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N.Z. GEOMECHANICS NEWS

No. 26

JUNE 1983

A NEWSLETTER OF THE N.Z. GEOMECHANICS SOCIETY

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No. 26, June 1983

A Newsletter of the N.Z. Geomechanics Society

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THIS IS A RESTRICTED PUBLICATION

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 $17.00 and is supplemented according to which of the International Societies, namely Soil Mechanics ($7.00), Rock Mechanics ($9.50), or Engineering Geology ($4.50) the member wishes to be affiliated. Members of the Society are required to affiliate to at least one International Society.

Editor: Guy Grocott
P.O. Box 9034
Newmarket
Auckland
(04)795 985

Advertising: Peter McGregor
P.O. Box 6345,
Auckland

(04)773 410

EDITOR'S NOTES

The feature article in this issue by Tony Mahoney is a look at what the Earthquake and War Damage Commission Act covers and excludes in respect of landslip claims. It covers aspects of interpretation of the Act, and factors to be considered in assessing whether or not damage is due to landslip causes. Those attending the forthcoming Auckland Group Meeting covering Section 641 (Power to Refuse Building Permit) of the Town and Country Planning Act wil find Tony's article timely. The article occurred originally in the form of a seminar presented by the author to Earthquake and War Damage Commission assessors in July 1982.

Following the failure of the Wheao Canal in January, 1983 the Minister of Works and Development appointed a committee of inquiry of four engineers from the Ministry of Works and Development. Their inquiry was held earlier this year, in Rotorua, to which the Geomechanics Society responded with a submission. The submission, prepared by a sub committee of the present Management Committee, is reproduced in this issue, together with the terms of reference under which the Committee of Inquiry was appointed.

In May 1982, the Institution of Professional Engineers New Zealand appointed a President's Committee to consider the lessons to be learned from the failure of the Ruahihi Canal in September, 1981. The Report of the President's Committee was completed in late 1982 and published in full in the June, 1983 edition of New Zealand Engineering. A review of the Report is included in this issue of Geomechanics News.

Recent failures of water retaining structures in the Bay of Plenty have led the Institution of Professional Engineers New Zealand to consider ways of minimising the possibility of any recurrence in the future. At the suggestion of the President of the Institution, a symposium on "Engineering for Dams and Canals" has been proposed to enable owners and operators of water retaining structures to become aware of the requirements of professionals involved in their investigation, design and construction. Organisation for the symposium to be held in Alexandra between 24 and 27 November 1983 is being undertaken jointly by the N.Z. Geomechanics Society and the N.Z. Society on Large Dams. A draft Programme of events is included in this issue of Geomechanics News.

Contributions to N.Z. Geomechanics would be welcome. They 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.

G.G. Grocott
Editor

PUBLICATIONS OF THE SOCIETY

The following publications of the Society are available:

(a) From the Secretary, IPENZ, 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 $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 IAEG 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.

P.C. McGregor
Publications Officer

LANDSLIP CLAIMS : A GEOLOGISTS LOOK AT WHAT THE EARTHQUAKE AND WAR DAMAGE COMMISSION ACT COVERS AND EXCLUDES

A.G. MAHONEY

Editor's Note: The following article by Tony Mahoney formed the text of a seminar presented to Earthquake and War Damage Commission assessors in Wellington on 8 July 1982. The author works with Brickell, Moss and Partners in their Wellington Office.

LANDSLIP DEFINITION

The Earthquake and War Damage Commission Act defines landslip as:-

> *"damage caused by the subsidence of a substantial land mass other than by settlement, soil shrinkage or compaction and includes the movement from any hill, mound, bank, slope, cliff or face of earth or rock of a substantial mass of earth or rock which before movement formed an integral part of the hill, mound, bank, slope, cliff or face".*

Land at present is not covered nor is any part of the cost of resiting a building or any part of the cost incurred in stabilising the existing site of, or any new site for a building or any part of the cost of clearing landslip debris except to the extent that clearing debris is necessary to enable the insured damaged to be repaired.

The definition of landslip according to the Dictionary of Geological Terms (Prepared under the direction of the American Geological Institute)-

Landslip - 1. *A portion of land that has slid down in consequence of disturbance by an earthquake or from being undermined by water washing away the lower beds which supported it.*
2. *A portion of a hillside or sloping mass which becomes loosened or detached, and slips down.*
3. *The slipping down of a considerable mass of earth or rock on a mountain or any steep slope.*

So, as can be seen, the technical and commercial definitions of landslip are in reasonable agreement.

Geologically there are a number of different types of land movements - classified according to their shape and mode of movement.

1. FALLS - mass often travels through the air; leaps a bank etc., (e.g. rocks falling down very steep slopes or off a cliff).

2. TOPPLES - overturning movement - slabs of ground falling from a steep face.

3. SLIDES - movement involving shear displacement along or over several surfaces - two typical types - rotational - curved surface of rupture, concave upheaval, clay soils typically; translational - movement downslope along a planar surface e.g. Abbotsford.

4. LATERAL SPREAD - often happens in major geological formations comprising hard rock movement outward and downward on softer more plastic material - not common in New Zealand.

5. FLOWS - generally occur in soil over rock and vary in rate of movement from slow to very rapid i.e. debris avalanche - distribution of material resembles movement of a viscous fluid.

6. COMPLEX - various combinations of the above.

While most of these types of movements can in general be said to fall within the definition of landslip - the flow category also falls within the realm of flooding if floodwater and its naturally transported solid contents are taken into account.

CAUSES OF LANDSLIP

Most are caused by an increase in surface slope and/or a decrease in shearing strength of slope forming materials, principally by addition of water.

Landslips are a normal widespread factor in terrain development in geologically young countries such as New Zealand. Flowing water from precipitation is constantly changing the earth's surface. The water cuts out a channel and the resulting valley sides are left over-steep and subject to landslip. These slopes gradually become less steep as the valley matures and the erosion and landslipping becomes less frequent. However steeper portions of the valley slopes remain in a state of marginal stability and some incident such as excavation or exceptionally heavy rain, can cause further landslipping to occur.

Naturally when development has occurred, the result of man-made alterations to the former natural surface may alter the stability balance for better or worse.

Some of mans' activities which can cause landslide failures are:

A. Inappropriate or poorly engineered cuts and fills.

B. Deflection or blockage of surface or subsurface drainage (usually resulting from site regrading).

C. Gross removal of protective vegetative cover (site regrading, fire etc.).

D. Increase in soil and rock moisture through either prolonged or excessive soakage or the use of septic tanks and leach fields.

E. Inadequate installations or insufficient maintenance of improvements such as culverts, storm drains etc.

The distinction between sliding and flowing is in the type of movement which occurs. In slides, the movement results from shear failure along one or more failure planes. In flows, the displacement resembles that of a viscous liquid. Slides often move in the form of large bedrock units or slump blocks which move as relatively undeformed masses. In contrast, flows are long tongue-like, down slope projections consisting of chaotic, saturated mixtures of earth, rock and often vegetation debris. The distinction between the type of movement which has occurred can be an important consideration when determining correction measures and perhaps more importantly to insurance assessors in whose province the insured damage lies.

FLOOD

Flood damage cover is generally covered by private insurance companies and their flood policies specifically exclude 'landslip' and often 'erosion'. On the surface this may appear to be a clear commercial distinction between landslip and flood. However in nature there is no definitive cutoff between the two.

The Concise Oxford dictionary defines flood as -

> *an irruption of water over land, inundation, outpouring of water, torrent, downpour.*

Matter deposited by a flood flow is termed alluvium and in the physical sense cannot be separated from flood as a natural occurrence. Therefore the depositional material carried by flood (alluvium - comprising soil, rock and vegetation) which is a natural product of flooding, can be interpreted as also being covered by flood insurance.

On hilly terrain, landslips often occur during intense rainfall or after prolonged rain - soil and rock debris is deposited within natural drainage channels and is then transported downslope. Usually at a major change in gradient where the surface flattens (e.g at a valley floor), the more coarse solid debris, gravel, sand and logs is deposited as alluvium due to the drop in energy of the transporting system. In the 1976 storm in Hutt Valley, all the steep streams off the western hills dropped much of their bedload at the Western Hutt motorway, both across the motorway and blocking all the drains and culverts beneath. Some of the fines are also deposited, but most of these are carried into the major water courses.

Due therefore to the different insurance cover on landslip and flood, a number of cases have arisen where our firm has in recent years, endeavoured to distinguish between the two types of events.

A clear-cut distinction is not always easily made.

