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No. 58

DECEMBER 1999

Merry Christmas & Happy New Millennium!!

A NEWSLETTER OF THE N.Z GEOTECHNICAL SOCIETY

NZ GEOMECHANICS NEWS

THE NZ GEOTECHNICAL SOCIETY MAGAZINE

NO. 58 DECEMBER 1999

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NOTES FOR CONTRIBUTORS

NZ Geomechanics News is a magazine for which we seek contributions of any sort for future editions. The following comments are offered to assist contributors:

Technical contributions can include any of the following:
- technical papers which may, but need not necessarily be, of a standard which would be required by the international journals and conferences
- technical notes
- comments on papers published in Geomechanics News
- descriptions of geotechnical projects of special interest.

General articles for publication may include:
- letters to the NZ Geotechnical Society
- letters to the Editor
- articles and news of personalities.
- news of current projects

Submission of text material in camera-ready format is not necessary. However, typed copy is encouraged particularly via e-mail (to the editor) or on floppy disk. Diagrams and tables should be of size and quality for direct reproduction. Photographs should be good contrast black and white gloss prints and of a suitable size for mounting to magazine format. *NZ Geomechanics News* is a magazine for Society members and papers are not necessarily refereed. Authors and other contributors must be responsible for the integrity of their material and for permission to publish.

Geoff Farquhar, Debbie Fellows, Doug Johnson, Rob Campbell
ASSISTANT EDITORS

Margo Donald
DESK TOP PUBLISHING

THIS IS A REGISTERED PUBLICATION

NZ Geomechanics News is a magazine issued to members of the NZ Geotechnical 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 the magazine. The basic subscription rates are given on the information pages at the rear of this issue. These rates are supplemented according to which of the international societies, (namely Soil Mechanics, Rock Mechanics or Engineering Geology) the member wishes to be affiliated. Members of the Society are required to affiliate to at least one International Society.

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THE SOCIETY AND THE NEW MILLENNIUM

As the Society enters the new millennium it is appropriate to reflect on where we have come from, where we are at present and where we are heading.

WHERE WE HAVE COME FROM

The Society was founded in 1958 as the NZ National Society for Soil Mechanics and Foundation Engineering and was the first technical group of the then NZ Institute of Engineers (now IPENZ). In 1972 the Society was renamed the NZ Geomechanics Society and also became the national group for the International Society for Rock Mechanics and the International Association of Engineering Geology. The objects of the Society became:

(a) To advance the study and application of soil mechanics, rock mechanics and engineering geology among engineers and scientists.
(b) To advance the practice and application of these disciplines in engineering.
(c) To implement the statutes of the respective international societies in so far as they are applicable in NZ.

The Society changed its name again in 1996 to the NZ Geotechnical Society to better represent its interests in geotechnical engineering, soil mechanics, foundation engineering, rock mechanics, engineering geology, hydrogeology, environmental geotechnics and geosynthetic engineering.

WHERE WE ARE NOW

We now have 440 members in the following classes:

Students	21
Affiliated to ISSMGE	279
Affiliated to ISRM	72
Affiliated to IAEG	153
Life members	5
Libraries etc	17

Vice Presidents represent our region (in this case Australasia) in the affairs, liaison and management of the International Societies. The positions are rotated between Australia and New Zealand with a NZGS member holding the position generally every third term and Australian Geomechanics Society members for the intervening two terms.

The affairs of the Society are managed by a Management Committee, which includes a remunerated Secretary.

We regularly hold local branch meetings (usually technical presentations) in Auckland, Wellington, Christchurch and Dunedin. Less regular meetings are held in Hamilton and this year for the first time a meeting was held in Tauranga.

Regular conferences are jointly held with the Australian Geomechanics Society. The Australia New Zealand Conference on Geomechanics has been held every 4 years since 1952, and the Australia New Zealand Young Geotechnical Professionals Conference has been held every 2 years since 1994. The Society has hosted one International conference, the 6th International Symposium on Landslides in Christchurch in 1992. Symposia on current issues of interest in geotechnical engineering are generally held every 2 years. Seminars and short courses are also held.

The Society's newsletter Geomechanics News, published in July and December each year, is the primary means of communication with members. It contains Society news, industry news and technical articles. A membership handbook is published every 2 years.

