE N.Z. GEOMECHANICS SOCIETY

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CONTENTS

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. The annual subscription rate is at present three dollars. For 1973 the annual subscription will vary depending on which International Society the member wishes to be affiliated to, as discussed elsewhere in this issue.

EDITOR'S NOTES

1. Metrication

In this issue we present a paper on a subject which is bound to loom large in the minds of all engineers in New Zealand within the next two to three years, and to a lesser extent in the minds of engineering geologists as well - the changing of the foot pound second system of units which we are all accustomed to using to the new System Internationale (or S.I. for short) system of metric units. We hope that our members are not going to let this change worry them more than it should do - and for this reason Professor P.W. Taylor's light-hearted treatment of the problem is especially welcome. However, although it may be written in this light-hearted vein, it still contains all the essential information which will be needed.

For each individual, the transition to metric units is bound to be a "two stage" one. First he will continue to think and work in the old system of units and then convert his answers to the new S.I. units. However, we would hope that most people will quickly be able to get beyond this transition stage to the second stage which is actually thinking and working in metric units.

For the soils and rock engineer, the units he has been used to working in will be principally lb/sq.in, lb/sq.ft., kip/sq.ft. and tons/sq.ft. These are used for shear strength of soils and rock and also for stresses applied and safe bearing capacity of soil and rock. These units are all to be replaced by the kilonewton per square metre (kN/m^2) which has recently become named the kilopascal. Obviously the kilopascal is going to be a much used unit in geomechanics and we sincerely hope that all our members read Professor Taylor's paper with the attention it deserves.

2. A New Name for Our Society

On the 9th February 1972 at a meeting in Christchurch the N.Z. Geomechanics Society came into being and the N.Z. National Society for Soil Mechanics and Foundation Engineering faded out of existence. The reasons for the formation of this new Society have been fully explained to members over the past two years and in our previous issue (No. 3) an article written by Mr R.O. Bullen covered fully how the Constitution of the new Society will work.

The first main consequence of the change in name of the Society is an enlarged national committee which has ten instead of eight members, and in addition a co-opted secretary. This committee is now called the Management Committee and is headed by the chairman, Mr J.H.H. Galloway. In addition three sub-committees have been established, each headed by a vice-chairman to promote and further the interests of each of the three disciplines involved. These vice-chairmen are Mr D.K. Taylor (Soil Mechanics), Mr L.E. Oborn (Engineering Geology), and Mr J.K. Hill (Rock Mechanics).

Another consequence of the change in name is that all members must choose which of the three International Societies now involved they wish to be affiliated with, and this of course will affect their annual subscription fee. For the meantime all members are affiliated to the International Society for Soil Mechanics and Foundation Engineering. This matter is discussed further in "News from the Management Secretary" in this issue.

The N.Z. Geomechanics Society has successfully come into being. Its success and growth will depend on the efforts of all members of the Society.

3. Wanganui Symposium

The last Symposium organised by the Society was the Site Investigations Symposium held in Christchurch in August 1969. This dealt broadly with techniques and procedures for obtaining information from the field for the design of building foundations. However, in foundation engineering, the problem is often not so much in obtaining the information from the field but after having obtained the information in deciding what to do with it, and this is the theme to be covered by the Wanganui Symposium which will be held on the first Friday and Saturday of September 1972.

We are most appreciative of the efforts of the Wanganui Branch of the N.Z.I.E. in hosting this symposium. The Wanganui Branch is one of the smaller branches and its resources will be much more strained than a larger branch in obtaining a local organising committee to do the work. We are hoping for an attendance at the Symposium which will justify their efforts. Wanganui will not have a large number of local members to swell the attendance but it is easily accessible by road and air from most places in the North Island, and by air from the South Island. In any case it is much better to not attend a Symposium or Conference in your home town as it avoids the horrible temptation to duck back to work between sessions "to see if anything has cropped up" - usually something has !

Therefore making the effort to get right away from it all can not only mean much more benefit from a Symposium technically, but also from informal discussions with other participants. We hope that many of our members will make the effort in September.

4. Contributions Still Wanted

Contributions to N.Z. 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:

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N.Z. Geomechanics News
c/- N.Z. Geomechanics Society
P.O. Box 12-241,
Wellington.

J.P. Blakeley
EDITOR

A LIGHT-HEARTED LOOK AT METRICATION

P.W. Taylor

When you go home after a tiring day and say to your wife, "I am so exhausted I could sleep for a megasecond", you will have been metricated. Maybe you don't want to be metricated, but metrication is coming whether you like it or not. (To save you working it out, a megasecond is about 11½ days.) As with all new systems of units, great advantages are claimed. It is a much more logical system than we had before; it will simplify our calculations immensely and replace a lot of out-moded illogical units. Some cynics say that it won't replace any of the existing units, it will just add some new ones to those presently in use. This is an unnecessarily pessimistic view. The old units do disappear. Take for example the Roman coin, the denarius. This is no longer with us. Even the d. has disappeared (about a year ago), to be replaced by the p. in the new British currency. Apothecaries' measures, which used to clutter the covers of school exercise books, have been disappearing. One scarcely ever hears of grains, drachms or scruples. (Who has any scruples nowadays?) The carat is still with us, but only for diamonds and gold, and these seldom turn up in soil mechanics.

There is I suspect, an element of international one-upmanship in the adoption of the 'Systeme International', (SI) by British Commonwealth countries as this will enable us to out-metricate the Continentals, where metrication first started. While French engineers may still be working in terms of kilograms per square centimetre, an old-fashioned gravitational unit, we'll be using kilonewtons per square meter, (or kilopascals, if you prefer). In these days when lunar soil mechanics form a topic for serious papers, we'll be using a system which will work perfectly well on the moon - think of the enormous advantages in that! To really go along with the SI system we must drop the confusing idea of 'weight'. <u>We must think in terms of mass</u>. When it comes to <u>force</u>, few will disagree with Newton, who said that force was mass times acceleration, so the unit of force, naturally enough called the newton, is the force exerted when unit acceleration (one meter per second per second) is applied to unit mass (one kilogram). The acceleration of gravity is about 9.8 m/s^2 so the force exerted by a body resting on the ground is 9.8 times its mass in kilograms, the answer being in newtons. (If of course, we are working on the moon a different factor has to be used.) How big is the newton? A rough but appropriate approximation is that an apple resting on a table exerts force of about one newton on it. In engineering practice, the newton is rather small, and the kilonewton (kN) will usually be more convenient.

In SI, the multiples and submultiples preferred are in terms of thousands, rather than tens or hundreds. With length, for example, the basic unit is the metre, so the preferred units include the kilometre (1000 m) and the millimetre (1/1000 m). The centimetre (being one hundredth of the basic unit) is not a preferred unit, and we should avoid it in laboratory work, using the mm instead.

Metric engineering drawings rarely state the units used for dimensions - they are either in metres or millimetres and it is never difficult to know which is being used. To employ centimetres would upset the system.

The most common multiples, in SI, are kilo-(k) and mega-(M) for x 1000 and x 1 000 000; milli-(m) and micro-(μ) for 1/1000 and 1/1 000 000. It is preferred, in ratio units, that only one multiple should be used, in the numerator. Taking velocity, as an example mm/s is an acceptable unit, preferable to m/ks or km/Ms which, although describing exactly the same sized unit, do not comply with the recommendation.

It seems to be agreed that we like to use units which result in numerical values in the range 0.1 to 1000. If this is done, we feel that the answers "mean something". They are numbers we can visualize, mentally. By contrast, numbers such as 10^{-9} or 10^{11} signify very little, other than "very small" or "very large". So, in SI, it is suggested that we choose units which result in values for the things we commonly measure, within the range 0.1 to 1000.

Now, let us try to apply these suggestions to an example in soil mechanics - the coefficient of permeability. A value of 2.0×10^{-6} cm./sec. (as currently expressed) might be found from a laboratory test on a compacted silt. This unit (cm./sec.) should not be used in the new system as the centimetre is not a 'preferred' unit. If we want the answer to be between 0.1 and 1000, then the multiple which fulfils the requirements is nanometres/second (1 nanometre = 10^{-9} metres) and our coefficient of permeability would be written

20 nm/s

This, however, did not appeal to the British engineers who studied the matter (Ref. 1). They preferred to use the SI unit metres/second, giving, for our compacted silt, a coefficient of permeability

2.0×10^{-8} m/s

Presumably the thought was that a factor of 10^{-8} was really no worse than the 10^{-6} which we customarily use. Particularly for a quantity, such as permeability, which has in practice an enormously wide range, it is not always desirable to use a unit which gives a numerical value between 0.1 and 1000 as suggested.