Our approach to defining damage to an insured property as flood damage rather than landslip includes establishing the following principal factor when deciding the cause of damage:-

> *"Could the solid debris against/in the damaged structure have been transported from its apparent origin to the damage location without the aid of an excessive flow of water ?"*

Indications of water being the primary transporting medium, including identifying the bared scarp where true slipping has occurred (generally in the headwater of stream valleys), identifying where water has flowed over the intervening ground (whether in a permanent or ephemeral stream bed), flattened vegetation, erosion to sides, the often flattened, crudely layered soil and rock content of the deposited mass at the damage site.

Bearing in mind the aforementioned, there are times when the difference between flood and landslip is not precisely defined. In such cases a decision has to be made on the best balance of factors available.

EROSION

It has been noted that in some private company's flood insurance policies, apart from landslip, erosion is also specifically excluded. To a geologist, the use of the bald term "erosion" as being an exclusion is difficult to understand. In the normal geological context, erosion is defined as 'the group of processes whereby earth or rock material is loosened or dissolved and removed from any part of the earth's surface'. Flooding and indeed landslip are important parts of this process. If this is the intent of the term 'erosion' in so far as the insurance industry is concerned, then it really excludes any damage to insured property except persumably due to water that comes directly as rain into the house or via defective plumbing or the like.

A more narrow use of the term erosion (which is derived from the Latin - rodere - to gnaw) could be applied geologically perhaps to the undercutting action of moving water. Such undercutting (eg alongside a river bank or coastal dunes) generally results in movement of the land due to removal of toe support. If this is the intention of the use of the term 'erosion' in the insurance exclusion, then it is probably quite reasonable in principle. However it still fails to definitely distinguish any difference in nature between erosion and landslip. Up until recent years, erosion by sea action was considered by the Earthquake and War Damage Commission as not being covered in their landslide cover. After however an arbitration on a claim resulting from sea erosion and consequent damage to a dwelling on the Kapiti Coast in 1978, the Commission was held liable for this particular claim. This decision was made on the basis that damage done to the insurance structure occurred as a result of two specific, large collapses from the sand dune beneath, during the course of the storm. The nature of the collapses were considered to be definable as landslip. Geologically such collapses are a perfectly normal result of undercutting by sea and river action (i.e. erosion) - therefore cannot really be distinguished from a landslip.

SPECIFIC EXCLUSIONS

Settlement in general literature and in the engineering service is sometimes loosely used to be synonymous with subsidence, a term which is included in the Commission's definition of landslip. However there is a specific difference between the two terms subsidence and settlement. Subsidence can be described as the sinking of the groundmass due to lack of support from beneath (e.g. collapse of overlying strata above natural limestone caves, karsts) or old mine working (e.g Kamo) or lowering of groundwater levels (for example - the gradual sinking of Venice) or excess oil extraction (e.g. in Texas).

Settlement however is the structure's response to lack of support from beneath - whether it is primarily caused by subsidence, landslip or indeed as is commonly the case, due to the inadequacy of the immediate founding soils to support the applied loads. Such problems are common for example, in the Lower Hutt area, where weak silt and peat layers are encountered for several metres immediately below the surface. The foundations sink into the weak ground thereby causing settlement of the structure.

Inadequately compacted filling is a primary cause of settlement in many residential properties.

The rationale for including subsidence but excluding settlement within landslip would appear to be the recognition that while subsidence is most likely to be beyond the control of normal sound building standards, the potential for serious settlement problems as a result of structures being founded upon weak ground is deemed to be within such control.

Soil shrinkage is the phenomenom of significant variations in volume of some soils with seasonal moisture changes. In dry periods, some soils (particularly ones with very high montmorillonitic clay content) exhibit severe shrinkage characteristics and consequent expansion during wet periods. Such seasonal soil movement can lead to substantial damage to structures founded upon them. Periodically parts of Auckland are affected by this phenomenom. Generally however, New Zealand does not appear to suffer significantly from such occurrences.

Compaction the third specific exclusion in the landslip definition is the process of densification of a soil mass under its own weight. As a result of downward movement, structures founded on the surface are forced to follow. This can theoretically occur in any very recently deposited stratum where a gradual increase in density (i.e. moving closer together of the solid particles) of the mass occurs. This is however more often than not, related to man-made fillings where a certain amount of densification of the soil mass (explusion of water from within the soil mass) may continue for a substantial period of time after construction is completed. Such compaction is more likely to occur within fine grained soils which were originally constructed at a moisture content higher than what is called its optimum.

With respect to filling in general, over the years, the Earthquake and War Damage Commission has generally accepted engineered filling as being the equivalent of natural ground (i.e. being an integral part of the land prior to failure). In the case however of non-engineered filling such as builder's filling, house owner fill etc (i.e. any fill which has not had some reasonable engineering control during the course of its emplacement), the attitude of the Commission depends on the circumstances.

GENERAL ASPECTS CLAIMS

It is in this realm of inadequate filling as well as several other common man-made faults (i.e. injudicious cutting and inadequate local stormwater control and retention measures) which contribute to so many landslips, that the Commission is entitled to weigh the claim against what may be considered as contributory negligence. The Act, states that:

"The Commission shall have regard to:

a. that the building complies with applicable building standards relating to foundations;

b. whether adequate site investigation and foundation design and construction has been observed;

c. the standard of repair and maintenance of the insured property;

d. any neglect or carelessness of the insured person;

e. or any other factors which the Commission considers relevant to the circumstances of the particular case."

The Commission is fair minded when it comes to weighing up contributing factors. In one memorable case concerning a 'written off' house at Eastbourne, the 'landslide' from above basically comprised loose filling derived from the collapse of a poorly constructed retaining wall built by the claimant's neighbour, some 100 metres above the insured house. The cause of the collapse was considered a case of blatant negligence by the neighbour above. The Commission paid out the 'victim' down below and then joined an ensuing law suit against the neighbour. The case was settled out of court.

Where insurance moneys have been paid out by the Commission and the claimant subsequently takes legal action against another party, the Commission may consider joining the suit in order to recover the moneys paid out.

Most claims however appear to be relatively modest, with an average slip being perhaps less than 20 cubic metres of material either falling from a cut bank onto the rear of a structure or away from beneath the outer face of a sloping house site.

Failures of cut batter slopes are a common cause of claims, particulary in the Wellington area. More often than not, the actual structural damage done to a building is slight but the minor damage when coupled with the cost of removing the debris with generally difficult access problems is usually well in exces of the $200 franchise. Another common cause of slip claims is the failure of outer slopes of properties often consequentially affecting the house foundations. Uncontrolled stormwater discharge has often been found to be the root cause of this particular problem. Runoff from extensive sloping driveways, defective roof plumbing, blocked external drains etc is often the cause.

Where a portion of the insured structure is effectively undermined by a slip, the home may be basically undamaged structurally, but with some if its foundations left unsupported. In the past, because the structure is not yet physiclly damaged, the claim has generally been declined. The rationale for this conclusion is in item 6 part (a) of the Act, Amendment 3 which reads *"for the purpose of this regulation, the expression deemed to be insured does not include (a) any part of the cost incurred in stabilising the existing site of or any new site for a building etc....".* Once some parts of the foundation of a structure have effectively lost their bearing support, then they are incapable of carrying out the function for which they were designed and constructed. While it may be strictly true to say that the structure above the unsupported foundation may not have undergone any specific damage, the floor in the vicinity of the unsupported foundation cannot support the design live loads without the likelihood of some damage occurring. Therefore it can be argued that the full and proper use of the insured structure is impaired and therefore the reinstatement of adequate support to the affected portion of the structure (provding it is in excess of the francise) is a legitimate claim against the Commission. Amending legislation concerning such problems is currently being considered.

It is of note that the standard timber framed/weatherboard house is a surprisingly resilient and tough customer with respect to even sizeable landslip debris accumlations against it. Naturally, brittle claddings such as asbestos panels, glass windows etc. are more vulnerable to breakage than timber sheathing. Brickwork and/or concrete blockwork is also generally relatively good with respect to resisting debris buildup. In the case however of minimising structural damage in the event of loss of support type slips, timber framed and clad houses win hands down.

Homes seemingly perched on the edge of a drop after a significant landslip event has occurred, always look far more precarious than they usually turn out to be. Again, this is mainly related to the resilience or toughness of a timber framed structure.

IDENTIFYING LANDSLIPS

Most landslips claims are relatively easily identified as to their legitimacy. However, often claims arise on the basis of certain defects in the structure having become apparent to the claimant. Particularly in the initial stages, the nature of structural damage to a home is identical in the case of either a developing landslip and/or settlement. Gaps appear in internal linings, between eaves, and external walls, diagonal cracking within exterior walls, block or brickwork. Such external cracking is generally found in the vicinity where stressed concentrations occur i.e. in window and door apertures etc.

