N.Z. GEOMECHANICS NEWS

No. 23

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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. The basic annual subscription rate is $12.00 and is supplemented according to which of the International Societies, namely Soil Mechanics ($5.00), Rock Mechanics ($7.50), or Engineering Geology ($3.50) the member wishes to be affiliated. Members of the Society are required to affiliate to at least one International Society.

EDITOR'S NOTES

1. Slope Stability in Rural and Urban Development

This issue contains 3 items related to slope stability in rural and urban development. The first is an article by John Hawley which suggests two categories of the Society's membership and discusses their role in slope stability assessment. The second is a copy of the submission made on behalf of the Society to the Local Bills Committee on the proposed Local Government Amendment Bill. In the third item John Blakeley discusses, from an engineering point of view, sites which are difficult to develop, and means of approaching their development.

2. Membership Application

To assist Society members in recruiting new members, an application form can be found at the back of this issue. Please note that to facilitate the management committee's task of scrutinising the applications, prospective members are required to be nominated by existing financial members of the Society. Prospective members are requested not to send subscription fees with their applications.

3. Change of Address

Members are reminded that changes of address should be notified to the Institution Secretary, using the form provided in the back of this newsletter.

4. Contributions 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 investigations, construction techniques or design methods which have been successfully used in New Zealand, and which would be of help to other members, would be particularly welcome. All contributions should be sent to:
The Editor, N.Z. Geomechanics News, C/- N.Z. Geomechanics Society,
P.O. Box 12-241, Wellington North.

S.A.L. Read
Editor

PUBLICATIONS OF THE SOCIETY

The following publications of the Society are available:

(a) From the Secretary, NZIE, P.O. Box 12-241, Wellington North:

- Proceedings of the Palmerston North Symposium "Geomechanics in Urban Planning", April 1981. Price $20.00

- "Stability of House Sites and Foundations - Advice to Prospective House and Section Owners". (Published for the Earthquake and War Damage Commission.) Price $0.50¢.

- Proceedings of the Third Australia-New Zealand Conference on Geomechanics, Wellington, May 1980. Price $90.00 for the three volume set.

- Proceedings of the Hamilton Symposium "Tunnelling in New Zealand", November 1977. Price $18.00 to members, $20.00 to non-members.

- Proceedings of the Second Australia-New Zealand Conference on Geomechanics, Brisbane, July 1975. Price only $25.00.

- Proceedings of the Wanganui Symposium "Using Geomechanics in Foundation Engineering", September 1972. Price $8.00 to members, $10.00 to non-members.

- Proceedings of the Christchurch Symposium "New Zealand Practices in Site Investigations for Building Foundations", August 1969. The last copies of a limited reprinting are available at $8.00 to members, $10.00 to non-members.

- Copies of all back-issues of "New Zealand Geomechanics News" are available to members at a nominal price of $2.00 per copy.

- The following back issues of the I.A.E.G. Bulletin are available. Price $3.00 to members.

Issue	No. available
14	1
15	10
21	1

(b) From Government Bookshops:

- "Slope Stability in Urban Development" (DSIR Information Series No.122) Price $2.00.

The following publications of the Society have been sold out:

- Proceedings of the Nelson Symposium "Stability of Slopes in Natural Ground", 1974.

- Proceedings of the Wellington Workshop "Lateral Earth Pressures and Retaining Wall Design", 1974.

T.J. Kayes
Publications Officer

THE *LITERATES* AND THE *NUMERATES*

J.G. Hawley

It may be suggested that the membership of the Society may be divided into two groups - the *literates* and the *numerates*. The first is dominated by geologists, who are supported by pedologists, and earth scientists. They think in words - words like "Quaternary", "loessial" and "entisol" - and are seldom stuck for something to say (usually lots) about any piece of land anywhere. The second group (the *numerates*) is dominated by civil engineers, gingered up by a sprinkling of applied mathematicians and classical physicists. They like to measure things and do sums.

Between these two main groups lie the physical geographers. They speak the languages of both main groups while adding a flavouring of statistics - correlation coefficients and standard deviations.

One of the most worthwhile functions of the Society has been to bring these groups together, and this it has done quite regularly. However, the discussions at conferences, symposia, local group meetings, and in this newsletter have often been less than satisfying. The heterogeneous nature of the membership is probably the principal reason for this. This example of the gap between the "two cultures" is, I believe, a very real one. The *literates* keep silent and concentrate on nodding wisely when discussion is of principal planes or integrations: the *numerates* do likewise when the subject changes to stratigraphy or soil profiles.

The real fun starts when members of both groups (or cultures) find themselves called upon to give professional opinions on the same issue. A recurring example is the prediction of the stability of slopes in natural ground.

The stability of slopes in natural ground - a matter for the *literates* or the *numerates?*

In an attempt to avoid drifting into making unhelpful generalisations I will be referring to three different scales of investigation:

(a) rural slope instability, i.e. soil conservation. In this situation the "site" is usually at least a few hundred km^2 in area, commonly thousands and occasionally tens of thousands,

(b) urban capability surveys. These usually cover areas of the order of tens of km^2 - a few hundred at most,

(c) the investigation of sites for individual structures. For buildings, bridges and for problem areas on roads and railways, the site is commonly a thousandth and rarely greater than a few hundredths of a km^2, though investigations may need to be made of the broader geological setting - over say one to ten km^2.

From the individual building site of .001 km^2 to the soil conservation problem covering 10,000 km^2 there is then a span of seven orders of magnitude!

A facile follow-on from this would be an unhelpful general comment that for the 'large area problems' the *literates* will dominate, and for the small area, site specific situations the *numerates* will play the key role.

This is a generalisation which I do not buy. My present view is that the *literates* have as important role to play on the small site as in a regional study, and that the *numerates* may yet have as significant a role to play in soil conservation studies (from detailed studies of the typical site) as they have in investigations of small sites for structures.

One part of the *numerates'* armoury which the *literates* are fond of picking up is the slope stability calculation - based on values of cohesion and internal friction and leading to calculations of factors of safety. (They were given a few lectures on it in their geology or geography courses at university, and since then have heard the *numerates* talking about such calculations being done for dams and embankments.)

Do calculations of factors of safety ever have any relevance to the stability of natural slopes?

Before considering natural slopes it is of interest to look at the procedures for 'unnatural' slopes - dams and embankments. In these structures the soil is recompacted to a known density, and checks are made during construction to see that density standards laid down in the design are being met. Laboratory samples of the same soil are compacted to that same density and value of cohesion (c) and internal friction (ϕ)* are obtained from triaxial tests. Factors of safety are then calculated using one or more of the sophisticated analyses, several of which are now widely available on computers. The influence of possible variations in ground water levels from those assumed in the design may be calculated, and the actual variations checked in the field during and after construction.

This is really a very sound procedure - for recompacted structures. In natural slopes by contrast there is a variability (commonly large and often unknown) in material properties with depth, and a layering of the different materials generally parallel to the slope surface. In recompacted structures, unsuitable (low strength) regolith materials are excluded (carted to waste) and the layering is all horizontal - between the different "approved" soils being used, and within each soil as a result of it having been recompacted in thin horizontal layers.

Arising from this commonly large but unknown variability of soil properties (particularly permeability and strength) in natural slopes is the very real possibility that a very low strength layer exists which may be too thin to sample - i.e. it does not survive even the most careful borehole sampling operation and is only detectable in the walls of inspection shafts. The stability in such situations is determined by the strength and disposition of this "defect". (It is worth remembering the Euclidean definition - "a surface has area but no thickness"). The defect may be a weak surface rather than a weak layer - as could occur at the boundary between two different materials.

Any variability in soil properties is likely to include significant changes in permeability which may lead to anomalous pore water pressures. Specifically, the pore water pressure in a highly permeable layer may relate to infiltration much higher up the slope. Furthermore the structural defects which occur in virtually every rock type have been known to transit anomalous pore water pressures over large distances. This makes the assignment of meaningful values to ground water levels in the factor of safety calculations virtually impossible - without field measurement over several months.