For volume, the cubic metre (m^3) will be suitable for most practical problems (earthworks etc.) but it is rather large for the laboratory. The next, smaller, recommended unit is the cubic millimetre (mm^3) but this, even in the laboratory, is rather small! ($1 m^3 = 10^9 mm^3$) The litre(l) and millilitre (ml) will, undoubtedly be used. Although a millilitre is the same as a cubic centimetre, the former name is to be preferred.

When it comes to density, we must describe it as mass per unit volume, and drop the term "unit weight". It may be desirable, for some years at least, to use the term "mass density" so that it is clear that we are not using gravitational units. Now 1000 kg may be called a megagram (Mg) or a tonne (t). While "megagram" is listed as the preferred SI unit, and "tonne" merely as an "other unit which may be used" it is the metric tonne (which differs by less than 2% from our existing "long ton") which is preferred by engineers in U.K. (Ref 1). This would lead to the tonne/cubic metre (t/m^3) as the logical unit for density, having the merit that the density of water (for all practical purposes) is 1.0 t/m^3, the same number as when using the gram/millilitre. (Let us recall, however, that g/ml, having the multiple in the bottom line will no longer be considered desirable). Despite all this, the British engineers have recommended, in their wisdom, the use of the kilogram/cubic metre (kg/m^3) for density. This will put all values of mass density, in soil or rock mechanics, in the range 1000-4000.

The adoption of the newton as the unit of force leads to the newton/square metre as the logical unit of stress. Many quantities, such as bearing pressure on foundations, cohesion and shear strength of soil, etc. are measured in units of stress. A special name, the pascal (Pa) has been adopted as a shorter term for the newton/square metre. For use in geomechanics the kilopascal (kPa) is a suitable multiple. The conversion from tons/sq.ft. (existing Imperial gravitational units) to kilopascals is

1 ton/sq.ft. = 107.3 kPa

For modulus of elasticity, which is also in units of stress, the megapascal (MPa) will be more suitable. In the literature which has appeared before approval of the pascal, we find kN/m^2 instead of kPa, and MN/m^2 instead of MPa. Don't let that confuse you! What might be confusing is the bar which crops up at this point. Already enshrined in the vocabulary of the meteorologist (that anticyclone with a central atmospheric pressure of 1015 millibars, for example) the bar has the advantage that 1 bar is about normal atmospheric pressure - roughly 1 ton/sq.ft. in our old-fashioned system. While it is a multiple of the SI unit (1 bar = 10^5 pascals) it is not a preferred unit, but seems likely to remain with us for no better reason than it has "achieved wide use and forms a convenient unit for pressures". (A similar claim could be made for some of the units to be thrown out!) To cap it all, a world-wide aluminium company has announced that it will be expressing the strength etc. of aluminium alloys in hectobars - a non-preferred multiple of a non-preferred unit! At this stage one can be forgiven for entertaining sadistic thoughts about directors (and engineers) in aluminium companies. This is better than the alternative - heading for the nearest mental hospital! Fortunately, aluminium products seldom appear in geomechanics problems.

For coefficient of consolidation (c_v is the usual symbol) which we now express in sq.in./sec. or sq.ft./year, the agreed best choice is mm^2/s.

The unit recommended for coefficient of compressibility (symbol m_v) is square metres per kilonewton (m^2/kN) which only contravenes one of the SI recommendations.

While the symbols used for various quantities will not, in general, be altered, it is necessary to use a new symbol for mass density, as it is dimensionally different from the "unit weight" or "density" in the old system. Unit weight is a measure of gravity force per unit volume, whereas mass density is a measure of mass per unit volume. To continue to use γ as the symbol would lead to confusion. The symbol ρ is used in allied disciplines for mass density, and is the obvious one to adopt in geomechanics.

Some items of punctuation are of interest. The full stop is not used to indicate an abbreviation. It is used as a decimal point or it may be used to indicate multiplication in the abbreviation for a compound unit. Torque, or bending moment, for example, might be in kilopascal metres, written kPa.m or kPa m. Commas are not used to split large numbers into groups of 3 digits - spaces are used instead; 1 234 000 for example, not 1,234,000. Units named after men are spelt with a small letter, but the abbreviations are capital letters (N, Pa etc).

Although the megasecond was mentioned at the beginning of this article, minutes and hours will, of course, still be used. Similarly, degrees, minutes and seconds will continue to be used for angles, although the radian is the preferred SI unit.

This article is intended to be an introductory outline of the use of SI units in geomechanics. The list of units which follows is not complete. Neither the formal definitions nor the conversion factors from existing to SI units are given. Ref. (2) should be consulted for such details and many more tables will appear as the new system is introduced. The following list includes the possible units for certain quantities in order of their "status", as based on the recommendations of international and national bodies.

It appears then, that provided we forget about "weight" and think in terms of "mass" and "force" - and double-check our calculations (written, of course on A4 paper) - metrication may prove to be an experience which is not too unpleasant.

SI UNITS IN GEOMECHANICS

Symbols used in column headed "status" -

(a) Base unit in the SI system

(b) Derived unit in the SI system

(c) Recommended decimal multiple in the SI system

(d) Other(not recommended) multiple in the SI system

(e) Other unit which may be used

(f) Supplementary unit in the SI system

(g) Recommended by the Institution of Civil Engineers for use in design offices Ref. (1).

Quantity	Unit	Abbrev.	Status	Conversion
Length	metre	m	(a)	
	kilometre	km	(c)	= 10^3m
	millimetre	mm	(c)	= 10^{-3}m
	micrometre	μm	(c)	= 10^{-6}m = (1 micron)
	centimetre	cm	(d)	= 10^{-2}m
Area	square metre	m^2	(b)	
	square kilometre	km^2	(c)	= $10^6 m^2$
	square millimetre	mm^2	(c)	= $10^{-6} m^2$
	hectare	ha	(d)	= $10^4 m^2$
Volume	cubic metre	m^3	(b)	
	cubic millimetre	mm^3	(c)	= $10^{-9} m^3$
	cubic centimeter	cm^3	(d)	= $10^{-6} m^3$ = 1 millilitre
	litre	l	(e)	= $10^{-3} m^3$
	millilitre	ml	(e)	= $10^{-6} m^3$ = 1 cubic centimetre
Mass	kilogram	kg	(a)	
	megagram	Mg	(c)	= 10^3kg
	gram	g	(c)	= 10^{-3}kg
	milligram	mg	(c)	= 10^{-6}kg
	tonne	t	(e)	= 1 Mg
Density	kilogram per cubic metre	kg/m^3	(b)(g)	
	tonne per cubic metre	t/m^3	(e)	= $10^3 kg/m^3$
	gram per millilitre	g/ml	(e)	= 1 t/m^3
Force	newton	N	(b)	= 1 kg m/s^2
	kilonewton	kN	(c)	= 10^3N
	meganewton	mN	(c)	= 10^6N
Stress	(also pressure, shear strength, bearing capacity, etc.)			
	pascal	Pa	(b)	= 1 N/m^2
	kilopascal	kPa	(c)(g)	= 10^3Pa
	megapascal	MPa	(c)	= 10^6Pa
	"		(g)	for modulus of elasticity
	bar	bar	(e)	= 10^5 N/m^2
	millibar	mbar	(e)	= 10^2 N/m^2

Quantity	Unit	Abbrev.	Status	Conversion
Velocity	metre per second	m/s	(b)	
			(g)	for coefficient of permeability
Coefficient of compressibility	square metre per newton	m^2/N	(b)	
	square metres per kilonewton	m^2/kN	(g)	$= 10^{-3}\ m^2/N$
Coefficient of consolidation	square metre per second	m^2/s	(b)	
	square millimetre per second	mm^2/s	(g)	$= 10^{-6}\ m^2/S$

REFERENCES

1. WALLEY, F: Metrication (Technical Note) Proc. Instn. Civ. Engrs. v.40 pp. 109-124 (May 1968).

2. STANDARDS ASSOCIATION OF N.Z.: The International System (SI) Units and their Application. NZS 6501P:1971 (Available from SANZ, Private Bag, Wellington for $1.45 including postage).