In the case of older houses, evidence of previously patched up defects i.e. remortared brickwork, paths, painted over cracks etc. is common. Such former defect evidence in older structures on moderate to gentle slopes suggest that without other evidence to the contrary, long term settlement is a real possibility. This is by no means however always the case. Similar reactivation of structural defects over a period of years is suspected in parts of the Dunedin area as being due to soil 'creep'. Soil creep being a very slow, virtually imperceptible downslope movement of the upper soil mantle. Variations of movement rates will coincide with significant variations in seasonal rainfall. While soil creep may not be like most landslips (i.e. a defined, identifiable movement within a relatively short period of time) nevertheless, as time is not mentioned within the definiton of landslip, such movement cannot be specifically excluded from the Commission's definition of landslip.

The only other term within the definition of landslip as defined by the Act, which can lead to some variation in interpretation is the word "substantial". To a geologist, the word substantial may relate to something that spans several hectares in area; to an 80 year old widowed homeowner, it may be 3 buckets full of mud against her back door; while to an engineer it is possible something that takes considerable time and effort to clean up and stabilise. Perhaps a resonable interpretation of 'substantial' in this landslip context is that remedial costs (inclusive of damage repairs) are likely to be in excess of the $200 franchise. A large boulder say half a cubic metre in volume, dislodged by rain from a steep bank could cause signficiant damage to a house. Such a fall could be defined as a landslip even though the debris is not large by volume. Practically speaking, once a slip has occurred, apart from minimising any inconvenience to the occupants of the insured property, from the physical damage view, the sooner the debris is removed from the structure the better. While the structure is unlikely to undergo further serious damage after the initial impact has hit the building, unless of course further material falls, water seepage and general dampness can seriously affect internal linings and general deterioration of the interior finishing unless corrected.

FACTORS TO BE CONSIDERED IN ASSESSING WHETHER OR NOT DAMAGE IS DUE TO A LANDSLIP

Most claims for landslip damage are clearly identifiable as being either a landslip as defined by the Act or not. However, in some instances, the true cause of claimed damage to insured structures cannot readily be established. In many cases where structural defects in buildings comonly comprising cracked linings, uneven floor level, sticking joinery such as doors etc. occur, the prime cause of such defects may be related to settlement rather than landslip. If the damage progressively worsens however, the essentially vertical movement associated with settlement or the substantial horizontal component associated with landslip movement, become manifest. Generally speaking, landslip damage to a house is likely to encompass the area beyond the structure and possibly will display symptoms in adjacent structures and ground. Settlement however is likely to be confined specifically to a portion only of the structure.

The following factors should be considered in assessing the probable cause of damage to an insured structure:-

1. Plumbness of existing adjoining houses, particularly if houses are old;

2. Straightness or uniform curvature of kerb and guttering in adjacent roadway, driveways, path etc;

3. Condition (plumbness, cracking etc) of retaining structures in immediate vicinity of claim;

4. Straightness and verticality of trees on and adjacent to the block;

5. Straightness of fencelines etc in the area;

6. Location of the damaged portion of the structure with respect to the surface topography. Typically land with 'bowl' or amphitheatre shaped areas is more prone to landslipping (due to unfavourable surface and subsurface drainage) than land on ridges;

7. Evidence of springs or seepage areas;

8. Presence of bed rock outcrop on the property;

9. Surface topography of the general area and any vacant land adjacent to the site. Is the ground surface generally uniform and smooth or is it uneven and hummocky?

10. Any evidence of cracks in the ground, sealed surfaces, lawns etc. If so, is there any seeming pattern to such defects? Discontinuous cracks arranged en echelon often indicate lateral extent of landslide even though movement has not really begun. Turf rolls - indicating compressional heave.

11. Is there any record of landslips elsewhere in the vicinity? Local Bodies may be able to help here, previous claims, local knowledge etc.

As can be seen from the above, unless otherwise quite obvious, one has to look beyond the immediate confines of the structure itself in order to establish the likely cause.

In the case where evidence on the cause of structural damage to property is insufficient to clearly identify a slip rather than settlement as being the prime cause, the claimant should be advised accordingly. Additionally it should be made clear to the claimant that in the meanwhile the claim can be kept alive and should further damage or indications of likely cause (possibly through the owner's engineers) become apparent, then the claim can be reassessed.

Naturally many of the above items require an experienced eye to optimise potential clues to the source of damage and is the reason for calling in an engineer or geologist who has had experience in such problems.

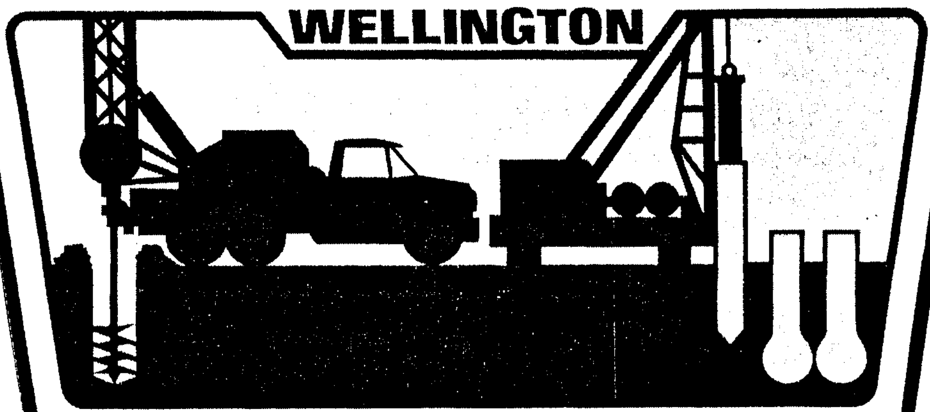
Apart from getting an engineer involved at the assessment stage for helping elucidate likely causes of damage, an engineering opinion on other aspects related to landslips may be wise and is generally welcomed by the insured. Some engineering advice or involvement should perhaps be sought in the following circumstances:-

1. Where some element of danger to the insured structure and/or occupants exists as a result of the slip.

2. Where there is a likelihood of further significant slipping occurring thereby increasing the risks of further damage and what immediate remedial works are practical for the owner to take to reduce or contain the risk of further damage.

3. Where there is considered to be a possible social obligation to help the insured with engineering advice for the future i.e in the case where the insured is an elderly person, widow etc.

4. Where there is some doubt as to how far clearance operations should or could safely go while removing only sufficient debris to effect repairs.



1983 IPENZ CONFERENCE

Conference this year was held at Waikato University, Hamilton from 14 to 18 February, 1983. The Geomechanics Society session was held on the afternoon of 16 February, attended by some 30 people. Two technical sessions were held, consisting of a paper by Graeme Salt, and an informal presentation by Dave Jennings to introduce MWD publication CDP 813/B:1982 "Site Investigation (Subsurface)". The annual general meeting was held on conclusion of the technical sessions.

The title of Graeme Salt's paper was "Design Methods using Residual Strength of Soils". A summary of the paper provided by the author is:

"A comparison of laboratory shear tests on possible dam core materials for the Clutha Valley Development project shows that design safety factors of 1.5 with respect to peak effective strength or 1.1 with respect to residual strength gives essentially similar results. To ensure the safety of earth dams after seismic deformations of slopes, a margin with respect to residual strength is required and design to this criterion will automatically ensure satisfactory safety factors with respect to peak strength for most soil types. The advantage of residual shear testing is that sample disturbance is of no consequence, technician time is similar to that taken for Atterberg Limit determinations and more relevant parameters are obtained. Examples are given which show how rational design can be simply applied to irrigation dams, retaining walls and bearing capacity determination as well as landslide stabilisation".

MWD publication CDP 813/B:1982 "Site Investigation (Subsurface)" is an inhouse document designed to assist in the planning and interpretation of site investigations for ground engineering purposes. Copies may be obtained from MWD Head Office, P.O. Box 12-041, Wellington North at a cost of $15.00

G.G. Grocott.