* or c' and ϕ'

The considerations outlined above, together with difficulties of obtaining good "undisturbed" samples from even the more homogeneous natural slopes, leads me to the view that it is not generally practicable to assign meaningful values of c and ϕ to slopes in natural ground.

Expressed in another way I am confident that for most natural slopes even the best sampling and testing operation would lead to a scatter of values of c and ϕ which would be more than sufficient to span the range between "should have failed" and "stable". The more thorough the investigation, the greater is the range likely to be.

To these reservations about the values of c and ϕ must be added reservations about the validity of assumptions built into the different methods of using them, i.e. the assumptions adopted in deriving the different formulae for factor of safety.

During the 1950's and 60's a large number of papers appeared in which the results of investigations into slope failures in natural ground were presented. In many of these the investigations stated that they had measured values of c and ϕ, and on calculating the factor of safety found that, indeed it would have been unity so the slope should have failed. The world was thereby invited (by implication) to believe that the problem was understood and that man was in control. For the reasons outlined above, such papers tend to be unconvincing. They appear less often now.

What are the legitimate roles of the *literates* and the *numerates* in studies of slope instability in natural ground? My present views are:

For (a) above - soil conservation - by which in this context I refer to the control of mass movement erosion in pastoral hill country:

The real question is not "What are the soil strengths?" but "By what processes and what rates will the soil strengths change, daily and seasonally, under different styles of land use/management?"

We may hope that the *numerates* will answer this question by recording and analysing the daily and seasonal patterns of pore water pressure and strength within the soil - at "type sites" under different styles of land use/management. The role of the *literates* will include

(i) selection of the "type sites" and

(ii) the extrapolation of understandings developed by the *numerates* to areas which are similar in relevant properties.

For (b) above, I believe that the *literates* must prevail at the urban capability survey stage, in the preparation of the geotechnical input to district schemes and even up to the concept plan stage. Only when likely areas for commercial buildings, bridges, major road cuts or fills have been identified is it appropriate for the *numerates* to get involved. In other words the soil mechanics must be site specific.

The work done by the *literates* in preparing an urban capability survey includes

(i) gathering together onto one map and one legend all relevant information on geology, engineering geology and soils

(ii) remapping these as necessary and adding slope, vegetation, present and potential fluvial and mass movement erosion, drainage characteristics (including flooding) and a terrain component description

(iii) presenting all of the above "factual" or "inventory" information in the form of homogeneous unit areas on one map

(iv) making an interpretation, i.e. an integrated appraisal, of the above information relating to each unit area, from an urban development viewpoint. This interpretation is called "urban capability".

For (c) above - the site investigations.

These should always begin with the *literates* describing the geological setting and indicating what types of problem could be expected. The *numerates* plan their investigations accordingly and after making their measurements and doing their sums confer with the *literates* again to confirm/revise and finalise the evaluation of the site.

In summary

Slope stability calculation methods have been developed for and are valid for recompacted structures (dams, embankments etc). To have any validity for natural slope such calculations would need to be supported by good field measurements of the daily and seasonal patterns of pore pressure changes, and density/strength changes.

The Society membership may be divided into the literates and the numerates, and a good deal of interest (and benefit) may be derived from the interaction of these two groups.

LOCAL GOVERNMENT AMENDMENT BILL

Recent proposed changes to the Local Government Amendment Act 1979 have drawn comments from several sectors of the community. The text of the submissions made to the Local Bills Committee on behalf of the Geomechanics Society is given below.

"Introduction

This submission has been prepared by the New Zealand Geomechanics Society in response to changes proposed to the Local Government Amendment Act 1979, which would allow councils to issue permits for the erection or alteration of buildings sited on land subject to erosion or inundation. The proposal is in contrast to current legislation, which prohibits councils from issuing building permits for land subject to erosion subsidence, slippage or inundation by the sea, river, stream or lake, unless the council is satisfied that adequate provision has been made to protect the land from these hazards. The Society acknowledges that these provisions in their present form are restrictive and some amendment is required. The proposed amendments, however, are not sufficiently definitive in some areas and wider powers to allow councils to issue building permits than contained in the amendments are proposed.

Comment

The following comments are presented in support of this submission.

1. The amendments are concerned with the issue of building permits on land subject to erosion and inundation. A distinction is made between erosion on the one hand and subsidence and slippage on the other. This distinction may not always be readily apparent. It is suggested that some consistency is required when dealing with land subject to these interrelated hazards.

2. A "relocatable" building is not adequately defined. Any building may be relocated, some types with greater ease than others. The introduction of the term "relocatable" raises many problems. For example:

   (a) how is a relocatable building defined?

   (b) when and by whom would the decision be made to move buildings?

   (c) where would buildings be located if removed successfully?

3. The proposed amendments are related to absolution of councils from civil liability when permits are issued on land subject to erosion. The Society suggests that the current provisions should be extended to require councils to commission urban capability studies to identify areas of land subject to erosion, landslip subsidence and inundation. Such studies have already been carried out to advise some local authorities in carrying out their statutory responsibilities under Section 641 of the Local Government Act and complementary provisions in the Town and Country Planning Act 1977, and may be applied to rural or urbanised land.

4. Where areas of land are identified through these studies as being subject to erosion, landslip, subsidence and inundation, these areas should be the subject of more intensive investigation prior to the issue of building permits. Where the council is satisfied that adequate provision has been made for the protection of the land or the dwelling, a building permit may be issued in the normal manner.

5. Where the council is not satisfied that adequate provision has been made for the protection of the land from the hazard, the council may issue a building permit and not be under any civil liability to any person having an interest in that building. Under these conditions the building or alteration would not be subject to insurance against damage from the hazard(s) as provided under current legislation (e.g. Earthquake and War Damages Act). Registration on the certificate of title of the land of the conditions pertaining to issue of a permit may be required to protect subsequent owners. This procedure would ensure the protection of civil rights but discourage the erection or alteration of buildings on land subject to hazards. It is foreseen that the number of cases where individuals seek to obtain building permits for land, identified by an urban capability survey as being subject to hazards, and adequate protection cannot be provided following more intensive investigations, will be a minimum and represents an extreme case which should, however, be considered.

6. A special case is envisaged for the issue of permits for low cost farm buildings. Greater freedom should be given to councils to issue permits for the erection of farm buildings on rural land or land within urbanised areas which is considered not suitable for urban subdivision. Periodic inundation or damage to buildings from erosion or landslip is unlikely to cause undue hardship, or result in substantial financial loss. This is seen in contrast to residential development or land subject to erosion, landslip or inundation where considerable financial hardship is likely to be experienced by a number of people.

Summary

Proposed changes to the Local Government Amendment Act 1979 are not supported by the Society in their present form. Greater consistency in the assessment and treatment of hazards such as erosion, subsidence, landslip and inundation is required. The preparation of urban capability surveys identifying areas of land subject to these hazards is proposed for urban land. Where adequate protection from these hazards cannot be provided, it is proposed that councils be able to issue building permits without civil liability. The buildings or alterations would not carry insurance for damage from these hazards. Greater flexibility in the issue of permits for farm buildings is proposed.

I.M. Parton
Chairman"

NEWS FROM THE MANAGEMENT SECRETARY

1. 1982 NZIE Conference

The conference is to be held at the School of Engineering, University of Canterbury, from 8-12 February 1982. The technical sessions of the Geomechanics Society will take place on Wednesday afternoon, 10 February. The session will have a theme of "Chemical Stabilisation of Dispersive Soils". The abstracts of the four papers that will be presented are given below:

R.D. Northey - "Engineering Characteristics of Dispersive Soils"

Tunnel gulley erosion of dispersive soils is a well known agricultural problem of long standing, but recent recognition that such soils have been the cause of failures in various engineering earthworks has led to an increased geotechnical interest in such materials. The results of conventional soil engineering classification testing have been shown to be generally poor predictors of dispersive performance. This has led to the development of special tests based directly on erodibility or on a better understanding of the soil chemistry related to dispersion and flocculation.