GEOMECHANICS SYMPOSIUM

WANGANUI, SEPTEMBER 1972

The symposium will be sponsored jointly by the N.Z. Geomechanics Society and by the Wanganui Branch of the N.Z.I.E.

The title will be -

"USING GEOMECHANICS IN FOUNDATION ENGINEERING"

The scope will be -

"The use of Soil Mechanics, Engineering Geology and Rock Mechanics in Foundation Engineering for Buildings from the Formulation of the Problem to its Successful Solution".

Background

In a previous symposium (Christchurch 1969) the task of defining the foundation conditions actually existing at a site was discussed. This symposium considers the way in which these defined conditions are then used in arriving at a successful solution. Success must be judged in terms of economy, acceptable level of risk and general fulfilment of the client's brief. While the foundation engineer may get a great deal of personal satisfaction from producing a technically elegant solution this in no way guarantees its success in the eyes of the client.

Programme

The Symposium will be held on Friday and Saturday, 1st and 2nd September. On the Friday morning there will be registration and the formal opening. On Friday afternoon will be the presentation of papers and discussion of Session I. This will be followed by an evening meal and then presentation of papers and discussion of Session II which may be followed by a social hour at the conclusion of the evening.

On Saturday morning there will be presentation of papers and discussion of Session III. Lunch will be available after the closing review and the Symposium will end in time for those attending to catch planes leaving Wanganui in the afternoon.

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The Secretary,
P.O. Box 686,
Wanganui

Please send me further information on the Symposium on "Using Geomechanics in Foundation Engineering"

Signed______________________________

Address_____________________________

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Wanganui Symposium Continued ....

Subjects to be Covered

The provisional titles of the set papers are:

Session I	The Logic of Foundation Engineering Evaluation & Interpretation of Site Information
Session II	Conception of Possible Foundation Solutions and their Evaluation Methods of Analysis in Relation to Data
Session III	Construction Problems, Limitations & Experience Departures from Assumed Conditions and Treatment thereof Observation of Performance of Foundations

Proceedings

Proceedings comprising the set papers and a transcript of the discussion will be published.

Limit on Attendance

In order to decide on a suitable venue it has been decided at this stage to limit attendance to 150 persons. Those attending need not necessarily be members of the Society.

Application Form

Members wishing to obtain further information on the Symposium should detach the form at the bottom of the previous page and post it to the address given.

NEWS FROM THE MANAGEMENT SECRETARY

1. Management Committee for 1972

Listed below are members of the 1972 Management Committee of the Society. Please feel free to contact any member at any time if you have any suggestion to make regarding the running of the Society.

J.H.H. Galloway (Chairman)
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P.O. Box 30325, Lower Hutt
Telephone: 688-033

J.P. Blakeley,
Beca,Carter,Hollings & Ferner
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Roading Division,
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D.K. Taylor
Tonkin and Taylor,
P.O. Box 5271, Auckland
Telephone: 361-784

Prof. P.W. Taylor
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University of Auckland
Private Bag, Auckland
Telephone: 74-740

2. Sub-Committees for 1972

These had not been finalised at the time of going to press but members so far appointed are as follows:

Soil Mechanics Sub-Committee

D.K. Taylor (vice-chairman), Prof. P.W. Taylor, J.P. Blakeley.

Engineering Geology Sub-Committee

L.E. Oborn (vice-chairman), R.O. Bullen, Dr B.W. Riddolls

Rock Mechanics Sub-Committee

J.K. Hill (vice-chairman)

3. New Members

New members elected to the Society since the last list was published in "N.Z. Geomechanics News No 2" (June 1971) are as follows:

O.M. Borlase	Gisborne
S. Chiet	Wellington
B.E. Coker	Papakura
G.C. Duske	Auckland
G.W. Gavin	Wellington
J. Gibbs	Napier
J.B.S. Huizing	Wellington
G.B. Judd	Christchurch
Kang Sin Chin	Selangor, Malaysia
Dr D. Kear	Wellington
D.S. Langdon	Twizel
P.J. North	Hamilton
W.M. Prebble	Auckland
A.B. Pullenger	Wellington
Dr B.W. Riddolls	Wellington
N.S. Smith	Auckland
Dr M.L. Stout	Los Angeles
A.S. Thompson	Tauranga
A.J. Watt	Auckland

4. Forthcoming Conferences

(a) Eighth International Conference on Soil Mechanics and Foundation Engineering

This conference is to be held in Moscow from 6th to 11th August 1973. The conference will feature four main technical sessions on the following themes.

(1) Up to date methods for investigating the strength and deformability of soils.
(2) Interaction of soil bases and structures
(3) Deep foundations, including pile foundations
(4) Problems of soil mechanics and construction on structurally unstable and weak soils

In addition, eight speciality sessions will be held on the subjects of:

(1) Equipment for the observation of settlements
(2) Problems of non linear soil mechanics
(3) Statical design of earth and rockfill dams
(4) Soft soil bases of hydrotechnical structures
(5) Lateral pressure of clayey soil on structures
(6) Stability of slopes of deep excavations, and of structures on slopes
(7) Methods of soil stabilisation
(8) Soil dynamics and seismic effects on foundations.

Two papers have been offered for presentation by New Zealand authors. These are:

"Dynamic Torsion Testing of Soil" by P.W. Taylor and I.M. Parton

"A Unified Theory for the Consolidation of Clays" by J.G. Hawley and D.L. Borrin

(b) Symposium on "Using Geomechanics in Foundation Engineering" Wanganui, August 1972

This two day symposium is described in more detail elsewhere in this issue.

(c) Other Conferences and Symposia

We list below other conferences and symposia in the 1972-4 period which we know about. Members may be interested in either attending or obtaining proceedings. Further details can be made available on request.

1972

1 - 3 Feb	Conference on Soil Penetrometer Testing, Texas A & M University, USA.
7 - 12 Feb	USA National Conference on Earthquake Engineering, Los Angeles, USA.
25 - 27 Feb	Symposium on Strength & Deformation of Soils, Bangalore, India.
9 - 14 April	10th International Symposium on the Application of Computer Methods to the Mining Industry, Johannesburg, South Africa.
10 - 13 April	5th European Conference on Soil Mechanics & Foundation Engineering, Madrid, Spain.
17 - 20 April	International Geochemical Exploration Symposium, London, England.
2 - 7 June	Conference on Rapid Excavation & Tunnelling, Chicago, USA.
5 - 14 June	Second International Mine-Surveying Conference, Budapest, Hungary
12 - 14 June	Conference on the Performance of Earth & Earth Supported Structures, Purdue University, USA.
12 - 14 June	14th Symposium on Rock Mechanics, Pennsylvania, USA.
15 - 19 June	International Symposium on Protection of Underground Constructions against Water, Bratislava, Czechoslovakia.
25 - 30 June	A.S.T.M. Symposium on the Evaluation of Relative Density Tests on Cohesionless Soils, Los Angeles, USA.
25 - 30 June	International Clay Conference, Madrid, Spain.
10 - 12 July	Dynamic Crack Propogation Conference, Lehigh University,USA.
21 - 25 Aug	5th International Rock Pressure Meeting, London, England.
21 - 30 Aug	24th International Geological Congress, Montreal, Canada.
4 - 8 Sept	6th International Congress on Rheology, Lyon, France.
4 - 9 Sept	7th International Congress on Mining, Bucarest, Rumania.
5 - 7 Sept	4th European Symposium on Earthquake Engineering, London, England.
11 - 14 Sept	International Symposium of the I.S.R.M. on Stress Problems in Underground Openings, Lucerne Switzerland.

1972

18 - 19 Sept	International Symposium of the I.S.R.M. on Percolation through Fissured Rock, Stuttgart, Germany.
6 - 10 Nov	3rd Southeast Asian Conference on Soil Engineering, Hong Kong.
16 - 17 Nov	Conference on Finite Element Methods, Vanderbilt University, USA.

1973

10 - 12 Feb	Symposium on Behaviour of Earth and earth-Structures Subjected to Earthquakes and Other Dynamic Loads, Roorkee, India.

1974

2 - 4 April	Conference on Settlement of Structures, Cambridge University, England.