The Society has published "Guidelines for the Field Description of Soils and Rocks in Engineering Use" and "Stability of Houses Sites and Foundations - Advice to Prospective House and Section Owners". Other publications include proceedings of conferences and symposia.

Awards made by the Society are the Geomechanics Lecture, Life Membership, Geomechanics Award and the Student Prize.

The Society has a firm financial footing.

WHERE WE ARE HEADING

We enter the new millennium in good shape. Our strength lies in our broad membership base and the wide interest in geotechnical matters by the engineering and scientific community. The main issues facing us at present are:

- The need for the Society to become an incorporated society (refer to the separate article on incorporation). This move will clarify our legal status, and our relationship with and liability to IPENZ.
- Strengthening service to members, particularly strengthening branch meetings, providing more seminars and short courses, improving the presentation of Geomechanics News and providing information and news to members via our web site and email.
- The need for guidelines for certain aspects of geotechnical practice. The need for fuller geotechnical standards or codes of practice may arise but will be eased by the recent move towards combined Australian and NZ standards, as the Australians are further ahead of us in that regard.

Other issues such as whether geotechnical professionals should be registered, should be resolved when the Engineers Registration Act is revised.

Our next major conference is the 9th Australia New Zealand Conference on Geomechanics to be held in Auckland in 2004.

As I step down as Chairman of the Society I am confident that the membership is in good heart and that the Society will make the most of future opportunities.

GEOFFREY FARQUHAR
CHAIRMAN

Dear Sir

Settlement Prediction Competition

I feel duty bound to provide some commentary on the reported results of the settlement prediction contest.

I have often heard experts advocate, and therefore repeated to clients myself, the age-old caveat that with the best data available and even the most sophisticated analysis it is foolhardy to offer a settlement prediction without including advice on the uncertainty. Setting confidence limits of +/-50% is often recommended therefore, in my opinion, the competition organisers should have disqualified all entries that fall outside these limits.

This action would have eliminated 15 of the 25 entries. Our eminent chairman would have survived elimination by less than the degree of accuracy of the survey (1.5mm) but some other learned and experienced members of our society would not have been so lucky.

It is my firm belief that settlement, and particularly prediction of permanent consolidation settlement following the long term emplacement of a surcharge, is not an elastic anlaysis. Therefore any submissions suggesting or implying the use of elastic theory should have been immediately disqualified. This would have eliminated a further five entries.

I also think it would have been appropriate for any entries suggesting the application of "empirical" methods be disqualified on the basis that simple guesses are not good enough for anyone purporting to be a serious member of a technical society steeped in traditions of scientific analysis. Of the three remaining valid submissions only two predicted the the correct location for the maximum settlement.

I therefore take great pleasure in congratulating Bruce Horide and myself as the only two entrants that satisfied the above criteria and therefore demonstrated an ability or aptitude for Geotechnical Engineering.

Unfortunately, I could not work out a way of disqualifying Bruce who was, by 6mm, the closest to the answer. This was extremely disappointing but in any event, since the judges were not prepared to countenance the logical arguments presented above, I therefore had no opportunity for justifying keeping the $100 prize myself or rewarding Bruce for his efforts.

Yours faithfully

J Grant Murray
NZGS Treasurer

Dear Sir

In the recent correspondence regarding slope stability the term "full saturation" is sometimes used when considering the worst-case groundwater condition. I am uncertain what "full saturation" means and would appreciate an explanation. The term would suggest a ground water table, or piezometric surface, at the ground surface, but I can see this is being a reasonable design case in only a very few situations. Certainly in Wellington, virtually no slope would survive if it experienced water levels at the ground surface. Some clarification please?

Ian McPherson

This letter was referred to Tonkin & Taylor Ltd who provided the "Suggested Slope Stability clauses for B1/VM4 revisions" on p11 of the last issue of Geomechanics News. - Ed

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"Full saturation", or "fully saturated", is generally used to describe a slope model, or design case, where a slope is saturated and subjected to heavy surface recharge. An example of this might be a high intensity rainfall event following a prolonged period of rainfall. Under such conditions the soil mantle can be considered "fully saturated". Most readers should be familiar with the circular failure charts in Hoek & Bray (1974), where this case is presented as Chart No. 5 (p 217). This is, of course, not the worst possible case, as higher groundwater pressures can develop in situations where groundwater is confined within a slope.