G.J. Schafer - "Identification of Dispersive Soils"

Chemical reasons for dispersive behaviour of soils, and some tests for assessing dispersibility are discussed. Characteristic erosion forms are described, and geographical distribution of dispersive soils in New Zealand is indicated.

D.H. Bell - "Chemical Stabilisation of Dispersive Soils including Case Histories from the Christchurch Area"

Chemical methods of stabilising dispersive soils are outlined, and their effectiveness and practical application are discussed with reference to several case histories in the Christchurch area.

T. Sameshima - "Chemical Stabilisation of Roading Aggregates - a Clay Mineralogical Approach"

Roading aggregates often contain expandable clay-minerals. Their chemical stabilisation using HCl, KCl and slaked lime have been studied. Reactions between these chemicals and expandable clay will be discussed.

The field aspects of chemical stabilisation and erosion control will be illustrated on a field trip around the Port Hills on Friday 12 February.

2. Annual General Meeting

The Annual General Meeting of the Society will be held during the 1982 NZIE conference at 5 p.m. on Wednesday February 10, following the presentation of the Society papers.

3. Nominations for 1982 Management Committee

Nominations for election to the Management Committee for 1982 were received on behalf of:

G. Crocott
T. Kayes
P. Millar
I. Parton
B. Paterson
A. Olsen
S. Read
G. Schafer

Since the number nominated represents the requisite number to be elected by the Society members, no ballot was necessary. These nominations will be put to the Annual General Meeting of the Society in February 1982 for confirmation of election.

4. New Members

The following people have recently been admitted to the Society:

W. Bowe
T. Lanigan
M. Goldsmith
R. Murfitt
D. McKenzie
M. Jessen
R. Croad

5. New Secretary-Generals of International Societies

ISSFME - Dr R.H. Parry, UK

IAEG - Dr L. Primel, France

6. IX ISSFME Conference, Tokyo 1977

The special volume of the proceedings of the conference, which was prepared due to discrepancies experienced between design and performance, has been sent to the Geomechanics Society. The Society has donated this "Case History Volume" to the Soil Bureau library. Soil Bureau has the msot complete collection in New Zealand of Soil Mechanics conferences including all conferences of the International Society and most of the Regional Conferences.

7. World Geo-Guide

The first issue of the World Geo-Guide, a document intended to be a source of information and communication for everybody who needs actual knowledge in the geotechnical field, has recently been issued. Anybody who is interested in obtaining the information folder for the guide should write to the Management Secretary. The selling price of the guide is US$49.50.

A.J. Olsen

DRAFT METHOD OF SOIL DESCRIPTION

FOR ENGINEERING USE

No further comments on the draft method have been received since the issue of Volume 22 of Geomechanics News. At the most recent Management Committee meeting, discussion of members' comments resulted in the method being extended to include the description of rock.

During the review of members' comments of the draft method of soil description, the sub-committee will extend the method to include rock. Any members who are interested in making suggestions on a description method for rock should forward their proposed methods, comments and/or views to the Management Secretary. It is anticipated that the complete material description method will be circulated with Volume 24 of Geomechanics News.

S.A.L. Read

PROFESSOR A. CASAGRANDE

Professor Arthur Casagrande died on 8 September 1981. As a token of respect the obituary prepared by Professor Skempton and which appeared in the New Civil Engineer on 1 October 1981 is reproduced below.

CASAGRANDE: ONE OF THE GREAT CIVIL ENGINEERS

Professor Casagrande died on 6 September, aged 79, and with his death our profession has lost one of the great civil engineers of this century. He was renowned as a university teacher, as a geotechnical consultant, and for his research work in soil mechanics.

Arthur Casagrande was born on 28 August 1902 in Haidenschaft, Austria. He entered the Technical University in Vienna in 1919 and, after graduating, worked for a year as assistant to Professor Schaffernack in the hydraulics laboratory. He then took the bold decision to emigrate to the United States, where he arrived in April 1926 with little money and no work. Soon after securing a draughtsman's job at Carnegie Steel, he gained an interview at Massachusetts Institute of Technology and it was on this visit that he met Karl Terzaghi.

Characteristically, Terzaghi made a rapid and accurate assessment of his young countryman's ability, and with his usual determination set about bypassing bureaucratic obstructions in order to get Casagrande appointed on the staff of the Bureau of Public Roads as his assistant at MIT. They worked together for a few weeks in the summer and the appointment came through in December 1926. From that date, for more than 50 years until ill health forced him to withdraw, Casagrande devoted the full power of his mind to advancing science and practice of soil mechanics.

In the Autumn of 1929 he went to Vienna to set up a soils laboratory for Terzaghi who had just accepted a Chair at that university. During the next two years, having returned to MIT, he constructed a triaxial compression cell, developed his shear box apparatus with which, for the first time, he studied volume changes during shear, and carried out the first consolidation tests on undisturbed clay samples. His report on the shear tests (written jointly with an assistant S.G. Albert) and the paper on the difference between remoulded and undisturbed clay, rank among the most significant contributions ever made in soil mechanics. In the same year, 1932, he published the celebrated paper Research on the Atterberg limits of soils.

Casagrande then moved to Harvard University, as a part time lecturer. In 1934 he became an assistant professor, in 1940 he was promoted to associate professor with tenure, and in 1946 came his appointment as Gordon McKay professor of soil mechanics and foundation engineering. This post he held with the utmost distinction until retirement in 1969, though he continued to work at Harvard until only two or three years ago.

On the research side of his activities, he wrote about 70 papers and reports, covering almost every aspect of geotechnics. Many of them are contributions of the highest order. Special reference must be made to the fact that it was he, in 1939, who persuaded the Waterways Experiment Station to sponsor the Cooperative Triaxial Research Program that was carried out at Harvard and, under Donald Taylor, at MIT in the years 1940-44. The results of this work, contained in progress reports (seven by Casagrande himself) and summarised by Philip Rudledge, initiated a new era in soil testing and our knowledge of shear strength.

As a teacher Casagrande was unsurpassed. His graduate course at Harvard, which he started in 1932-33, became the model for others throughout the world and the class lists contain an amazing number of names later to become distinguished in soil mechanics. Rudledge, Shannon, Peck, Carillo, Stan Wilson, Seed and Sherard are just a few.

In the consulting field Casagrande was engaged internationally on a wide variety of projects to which he contributed his particular combination of scientific insight, originality and engineering commonsense. Problems in building foundations, airfields and slopes all came his way, but during the past 20 years he tended to concentrate on earth and rockfill dams, the most difficult and rewarding aspect of geotechnical engineering, in which he displayed masterly skills.

Casagrande's list of honours is naturally a long one: the first Karl Terzaghi Award, the first Rankine lecturer, honorary doctorates from the universities of Vienna and Mexico, and president of the Boston Society of Civil Engineers, to mention about half of them. It was he who conceived, and personally carried into execution, the idea of organising the first international conference. This was in 1936, at a time when even Terzaghi thought the scheme to be impractical and premature. That it proved to be an unqualified success is now part of engineering history, and of course it led to the formation of the International Society of Soil Mechanics and Foundation Engineering. Casagrande therefore has the honour of being effectively the founder of this famous society, of which he was president during 1961-65.

We owe an incalculable debt for the life's work of this modest but very eminent engineer.