5. Australian Geomechanics Journal

This is produced jointly by the Institution of Engineers (Australia) and the Australian Institute of Mining and Metallurgy and contains various papers on geomechanics topics. It is published once a year and the cost is $4.00 to members of either of these bodies or $5.00 to non members. Members of the Society who may wish to purchase the 1971 issue should write to the
Institution of Engineers (Australia)
Science House,
157 Gloucester St,
Sydney, N.S.W. 2000,
AUSTRALIA.

6. Proceedings of a Symposium on Foundations on Interbedded Sands, Perth, October 1970

A Symposium on Foundations on Interbedded Sands was convened in Perth in October 1970. It reviewed the existing state of knowledge and current research on the design of foundations on sand or interbedded sand and clay layers. Although most of the papers deal with design and performance problems in the Perth area, the conclusions arising from the discussion will be of interest to engineers in other areas. The Proceedings volume, containing the sixteen papers presented and a record of the discussions, is available for $5.00 per copy from the Chief, Division of Applied Geomechanics, C.S.I.R.O., P.O. Box 54, Mount Waverley, Victoria 3149, Australia.

7. International Group on Soil Sampling - Proceedings of Speciality Session on Quality in Soil Sampling.

A speciality session on the question of quality in soil sampling was convened by IGOSS as part of the technical programme at the 4th Asian Regional Conference held in Bangkok, 26 July - 1 August 1971. The Proceedings of this speciality session have been published in two volumes and may be obtained for $U.S.8.00 on application to Dr Aitcheson, Convenor IGOSS, c/- Division of Applied Geomechanics, C.S.I.R.O., P.O. Box 54, Mount Waverley, Victoria 3149, Australia.

The proceedings of the speciality session on soil sampling held by IGOSS at the International Conference in Mexico City in 1969 are now out of print but a reprinting will be made if sufficient orders are received. Orders should be sent to Dr Aitcheson at the above address.

8. Affiliation to International Societies

The rules (clause 8.3) require that each member of the N.Z. Geomechanics Society be affiliated to at least one International Society. Unless members request otherwise, they will be affiliated to the International Society for Soil Mechanics and Foundation Engineering. Members wishing to affiliate with either of the other International Societies (and including withdrawal from ISSMFE if desired) should advise the Management Secretary. The relevant portion of the membership application form at the rear of this issue may be used for this purpose.

Annual subscription and capitation fees vary for each International Society, and accordingly the annual subscription to the N.Z. Geomechanics Society will vary depending on the affiliation of that member. For the current year, however a uniform fee of $3.00 was set pending clarification of both affiliation of members and of operating expenses of the new society.

As a guide for members considering affiliation with other than the ISSMFE the annual capitation fees to the International Societies are:

ISSMFE	(Soil Mechanics & Foundation Engineering)	$0.60
ISRM	(Rock Mechanics)	$2.40
IAEG	(Engineering Geology)	$1.60

9. Membership Application Form

A membership application form is included at the rear 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.

P.G.M. Imrie
MANAGEMENT SECRETARY

N.Z. Geomechanics Society
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CONTINUOUS SOIL SAMPLING USING HOLLOW STEM AUGERS

R.F. Thomas and P.R. Barker
Soil Bureau, D.S.I.R.

INTRODUCTION

When engineering soil surveys are being conducted over extensive areas it is common practice to sink a number of widely spaced boreholes. Variations in the thickness of soil layers between boreholes may then be interpreted from the results of penetration, resistivity or seismic tests. This system is used extensively overseas for the investigation of soil conditions in highway and airfield work (Shurig and Yoder, 1959). A similar system has been used by the authors' organisation to carry out surveys of the environs of growing urban areas. Static cone penetration tests have been used to provide information between bore-holes.

A convenient method of drilling to the depths required for this type of investigation, often about 30 feet, is to employ power driven augers operated by a light or medium weight drilling rig. Generally continuous flight augers are used, but considerable difficulty may be experienced in identifying the depth from which cuttings returned to the surface have originated. In recent years hollow stem augers have been developed particularly for soil exploration for engineering works (Dickinson, pers. comm., Shurig and Yoder, 1959). This type of auger is now available from a number of manufacturers, and is widely used. Continuous flight augers are not suitable for drilling hard rock, large gravel, or sand below the water table. Within these limitations there is a broad field of applications in which their use is both economical and allows rapid progress to be made. This communication describes the normal operation of hollow stem augers and a modification of the equipment which, for certain purposes, offers a number of advantages.

NORMAL OPERATION OF HOLLOW STEM AUGERS

The hollow stem auger is essentially a conventional continuous flight auger built around a central tube. Sections of auger are screwed together in five feet lengths, and a locking device may be provided between sections which, if necessary, enables the flights to be removed from the ground by reverse rotation. When drilling, the lower end of the central tube is closed off with a combined pilot bit and plug which is attached to drill rods extending through the augers to the head. The drill rods are rigidly connected to the auger head so that torque applied to the head is transmitted to both the augers and the pilot bit. When drilling has been advanced to the depth at which a sample is required, the rotation is stopped and the drill rods with the pilot bit attached are withdrawn. Sampling from an exact known depth can then be carried out through the central tube.

Hollow stem augers are made in a variety of sizes, those used by the authors having an outside diameter of 8½ inches. The inside diameter of the central tube of these augers is 3⅜ inches, permitting the passage of three inch samplers and NX size core barrels. The selection of the type of sampler to be used depends upon the type of soil encountered and the purpose for which the samples are required. After a sample has been taken with an appropriate sampler, the pilot bit is replaced on the drill rods and re-installed in its drilling position. Drilling is then continued until a further sample is required. Hollow stem augers are sometimes used without a centre plug, and when this is done a hard plug of disturbed soil forms at the base of the central tube. Since this technique would make the removal of a reasonably "undisturbed" sample difficult it was not considered appropriate for the type of work described.

QUALITY AND FREQUENCY OF SAMPLES

The quality of samples taken for soil engineering purposes ranges from those which are incomplete and disturbed to those suitable for the determination of consolidation characteristics and critical stress-strain relationships. The soil properties which can be determined from samples taken in a variety of ways have been set out in tabular form by the German National Committee of the International Group on Soil Sampling (DIN 4021 in Northey 1969). This shows clearly that only samples taken with great care using the best modern equipment are suitable for determinations of critical stress-strain relationships. Determination of these properties is not usually required in extensive engineering soil surveys. However, even if only an assessment of strength or consistency of a soil is required a reasonably "undisturbed" sample will be necessary. A thin-wall open-drive sampler which is pushed into the soil is probably the simplest type from which satisfactory samples can be obtained, and generally, when using hollow stem augers, fine grained materials are sampled in this way. Other types of sampling equipment can be used in appropriate conditions.

When drilling is being carried out to determine the areal extent of comparatively thin layers of materials of similar texture nearly continuous sampling is required. Without resorting to two adjacent bore-holes in which samples overlapping in depth may be taken, continuous sampling can only be achieved using specialised equipment capable of taking and retaining very long samples (Kjellman et al., 1950). When sampling from a bore-hole sunk by conventional means, disturbed material can be removed with a clean-out auger or similar equipment. This may not be practical when using hollow stem augers, and consequently as much as six sinches of material disturbed by the pilot bit may form the top section of each sample. Thus continuous sampling is not possible when hollow stem augers are used in the normal way.

DIFFICULTIES ENCOUNTERED IN NORMAL OPERATION

Satisfactory samples can be obtained under most conditions with thin-wall samplers when the sample length is restricted to about 10 diameters (Hvorslev, 1949). A three inch diameter sampler capable of taking a 24 inch long sample has been used in this work. Thus to achieve as near continuous sampling as possible, drilling is carried out in increments of about two feet. After sinking the augers two feet, the pilot bit is removed, the sampling device is lowered down the central tube, the sample is taken, and the pilot bit replaced in its drilling position. When sampling at depths greater than a few feet this becomes a time consuming and tedious process.