'Full saturation' is considered to be a reasonable case against which to check a slope model for failure under extreme conditions. The maximum design condition may well be a lower groundwater level depending on the extent of knowledge of the site specific geology and geohydrology, and judgement is required to determine which case should be used for design. There has been general application of a FOS of 1.5 for maximum design conditions during the life of the structure and 1.2 for extreme conditions.

I suspect that many Wellington slopes are standing up because of high underlying rock mass strengths, rather than a lack of 'saturation' or high groundwater pressures.

Nick Rogers
Tonkin & Taylor Ltd

Twelve Reasons Why The Scala Probe Is The Only Tool Required For Soils Investigations

1. You don't need to know if cohesive or granular soils are being tested, just count the blows.
2. If I want higher blow counts I just wait for summer. Winter should be avoided as for some reason the blow counts are often lower, especially in clayey soils.
3. If I want higher blow accounts I can lean the Scala off vertical. This really helps.
4. I know if I go deep enough I will find hard soil eventually (although the soil seems to stick to the sides of the rods and the Scala is really hard to pull out, especially in clayey soils).
5. Scalas last forever. Bent rods and worn threads don't affect results and don't matter.
6. Scala results are easily and accurately be converted into SPT 'N' values using Table 2.10 of the Geotechnical Society's field description for rocks and soil. This is good news because I can solve all soil mechanics problems with a 'N' value.
7. All Scalas give identical results. The bigger external couplings on some Scalas do not drag on the sides of the hole and do not affect results, or not that I have noticed.
8. I had complete freedom to produce the results in any way I want, blows per millimetre, blows per 50mm, or blows per hundred millimetres. My favourite is bearing capacity.
9. I can record Scala blow counts at any frequency I like. Penetration per 10 blows is good, especially in soft soils when the Scala goes down heaps. Sometimes I can do 1m or more and only have to write down a few figures.
10. If I get tired I don't need to lift the weight all the way up. This saves time as well as energy.
11. Don't get your finger jammed under the hammer. It really hurts.
12. I used to find the Scala quite noisy but the problem seems to be getting less with time. I guess I must be getting used to the noise.

Yours faithfully

N J Near

Dear Sir

CLIFF TOP PROPERTIES – BUILDING LINE RESTRICTIONS

Many geotechnical practitioners have been involved in subdivisions and other residential developments over the years. These developments often involve coastal or cliff top properties, where Building Line Restrictions (or other restrictions on the form or extent of development) are of vital importance to the developer, to the local authority and to eventual owners.

A significant consideration when setting building restrictions is the ongoing erosion and regression of coastal land due to weathering and wave action. Movements resulting from coastal erosion are commonly episodic rather than gradual, and result in significant loss of land at discrete times.

While I am sure that most in the geotechnical community would appreciate that all these cliff top Building Line Restrictions are essentially predictive in nature and therefore have a finite life, I suspect this consideration is easily overlooked by regulatory authorities and property owners. While this "life" will hopefully be relatively long (and considerably greater than the 50 year design life nominated in the Building Act), at some time in the future the building line recommendations made in the 1970's and 80's will no longer be appropriate for those sites. The episodic nature of typical cliff face failures also means that the loss of land allowed for over a particular design life is as likely to occur in the first few years as in the last remaining years.
Many Building Line Restrictions are now over 20 years old. This does not mean that there was any error in setting them in the first instance. On the contrary, the fact that any building constructed on the land in conformity with the restriction has remained stable during the intervening period demonstrates the reliability of the recommendation. However, the actual experience provides a further basis for a review and/or reassessment. Territorial Local Authorities (TLA) are best placed to set up the appropriate procedures and mandates to ensure that this is done.
Some confusion also exists regarding design standards relative to building lines. Standard (e.g. NZS3604) foundations may be suitable where construction is set back sufficiently far from a cliff face. Closer to the cliff, specific design is required, and eventually the point is reached where no building work should be considered. Agreement is needed within the geotechnical community on terminology and on the design approach for these different zones.
It is essential that the limitations and assumptions inherent in Building Line Restrictions are clearly understood by TLA's, and that in turn this information is disseminated to existing and prospective cliff top property owners. It seems to me that such an education campaign would most appropriately be led by the Geotechnical Society, and should be initiated sooner rather than later. All of those building lines we have nominated are getting closer to the end of their design life.