FORTHCOMING CONFERENCES

08-12	February	1982	NZIE Annual Conference. Christchurch, New Zealand.
10-12	February	1982	Grouting in Geotechnical Engineering - 2½ day ASCE speciality Conference. New Orleans, USA.
05-07	April	1982	Strata Mechanics. Newcastle-upon-Tyne, UK.
19-20	April	1982	Symposium on the Pressuremeter and its Marine Applications. Paris, France.
19-23	April	1982	1st International Mine Water Congress. Budapest, Hungary.
24-27	May	1982	European Symposium on Penetretation Testing. Amsterdam, The Netherlands.
26-28	May	1982	Rock Mechanics Related to Caverns and Pressure Shafts. Aachen, Germany FR.
31 May - 4	June	1982	4th International Conference on Numerical Methods in Geomechanics. Edmonton, Canada.
07-11	June	1982	Tunnelling '82. 3rd International Symposium and Exhibition. New Brighton, UK.
01-06	August	1982	Second International Conference on Geotextiles. Las Vegas, USA.
25-27	August	1982	23rd US Symposium on Rock Mechanics. Berkeley, USA.
13-17	September	1982	International Symposium on Seismicity in Mines. Johannesburg, South Africa.
22-26	November	1982	VII Southeast Asian Geotechnical Conference. Hong Kong.
01-06	December	1982	4th International Congress of the IAEG. New Delhi, India.
10-15	April	1983	ISRM 5th International Congress on Rock Mechanics. Melbourne, Australia.
01-11	February	1983	XV Pacific Science Congress, Dunedin, New Zealand.

Further information on these conferences may be obtained by writing to the Management Secretary.

A.J. Olsen

NEWS FROM THE INTERNATIONAL TUNNELLING ASSOCIATION

Nice, 10 and 13 May 1981

1) Minutes of 1982 General Assembly

Member Nations Present

South Africa, Federal Republic of Germany, Belgium, Canada, Korea (Republic of), Spain, United States of America, France, India, Iraq, Iceland, Italy, Japan, Norway, Netherlands, Poland, United Kingdom, Sweden, Switzerland, Venezuela, Algeria.

Member Nations Represented

Saudi Arabia, Cameroun, Luxemburg, Morocco, Czechoslovakia, USSR.

Member Nations Absent

Australia, Austria, Brazil, Denmark, Finland, Greece, New Zealand, People's Republic of China, Turkey.

New Members

Since the 1980 General Assembly the following new member nations have been admitted: Iraq, Republic of Korea, Brazil and Venezuela.

ITA Brochure

Orders for the ITA brochure may now be made through National Societies. It was emphasised that particular effort must be made to publicise and circulate the brochure.

Working Groups (update from summary in Vol. 22 Geomechanics News)

(a) Standardisation. Work is progressing on compiling information on standardisation of profiles. Aspects being examined include the practical distribution of underground structures achieved, according to their diameter and use.

(b) Research. Investigations continued into tunnel boring machines and water problems in underground works.

(c) Contractural Sharing of Risks. Recommendations on ground support and mobilisation payments were tabled as follows:

- Ground Support:

The International Tunnelling Association recommends that all tunnelling tender and contract documents define:

(1) the assumed character of the ground throughout the construction site;

(2) parameters required for the design of ground supports, and more particularly whether the ground support has been included in the design of the "permanent" structure;

(3) bills of quantities for ground support covering a reasonable range of site conditions;

(4) methods to take account of changes in the quantity or type of ground support dictated by the actual site conditions differing from those assumed.

- Mobilisation Payments:

The International Tunnelling Association recommends the inclusion in all tunnelling contracts of suitable mobilisation items, independent of the work rates, and covering the expenditures for setting-up.

(d) Subsurface Planning. Papers are being prepared by eight European countries and the USA on the aspects of subsurface planning with which the individual country is most familiar. The papers are intended to cover social, economic, political, environmental and energy aspects.

(e) Health and Safety in Work (formerly safety in work). A document entitled "Guidelines for Good Tunnelling Practice" is being prepared.

(f) Maintenance and Repair of Underground Works. The topic has been broken into four main areas: typical problems; inspection and monitoring; economics and finance; repair and maintenance. Members of the group are compiling information in each of these areas.

(g) Structural Design Models for Tunnelling. The work of the group has been extended by one year.

(h) Catalogue of Works in Progress. Data from more than 2500 tunnels have been collected, and are being assimilated.

(i) Seismic Effects on Underground Structures. Work on the aseismic design procedures has identified the need for instrumentation programmes to improve aseismic design procedures. Placement and maintenance of instrumentation should be vigorously encouraged.

The next council meeting will take place at 'Tunnelling '82' to be held in New Brighton, U.S. on 7-11 June 1982.

2) Tunnel Construction Methods

The subcommittee on Education and Training of the US National Committee on Tunnelling Technology has compiled a set of 215 35mm slides illustrating tunnel construction and history. Topics include soft-ground tunnel excavation procedures and equipment, tunnel linings, shield tunnelling, settlement over tunnels, braced-cut construction, rock tunnel excavation, tunnel boring machines, rock support and submerged tube construction.

The sets are available from the US National Committee on Tunnelling Technology, 2101 Constitution Avenue N.W., Washington, DC 20418, USA. Price is US$50.00; cheques payable to the National Acadamy of Sciences.

R.L. Preston

LOCAL GROUP ACTIVITIES

1. AUCKLAND GROUP

1.1 Piled Foundations

The design, performance and case histories of piles and piled foundations were discussed at a joint meeting with the Structural Group of the N.Z.I.E. Auckland Branch. The three speakers addressed a gathering of more than sixty people at The Professional Club on the evening of 20 August 1981.

Susan Jackson of the Ministry of Works and Development outlined her recently completed research project on the "Underwater Concreting of Small Diameter Piles". The work was conducted on behalf of the National Roads Board and was initiated after excavation alongside an existing concrete pile constructed under drowned conditions revealed extensive exposure of the steel. The exercise was carried out at the Devonport dockyard by different piling contractors; with variations in concrete mix, equipment and procedures. Rarely are piles brought to the surface as they were during this project and Susan's talk was well illustrated with colour slides which served as clear evidence of the wide differences in pile quality and the sometimes disastrous results. All concrete mix designs used in the project were satisfactory and the most successful equipment used was the two line bucket. However, the success or otherwise of underwater concreting of piles proved to depend largely on the proficiency and knowledge of the contractor. It was demonstrated that under experienced supervision it is possible to construct a reliable structural foundation with any of the five methods tested.

Driven Timber Piles was the subject of an address by Rodney Melville-Smith of Foundation Engineering Ltd. He emphasised the load bearing capabilities of this type of pile (400 kN on a 300 Ø pile) and their suitability for small and medium sized buildings, particularly where there is fill or soft material at the surface. For example on a Papatoetoe residential site where about 12 m of sawdust existed, piles for six units were driven in only two days. In another case timber piles were used in 6 m of fill under one corner of a Henderson factory. Currently treated timber piles are available in diameters from 140 up to 300 mm in lengths up to 15 m ex stock with greater lengths to order. Loading tests performed on behalf of T.R.A.D.A. revealed that for short timber piles, the pile driving formulae (including the Hiley formula) are unreliable and over estimate load capacity. It is understood that a number of engineers are reviewing the safety factors they use with these equations. From the general discussion which followed it was agreed that where high shrinkage soils are anticipated, the piles should be deeper to counteract the problem of uplift.

One of New Zealand's most experienced piling practitioners, Bryce Hadfield of Gilberd Hadfield Pile Co. Ltd, gave his personal account of specific piling problems encountered during the past thirty years. Difficulties had arisen mainly due to unexpected subsoil conditions or human error. Typical examples included inadequate initial site investigation, inappropriate test drilling methods, unexpected half in lava flows, unforeseen contents in fill, failure to inspect pile shafts immediately prior to pouring of concrete, unsuitable mix design and/or construction procedures, specification of underdesigned casings and so on. In one alarming example, a clerk of works who was persuaded to have his smoko before being lowered to the base of a shaft for an inspection was shaken when he returned to find that the casing had been crushed completely flat during his brief absence. Problems experienced with various piling methods have prompted improvements in field control, techniques and plant. The use of modern vibratory extractors has reduced the quantity of

permanent casing used by enabling contractors to withdraw a large number of steel casings, after these casings have been filled with concrete. On a single contract at least $250,000 was saved by recovering casing. Current approximate costs for steel casing range from $90/m for 600 mm dia. to $400/m for 1500 mm dia.

W. Litherland

1.2 "The Lessons of Abbotsford"

The final meeting of the year, held in conjunction with the Auckland Branch of N.Z.I.E., took place on Wednesday, 21 October 1981 and was attended by approximately 110 people.