Open drive samplers have themselves some characteristics which may, in certain conditions, make sampling operations difficult or impossible. In some materials when a sampler is withdrawn after full penetration, the sample may not be retained. This occurs when the forces tending to retain the sample do not exceed the tensile strength of the soil. The thin-wall samplers commonly used may have an inside clearance ratio greater than 1%. This amount of clearance may be too great to permit the development of significant friction between the sample and the walls of the sampler. Loss of samples may be prevented by using a sampler with a smaller inside clearance ratio, however, this is likely to cause an unacceptable amount of disturbance and a low recovery ratio, particularly in soft soils (Hvorslev, 1949). When purchased most thin-wall samplers are provided with a considerable inside clearance, but loss of samples can sometimes be prevented by allowing a period of time, say 15 minutes, to elapse between pushing in and withdrawing the sampler. This allows softer materials to expand against the sampler wall, and increased adhesion results. When using thin wall samplers it is not possible to select inside clearance ratios appropriate to soil conditions as it is when using a sampler with interchangeable cutting shoes. Loss of a sample due to excessive suction is not so likely when the depth of embedment of the sampler is only a few inches. Water or air can then more easily find its way to the cutting edge and release the suction.

When harder soils are encountered it is frequently impossible to provide sufficient reaction from a medium size drilling rig to force a sampler to penetrate more than a few inches. When this occurs a heavier walled sampler may be hammered into the soil, but the resulting sample may be so severely disturbed that it can be used only for identification purposes. If, because of insufficient reaction, sampling and drilling can proceed only in increments of a few inches the time and effort required are considerably increased.

DESCRIPTION AND OPERATION OF MODIFIED HOLLOW STEM AUGER SAMPLER

The difficulties associated with the use of an open-drive sampler in the circumstances described led to the development of a new technique with which satisfactory samples can be obtained more rapidly and surely than with the normal techniques. The new technique and equipment allow drilling and sampling to be carried out simultaneously.

The pilot bit used in normal operations with hollow stem augers is replaced with a three inch diameter thin-wall or other suitable open-drive sampler which extends beyond the mouth of the auger and is thus being pushed into undisturbed soil. A standard head with a check valve is used with the sampler. This is connected to a swivel which incorporates a heavy duty thrust bearing. Above the swivel is mounted an adjustable extension piece by means of which the length of sampler extending beyond the mouth of the auger can be controlled. In softer soils, when the action of the auger may cause disturbance to a depth comparable with its diameter, the adjustment allows an extension in excess of 12 inches if required. A smaller extension can be used when the hardness of the soil is such that under normal open-drive conditions the sampler would only penetrate a few inches. With the reduced extension the stress required to effect penetration should be substantially lower, which may result in less sample disturbance. Sufficient adjustment is available to accommodate samplers of greater or lesser length than that normally used. The adjustable fitting is connected to drill rods extending to the auger head. The swivel allows the sampler to remain stationary with respect to the auger and rods which are rotated from the head in the usual way. The friction introduced by the swivel is very small, and when working at the surface, only a few tenths of an inch penetration is required to prevent the sampler turning. There is no reason to suspect that the friction is significantly greater at greater depths, and little torque should be applied to the sample. The annular clearance between the sampler and the mouth of the auger is about 3/16 inch. No significant quantity of soil has ever been forced into this space, and there is no evidence that the sampler has been forced to rotate. No twisting or helical disturbance have been observed in samples taken with this equipment.

The basic features and operation of the modified equipment are similar to those of the auger sampler described by Lang (1967) except that no provision is made for automatic adjustment to the extension of the sample tube. In operation the auger and sampler advance together, the sample being protected inside the sampler while the auger removes material from the annular space around it. When drilling has advanced two feet, rotation of the auger is stopped and the drill rods and sampler are withdrawn. The sample tube is removed from the head and replaced by another. The assembly is then lowered down through the augers and drilling is continued. The time required for this operation is short compared with the time previously required for alternate drilling and sampling.

The new technique has been used successfully on a number of occasions. As well as permitting much more rapid progress than the conventional technique, it has substantially overcome the previously mentioned disadvantages associated with the use of thin-wall samplers when using a medium size drilling rig and hollow stem augers. No difficulty has been experienced in withdrawing the sampler, and the number of samples lost has been greatly reduced. In hard soils, using a sampler extension of a half an inch it has been possible to take a full length sample. All samples so far obtained appear to have been of good quality, and it is judged that they would have been suitable for all but the most critical measurements. There has been no opportunity, as yet, to use the technique in soft sensitive soils. Since open-drive samplers are inappropriate in these materials it is unlikely that satisfactory samples would be obtained for other than identification purposes.

When unexpected changes from fine grained soils to gravels occur, it is likely that a thin-wall sampler would suffer damage when used in the way described here. For this reason, in locations where the sequence and consistency of layers is unknown, the new sampling system is used only after an adjacent cone penetration test has been carried out. In broad based work, for which this equipment was designed, a knowledge of the penetration characteristics of soil layers may be an important element of the programme of investigation. Where the equipment used is sufficiently versatile, it is no disadvantage to carry out a cone penetration test before a bore-hole is sunk. In fact this procedure will often save much time whenever auger boring is being undertaken. The drilling rig employed in this work may be used to carry out static cone penetration tests.

Once the rig is on site a penetration test to about 30 feet can be carried out in about half an hour. The change over from penetration testing to auger boring can be effected in a few minutes.

There seems to be no reason why, in appropriate conditions, the new technique should not produce samples of sufficient quality for most soil engineering testing. The thin wall sampler may be replaced by a sampler with a low effective area ratio containing a liner composed of a series of one inch high rings. Consolidation and shear tests can then be carried out on sections of the sample contained in one or more rings as required. A few reasonably satisfactory samples have been taken in this way. While not replacing samples obtained by modern high precision methods, samples obtained with this equipment would normally be satisfactory, at least for preliminary investigations. It is also possible that the equipment described here may have some application where other auger samplers such as that described by Lang (1967) would normally be used. Combining as it does the speed of augering for advancing the hole with the possibility of obtaining good quality samples from known depths, the system seems ideally suited for investigational work in fine grained materials.

CONCLUSION

The use of hollow stem augers provides a number of advantages when used in broad-scale investigational drilling. Some disadvantages associated with the need for continuous sampling through hollow stem augers have been overcome using the technique described here. Satisfactory samples have been obtained in a number of types of soil where previously short samples, or no sample at all, had been recovered. The use of the new system considerably reduces the time required for continuous sampling operations. Further development of the method may permit samples to be taken which are suitable for more rigorous testing than that required for the present work.

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SHORT COURSE IN ROCK MECHANICS
UNIVERSITY OF NEW SOUTH WALES, FEBRUARY 1972

W.M. Prebble

In response to interest shown by the mining and civil engineering industries in Australia, the Faculty of Engineering at the University of New South Wales, Kensington, arranged a one week course in Rock Mechanics commencing on February 7th, 1972. The course consisted of 25 lectures each of one hour's duration and these were interspersed with generous mid morning, mid afternoon and lunchtime adjournments, during which informed discussion and criticism of papers took place. A period of free discussion was provided during one of the afternoon sessions.

All the lectures were bound into the cyclostyled proceedings of the course which were available at the University of N.S.W. upon registration. This did not permit any opportunity to preview the course material before travelling to Sydney. Although the lecturers and the titles of their papers were distributed some weeks beforehand, a complete list of participants did not appear until half way through the course but there was ample opportunity to make new acquaintances and contact participants with particular or common interests.

The material presented in the proceedings was of a high standard and contained some papers of considerable specialisation within the field of rock mechanics.

There were a number of lectures either directly related to or derived mainly from underground coal mining and base metal mining techniques and large-scale open pit mining.

The lecturers were mainly staff from the Faculty of Engineering, University of New South Wales. Other key lecturers were drawn from Government agencies and private enterprise.

Participants were almost entirely from Australia, mainly from the eastern states and were spread evenly throughout mining companies, State Government construction agencies and consulting engineering firms. Only one other participant came directly from New Zealand, Mr P.J. Miller of the University of Auckland School of Engineering. Other New Zealanders, currently employed in Australia, attended.

Australian mining companies and some consulting firms are advancing their expertise in the fields of Quantitative Slope Stability and Design of Underground Structures. The former field is concerned, in Australia, largely with open pit mining but the latter has been applied to hydroelectric construction for some time. For those unfamiliar with the techniques, the course provided a useful introduction to the graphical method of stability analyses of jointed rock slopes and to the finite element analysis of jointed rock.

Graphical stability analysis of jointed rock slopes as presented at the course was drawn mainly from the work of people such as Klaus John whose paper appears in the Journal of the Soil Mechanics and Foundations Division A.S.C.E. Vol. 94 No. SM2 Mar. 1968.