NEWS FROM THE MANAGEMENT SECRETARY

1. MANAGEMENT COMMITTEE

The Management Committee for 1983 is:

T.J. Kayes	(Chairman)	Wellington
S.A.L Read	(Secretary)	Wellington
D.H. Bell	(Australasian Vice-President, IAEG)	Christchurch
J.H.H. Galloway	(IPENZ Appointee)	Wellington
G.G. Grocott	(Editor, Geomechanics News)	Auckland
D.N. Jennings		Wellington
N.S. Luxford	(Vice-Chairman, Soil Mechanics)	Auckland
P.C. McGregor	Publications Officer)	Auckland
P.J. Millar	(Vice-Chairman, Rock Mechanics)	Wellington
R.D. Northey	(Australasian Vice-President,ISSMFE)	Wellington
I.M. Parton	(IPENZ Appointee)	Auckland
B.R. Paterson	(Vice-Chairman, Engineering Geology)	Christchurch

2. LOCAL GROUP ACTIVITIES CONVENORS

Auckland	P.B. Riley	Beca Carter Hollings & Ferner
Wellington	D.N. Jennings	MWD, Head Office
Christchurch	B.R. Paterson	N.Z. Geological Survey
Dunedin	W.J. Henderson	City Council

3. NEW MEMBERS

P. Ackroyd	J.D. Bennion	A. Bracegirdle
D.A. Burns	M. Carroll	P.H. Cato
M. Chambers	B.I. Chisholm	P.H.C. Cocks
K.J. Cooper	W.D.M. Crombie	N.R. Fitch
K.J. Forsman	C.J. Freer	H.B. Goodman
M.K. Hall	R.A. Hodgson	C.K. Hui
A.M.P. Kay	R.T. Kernot	J.A. King
A.W. Levy	C.G. Lewis	R.K. MacLeod
I.D. McPherson	C.D. Nichols	S.J. Palmer
G.E. Peters	S.D.C. Rabone	M.L. Raub
M.J. Robins	I.J. Robertson	K.P. Rogan
G.A. Salt	W.J.R. Sheehy	A.W. Smith
G. Trippner	D.W. Whyte	S.J. Woodward
D.P. Wright		

4. ENGINEERING FOR DAMS AND CANALS

The Society, together with the New Zealand Society for Large Dams is organizing and sponsoring a symposium entitled "Engineering for Dams and Canals". The symposium will be held in Alexandra from 24-27 November and continues the series of Society sponsored symposia including Stability of Slopes in Natural Ground in Nelson in 1974, Tunnelling in New Zealand in Hamilton in 1977 and Geomechanics in Urban Planning in Palmerston North in 1981. Further details on the forthcoming symposium are given elsewhere in this issue.

5. IPENZ 1984 CONFERENCE

The conference is to be held in Hastings from 14-18 February 1984. As in the past years, the Geomechanics Society will contribute to the conference which this year has the theme "Engineering for Primary Production and Processing".

The conference will have a rural bias and papers are still required for nomination to the two Geomechanics sessions at the conference. Intending authors should submit synopses of their papers to the Management Secretary by 31 August. The deadline for submission of draft papers for pre-printing will be 30 November 1983.

The Annual General Meeting of the Society will take place during the Conference.

6. IPENZ AWARDS

The Institution annually makes a number of Awards for papers presented by members. Nominations are being sought from Society members for the following awards:

a) Fulton/Downer Award - for papers presented at the Institution conference.

b) Furkert Award - for papers in Civil Engineering particularly the interaction of water on the faces of nature.

c) Rabone Award - general nature subject not qualifying for one of the other awards.

d) Environmental Award - for predominantly engineering work which best exemplifies care for and consideration of environmental values.

Further information on the above awards is outlined in a brochure issued by the IPENZ Secretariat. Nominations should be forwarded to the Management Secretary by 30 September.

The Otto Glogau Award sponsored by the New Zealand National Society for Earthquake Engineering was awarded for the first time this year. Society members are also eligible for this award. Further details may be obtained from the secretary of that Society.

7. 4TH AUSTRALIA-NEW ZEALAND CONFERENCE ON GEOMECHANICS

The conference which is being organised by the Australian Geomechanics Society will be held in Perth from 11-14 May 1984. The call for papers resulted in 156 abstracts being accepted, 9 of which being by New Zealand authors. As for previous conferences the papers covered a wide range of topics in Geomechanics.

The conference theme is 'Geomechanics - Interaction', and the keynote speaker will be Prof. V. de Mello, President of the ISSMFE.

The program will be finalized in September on receipt of final papers. Bulletin No.2 including the draft program and the call for registrations should be distributed by November.

8. GOLDEN JUBILEE COMMEMORATIVE VOLUME

The XI International Congress of the ISSMFE to be held in San Francisco in August 1985 marks the golden jubilee of the ISSMFE. To mark the jubilee the ISSMFE has invited national groups to prepare commemorative volumes for the congress and to distribute them as their own "visiting cards". The New Zealand volume would bring together the best New Zealand papers under the broad headings of geotechnical engineering, also including bibliographic reference lists and documentation of companies involved in research, design, construction and active members.

Society members who support the idea of the commemorative volume or are interested in making contributions to it are invited to submit their contributions to the Soil Mechanics Vice Chairman.

9. AUSTRALASIAN GEOMECHANICS COMPUTING NEWSLETTER

The Australasian Geomechanics Computing Newsletter which is issued once or twice a year is presently circulated to Society members who have forwarded their names to the Publications Officer.

Members who are not aware of this arrangement and who would like to receive the newsletter should contact the Publications Officer.

10. FORTHCOMING CONFERENCES

15-19 August	1983	New Zealand Road Symposium, Wellington New Zealand.
28 August-02 Sept	1983	Rock Bolting - Theory and Application in Mining and Underground Construction. Abisko, Sweden.
12-15 September	1983	International Symposium on Engineering Geology and Underground Construction. Lisbon, Portugal.
05-09 December	1983	International Conference on Groundwater and Man. Sydney, Australia.
06-09 December	1983	Recent Developments in Laboratory and Field Tests and Analysis of Geotechnical Problems. Bangkok, Thailand.
14-18 February	1984	IPENZ Annual Conference, Hastings, New Zealand.
19-24 March	1984	Third International Symposium on Land Subsidence. Venice, Italy.
06-11 May	1984	International Conference on case histories in Geotechnical Engineering. St Louis, Missouri, U.S.A.

14-18 May	1984	4th Australian and New Zealand Geomechanics Conference. Perth, Australia.
21-23 May	1984	5th International Conference on Expansive Soils. Adelaide, Australia.
20-24 June	1984	25th US Symposium on Rock Mechanics. Evanston. Illinois, U.S.A.
4-14 August	1984	27th International Geological Congress. Moscow, USSR.
03-06 September	1984	Design and Performance of Underground Excavations. Cambridge, U.K.
16-22 September	1984	IVth International Symposium on Landslides. Toronto, Canada.
11-15 August	1985	XI ICSMFE. ISSMFE Jubilee International Conference. San Francisco, U.S.A.

Further information on these conferences may be obtained by writing to the Management Secretary or the Vice Chairman of the appropriate discipline.

S.A.L. Read
Management Secretary

NZSOLD/NZGS SYMPOSIUM

"ENGINEERING FOR DAMS AND CANALS"

Following an invitation from the President of the Institution, two IPENZ Technical Groups - the New Zealand Society on Large Dams and the Geomechanics Society - have undertaken to run a four day symposium on the above subject between 24 and 27 November, 1983. The venue will be located in Alexandra and the programme will be finalised shortly.

The symposium will centre on the presentation of management techniques and current practices associated with three major topics - "Philosophy and Methods of Investigation", "Problems of Design and Construction", and "Preventive Engineering". The topics will address a wide range of subjects including hydrological studies, investigation in New Zealand terrain, the identification and evaluation of hazards, design criteria and requirements, construction control and surveillance. Each subject will be addressed by a selected speaker and opportunities will be available for the free interchange of ideas and opinions. A site visit to the Clyde dam site to view the exposed foundation and discuss the techniques being undertaken to overcome the foundation defects wil be incorporated within the programme.

Planning of the symposium is in the hands of a committee comprising J.H.H. Galloway and A.J. Pickford (NZSOLD), and T.J. Kayes and I.R. Brown (NZGS). The draft programme has the following form:

DAY I

- Registration
- Welcome to Participants
- Key note Address

DAY II: Philosophy and Methods of Investigation

- Opening Address
- Hydrological Studies
- Presentation of Geological Data
- Investigation in NZ Terrain (Hard Rocks)
- Investigation in NZ Terrain (Soft Rocks)
- Investigation in NZ Terrain (Volcanic Deposits)
- Investigation in NZ Terrain (Unconsolidated Sediments)
- Identification and Evaluation of Geotechnical Hazards

DAY III: The Problems of Design and Construction

- Opening Address
- Foundations and Construction Materials
- Instrumentation and Performance
- Field Trip

DAY IV: Preventive Engineering

- Opening Address
- Geological Hazards
- Seismic and Volcanic Hazards
- Hydrological Hazards
- Seepage Hazards
- Operational Hazards
- Surveillance
- Panel Discussion
- Closure

Additional information on the symposium will be presented in future editions of New Zealand Engineering. It is anticipated that invitations to register for the symposium will be circulated in the August edition of New Zealand Engineering.