The speakers were:

Mr John Pritchard	Secretary, Earthquake & War Damage Commission.
Prof. Peter Taylor	Head of Auckland University School of Civil Engineering.
Mr Simon Carryer	Consulting Engineering Geologist.

The meeting was preceeded by an eight minute film of Abbotsford and the aftermath of the effects of this devastating landslide.

Simon Carryer spoke first and discussed the geological setting of the site and its previous slip history, together with information about the physical geology of Abbotsford. Professor Peter Taylor discussed aspects relating to the stability of the slide and a review of its possible causes. John Pritchard, who had travelled from Wellington to attend the meeting, concluded with a very informative review of the Earthquake and War Damage Commission. He outlined aspects of its funding, extent, type and number of claims, procedure for investigation and assessment of claims and possible courses for the extension of existing legislation. The principal technical aspects of the landslide are reviewed in Volume 22 of Geomechanics News on pages 22 and 23.

The meeting was enthusiastically received by the large audience and a very full and lively discussion took place. Following the meeting the speakers and approximately 60 people attended a very enjoyable dinner at the Auckland University Club.

M. Wesseldine

2. WELLINGTON GROUP

2.1 Tied Back Walls

On Tuesday 13th October 28 people attended the Wellington Group meeting to hear John Travers, Tony Mahoney and Gavin Archer from Brickell Moss and Partners talk about their experiences with tied back walls in downtown Wellington. They have been involved with a number of construction excavations in Wellington over the past ten years.

John Travers introduced their subject by outlining the various projects with which they have been involved. Their first major wall was an 18 metre high tied back permanent wall constructed in 1971 for the Bank of New South Wales head office development. Following this were the temporary walls for the

Bank of New Zealand head office development, a temporary wall at the Clifton Street overbridge, a strengthening job on the James Cook lift shaft in 1978 and more recently there have been permanent walls for the Quay Point and Phoenix developments.

Tony Mahoney outlined the geology of the downtown area and commented on the significance of the engineering geology on excavations and tied back wall construction. He pointed out that throughout much of Wellington the basement rock is present in surface exposures and that in some areas Pleistocene alluvium (erosion debris) mantels the basement rock. Through his cross-sections (see Figure 1) he identified the old erosion cliff slope between The Terrace and Lambton Quay and described how Lambton Quay is located on an erosion shelf in the basement rock. In addition the areas of alluvium and recent fill were indicated. The location of the Lambton fault was discussed. Features such as the Lambton fault, the alluvium and recent fill had been found to influence the performance of walls constructed through them.

Aspects related to the design of the walls were discussed by Gavin Archer. The design approach has developed from a planar wedge approach through a two plane wedge and currently a log-spiral surface is considered in the analysis. Simultaneously anchors have developed from simple mild steel bar passive anchors to high capacity stressed multi strand active anchors. The high strength anchors require greater anchorage lengths but significant savings have been achieved through reductions in the number of anchors used. Walls have been designed usually for a static factor of safety of 1.7 and 1.3 for static plus earthquake loading.

Numerous interesting features and developments associated with the design of tied back walls were discussed. It was noted that it is important to consider the vertical forces component on the wall when construction proceeds from top to bottom to ensure that the wall does not migrate downwards. Anchorage capacity is important. Acceptance testing and overload testing (150% of design load) was strongly advocated. Experience had shown that anchor holes should not be left open any longer than necessary because softening of the surface anulus of soil results in poor bond development with the anchors.

With the early ground anchors an additive was used with the anchor grout. This was found to be undesirable because it produced a porous grout with a reduced strength and it retarded the time to initial set. The current approach is to discard additives in preference for pressure grouting which produces a grout of uniform density with no apparent shrinkage problem.

Corrosion protection is very important particularly with permanent anchored wall structures. For maximum protection the speakers said they now favoured a double corrosion protection system.

To finish the discussion various international codes of practice were referenced including the Swiss, French and German codes, the British draft code and the new FIP Recommendations. The Swiss code was cited as being quite appropriate for New Zealand application.

Following the presentation a free ranging discussion from the floor developed. One point of some interest was the potential value of and need for, a central register of site investigations data which would identify what work had previously been undertaken. However a word of caution was raised to the reliability and responsibility associated with such private data. The need for the monitoring of ground anchors was discussed so as to ensure their integrity and to provide future information for design.

The chairman thanked the speakers for the efforts behind the presentation and noted, with some relief, as an interested lunchtime stroller, that the downtown developments on Lambton Quay were being given appropriate technical consideration.

D.N. Jennings

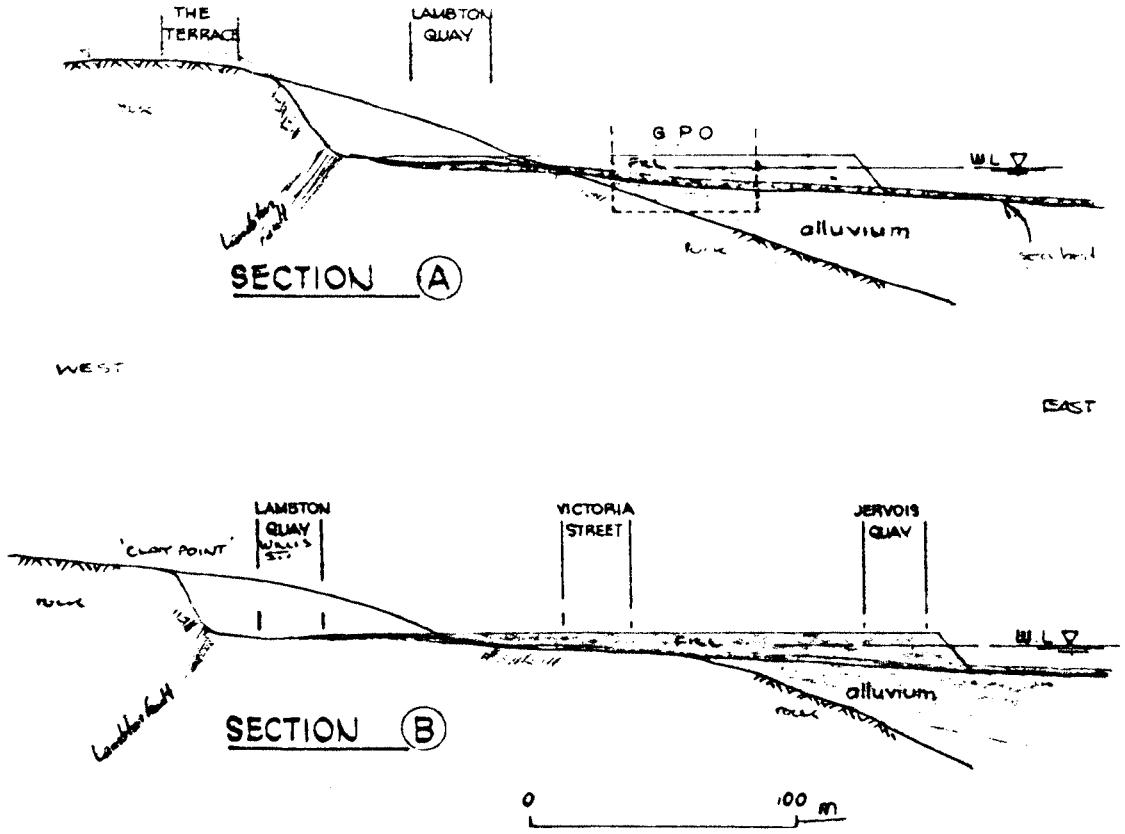

Figure 1 - Typical Geological Sections in Downtown Area.