Finite element analysis of jointed rock was presented by staff of the University of N.S.W. who appeared to be leading the way in this field in Australia.

A resumé of the now superseded photoelastic methods and a lengthy discussion on creep and the design of room and pillar mines were given. Advanced tunnelling techniques, of the European school, were given only token reference and there was, as anticipated, little reference to seismic risk or to any geological environments other than simple cases of jointed rock slopes.

Considerable interest in the use of rock mechanics was stimulated by the course which drew much informed comment and criticism by participants. The response produced a questionnaire which was circulated to participants a few weeks after the course, with a view to organising similar gatherings at regular intervals in the future.

S T O P   P R E S S

8th INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING

Advice has just been received that reports for the Specialty Sessions at the above Conference should be submitted to the Organising Committee by August 1st, 1972. At the time of writing, the information bulletins on preparation of reports and subject matter for the Specialty Sessions are not to hand, but are expected shortly.

So that the information bulletins can be forwarded upon their arrival, members interested in these sessions and/or intending to submit reports should make their intentions known to the Management Secretary.

DESCRIBING WELLINGTON GREYWACKE

M.J. Pender

The purpose of this short article is to describe and discuss a method that has been in use at the M.O.W. Central Laboratory, for the last 18 months or so, in logging cores of in-situ weathered greywacke from around Wellington.

Unless attended by much conscious effort, vagueness easily creeps into logging processes, so that the idea conveyed to someone who has not set eyes on the material can be quite misleading. Since so much of Wellington is founded on greywacke weathered insitu to varying degrees it seemed worthwhile to devise a logging method intended specifically for describing this material. Hopefully the use of such a procedure would lead to more accurate description of the condition of the weathered rock. There have been a number of engineering classifications developed for describing materials produced by insitu weathering from parent rock. I am informed, that the idea was first developed at the Snowy Mountains Scheme in Australia. All the classifications have in common the division of the material into a number of grades, starting with grade I for the unweathered rock. In devising a scheme for weathered greywacke I have used the classification of Fookes and Horswill (Ref 1), partly because of the manner in which I came across it and partly because their work, particularly as further explained by Sanders and Fookes (Ref 2), it seems to have been based on a more general approach to the description of rock weathered insitu. My application of Fookes's and Horswill's work to weathered greywacke is set out in the accompanying Table I. As can be seen there are six distinct stages of weathering suggested, each of which has a number of easily recognisable physical characteristics. The obvious advantage of such a checklist is that at least some of the subjective element in the logging process is removed. There are of course, difficulties that need to be considered.

Firstly Table I divides the greywacke into six distinct grades, thus implying that there is very clear cut distinction between each of the six. This certainly is true of typical material in each grade, but the weathering process results in a continuous spectrum of materials so there is sometimes a little difficulty in classifying material near the dividing line between two grades. Also the scheme is intended only for material that has been weathered insitu, that is no relative movement has occurred between the separate pieces during the weathering process and so each piece of weathered material is in the same position relative to the surrounding material as in the original unweathered rock. The main evidence that this is so is provided when the original joint structure is still clearly visible with the separate pieces still in intimate contact. The opposite situation, to which the classification is not applied, is when unweathered or partially weathered rock is moved elsewhere, deposited and weathered. In this case no joint planes are evident and there is often a softer matrix between separate harder pieces.

Two warnings were given by Fookes and Horswill when presenting their classification. The first of these is related to the weathering of rocks of different origin. Clearly the classification scheme assumes that the original unweathered rock was all of the same type. The relevance of this to the Wellington area is connected with the appearance of bands of argillite which are found in the greywacke. The weathering characteristics of this are no doubt different from those of the greywacke and I have not tried to apply a classification to argillite.

The second is related to jointing. There does seem to be a characteristic very closely spaced joint pattern in the greywacke. In the more weathered material this is marked by a black deposit of manganese dioxide. Although numerous, the total volume occupied by these joints is only a few per cent of the total volume of the material. In addition they do not tend to be very extensive. To the naked eye no characteristic joint orientation seems evident and also the joint geometry seems to be independent of the extent to weathering. The nature of the jointing cannot be discussed in more detail at this stage simply because it is difficult to make general comments about jointing when examining cores which reveal such an infintesimal proportion of the material from which they are taken.

Now in addition to these joints which are characteristic of the material, essentially local in nature, and more or less homogeneously distributed throughout the greywacke there are major discontinuities. These can be found around Wellington with spacings ranging upwards from tens of feet. Included are major joints, differentiated from those discussed above by extent and thickness, shear and crushed zones, bands of argillite, and seams of clay. These are major defects and must be noted and described separately from the weathered greywacke lying between. Actually Fookes and Horswill also suggested a means of classifying joints and faults when presenting their classification for weathered rock.

There is also a problem with the recognition of grade VI material. If the material is so weathered that the original fabric is completely destroyed, as grade VI is defined in Table I, then how does one decide that it is in fact weathered insitu? Fortunately this pattern does not arise too often because most of the greywacke around Wellington is not weathered past grade V.

The use of this classification process for specific sites has been described in recent Central Laboratories Reports (Refs. 3 and 4) and reports for investigations at two other sites should be completed by the end of the year. It has also been found that for the more weathered material there is a relation between the classification grade and the values of various properties (Ref 5). Although the details set out in Table I are for describing cores the general features should apply to exposed faces around Wellington provided due allowance is made for any drying that has taken place.

In as much as the subject of this article belongs more to the domain of the rock mechanics and engineering geology enthusiasts rather than that of a soils engineer any comments would be received with great interest by the writer.

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TABLE I

DESCRIPTION OF GREYWACKE WEATHERED INSITU AROUND WELLINGTON

(Following Classification Scheme of Fookes and Horswill)

Term	Grade	Colour	Appearance of Weathered Material	Sampling
True Residual Soil (Rw)	VI	Various	Rock discoloured and completely changed to soil. Original fabric of rock has completely disappeared.	Readily sampled with triple tube core barrel. Core recovery in excess of 90% possible with careful drilling with well maintained equipment.
Completely Weathered (Cw)	V	Generally light yellow-brown. In some places has red to orange tinge	Completely crushable to silt under finger pressure. Sandy texture of original rock fabric clearly visible in undisturbed material. Very closely spaced joints in original rock clearly marked with black stains in undisturbed material. There does not seem to be any characteristic joint orientation evident.	As above
Highly Weathered (Hw)	IV	Generally light yellow-brown	Most of the material can be crushed to silt and sand sizes under finger pressure but occasional lumps of harder material remain, typically smaller than ¾". Sandy texture of original rock clearly visible in undisturbed material.	Can be sampled with triple tube core barrel. Core recovery generally in excess of 75% with careful drilling and well maintained equipment.
Moderately Weathered (Mw)	III	Brown to rusty brown	Undisturbed material is very tight, sometimes with a small amount of fines on the joint surfaces. On disturbing can be separated into individual pieces which are hard, angular and apart from slight crumbling at edges cannot be crushed under hand pressure. Pieces easily broken with a light hammer blow and trimmed with a knife. Brown colour due to weathering extends through pieces. Joint surfaces are clearly marked but not so stained as grades IV or V. As above no characteristic joint orientation evident.	Can be sampled with triple tube core barrel but with some difficulty. Runs tend to be short, usually less than 18". Core recovery may be down to 50%.
Slightly Weathered (Sw)	II	Brown to rusty brown	Hard very closely jointed rock. Separate pieces angular and require moderate hammer blow to break. Brown colour penetrates only a short distance into material, interior has colour and texture of unweathered greywacke.	Cannot be sampled with triple tube core barrel used on above grades; requires diamond drilling.
Fresh Rock (Fr)	I	Light grey	Unweathered greywacke, shows no discolouration, loss of strength or any other effects due to weathering.	Cannot be sampled with triple tube core barrel; requires diamond drilling.

FORTHCOMING STANDARDS ASSOCIATION OF N.Z. PUBLICATIONS

J.P. Blakeley

1. Provisional New Zealand Standard for Foundations

The original draft was issued in 1966. It was intended for publication as an additional Chapter (Chapter 12) of N.Z.S. 1900 "Model Building Bylaw" to replace the requirements for foundations contained in various chapters of the bylaw. However, the format of the bylaw is being changed so that the bylaw itself will contain only general and legal requirements, with technical details that will meet these requirements set out in separate standards that are not part of the bylaw but are named in it as "means of compliance". It was therefore considered inappropriate to issue this standard as "N.Z.S. 1900 Chapter 12".