Yours faithfully

GAVIN ALEXANDER

INCORPORATION OF THE SOCIETY

The Management Committee intends to recommend to the membership that the Society become an Incorporated Society. The main reasons for becoming an Incorporated Society are to clarify the Society's relationship with IPENZ and to clarify liability issues for the Society's officers and members. At present the Society is not legally separate from IPENZ. A recent legal opinion for IPENZ indicated that the financial relationship between IPENZ and its technical groups was unclear. Either party may have a call on the other's funds if circumstances dictated, eg we could run an international conference at a substantial loss or IPENZ could run into financial difficulties. The Society may also have future opportunities to enter into research funding contracts for example to produce slope stability guidelines, but present uncertainty over liability of officers and members prevents this.

It is noted that the NZ National Society for Earthquake Engineering has become an Incorporated Society and SESOC is part way through the process of becoming an Incorporated Society.

What is an Incorporated Society?

An Incorporated Society is a group or organisation that has been registered under the Incorporated Societies Act and is authorised by law to run its affairs as though it were an individual person.

What can an Incorporated Society do?

An Incorporated Society can do anything provided that its activities are:

- Lawful.
- Not for the financial gain of the members.
- Authorised by the "objects" in its rules.

Advantages and Disadvantages of Incorporation

Advantages:
- Society becomes a separate legal entity from its members. It can enter into contracts in its own name, buy or lease property, borrow money etc. It becomes capable of perpetual succession, ie its existence continues despite membership changes.
- Members have no personal liability for debts, contracts or other obligations of their Society.
- The Society's liability is limited to the value of its assets.
- The Society's officers are protected from personal liability for the actions of the Society.
- Society members are protected from personal liability for the actions of the Society.
- IPENZ is protected from liability for the actions of the Society.
- The Society is protected from liability for the actions of IPENZ.

Disadvantages:
- There will be a small increase in the required level of administration.
- The Society must have a registered office.

What actions are required to become an Incorporated Society?

1. Approval is sought to use the name "NZ Geotechnical Society Inc".
2. Our rules need to be amended, not significantly, to comply with certain requirements of the Act. A draft set of new rules will be put to the membership at the next AGM together with a resolution that the Society proceeds towards Incorporation.
3. The draft rules are then forwarded to the Registrar of Incorporated Societies for approval.
4. Following approval, a Postal Ballot of the Society membership will be held to adopt the new rules and pass a motion that the Society becomes an Incorporated Society.

5. The new rules and an application form are then sent off to the Registrar. An application for incorporation must carry 15 signatures of members. A Registered Office needs to be identified and registered. It is probable that the IPENZ office would be the most suitable for this.
6. A Society Seal needs to be designed and manufactured.

Motion passed at October Management Committee Meeting

The following motion was passed at the last committee meeting:

"That the Management Committee prepare a draft set of Rules suitable for Incorporation together with an appropriate motion that the Society proceeds towards Incorporation to be circulated to members with the notice of the next AGM and to be put at that AGM and that, subject to approval at that AGM, the Society forward the approved draft rules to the Registrar of Incorporated Societies for prior approval of the rules and then proceeds towards holding a postal ballot by about the middle of 2000 for formal approval of the Rules and Application for Incorporation."

Conclusion

Changing the Society to become an Incorporated Society is a prudent action. It is not intended that we become independent of IPENZ, but rather that our legal status with respect to IPENZ and the outside world is clarified.

GEOFFREY FARQUHAR
CHAIRMAN

Society membership is currently flourishing with a total of 440 members.

New Members

It is a pleasure to welcome the following new members into the Society since the last Geomechanics News: -

Anton Lush
Bradley Miln
Carol Wills
Cherie Lee
Craig Scott
Donald Davidson
Envirolab Geotest
Geoffrey Boswell
Greg Johnston
Steven Crook
Harco Scuderi
Jason Redgers
Jeremy Yates
Jonathon Sickling
Justin Franklin
Justin Harrison
Lamorna Cooper
Mark Davis
Peter Gringinger
Wayne Gunn
Phil Woodmansey
Philip Cook
Richard Cobb
Rostyn Wallace
Scott Stewart
Tony MacPherson
Virginia Toy
William Rawstron
Gyon Smith

Resignations

Robert Shelton and Julian Maund have tendered their resignations from the Society.