A.J. Pickford

NEW ZEALAND GEOMECHANICS SOCIETY SUBMISSION TO THE M.W.D COMMITTEE TO INQUIRE INTO THE WHEAO CANAL FAILURE

1. INTRODUCTION

The Geomechanics Society of New Zealand (Inc.) is an organisation representing the interests of engineering geologists and geomechanics (or geotechnical) engineers in New Zealand and those concerned with advancing the art of ground engineering in New Zealand. The Geomechanics Society, through a sub-committee drawn from its Management Committee, wishes to present the following submission to the Committee to inquire into the Wheao Canal failure.

We have not had the opportunity to carry out an inspection of the site, nor to review existing data related to the field investigations or laboratory testing. We have, however, read the submission of the Geological Society of New Zealand which incudes observations made during a site visit. Our submission, therefore, is confined to matters of general practice applicable to the type of ground at the Wheao project and other major engineering works of this nature.

The Society wishes to comment on two aspects:

(i) Geotechnical factors which may have contributed to the failure of the canal and specifically the influence of "Brown Ash".

(ii) The role of geotechnical engineering in major projects involving ground engineering.

2. GEOTECHNICAL FACTORS WHICH MAY HAVE CONTRIBUTED TO THE FAILURE OF THE CANAL

2.1 Natural Ground Conditions

We believe the submission of the Geological Society of New Zealand accurately summarises the complex and highly variable ground conditions which are typical of this type of volcanic terrain. While no one factor was identified as the main "cause" of the failure, it is evident that the presence of the low density granular soils and open fractures in the underlying ignimbrite rock were not conducive to ground stability under changed groundwater conditions.

2.2 Construction Materials and Practice

Following the Wheao Canal incident there has been considerable speculation as to the influence of "brown ash", which blankets the site and was used as a lining material in the canal.

Brown ash has been used as a construction material in a number of hydro electric schemes. The properties of the ash vary depending upon the state of weathering and the location of the ash with respect to its source. Weathering produces the complex clay mineral allophane which imparts particular properties to the ash. Briefly, these properties may be summarised as:

- High natural water contents
- Extreme sensitivity
- Irreversible changes on drying
- High potential for shrinkage

These properties do pose problems when ash is used as a lining material in water-retaining structures. However, the proven performance of ash in operating hydro electric schemes demonstrates it can be an effective construction material under certain conditions.

Leakage from any water retaining structure into complex volcanic materials, often containing highly permeable cohesionless sands, has the potential for initiating erosion and/or piping failures. Under these conditions brown ash or any other semi-pervious lining may be inappropriate. Similarly, an impermeable lining such as concrete, without an effective underdrain system to remove seepage from construction joints, may also be inappropriate.

We therefore believe the influence of brown ash has been unduly emphasised. Of greater significance is the effect of geological variability, as described in the Geological Society submission, and the influence of seepage or changed groundwater conditions on volcanic terrain. In reinstatement of the canal we believe that this aspect should be closely examined.

3. THE ROLE OF GEOTECHNICAL ENGINEERING IN MAJOR PROJECTS INVOLVING GROUND ENGINEERING

The Society is concerned that major construction projects are able to proceed without adequate geotechnical engineering input. "Geotechnical Engineering" in this wider sense is considered to include input from professionally qualified Geologists and Engineers who are trained or directly experienced in the application of techniques and principles in geotechnical engineering. To be effective, we see the following minimum input required for most major works.

(i) Appropriate geotechnical advice during the planning or prefeasibility phase.

(ii) Engineering geological and geomechanical engineering during the investigation phase with continuing input through the design phase.

(iii) A project engineering geologist responsible for logging excavations and reporting ground conditions during construction.

(iv) Geomechanics engineers who are able to interpret ground conditions recorded during construction and implement design changes as required.

(v) Continuing surveillance during the commissioning and long term operation of the project, recording changes in behaviour or service conditions of structures and recommending maintenance or remedial works where necessary to preserve the integrity of structures.

We consider it essential that the recording and interpretation process suggested above be required for all major projects, not only those constructed in highly variable volcanic terrain. It is not sufficient to obtain preliminary geological reports; there must be a continuing involvement of engineering geologists and geomechanics engineers from project conception through to commissioning and operational surveillance.

It cannot be over-emphasised that geotechnical input at the planning stage is vital to proving the viability of a project. Adverse ground conditions may preclude major projects or impose major design constraints influencing project economics.

4. CONCLUDING REMARKS

The geotechnical characteristics of the volcanic plateau deposits are still imperfectly known, and there is a need for major research into all aspects, including geological processes, methods of engineering geological description, and geomechanical properties. The Geomechanics Society supports this concept which is envisaged as bringing together the earth science and geotechnical engineering disciplines to give improved understanding of volcanic terrain.

New Zealand Geomechanics Society.
April, 1983.

Editor's Note: The Committee to inquire into the Wheao Canal failure comprised the following engineers from the Ministry of Works and Development:

Chairman: O.T. Jones
Members: Alan Howarth
John Galloway
Technical Secretary: Graham Ramsay

The Terms of Reference were:

a) to inquire into and report on the engineering investigations, design and construction of the Wheao Power Scheme,
b) to identify factors and causes which have or may have contributed to the failure of the canal,
c) to evaluate the relevance of any reports or complaints made by persons about the work before the failure occurred,
d) to identify any other aspects of the project which may require further engineering consideration before the power station can be recommissioned.

REPORT OF THE PRESIDENT'S COMMITTEE ON THE RUAHIHI CANAL COLLAPSE

Following the Ruahihi incident a committee was set up by IPENZ President, Professor R.F. Meyer to consider the lessons to be learned from the collapse of the Ruahihi Canal. The committee consisted of J.P. Blakeley, Convenor, K.L. Hayman and T.J. Kayes. The Report was placed before IPENZ Council towards the end of 1982 and given limited circulation. The failure of the Wheao Canal at the end of that year caused the Council to ask the members of the Committee to take this failure also into account but, as the Report of the Committee of Enquiry on Wheao has taken some time to produce, the Council agreed in April to issue the report of the President's Committee on Ruahihi as a document for discussion among the whole memebership. The Report is produced in full in New Zealand Engineering, June 1983, and a precis of the document is presented below.

TERMS OF REFERENCE

The Terms of Reference of the Committee were:

1. To advise the Council of the lessons to be learned from the collapse of the Ruahihi Canal.

2. To advise the Council of any action that might need to be taken or procedures that might need to be set up to minimise the possibility of such failures in the future.

The Committee was asked to take into account the President's Letter to the Editor, N.Z. Engineering, June 1982, which referred particularly to points raised in relation to the Ruahihi failure in the editoral of the May 1982 issue.

THE RUAHIHI CANAL COLLAPSE

As the Manager of the Tauranga Joint Generation Committee (TJGC) was unable to speak to the Committee on advice from his Committee's solicitor and the consultants also were unable to speak on advice from their solicitor, only information on the collapse which had been made public was studied by the Committee. The Report of the Committee to Enquire into the Failure of the Ruahihi Canal, prepared by the Ministry of Works and Development, was taken as providing the technical reasons for the failure. The Committee therefore considered the role of the Institution in setting standards for professional engineering in New Zealand, the need for the professional engineer to practice within his competence and disciplinary action under the rules of the Institution. The Committee made recommendations principally concerned with the establishment of Institution Committees to determine whether the rules of the Institution have been breached and to safeguard the interests of both the profession and the public.

CODE OF PRACTICE

The Committee recommended that the Institution undertakes the writing of a "Code of Practice". The Code of Practice should consider the following:

1. Definition of the type of project to be considered including the consequences of failure and the loss of the facility.

2. The relationship between the owner and the engineer including responsibility for the initial concept, investigation, design and commissioning and responsibility for subsequent maintenance and monitoring of performance of the structure throughout its life. The Committee's proposals went on to describe preparation of a final design report, a series of technically oriented construction reports and the final report to the owner at the completion of construction.

3. The Committee realized that changes of personnel must of necessity occur throughout a major project. It is essential that the engineer recognises the importance of ensuring sufficient continuity of senior staff involved in the design and construction management of a project.

4. There must be adequate communication between the designers and construction supervisors to ensure that all design assumptions have been realised in practice and where unexpected difficulties arise during construction the designers are fully informed.

5. Provision should be made for automatic internal review of all design decisions, methods and procedures. This review process should continue throughout the construction phase and formal documentation should be made of all significant findings from reviews and inspections.

6. The Committee recommended procedures be implemented for providing independent reviews of a project. These procedures include the appointment of a reviewing engineer and the division of his work into 5 distinct stages including overall concept, preliminary design, final design, construction and final review at commissioning.