Because of this the document has been rewritten as a Provisional New Zealand Standard for Foundations in advance of its formal authorisation as a means of compliance with N.Z.S. 1900. Nevertheless pending such authorisation, it is expected that by virtue of Clause 3.2 of N.Z.S. 1900 Chapter 3, local authorities will be prepared to accept compliance with this document as being equivalent to compliance with the general and specific requirements for foundations contained in the various chapters of N.Z.S. 1900.

This standard has been divided into two parts.

Part 1 sets out minimum provisions for investigation and provision of foundations for buildings for which specific design of the foundations is not required. Work under Part 1 need not be under the control of a registered engineer.

Part 2 sets out basic principles relating to investigation, foundation design and supervision of construction of foundations for all types of buildings and earthworks. Work under Part 2 is required to be under the control of a registered engineer experienced in this type of work.

It is hoped that the documents will be printed later in 1972 for sale as a Provisional Standard. It will be reviewed after twelve months of actual use, and during this period people who use the document will be invited to advise the Standards Association of suggestions for improvement.

2. Draft N.Z. Standard Code of Practice for Earth Fill for Residential Development

With the increasing use of mass earth fills to produce suitably shaped land forms for residential developments various sections of the community and public authorities require assurance that the man-made landforms are sufficiently stable to prevent subsequent damage to property through ground movement in the form of slips, subsidence, creep or erosion, whether due to the nature or compaction of the fill itself or whether due to the nature of the underlying strata.

A technical committee of the Standards Association of New Zealand has prepared a draft Code of Practice DZ 4431/272 on this subject which is now available for comment. If adopted, this Code of Practice will be a means of compliance with a bylaw which would be an amendment to N.Z. 1900 Chapter 3. The same committee has also prepared a draft bylaw DZ 1900.3/271 which is also now available for comment. These two documents are available from the Director, Standards Association of New Zealand, Private Bag, Wellington. Persons who may wish to comment should obtain these documents as soon as possible in order that their comments may be received before the closing date.

3. Draft N.Z. Standard on Methods of Testing Soils for Civil Engineering Purposes

The technical committee of the Standards Association of New Zealand which will consider this matter has still not had its first meeting, but is expected to do so shortly.

The Standard will be based on B.S. 1377:1967 up to and including Test 14 (i.e. not including Soil Strength Tests). It may also include a N.Z. Standard for the C.B.R. Test. The standard will take into account some of the peculiar problems associated with some of the volcanic soils found in New Zealand.

4. Draft New Zealand Standard on Methods of Test for Stabilized Soils

The formation of the technical committee of the Standards Association of New Zealand which will consider this matter has still not been completed.

It is expected that the Standard will be based on B.S. 1924 : 1967, but again with modifications made for New Zealand conditions.

ROCK MECHANICS INFORMATION SERVICE

L.E. Oborn

Rock Mechanics Information Service is a non-profit service offered by the American Institute of Mining, Metallurgical and Petroleum Engineers in cooperation with the Rock Mechanics Section, Imperial College of Science and Technology.

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Address enquiries and order (with cash) for 3 to:

Rock Mechanics Information Service,
Imperial College of Science & Technology,
Prince Consort Road,
London, S.W.7,
England.

The N.Z. Geological Survey, P.O. Box 30-368, Lower Hutt, has subscribed to No. 2 above and copies obtained so far could be inspected by members of the Society who may so wish. The writer would be prepared to attempt to answer questions if any member wishes to know more about this information and he can be contacted at the above address.

MEASUREMENT OF IN-SITU SOIL DENSITY
(No. 3 of a Series)

J.H.H. Galloway

3. OIL REPLACEMENT

This article discusses the use of oil, or other suitable liquid to measure the volume of the test hole. The method is essentially the same as the sand replacement method (see previous article) modified to allow for the different nature of the measuring medium.

Generally a heavy motor oil makes a satisfactory measuring liquid. Different operators in different jobs have used new and waste oil but generally waste oil has not been particularly successful. It is usually too variable in unit weight, viscosity etc. to be successful and is even messier to handle than new oil. Reclaimed oil, in which the gross particulate contamination has been removed and the other properties adjusted to give a reasonably uniform product should be adequate though I cannot recall any specific case of this being tried.

Obviously the method can only be used in soils into which the oil will not penetrate significantly. This should always be checked by leaving the test hole for a few minutes after filling and watching for any drop in the oil level. The first sign of this is often a change in the meniscus shape at the edges of the hole - but this is not an infallible sign as some soils have sufficient capillary attraction for the oil to change the meniscus shape but do not absorb significant amounts of oil.

The greatest source of error in the method is normally the ground surface prepared for testing. This must be level with a clean, sharp edge to the hole. The digging plate should always be removed before topping up the hole or else a depth gauge, set to the thickness of the plate used to set the oil level. These requirements often preclude the method from being used in soils with a significant gravel content or which lack cohesion. As with the sand replacement method a significant improvement in accuracy and range of suitable soil types can be produced by carefully levelling the test area with a fine grained bedding material.

One useful attribute of the method is automatic compensation for oversize material. Specifications often call for a certain unit weight in the finer soil fractions (e.g. passing ¾"). This can be determined directly in the field by sieving out the oversize in the field and returning it to the test hole before the oil is poured in.

Generally it is easier to weigh the amount of oil used to fill the test hole. Volume measures usually are glass and easily broken. Also the rather high oil viscosity needed to prevent penetration into the oil means that it takes quite a time for the reading in the volume measure to stabilise With weight measurement it is important to check the unit weight of the oil and also its temperature. With use the oil tends to pick up soil particles so increasing its unit weight, and thermal expansion coefficients are appreciable.

After use the oil in the test hole can normally be saved for further use. One job used a large grease gun, suitably modified, for this purpose. Its capacity was about 90% of the typical test hole volume so all the recoverable oil was removed in a single stroke. The recovered oil should be put aside for any dirt to settle, decanted to remove sediment and then be thoroughly mixed and its unit weight checked before reuse.

PUBLICATIONS

N.Z. GEOMECHANICS PUBLICATIONS 1969-71

1. INTRODUCTION

Previously it has been possible 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. With the formation of the N.Z. Geomechanics Society and hence the broadening of fields of interest of our membership, this is no longer a practical proposition. Instead as promised in our previous issue we present below a list of papers on geomechanics topics by New Zealand authors published in the three years 1969 to 1971. It is hoped that this list will now become an annual one. Members will be able to peruse this list and obtain copies of papers which interest them from their nearest engineering library.

The list has been divided into two sections, the first being technical papers by New Zealanders appearing in both New Zealand and overseas publications and the second being theses presented at the Universities of Auckland and Canterbury.

We hope that the list is a complete one, but will be grateful to receive information on any publications which have been omitted.

2. LIST OF TECHNICAL PAPERS PUBLISHED BY NEW ZEALANDERS ON GEOMECHANICS TOPICS IN THE YEARS 1969-71

N.Z. ENGINEERING

FLYNN E.A. (1969)	"The Design and Construction of Auckland International Airport -3 Earthworks and Drainage" Vol. 24 (2) pp 62-67
PALMER D.J. (1969)	"The Effect of Ground Compliance on the Free Vibration of Shear Buildings" Vol. 24 (11) pp 337-339
BROOKS S.E. (1970)	"Manapouri Power Project - Tailrace Tunnel Construction" Vol. 25 (5) pp 120-124
FIRTH N.W. (1970)	"Soft Tunnelling Techniques Used in the United Kingdom" Vol. 25 (6) pp 150-153
LEWTHWAITE W.J. (1970)	"The Use of Dynamic Formulae in Calculations for Internally Driven Steel Shell Piles" Vol. 25 (7) pp 180-181
PICKENS G.A. (1970)	"The Whau Valley Dam" Vol. 25 (12) pp 319-324
SHEPHERD R. and TRAVERS J.H. (1970)	"Surface Layer Modifications of Seismic Shear Waves" Vol. 25 (2) pp 36-39
WEBLEY J.F. (1970)	"Repairs to a Main Trunk Railway Tunnel" Vol. 25 (7) pp 186-189
BLAKELEY J.P. (1971)	"The Stresses Around Openings in Rock" Vol. 26 (4) pp 105-110
NICHOLAS C.J.A. (1971)	"Settlement Analysis of Building Foundations" Vol. 26 (8) pp 229-234
SHEPHERD R. and CHARLESON A.W. (1971)	"A Method of In-situ Soil Stiffness Measurement" Vol. 26 (4) pp 97-101