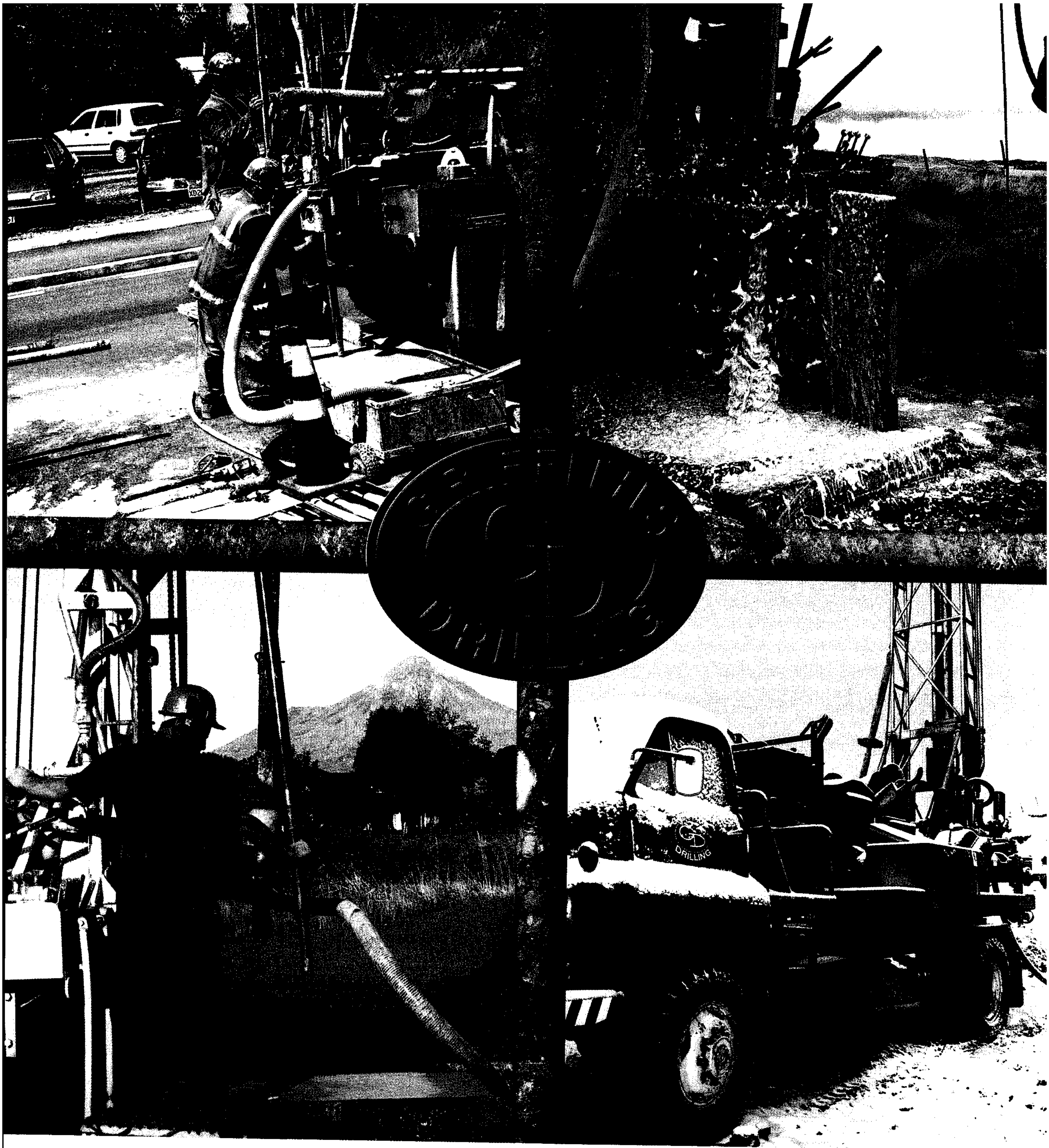
Subscriptions and Invoices

All members have been notified of the subscription increases. New invoices will have been issued in November. Should you no longer which to receive the IAEG bulletin please let the Society know as soon as possible. The invoice form gives you the opportunity to confirm and change your post and e-mail address. Please use it and keep us up to date on your contact details.