CLAHD COMMITTEE BRIEF

Following the Wheao Canal collapse the Minister of Works asked that the Terms of Reference for the Committee for Local Authority Hydro Development (CLAHD) be reviewed to include a technical as well as financial appraisal of proposed schemes. A draft document was prepared by the Commissioner of Works and comment on this draft has been made by IPENZ. Included in the draft Terms of Reference are provision for the technical review referred to above but also for the establishment of a Review Panel to implement the general proposals described above. The Review Panel would be appointed by the Owner and meet as often as required to fulfill their brief. Although this draft document has not been circulated widely there has been considerable comment on the role and responsibilities of the Review Panel with particular reference to the traditional responsibilities of the Engineer.

LETTERS TO THE EDITOR

The following items of correspondence have been received by the Editor:

Sir,

We suggest that a name change for the Society may be timely.

There are two main reasons for our suggestion. Firstly, it is evident that beyond the Society there is little appreciation of what "geomechanics" means and hence there is an identity problem. Secondly, "geomechanics" is increasingly used more specifically to encompass soil and rock mechanics, viz the number of "geomechanics laboratories" around the country.

All members of this Society practice in the field of geotechnical engineering, the meaning of which is more widely recognized. Geotechnical engineering requires input from both geomechanics engineers and engineering geologists.

We therefore propose that the name of the Society be changed to "NEW ZEALAND GEOTECHNICAL SOCIETY" and a postal ballot carried out to ascertain members' views accordingly.

Yours faithfully,
B.W. RIDDOLLS, A.J. OLSEN.

Sir,

I was one of the four delegates from New Zealand who attended the 5th Congress of the ISRM in Melbourne in April. This very successful conference is reported elsewhere in this issue of Geomechanics News.

I feel obliged to point out to the membership of our Society that I was somewhat embarrassed by the number of comments I received from the Australians as to the small New Zealand registration. They had clearly expected more than four registrants.

My embarrassment at their disappointment was heightened in recalling the large Australian registration for the 3rd Australia New Zealand Geomechanics Conference our Society hosted in Wellington in 1980.

Next year the 4th Australia New Zealand Conference on Geomechanics is to be held in Perth. I do hope that the New Zealand delegates there will not be met with similarly embarrassing questions regarding the number of New Zealand registrants.

Yours faithfully,
M.J. Pender

Bored pile retaining wall constructed prior to excavation. M/C adapted to operate from the base of a 14 metre cliff.

PILES: BORED OR PUNCHED

A Comprehensive range of piling methods & types available to cover variations of sub soils & loading conditions.

Driven cast in situ pile – formed by driving a steel tube bulbing with dry concrete, & withdrawing the tube with vibratory extractor after placing r/steel & concrete over full depth of pile.

GILBERD HADFIELD

5TH INTERNATIONAL CONGRESS ON ROCK MECHANICS

"ROCK MECHANICS FOR RESOURCE DEVELOPMENT, MINING, AND CIVIL ENGINEERING"

The 5th International Congress on Rock Mechanics was held in Melbourne from Monday 11 April to Friday 15 April 1983, with technical sessions on four days, and a day field excursion arranged on Wednesday 13 April. The Congress was divided into 5 themes, with a total of 235 papers included in the Congress preprints. The themes were:

A. **Site exploration and evaluation**
1. Geophysical testing and exploration.
2. In situ and laboratory testing.
3. Classification, prediction, observation and monitoring.
4. Hydrology.

B. **Surface and near surface excavations**
1. Stability of slopes.
2. Foundations on and in rock, incuding dam foundations.
3. Near-surface construction especially in cities.

C. **Deep underground excavations**
1. Mining excavations and mining methods including caving.
2. Permanent underground excavations including tunnels, power stations.
3. Coal mining including ground control and gas outbursts.
4. Prediction, control and measurement of subsidence.
5. Nuclear waste disposal and thermal behaviour of rocks.

D. **Rock dynamics**
1. Drilling and blasting.
2. Crushing and grinding.
3. Petroleum reservoir behaviour and in situ fracture methods for resource development.

E. **Special topics in rock mechanics**
1. Fracture and flow of the earth's crust, including tectonic stresses.
2. Numerical modelling of rock behaviour.
3. Future developments and directions in rock mechanics.

General reporters, appointed for each theme, prepared a summary report of the papers submitted. The style of general report varied. Stapledon and Rissler (Theme A), and Fairhurst and Brady (Theme C) provided a concise summary of the papers, as well as a critical evaluation of some of the findings. John (Theme B) briefly discussed the trends reflected by the papers, then provided his assessment of the state-of-the-art with some recommendations for discussions. Goodman (Theme B) devoted most of his report to key block theory that he and Gen Hua Shi have developed over the past few years. Hiramatsu (Theme C) summarised developments that have occurred since the last Congress, as did Persson and Holmberg (Theme D). Cornet (Theme E) concisely reviewed recent developments in in situ stress determination, the geomechanical characterisation of discontinuities in rock masses, and models for the representation of rock mass behaviour.

Papers of special interest or of particular merit were chosen for presentation. The only paper from New Zealand that was among the 58 presented was that of Pender et al. Running concurrently with each techncial session were poster presentations and about 170 papers were presented in this way.

There was a feeling among the General Reporters that few significant advances in rock mechanics have occurred in the four years since the last Congress. However an advance that is worth noting is the contribution of Dick Goodman and Gen Hua Shi with their key block theory. Otherwise this period has been one of consolidation in the rock mechanics field. Numerous projects were reported on which have been successfully completed in difficult ground (surface and underground works) utilising rock mechanics methods of investigation, analysis and design, and observation during construction. A trend was noted away from the use of rock classifications for engineering purposes. It seems that people are realising the ideal of a universal classification is unrealistic, and some of the classifications that have been vigorously promoted have serious limitations. Many of the papers were concerned with the collection of data, without any clear indication as to why this was done or how the data was used. The Japanese in particular have gathered an impressive amount of performance data in many of their projects but I am left in some doubt as to whether they have been able to use these data in a meaningful way.

An interesting contribution was made by L. Muller (Austria), the first President of ISRM, during the closing session on "Future developments and directions in rock mechanics". He pointed out that although rock mechanics knowledge has increased considerably since ISRM was founded in 1964, there are often problems associated with construction in rock. A few of the problems encountered in modern construction can be explained by the increased size of structures, however Muller considered a more fundamental problem to be that in most countries there are too few connections between theory and practice, research and application. He estimated that many millions of dollars have been wasted because of insufficient transfer of research results into the practice of design and construction. A further problem is that some of the earlier findings and principles which illustrate the fundamental behaviour of rock have been overlooked by modern works who have concentrated on developments in analytical methods, indices, and classification systems. Published papers generally only tell of success in rock mechanics, when the experience derived from failures is most important. Muller called for the increased publication of case histories, and for more work on the interpretation of geological data and their processing for geomechanical use.

Perhaps the major benefit of attending the 5th ISRM Congress was meeting with other workers in this field. Although registrations were down on the previous Congress (350 in Melbourne, 1000 in Montreux) there was a good representation with delegrates from 29 countries). Only four delegates from New Zealand attended. It was unfortunate that we were so poorly represented as it is unlikely that such an important rock mechanics event will be held in this part of the world in the foreseeable future.

The Congress was well organised, with a very full technical and social programme. One day field trips in the middle of the Congress provided a pleasant break from the technical sessions, and enabled delegates to visit open pit coal mines in the Latrobe Valley, underground scheelite mines on King Island, the Thomson and Blue Rock dams, and CSIRO Division of Applied Geomechanics Laboratories. Several non-technical trips were arranged, as well as pre and post-Congress technical tours.

I.R. Brown.

VISITORS TO NEW ZEALAND

1. PROFESSOR R.E. GOODMAN

Dick Goodman, Professor of Geological Engineering, Civil Engineering Department, of the University of California, Berkeley visited New Zealand for 5 days en-route to Melbourne for the ISRM congress, where he was the keynote speaker on surface and near surface excavations. His itinerary took him to Auckland, Wellington and Christchurch where he delivered addresses to combined meetings of the Geomechanics Society and local branch members of IPENZ.

His entertaining lecture included material drawn from his wide consulting and academic experience. He also spent some time introducing the concept of key block theory. This theory is a development of the use of stereographic projection techniques and can be used to identify specific sections of exposed rock which are critical to the stability of the rock mass. A seminar held in Wellington provided Dick with the opportunity to give a more detailed presentation of the theory and to outline future areas of research.