EXECUTIVE COMMITTEE MEETING ISSMFE

Stockholm, June 1981

When I agreed to attend the above meeting held in conjunction with the Xth ICSMFE as New Zealand's voting representative and vice president elect for Australasia, I knew there was a full agenda including some matters important to the region to be discussed but had not anticipated the marathon it proved to be. The tragic death of our Secretary General, Kevin Nash, shortly before the Conference certainly compounded the problem despite the magnificent way John Burland stepped into the breach and kept things rolling. The meeting was scheduled 0900-1230 and 1330-1700 on Friday and Saturday 12/13 June 1981 but ran through to 2010 on Saturday and was reconvened on Wednesday 17 1400-1630 to consider the recommendations of the ad hoc committee (on which I also served) concerning the manner of appointment of the Secretary General.

1. Membership

Attendance at the meeting was rather large for a committee, especially an executive one. Of the 51 National Societies in good standing 49 sent voting representatives. These were augmented by 30 non voting representatives, the vice presidents, the vice presidents elect, the chairmen of the various sub-committees as well as the president and secretary general - about 100 in all.

2. President

Our new president for the period 1981-5 is Professor Victor de Mello of Brazil. Of the three candidates, Prof. Bolton Seed was eliminated on the first ballot and Prof. Bengt Broms on the second.

3. Statutes

There was only one minor change in statutes clarifying the responsibilities for preparation of the budget (Secretary General) and its approval (Executive Committee).

A lengthy debate developed following the Finnish motion aimed at restricting the official languages of the Society to English covering such matters as, the cost of simultaneous translation facilities at international conferences, the proportion of French speaking members in the Society and the traditional status and importance of the French language. By a large majority it was agreed to maintain the status quo but I am sure the matter will be raised again.

4. Management of the Society

A very important decision was taken to set up a body mainly consisting of the Officers of the Society to assist in the implementation of the decisions of the Executive Committee and in the effective administration of the affairs of the Society. It was resolved "That a Steering Committee be established consisting of the President, Vice-Presidents, Secretary General, immediate Past-President and 3 members from the Society, nominated by the President. The purpose of this Committee is to advise the President and Secretary General on (1) Membership, (2) Finance and Budget and (3) Establishment and continuity of

Technical Committees. The Steering Committee shall bring to the next Executive Committee suggestions for its future scope and make-up.".

The impact of this is to considerably increase the status of the regions through their Vice Presidents. Later in the meeting it became obvious that there was also a growing feeling for more autonomy in the regions with less centralised control than in the past. Thus the development of functions and activities of the Steering Committee is of some importance especially to promote regions like our own. It was suggested that this Steering Committee should meet at least once a year and that individual members seek their own finance for travel during the immediate future.

Most of the members of the Committee appear to have access to adequate travel funds so this decision was no hardship but as I indicated privately to John Burland, members in government or university employ may well find financial difficulty in annual attendance, and thus have less influence on the course of the Society's affairs. The next meeting is to be in San Francisco, 7-9 January 1982.

5. Regional Conferences - Travel Expenses and Surcharges

The case I presented (ably prepared by Ian Parton and others) was almost unanimously accepted. Thus the heavy burden that recent resolutions of the Executive Committee had placed on the financing of regional conferences has been removed and the matter is to be considered by the Steering Committee. It was accepted as reasonable that the expenses of the regional Vice President attending the conference should be met but the special situation in this region with three Vice Presidents attending (representing ISSMFE, ISRM and IAEG) will need to be clarified.

6. Appointment of Secretary General

The Executive Committee was most reluctant to delegate its powers but on this occasion because of the present emergency the Executive Committee delegated the authority to appoint the new Secretary General to the President on the advice of the Steering Committee. Action has now been taken on this and Prof. Dick Parry (ex Melbourne new Cambridge) has been appointed until reviewed in May 1983.

7. XIIth ICSMFE - 1989

Despite a warm invitation from India the decision on the venue for 1989 was deferred to next Executive Meeting Paris, May 1983.

R.D. Northey

FROM THE ISRM VICE-CHAIRMAN

1.1 Death of M. Rocha

Manuel Rocha, who was Past President of the International Society of Rock Mechanics (1966-1970) died on the 1st August 1981 shortly before his 68th birthday.

Professor Rocha graduated in civil engineering grom the Instituto Superior Tecnico, Lisbon in 1938. He then undertook post-graduate study at MIT in the fields of applied physics and experimental design of structures. Later in 1945 he studied soil mechanics at the Ecole Polytechnique Federale, Zurich, where he also undertook an intensive study of the organisation of research in civil engineering.

From 1941 to 1952 Manuel Rocha taught strength of materials at the Instituto Superior Tecnico. In 1941 he established the Civil Engineering Research Centre at this institute and directed it until its integration in 1947 in the Laboratorio Nacional de Engenharia Civil (LNEC) created in 1946. In 1954 he was appointed director of the LNEC and under his guidance and leadership it developed rapidly into one of the foremost civil engineering research establishments in the world. He was concerned principally with research on building materials, experimental design of structures, observation of structures, soil mechanics, embankment and concrete dams and rock mechanics.

Manuel Rocha published over eighty papers on many aspects of civil engineering. His main interest lay with dams, underground works and rock mechanics and he acted as a consultant on many major projects throughout the world. He also undertook many other activities both in Portugal and abroad in connection with his interest in higher education, organisation of research and international co-operation in the field of science and technology. For a time he was the Minsiter of Housing and Public Works. Manuel Rocha's list of honours is a long one and reflects the breadth of his activities and his international standing. They include Honorary President of the Portuguese Society for Geotechnique, Honorary member of RILEM, Gold Medal of the Societe d'Encouragement pour la Recherche et l'Invention (France), Officer of the Legion d'Honneur (France) and Grand Officer of Ordem do Cruzeiro do Sul (Brazil). He will be long remembered and respected in our profession and his many friends throughout the world will mourn his passing.

1.2 Death of D.F. Coates

Dr D.F. Coates, who was previously Director-General of the Canada Centre for Mineral and Energy Technology (CANMET) died on the 15th August 1981.

Dr Coates actively promoted the use of instrumentation and analysis to provide improved control of mining and made many significant contributions to the understanding of ground behaviour, including tributary area theory.

1.3 5th ISRM Congress, Melbourne, 10-15 April 1983

Bulletin No. 1 for the 5th Congress of the International Society for Rock Mechanics in Melbourne, Australia on 10-15 April 1983 has been distributed to all affiliated members. Additional copies are available by writing to the N.Z. Vice Chairman.

Synopsis of papers for presentation at the Congress are required to be sent to the N.Z. Vice Chairman by 31 December 1981. Selected authors will be notified by 28 February 1982 and papers must be completed for review by the National Committee by 31 August 1982.

We are fortunate to have the opportunity to contribute to a conference of this stature so close to New Zealand and recommend that members take full advantage to particpate.

1.4 ISRM Suggested Methods of Test

All the ISRM Suggested Methods that have been published up to 1981 are now available in a single 200-page volume "Rock Characterization, Testing and Monitoring" edited by E.T. Brown.

Copies of this volume can be obtained through the ISRM Secretariat - price US$40, hardcover/US$20 flexicover.

The final report of the Commission on Classification of Rocks and Rock Masses was reproduced in the International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts, Vol. 18 No. 1, February 1981. The report is also available through the ISRM Secretariat - price US$6 for non-members, US$3 for members.

P.J. Millar

INTERNATIONAL SYMPOSIUM ON WEAK ROCK

The ISRM sponsored International Symposium on Weak Rock - Soft, Fractured and Weathered Rock - was held in Tokyo from 21 to 24 September 1981. The symposium was attended by 600 registrants, approximately 450 being from Japan.

The technical programme was divided into five themes

1) Engineering Properties of Weak Rock
2) In situ Investigation of Weak Rock
3) Specialized Theory and Analysis of Weak Rock
4) Adequate Design and Construction Practice for Weak Rock
5) Dynamics and Tectonics of Weak Rock

Special keynote addresses were given by Prof. W. Wittke on the investigation, instrumentation, design and construction of underground openings in soft rocks with examples from West Germany and by Dr I. Nisugi on the design and construction of the 53 km undersea Seikan tunnel. The tunnel (actually three - pilot, service and transport), which will link Honshu and Hokkaido islands, is now 90% complete. Soft rock engineering in Japan was also summarised in five papers prepared by Working Groups of the Japan Society of Civil Engineers on - distribution and engineering properties of soft rocks, dam construction, tunnelling, bridge construction and slope engineering in soft rocks.