BULLETIN OF THE N.Z. SOCIETY FOR EARTHQUAKE ENGINEERING

LENSEN G.J. (1969)	"Earth Deformation and Earthquake Prediction" Vol. 2 (4) pp 443-458
LENSEN G.J. (1970)	"Elastic and Non-Elastic Surface Deformation in New Zealand" Vol. 3 (4) pp 131-142

STEPHENSON W.R. (1971)	"Seismic Microzoning in New Zealand" Vol. 4 (1) pp 43-50
MARTIN G.R. and TAYLOR P.W. (1971)	"Earthquake Resistant Design of Cohesive Earth Slopes" Vol. 4 (1) pp 51-72
PARTON I.M. and MELVILLE-SMITH R.W. (1971)	"Effect of Soil Properties on Earthquake Response" Vol. 4 (1) pp 51-72
EVANS G.L. (1971)	"A Field Test for Dynamic Soil Properties" Vol. 4 (2) pp 176-204
CARR A.J. and MOSS P.J. (1971)	"Elastic Soil Structure Interaction" Vol. 4 (2) pp 258-269

PROCEEDINGS OF THE FIRST AUSTRALIA - NEW ZEALAND CONFERENCE ON GEOMECHANICS, MELBOURNE, AUGUST 1971

HAWLEY J.G.	"The Primary/Secondary Transition During the Consolidation of Clay" Vol. 1 pp 127-131
MOSS J.D.	"A High Capacity Load Test for Deep Bored Piles" Vol. 1 pp 261-267
MARTIN G.R. and KAYES T.J.	"Effects of Anisotopy and Sample Disturbance on the Cu = 0 Stability Analysis" Vol. 1 pp 349-354
PENDER M.J.	"Some Properties of Weathered Greywacke" Vol. 1 pp 423-429
GALLOWAY J.H.H.	"Contribution to Seminar on "Geomechanics - A Tool in National Development" Vol. 2 (to be published)

PROCEEDINGS OF SEVENTH INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING, MEXICO CITY, AUGUST 1969

TAYLOR P.W. and BACCHUS D.R.	"Dynamic Cyclic Strain Tests on a Clay" Vol. 1 pp 401-409
NORTHEY R.D.	Chairmans report on Speciality Session on "Engineering Properties of Loess and other Collapsible Soils" Vol. 3 pg 445
TAYLOR P.W.	"Notes on the Design of a foundation for a Large Gang-Saw, Kawerau, New Zealand". Proceedings of Speciality Session No. 2 (Soil Dynamics) pg 138

GEOTECHNIQUE

TAYLOR P.W. and OOI T.A. (1971)	"The Increase in Bearing Capacity Resulting from Consolidation" Vol. 21 (4) pp 376-390

PROCEEDINGS OF FIRST INTERNATIONAL CONGRESS OF THE INTERNATIONAL ASSOCIATION OF ENGINEERING GEOLOGY, PARIS, 1970

OBORN L.E.	"Seismic Microzoning in New Zealand" Preprints Vol. 2 pp 1326-1333
THOMPSON B.N.	"Geological Investigations of the Aratiatia Rapids Power House Area, Waikato River, N.Z." Preprints Vol. 2 pp 1149-1158

JOURNAL OF THE SOIL MECHANICS AND FOUNDATIONS DIVISION OF A.S.C.E.

No papers by New Zealanders in the period 1969-71

PROCEEDINGS OF SYMPOSIUM ON NEW ZEALAND PRACTICES IN SITE INVESTIGATIONS FOR BUILDING FOUNDATIONS, CHRISTCHURCH, AUGUST 1969

TAYLOR D.K.	"Basic Objectives of Site Investigation"
NORTHEY R.D.	"Overseas Soil Sampling Practice"
OBORN L.E.	"Geology as an Aid to Site Investigation"
INGHAM C.E.	"Geophysical Methods of Site Investigation"
CORNWELL W.L.	"The Drilling Organisation"
NORTHEY R.D. and THOMAS R.F.	"Drilling and Sampling Techniques"
BULLEN R.O.	"Logging Boreholes, Handling and Transportation of Samples"
GILLESPIE K.H.	"Field Testing of Soils"

PROCEEDINGS OF NEW ZEALAND ROADING SYMPOSIUM, WELLINGTON, AUGUST, 1971

(To be published)

SESSION H - PAVEMENT DESIGN

STACEY A.F. and SUTTON P.N.	"Pavement Design for State Highways"
VAN BARNEVELD D.	"Reconsideration of Pavement Design for Urban Roads and Streets"
RALSTON J.	"Modern Design and Construction Techniques for Concrete Road Pavements"
BELSHAW T.	"Pavement Design using Benkelman Beam Data"

SESSION J - EARTHWORKS AND TESTING

BULLEN R.O.	"Slopes in Rocks and Soft Rock Materials"
FERGUSON D.J.	"Quality Control of Compaction in Earthworks and Pavements by Nuclear Methods"
PICKENS G.A.	"Compaction Control of Cohesive Fill"

SESSION K - AGGREGATES RESEARCH

RAUDKIVI A.J. and NGUYEN V.J.	"Moisture Movements in Porous Media due to Temperature Gradients"
MARTIN G.R. and TOAN D.V.	"Effect of Basecourse Saturation on Pavement Stability"
BARTLEY F.G.	"An Investigation of the Stability of Unbound Basecourse Pavements"

SESSION L - AGGREGATES PRACTICE

BULLEN R.O. and MAJOR N.G.	"Granular Base Layers - what do we really know?"
BARTLEY B.A.	"Economics of Quarry Production of Roading Aggregates"
RALSTON J.	"Cement Stabilised Pavements"

SESSION P - BRIDGE RESEARCH

SHEPHERD R. and CHARLESON A.W.	"Some Measured Dynamic Properties of Laterally Loaded Piles"
SHARPE R.D.	"The Seismic Response of an Elastic Bridge Structure, Taking the Site into Consideration"
EVANS G.L.	"The Behaviour of Bridges Under Earthquakes"

3. LIST OF NEW ZEALAND UNIVERSITY THESES ON GEOMECHANICS TOPICS IN THE YEARS 1968-71

UNIVERSITY OF AUCKLAND

1968

KAYES T.J.	"Computer Analysis of Earth Slope Stability" M.E. Thesis
OOI T.A.	"Preloaded Foundations" M.E. Thesis
TUOHEY G.J.	"Some Investigations into Pavement Design" M.E. Thesis

1969

BACCHUS D.R.	"Cyclic Deformation of a Clay" Ph.D. Thesis
SALT P.E.	"Microtremor Studies" M.E. Thesis

1970

JAMES R.R.	"Recoverable Deformation in a Flexible Pavement" M.E. Thesis
McGREGOR P.J.	"Computer Analysis of Earth Dam Stability" M.E. Thesis
NICHOLAS C.J.A.	"Computer Analysis for Building Foundation Settlement" M.E. Thesis

1971

HADFIELD G.J.	"Analysis of Beams on Elastic Foundations" M.E. Thesis
LUXFORD N.S.	"Lime Stabilisation" M.E. Thesis
SMITH R.W.M.	"The Determination of Dynamic Soil Properties and their Use in Response Analysis" M.E. Thesis
TAYLOR P.W.	"The Properties of Soils Under Dynamic Stress Conditions with applications to the Design of Foundations" Ph.D. Thesis

UNIVERSITY OF CANTERBURY

1969

MATTHEWSON C.D.	"The Elastic Behaviour of a Laterally Loaded Pile" Ph.D. Thesis

1970

CHARLESON A.W.	"The Dynamics of Bridge Sub-Structures" M.E. Thesis
GILLON M.D.	"The Ultimate Resistance of Deadman Anchors Subject to Inclined Load" M.E. Thesis

1971

PENDER M.J.	"The Stress-Deformation Behaviour of a Compacted Clay" Ph.D. Thesis
EVANS G.L.	"The Dynamic Properties of Soils; Field Determination From Wave Pulse Velocities"

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 ____

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