His lectures were followed by a brief tour of the Central Otago region which allowed Dick to obtain an appreciation of some of the geotechnical projects in this region, including part of the Maniototo irrigation and power project, and the Clyde dam site. At Maniototo the site inspection was restricted to the tunnel and deep canal excavations of the Paerau power diversion where rock defects in the schist have caused local ground support and batter stability problems respectively. The occurrence of weak, clay gouge seams parallel to the foliation of the schist, and the squeezing ground in a thick fault zone in the tunnel are problems which Dick Goodman had encountered in similar terrain elsewhere. He was also shown the main geological rock defects of the Clyde dam foundation and the remedial treatment which was in progress.

A number of sites were visited in the Kawarau Valley (including Nevis Bluff) and around Cromwell where a variety of slope failures in schist had been investigated. Professor Goodman was able to draw comparisons with other similar large slope failures that he had visited or had been involved with in steep terrain elsewhere. An excellent aerial view of these extensive slope failures and the active rock-mass wasting processes gained during the low level flight from Cromwell to Christchurch concluded a very successful South Island visit.

P.J. Millar and B.R. Paterson.

2. PROFESSOR E.T. BROWN

Ted Brown is Professor of Rock Mechanics at the Royal School of Mines, Imperial College, London. He toured New Zealand following the ISRM Congress in Melbourne giving addresses to local groups of the Geomechanics Society in Auckland, Wellington and Dunedin.

In his addresses to local groups, Ted Brown discussed the results of recent research into the properties of very closely jointed and fissured soil and rock. He concentrated on failure criteria that he and Hoek (1982 Rankine Lecturer) had developed (see reference), based on an empirical approach to describe the strength of these materials. The talk was illustrated with numerous examples of these concepts. The material that he covered was of particular relevance to New Zealand conditions because of the very closely jointed nature of our rock masses here. The problems associated with very closely jointed rock masses have not been discussed in any depth in rock mechanics literature prior to the work of Hoek and Brown. It was very fortunate that Professor Brown was able to visit New Zealand and acquaint us with this work.

As part of his Auckland visit, Ted Brown was taken on a tour of the Maramarua and Huntly Coalfields visiting a number of existing opencast mines. In Dunedin he visited the Department of Mineral Technology, University of Otago.

Hoek, E. and Brown E.T., 1980: Empirical strength criteria for rock masses. Jl. Geot. Engng. Div., Proc. ASCE., Vol. 106, GT9, pp. 1013-1035.

M.J. Pender

FROM THE INTERNATIONAL VICE-CHAIRMEN

1. ROCK MECHANICS

1.1 ISRM Congress

The 5th Congress of the International Society of Rock Mechanics (ISRM) was held in Melbourne from 15-19 April. A report on the conference appears elsewhere in the magazine. Reports indicate that the paper presented by Mick Pender of Auckland University was particularly well received.

The on-again off-again post ISRM conference tour of New Zealand attracted a flood of last minute registrants causing some accommodation problems, and some potential language problems for the largely Japanese and Chinese participants. The party of 31 arrived in Christchurch on 20 April and spent 6 days visiting sites of technical and tourist interest in the Central Otago, Mid Canterbury and Central North Island regions.

Professor Ted Brown was elected International President of ISRM for the next four years of the Congress while Mr Bill Bamford was re-elected Australasian Regional Vice President.

1.2 Recent Visitors

Professors Richard Goodman and Ted Brown visited New Zealand on Geomechanics Society sponsored tours, giving lectures in Auckland, Wellington, Christchurch and Dunedin. The visits were also supported by contributions by MWD, NZ Geological Survey, Mines Division of the Ministry of Energy, Otago University (Dept. of Mineral Technology), University of Canterbury (Engineering and Geology Faculties), and University of Auckland School of Engineering.

The visits were highly successful and the lectures were well attended. Separate reports appear elsewhere in the magazine. However, the Vice Chairman would like to express his thanks to all those who assisted in arranging the programmes.

P.J. Millar

2. ENGINEERING GEOLOGY

2.1 Australasian IAEG Vice President

Mr D.H. Bell, Senior Lecturer in Engineering Geology University of Canterbury, Christchurch was elected as Australasian IAEG Vice President at the New Delhi Executive Council Meeting in December 1982. Mr Bell replaces Prof. D.H. Stapledon of Australia and will hold the position until 1986. The Geomechanics Society congratulates David Bell on his election to this Office.

IAEG Bulletins

IAEG Bullentin No.25 has been distributed to members - if you have ordered but not received your copy please write to the Engineering Geology Vice Chairman. This issue contains another series of papers from the "Symposium on engineering geological problems of construction on soluble rocks" (Istanbul 1981). Bulletin No. 26/27 will contain a large number of papers (78) many of them from the Paris Symposium on "Soils and rocks investigation by in situ testing". The next issue (No. 28) will not include symposium papers, so that space will be available for any suitable papers from N.Z. contributors. Contact the Engineering Geology Vice Chairman if you would like to submit a paper.

2.3 27th International Geological Congress Moscow August 1984

A section of the 27th IGC is devoted to engineering geology which includes the following themes:-

a) theoretical problems of engineering geology

b) engineering geological fundamentals for the rational use and protection of the geological environment

c) engineering geological problems in studying rocks and their properties

d) the quantitative and temporal-spatial prediction of development of geological and engineering geological processes

e) regional engineering geology - problems of engineering geological mapping and zonation

f) new methods in engineering geological studies and surveying

g) application of the airborne and satellite methods in engineering geological and hydrogeological mapping

h) engineering geological and hydrogeological studies related to the economic development of permafrost regions

Further information is available from the Engineering Geology Vice Chairman.

2.4 IAEG BOOK: Engineering Geology

Information has been received on the IAEG book on "engineering geology" which is aimed at a publication date of mid 1986, including main chapter headings and outlines, and instruction to authors.

Invitation was received to suggest additions and modifications to the outlines and to volunteer as, or nominate authors for, particular chapters or subsections. The format will be similar to the IAEG Bulletin and the final manuscript is intended to be no more than 60 pages. Anyone interested in a copy of these details or wishing to contribute should contact the Engineering Geology Vice Chairman.

B.R. Paterson.

3. SOIL MECHANICS

3.1 XITH International Conference on Soil Mechanics and Foundation Engineering, 11th-15th August, 1985, San Francisco

Details of the above Conference are included with this issue of Geomechanics News. Those wishing to submit papers are requested to forward an abstract to the Secretary of the N.Z. Geomechanics Society no later than September, 1983 for selection. Final copies of papers will be required by the Society by 30th June, 1984. Anyone intending to attend the Conference who would like to be nominated as either a discussion leader and/or discussion session Chairman should contact the Soil Mechanics Vice Chairman.

A sub-committee has been set up to prepare a collection of New Zealand papers which have not previously been published internationally. These papers will form part of a San Francisco Commemorative Volume of papers to provide the international community with information on New Zealand problems and expertise. It will also contain documentation on New Zealand Companies and bodies engaged in geotechnical design and construction. Papers based on case histories, field work, testing, design, monitoring or theses will be considered. Anybody wishing to contribute to such a volume should contact one of the following Committee memebers:-

Paddy Luxford, c/- Babbage Partners Ltd., Auckland,
Guy Grocott, c/- Investigation Geology Ltd., Auckland,
Peter McGreogor, c/- Beca Carter Hollings and Ferner Ltd., Auckland.

N.S. Luxford.

LOCAL GROUP ACTIVITIES

1. AUCKLAND GROUP

1.1 Visit of Professors Goodman and Brown

The proximity of the Rock Mechanics Congress in Melbourne resulted in two excellent addresses to the Auckland Branch by participants in the Congress on their way to and from the Congress. Professor Richard Goodman of the Department of Geological Engineering at the University of California in Berkeley, gave an excellent and animated address on 6th April on his "key block" theory for the solution of rock support problems either in slopes or underground openings where a number of known intersecting discontinuities are present. The method involved the use of stereographic projections in their full three dimensional sense to solve these problems graphically and has the great advantage that it can be used in the field to give an on the spot appreciation of the problem. The problem is also readily amenable to computer solution using mini computers.

Professor Goodman also described his more interesting consulting experiences on siting studies for nuclear reactors in a region of southern California where sediments have been folded by tectonic movements creating bedding plane slips.

On April 24th we were favoured by a visit from the newly elected President of the International Society of Rock Mechanics, Professor Ted Brown of Imperial College, London. Professor Brown's talk was based on treatment of rock as a highly jointed mass, describing parameters which reflected the intact strength of the rock and the nature of the rock itself e.g. sandstone, mudstone, granites, limestones etc. This method is particularly applicable to slope stability studies in highly jointed rock masses and has allowed the solution of slope stability problems in such major slopes as the 1,000 metre high mine slope at the Bouganville Copper Mine.

Both talks were well attended and were followed by dinners to entertain the overseas guests.