The 203 papers submitted to the conference were presented in three concurrent sessions. All papers were written in English and presented in English or Japanese with simultaneous translation. The papers were evenly divided among the first four themes with considerably fewer in the fifth. 8 minutes (not 8½) were allowed for their presentation. Sadly, as is often the case, too few authors tried to talk around their written paper - resulting in a large number of reproduced Figure x's and Figure y's on a blue background. The amount of free discussion depended on the number of "non=appearances".

Five equipment manufacturers displayed their wares during the conference, covering a wide range of laboratory testing, field monitoring and geophysical equipment. The midweek ½-day technical tour gave one the choice of seeing the construction of the Ueno underground station for the bullet train (Shinkansen) or learning about tea ceremonies and other aspects of Japanese culture. The Sumo tournament, an afternoon event was also in progress in Tokyo during the week, acting as further competition.

The symposium was very well organised and run, compatible with the high standard of facilities. The Japanese are very active in the field of weak rock (and soil) engineering which made the symposium most interesting and invaluable, bearing in mind the similar geological nature of New Zealand to Japan.

S.A.L. Read

DIFFICULT SITES - AN ENGINEERING VIEWPOINT

J.P. Blakeley

1. Introduction

This paper will discuss principally the problems associated with sites which are difficult to develop because of a known or potential land instability problem. Difficult sites of this nature are within the author's field of knowledge and experience. However, much of what is said can be applied to sites which are difficult to develop because of likely flooding problems or problems with coastal erosion.

2. Recent Developments

In the author's opinion, the most significant recent development in this area of civil engineering is that the standard of care expected of the civil engineer in giving a professional opinion of land stability has been steadily increasing over the past few years (i.e. the standard of technical skill which is regarded as being necessary before such professional opinions should be given). In addition the degree of risk which the engineer runs of being sued for professional negligence in giving such an opinion, if a land stabilty problem subsequently occurs, has risen significantly because of recent court decisions. This risk applies both to the engineer preparing and signing a stability report and also to the Local Authority engineer responsible for approving a housing subdivision or permission to build a house on a specific site.

No longer is the risk of purchasing a site which may have a stability (or a flooding or coastal erosion problem) principally the risk of the purchaser of the site, but increasingly the purchaser seeks to share the risk with his consulting engineer and with the Local Authority engineer who issued a building permit.

3. Who accepts the Risk?

On the majority of potential building sites, it is possible for a consulting engineer to provide a statement that there is a building platform which can be relied upon to remain stable in all reasonable and foreseeable circumstances without him considering that he himself is running an unacceptable risk of being sued by providing such a statement.

On a limited number of sites, it is possible for the consulting engineer to state quite categorically that, because of past land instability or for some other reason, it is not possible to provide a stable building platform, bearing in mind the economic limits of site stablisation works which might be considered. However, as cities grow and land becomes more and more valuable and most of the desirable sites are already built on, even such sites as these become increasingly attractive to developers. This results in pressure being applied on engineers to prepare stability reports or statements of land stability which will enable such sites to be built on. The consulting engineer must resist this pressure and be very sure that he is aware of existing information (especially with regard to past instability in the area) before committing himself to carry out investigations for the preparation of a stability report. This is because once he has accepted the commission, unless he has specifically warned his client of the possibility, he will have a most dissatisfied client if the report is unfavourable.

If the report prepared is favourable, the Local Authority engineer then has the dilemma of either accepting the recommendations of the stability report or statement and thereafter running the risk of being sued (along with the consulting engineer) if instability subsequently occurs, or refusing to accept the report and coming into direct conflict with both the developer and the consulting engineer who has prepared the report. This matter of acceptance of signed stability statements is discussed further in section 4 below.

The situation becomes even more complex in the case of sites on which it is probably safe to build a house (subject to certain provisos regarding drainage works, types of house construction and possible future maintenance of the site surface, such as filling in tension cracks in the ground surface or providing a cover of vegetation) but where there is recognised to be a small risk (either quantifiable or not) in building. The consulting engineer justifiably believes that since he has identified the risk, if a stability failure does occur he should not be sued. In these situations, the engineer's client will often state that he is prepared to accept this small risk but the Local Authority engineer, while recognising that the risk may be small is not prepared to accept it. This is because there is no reliable mechanism for alerting subsequent owners that they are "taking over" such a risk when they purchase the property. As a result, subsequent owners will believe that they are justified in sueing the Local Authority who issued the building permit if a slip subsequently occurs.

This problem can only be overcome if a mechanism is available whereby all subsequent potential purchasers can be alerted to the risk which the original owners of the property accepted when permission to build was granted by the Local Authority. The normally suggested method of doing this is by noting on the title of the property that, either a stability report exists or that there are definite stability hazards (or other types of hazards) which are actually spelled out on the title. The former is preferable to the latter, if only because it may not have quite such a depressing effect on the value of the land.

Apart from this factor, there is other strong opposition to placing this information on legal titles from those responsible for the administration of the title system, as it is stated that this is not within the purpose for which titles are meant to be used. The searching of the legal title is one step which is nearly always carried out prior to purchase of property and hence anything written on the title will definitely be brought to the potential purchaser's attention. No other effective way of achieving this aim has yet been proposed.

Indirect methods have been used already in some cases to circumvent the opposition to registration of this type of information on legal titles and to make sure the information is brought to a purchaser's attention. However, a recent legal decision has brought the legality of such methods into question.

In recent months the Abbotsford Commission of Inquiry recommended that such information be placed on legal titles. Subsequently by a majority vote, the Municipal Association recommended that this be done, but to the author's knowledge no legislation has yet been brought forward to bring this into effect.

Unless a solution to this problem can be found, there will be many building sites within New Zealand cities which will not be developed and which probably the community at large would believe should be developed. People would be prepared to accept the risk of building or purchasing a property on this land if a report by a consulting engineer spelt out clearly the degree of risk which they were taking and precautionary or maintenance measures which must be adopted. The present situation is that the Local Authority engineer cannot take this risk

on behalf of subsequent owners in granting a building permit. Many consulting engineers are also reaching the position where they are concluding it is not good business to write stability reports or stability statements for marginal sites as the risk they run of being sued if a stability failure occurs is out of proportion to the income received from being involved in such work. Their concern is increased because the site may develop in a manner over which they have no control and which also may not be in accordance with their recommendations.

In such situations, some consulting engineers have used a disclaimer of responsibility clause in an attempt to lessen their risk of being sued. This is not necessarily the case, especially if a third party is affected and brings a claim in court, and in any event such disclaimer clauses when tested by the courts may be found to be invalid.

In summary therefore, the author believes that although the consulting engineer can spell out the risks involved in developing a site, it is the purchaser of a property who should be responsible for accepting such a risk, but the Local Authority engineer will be only able to accept this position if a method is found whereby every potential purchaser of a property can be alerted to the risks he is running in purchasing the property. It is hoped that a solution to this conundrum can be found in the next year or two.

4. Engineers' statements of land stability using the format proposed by the Earthquake and War Damages Commission

In 1977 the Earthquake and War Damages Commission produced three standard formats for statements by engineers regarding land slope stability. Two of these three formats require statements from a registered engineer experienced in the field of soils engineering and more particularly land slope and foundation stability. This recognises the fact that it is no longer considered acceptable for any registered engineer, or indeed any registered civil engineer, to sign such statements. The assessment of land slope stability does require specialist knowledge and experience.

However since there is no recognised formal qualification in this area, it is now up to the Local Authority engineer who receives such statements whether or not he is prepared to accept them. This places a considerable responsibility on the Local Authority engineer in rejecting such statements and he is then being placed in a judgmental situation when he himself may have no specialist knowledge in this field. Presently the Local Authority Engineer cannot avoid being placed in this position and in the course of time evaluation panels may be set up in the main metropolitan areas of New Zealand to decide which registered engineers have the qualifications and experience to sign such statements. This would remove some of the burden from the Local Authority engineer.