IAEG Bulletin Distribution

I have received a number of complaints about the distribution of the IAEG bulletin, particularly the use of old addresses and receipt of the bulletin following cancellation of membership. The distribution system for the bulletin has changed in the last year and the publishers have taken over the mailout. Unfortunately they do not request updated mailing lists before each issue and this is causing the problems. We apologise for the inconvenience but ask that you bear with us while we try and iron out these problems.

Debbie Fellows
Management Secretary


DRILLING

Report on ISSMGE Activities: October 1998 – March 1999

A Board meeting of ISSMGE was held in Paris in March 1999, and the following main issues were discussed.

(1) Guidelines are to be drawn up for organisers of conferences held under the auspices of the ISSMGE (mainly International, Regional and TC-generated conferences) with regard to:

(a) extent of hospitality or concessions to selected participants (such as keynote speakers etc), in order to avoid the risk of running at a loss;

(b) reduced conference fees (for example, through shared registration fees for groups) for participants from developing countries, and also for full-time students.

(2) The new web-site (www.issmge.org) will gradually replace the current ISSMGE newsletter, and also provide a vehicle for accessing details of individual members. In order to avoid problems of personal privacy, it will be necessary for each member society to include a check-box on subscription forms, allowing public access to email address (and other relevant information). As a first step, AGS should endeavour to assemble a list of members accessible through our own web-site. I have been in contact with the webmaster to correct errors in some of the information for the Australasian region, although there has been no update recently.

(3) The principle of a tiered voting system was agreed to, probably along the lines of 1 vote for 1 to 50 members, 2 votes for 50 to 750 members, and 3 votes for over 750 members. The next stage will be to present a proposal to all member societies, with a view to debating the issue and agreeing a change in statutes at the Council meeting at Istanbul in 2001.

(4) Separate Heritage Museums have been proposed from Austria, Germany and Turkey. There was support for these initiatives, both as a means of recording historical data and exhibiting early equipment, but also as an educational facility for the general public.

(5) The Young Geotechnical Engineers Award, to be presented for the first time at the Istanbul conference in 2001, is to be worth GB£400. Final guidelines for the award will be circulated later this year, but it will be based on a paper submitted to the previous regional conference (e.g. Hobart) and the international conference (Istanbul), together with a cv and supporting nomination. Up to 3 awards are anticipated at each international conference.

(6) The first international conference for Young Geotechnical Engineers will be held in Southampton, UK, in September 2000. A sub-group of the Board is preparing a list of developing countries where travel assistance will be made available for a delegate to attend the conference.

(7) Mr Springall, Vice President for North America, presented an initial document on Corporate Membership of the ISSMGE. The next stage is to form an action plan to increase the extent of Corporate sponsorship of the ISSMGE. Professor Jamiolkowski is preparing a letter to promote Touring Lecture courses on different aspects of construction and design in geotechnical engineering.

(8) The geotechnical database, SGI-line (http://public.sgi.geotek.se/sgi-line.html), is now only available on payment of a subscription of US$250 per annum. The ISSMGE will provide 24 free subscriptions in areas of need, allocated 6 each in Asia, Africa and South America, 5 in Europe and 1 in Mexico.

(9) The Secretary-General, Professor Neil Taylor, is preparing a manual for preparation of technical papers, to be presented to the Council meeting in Amsterdam.