P. Riley

2. WELLINGTON GROUP

2.1 Panguna Copper Mine and Goonyella Mine

Activities for the Group in 1982 were completed with a meeting on Thursday 25 November at which Stuart Read gave a most interesting presentation, complete with several slides, on his recent visit to Bouganville and also the Goonyella Coal Mine in Queensland. Stuart visited these mining activities on his return from the International Symposium on Weak Rocks held in Tokyo in September 1981. The small audience was rewarded with a well prepared technical presentation and informal detailed discussion. Stuart has kindly provided some notes which will be of interest to many members.

Bouganville Copper Limited (BCL) operates a major open pit copper mine and concentrator at Panguna. In 1980 the mine produced 145,000 tonnes of copper (at an average of 0.68%/tonne of ore) 14 tonnes of gold and 37 tonnes of silver. The deposit is a typical porphyry copper ore body. Mineralisation, principally in the form of chalcopyrite, is associated with a diorite and granodiorite complex which intruded a sequence of andesitic rocks. Approximately 83 x 10^6 tonnes of ore and waste rock are moved per year and mine management relies heavily on computing techniques for production control and planning.

Pre-production stripping of the mine commenced in 1969, production in April 1972 and approximately 20 years of reserves now remain. In 1981 some of the working faces were approaching the final walls, and at the time of the visit, geomechanical investigations were concentrated on the determination of these final slope angles.

The rocks are closely jointed having 40-45 fractures per metre within the ore body, decreasing to 20-25 away from it. The original feasibility study set the final wall at an overall slope of 35^o , stability analyses being based on circular shaped failures. Current work has shown that although there are no single defects that would cause failure, combinations of fracture sets (e.g. at 44^o and 63^o) could combine to produce active-passive wedge failures. The final slope angle which is now likely to be set between 42^o and 45^o), will be influenced by optimum bench design, haul road and drainage requirements, blasting practices and rock wall stability. The best ore occurs at the base of the east wall which will have an overall vertical height of 900m. The other walls will be from 315 to 615 metres high.

The closely jointed nature of the rocks poses problems when selecting the input parameters and mode of failure for numerical analysis. Friction angles obtained during triaxial testing range from 61^o (on 6" intact cores) to 35^o (on graded recompacted material), and consequently considerable effort has gone into observing the performance of temporary slopes in the mine. Independent of the analytical method (normally BISHOP or BIWEDGE), the depth of drainage behind the final wall face imparts a critically important influence on rock stability. The drainage needs to extend to at least 100m behind the final wall to have any beneficial effect. Bouganville is in a seismically active zone and accelerogrphs are positioned in the top, middle and bottom of the pit to monitor both the seismic and the blast induced ground motions. Experimental trials for final batter profiles were being excavated, with different batter slopes, benches, dimensions, blasting techniques and excavation methods.

The stability of the spoil dumps and tailing are closely monitored. The spoil dumps are zoned to allow drainage, particularly close to the pre-existing ground surface. Liaison with personnel at the mine is continuing.

Further details on the pit slope design are contained in:

Read J.R.L. & Lye G.N. (1983) "Pit Slope Design Methods, Bouganville Copper Limited Open Cut", Proceedings of 5th ISRM Congress, Melbourne, April 1983.

Utah Development Company operates a 15km long open cast strip coal mine at Goonyella in Queensland. The mine produces 4,000 tonnes/day of coking coal and operates from 5 pits, each of which has a 45 m^3 dragline. The coal occurs in two seams each 7m thick, dipping at 5^o - 7^o, and occuring within the Permian age Bowen Basin Coal Measures. The coal measures are overlain by up to 30m of terrestial Tertiary sediments with occasional interbedded basalt flow. The contact between the Tertiary and Permian deposits is highly irregular due to incised stream courses. The sequence has been lateritically weathered; weathering penetrating to depths of 40m.

Stability problems in the mine, particularly in the rainy season, have occurred both in the high wall and in the spoil pile which follows the advance of the dragline along the strip. The failures that occur in the high wall are due to unfavourably oriented thin claystone or weathered claystone beds in the coal measures where they dip into the pit. The unfavourable attitudes are thought to be the result of soft sediment deformation induced by "overpressuring" within sand units. Considerable mapping effort, backed by terrestrial and aerial photography is put into determining the palaeoenvironment and geometry of the sand units (now sandstone) which occur as channels. The potentially unfavourable claystone attitudes at the high wall are then attempted to be avoided during the rainly season. Blasting practices have also been refined to minimise ground damage in the high wall and prevent the infiltration of water to the claystone beds.

The spoil dumps fail in an active-passive (biwedge) manner along a weak sloping basal plane. The weak basal layer is formed by the dumping of sensitive, slaking materials from the top of the high wall to the pit floor and the layer then fails with the introduction of water. Many of these failures have been instrumented by the CSIRO and numerically analysed using the computer programme BIWEDGE. Measures to avoid instability include dumping non-slaking blocky material in the base pit floor, blasting the pit floor, throw blasting or subsurface drainage.

For furhter reading refer to Richards, G.B., Coulthard, M.A., and Toh, C.T. (1981): "Analysis of Slope Stability of Goonyella Mine", Canadian Geotechnical Journal, Vol. 18, 1981.

The third paper presented was by D.H. Bell of Canterbury University who spoke on the K9 landslide in the Kawarau Valley. The K9 Landslide is located in the lower Kawarau Valley and covers an area of about 950 hectares on the southern flank of the Pisa Range. The area is formed of in-situ chlorite schist and there is evidence to suggest that the K9 landslide is only part of an 1800+ hectare mass movement complex that extends more than 9 km along the Kawarau River - Roaring Meg alignment. Mr Bell reviewed the progress of recent geological investigations and went on to consider the 'original' rock slope failure mechanism which involved essentially down - slope movement on the schist foliation. The failure mechanism for the major landslide phase appears to involve schist buckling and gravitional spreading, whilst detailed sampling of landslide sag ponds has provided additonal data on climatic and geomorphic events during post-glacial (Arunuian) times. Mr Bell discussed the implications of these findings as it related to the K9 landslide and the implications of such large scale mass movements in schist terrain.

4.2 Visit of Professor Brown

A meeting of the Group was held on 22 April to which members of other associated fields were also invited. An audience of 28 persons heard a most interesting address by Ted Brown in which he outlined the research and theory behind the characterisation and strength/stability analysis and predictions of closely joined and weathered rock masses and slopes.

W.J. Henderson.

CURRENT RESEARCH AND DEVELOPMENT PROJECTS

MWD - CENTRAL LABORATORIES

The Geomechanics Section of Central Laboratories carried out a limited amount of research and development work to supplement its geotechnical and geophysical testing service to the Department. Some of the current projects include:-

1. BENKELMAN BEAM

The MWD design beam has been redesigned to simplify the equipment and to minimise problems associated with friction, distortion and thermal effects. A test programme is being undertaken to provide statistical data for repeatability and reproducibility of results.

2. SAND SAMPLER

A sand sampler has been design and manufactured to allow sampling of loose sands in boreholes. It uses the same principles as the Bishop Sand sampler but comprises of a single concentric tube system which greatly simplifies the equipment and has been found to give good recovery of samples.

3. FIELD DATA LOGGER AND SCANIVALVE

A cheap data logger has been designed and built to provide a convenient field system. Features include provision for variable reading intervals, switching transducer on for a warm up period before readings, and two month battery life. A paper tape digital record is obtained with daily print out of time and date.

A scanivalve has also been constructed to operate with the data logger to allow up to 10 piezometers to be monitored by a single transducer. The data logger also switches the valve between readings.

4. CONTINUOUS READING PIEZOMETER

A piezometer has been developed to provide continuous readings over the full length of a borehole. A rubber lined perforated tube is grouted into a borehole. Horizontal shrinkage cracking of the grout ensures the water pressures are transmitted to the water filled rubber lining while soil layers are isolated vertically. A 3 section packer allows sections of the hole to be isolated while ground water pressures are measured at any depth in the borehole.

5. LEAKAGE CHECKS BY GEOPHYSICAL AND ELECTRICAL METHODS

Several methods to determine leakage from canals and lakes are being investigated. These include resistivity techniques, self potential measurements, capacitance probes and dielectric constant measurements. Leakages are reflected by anomalies in the readings obtained. All the methods may be used under water with the resistivity method being successfully used on several projects to date.

NEW ZEALAND GEOMECHANICS SOCIETY

NOTIFICATION OF CHANGE OF ADDRESS

The Secretary,
The Institution of Professional Engineers New Zealand,
P.O. Box 12241,
WELLINGTON.

Dear Sir,

CHANGE OF ADDRESS

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

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Name: ____

Address to which present correspondence is being sent:

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Signature ____________________

Date ____________________