Even so, the ultimate decision as to whether to accept a stability statement and allow a building permit to be granted must rest with the Local Authority engineer. From time to time he may find himself in disagreement with the engineer who has signed the stability statement. He must then decide whether he believes his legal responsibilities are such that he must override the recommendation of the engineer providing the stability statement.

5. Technical Requirements of a Land Stability Investigation

The fundamental dilemma usually faced in assessing the stability of a difficult site is the extent of investigations it is financially practicable to carry out on which to base conclusions. It is often said that the extent of engineering judgement required in relation to the available investigation budget is many

times higher for a house site than for (say) the soils investigation for a major industrial project.

In the event of a stability failure subsequently occurring and the consulting engineer being sued for negligence, his defence will usually be that the standard of care which he exercised would be comparable with that of his peers with the requisite training and experience. As mentioned in section 2, the standard of care expected of a civil engineer in giving a professional opinion on land stability has been steadily increasing over the past few years to the point where such professional opinions are moving out of the realm of the "general practitioner" and into that of the geotechnical specialist.

About 15 years ago, an adequate soils investigation on a difficult house site might have been regarded as putting down (say) 3 hand auger bores, each to a depth of 4-5 m, and taking some "undisturbed" samples in 40 millimetre diameter tubes. Some quick undrained triaxial tests were then carried out and the results used to perform a hand slip circle analysis using the method of slices. The whole process came up with a factor of safety equal to or greater than 1.5.

In the author's view, such an investigation would today be regarded as quite inadequate for a number of reasons as follows:

(i) The investigation bores must be taken down to a hard base - either bedrock or a very strong soil beneath which the possibility of any weak layer along which a failure plane could develop is negligible. Often this will be at a greater depth than it is possible to reach with hand auger bores.

(ii) If there is any possibility of a "greasy back" situation being present in which a thin, very weak soil layer may cause failure, then the bores must be continuously cored. This can only be done readily by using a machine drilling rig. Hand augering produces a very disturbed sample and a thin weak layer can easily be missed.

(iii) If a slope stability analysis is to be carried out to determine the long term stability of the slope, then the analysis must be carried out using effective stress. This will involve either assessing suitable soil shear strength parameters or carrying out several sets of consolidated=undrained triaxial tests with measurement of pore-water pressure which is expensive.

(iv) In the case of brittle soil (in which the peak shear strength is considerably higher than the residual shear strength) then stability analysis using peak shear strength parameters may give a false sense of security. The ratio between peak shear strength and residual shear strength can only be readily determined by means of carefully controlled direct shear tests.

(v) In effective stress stability analysis, the position of the ground water table level must be carefully defined as this can be a critical factor in the results obtained from the analysis. This will normally require investigation bores to be left open for observation in holes with perforated liners over a winter period. If time does not permit this, then in the slope stability analysis the water table level must be assumed to be close to the ground surface, unless permanent subsoil drainage can be assumed to hold the water table down to a lower level. If there is a possibility of artesian pressure developing in any soil layer, then it may be necessary to install piezometers in such layers to measure any artesian pressure.

(vi) The slope stability analysis should be carried out by computer using one of the more recent programmes which are more sophisticated than the original methods of analysis and also enable analysis of non-circular failure surfaces (where the soil profile indicates that this is likely).

(vii) Up until a few years ago, it was generally regarded that a factor of safety of 1.5 in such stability analyses could generally be regarded as sufficient in a land stability evaluation. However, the author believes that it is now essential to review the possible variations in soil parameters and other uncertainties in the analysis before deciding what is an acceptable factor of safety.

In very many situations the above procedure will be prohibitively expensive for the evaluation of stability of residential land. In such situations, the author believes that it is much better for the engineer to rely on his observation and judgement (often backed up by the opinions of an engineering geologist) than to carry out investigations and stability analyses which are not up to an acceptable standard. This does, of course, throw a greater weight of responsibility on to the engineer in using his judgement and this is discussed further in section 7 below.

6. Minotoring of Ground Movement

In some situations where land instability is suspected, monitoring is carried out by means of pegs installed near the ground surface and regularly surveyed. This is a costly and time consuming procedure and also has difficulties when it is possible the pegs may be disturbed in some way (e.g. by animals or construction operations). In such situations consideration of the use of slope-meters is recommended, as often the cost of installing and monitoring these instruments may not be much greater than the cost of continual surveying of the area. They also have the distinct advantage that they can show the depth at which the ground movement is actually occurring.

In the case of an area where ground movements have occurred and remedial works which the engineer believes are satisfactory have subsequently been carried out, then it is the author's opinion that the effectiveness of such remedial works should be monitored by measurement of any ground movement and by water table measurements (where appropriate) for at least two winters before a good judgement can be made on the effectiveness of such works. The cost associated with this delay must be added to the cost of carrying out the remedial works in deciding whether such measures are an economic solution to a land stability problem.

7. Land Stability Assessment by Observational Methods

There has been a very definite trend over the past five years away from conducting soils investigations which are mainly site specific towards the evaluation of the stability of the area surrounding the site as a whole. This is because engineers are coming to the conclusion that it is not possible to consider the stability of a small area or one building site in isolation as it will be very much affected by what goes on around it.

As a result of this, there has been less emphasis on physical investigation within the site itself and much more emphasis on observations of the surrounding area.

Such procedures will involve:

(i) A careful ground surface observation of the surrounding area and consideration of the likely subsurface geology carried out by an experienced engineering geologist with attention being given to any existing geological reports, exposures in cliffs of the soil/rock profile and any existing investigation borehole information.

(ii) Careful study using stereo pairs of all available aerial photographs of the area for any signs of instability or land subsidence. These will show up much more readily in three dimensional viewing than on a photograph. If photographs are available at different times over (say) a twenty year period, this can be most useful in detecting any changes in the landform that have recently occurred.

(iii) If insufficient information is available from existing aerial photographs and the time and/or cost of obtaining new aerial photographs is considered to be prohibitive, then consideration should be given to hiring a helicopter or light plane to view the land from above for any signs of instability. This is seldom done but if there are any existing land stability problems, they are likely to be much more apparent from the air than they are on the ground.

(iv) The Local Authority should be consulted regarding any part instances of land instability in the area which they are aware of. In some Local Authorities, land stability maps of their territorial area are now being prepared on which all recorded cases of land instability are being recorded and these Local Authorities are to be applauded in taking this action. Otherwise, with changes of personnel which are bound to occur, if such information is only stored in people's heads, then it is bound to be lost over a period of even a few years.

In summary, a close observation of nature can often be worth many thousands of dollars spent on physical investigations in coming up with a good assessment of the stability of an area of land.

8. Conclusion

The assessment of difficult sites for their suitability for building on is not so much a science as a "developing art". Also the legal consequences on the engineer of errors being made in such assessments should be of great concern and are likely to become more so. Hence the author strongly believes that civil engineers working in this field and responsible for making stability assessments must be fully aware of their responsibilities and of the present "state of the art".

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 N.Z. 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.) Affiliation fees are in addition to the Geomechanics Society membership fee of $12.00.

I wish to affiliate to:

International Society for Soil Mechanics and Foundation Engineering	(ISSMFE)	Yes/No	($5.00)
International Society for Rock Mechanics	(ISRM)	Yes/No	($7.50)
International Association of Engineering Geology	(IAEG)	Yes/No	($3.50) ($8.00 with Bulletin)

Signature of Applicant _____

Date _____ 19__

PLEASE DO NOT SEND FEES WITH THIS APPLICATION, AS AN ACCOUNT WILL BE RENDERED ON YOUR ACCEPTANCE INTO THE SOCIETY.

Nomination:

I _____ being a financial member of the

N.Z. Geomechanics Society hereby nominate _____

_____ for membership of the above Society.

Signed _____ 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 _____