Mark Randolph
Vice-President (Australasia), ISSMGE

If you have any comments to forward to our representative on the ISSMGE Board, Mark Randolph, please contact him via email (randolph@civil.uwa.edu.au), phone: (618 9380 3075) or fax (618 9380 1044)

TECHNICAL COMMITTEE	SMS	Chairman	Australian or (NZ) Representative	Fax No:
TC-1 Instrumentation for Geotechnical Monitoring	Turkey	Dr. T. Durgunoglu		
TC-2 Centrifuge Testing	Canada	Dr R. Phillips	Prof. M. Randolph	+61 8 9380 1044
TC-4 Earthquake Geotechnical Engineering	Portugal	Dr.P. Seco E. Pinto	**Prof. M. Pender (NZ)**	+61 9 3737 462
TC-5 Environmental Geotechnics	Germany	Prof. J.L. Katzenbach	Mr. R. Parker Dr M. Bouazza	+61 3 9818 7990 +61 3 9905 4944
TC-6 Unsaturated Soils	Canada	Prof. D. Fredlund	Dr. B. Richards	+61 7 3378 2078
TC-7 Tailing Dams	Chile	Prof. J.H. Troncoso	A/Prof. M. Fahey	+61 8 9380 1044
TC-8 Frost	Finland	Prof.E. Slunga		
TC-9 Geosynthetics and Earth Reinforcement	Japan	Prof. H. Ochiai	Prof. M. Hausman	+61 2 9330 2633
TC-10 Geophysical Site Characterisation	Sweden	Dr.R. Massarsch	Mr B. Whiteley	+61 2 9888 9977
TC-11 Landslides	Canada	Dr. J. Locat	Prof. R. Fell	+61 2 9385 6139
TC-12 Validation of Computer Simulations	Australia	Prof. J. Carter	Prof. J. Carter	+61 2 9351 3343
TC-14 Offshore Geotechnical Engineering	Norway	Dr. S. Lacasse	Prof. M. Randolph	+61 8 9380 1044
TC-15 Peat	Netherlands	Mr. R.J. Termaat		
TC-16 Ground Property Characterisation from In Situ Testing	Canada	Prof. P.K. Robertson	A/Prof. M.Fahey	+61 8 9380 1044
TC-17 Ground Improvement	USA	Prof. I. Juran	Mr. G. Mostyn	+61 2 9385 6139
TC-18 Pile Foundation	Belgium	Prof. W. van Impe	Prof. H. Poulos	+61 2 9888 9977
TC-19 Preservation of Historic Sites	Italy	Prof. C. Viggiani		
TC-20 Professional Practice	India	Prof. V.V.S. Rao	Mr. D. Starr **Mr. M. Stapleton (NZ)**	+61 7 3832 1687 +64 9 377 1170
TC-22 Indurated Soils and soft Rocks	France	Mr. J.L. Durville	Prof. I. Johnston	+61 8 9639 0138
TC-23 Limit State Design in Geotechnical. Engineering	S. Africa	Prof. P. Day	Mr. G. Mostyn	+61 2 9385 6139
TC-24 Soil Sampling	UK	Dr. D. Hight		
TC-25 Tropical and Residual Soils	Brazil	Dr P.T. Cruz	Dr. J. Simmons **Dr L. Wesley (NZ)**	+61 7 3278 1004
TC-26 Calcareous Sediments	Australia	Prof. R.J. Jewell	Dr. M. Khorshid	+61 8 9367 7576
TC-28 Underground Construction in Soft Ground	UK	Dr. R. Mair		
TC-29 Stress-Strain Testing Geomaterials in the Lab	Japan	Prof. F. Tatsouka	Dr. D. Airey	+61 2 9351 3343
TC-30 Coastal Geotechnical Engineering	Japan	Prof. A. Nakase		
TC-31 Education in Geotechnical Engineering	France	Prof J P Magnan	Prof H.H Poulos	+64 2 9888 9977
TC-32 Risk Assessment And Management	USA	Dr E. van Marcke	Prof. R. Fell	+61 2 9385 6139
TC-33 Scour of Foundations	USA	Prof J.-L. Briaud	Dr L. Cheng **Mr B. Melville (NZ)**	+61 8 9380 1018
TC-34 Deformation of Earth Materials	Greece	Prof Vardoulakis	Dr Hans Muhlhaus	+61 8 9389 1906

Technical Committee TC2
Centrifuge and Physical Model Testing

This Technical Committee is now hosted by Canada, chaired by Professor Ryan Phillips of St John's University, Newfoundland and with Dr Colin Leung, National University of Singapore, as secretary. The brief of the Technical Committee is to be enlarged to cover all physical modelling in geotechnical engineering, rather than just centrifuge modelling. A web-site has been developed (www.mun.ca/~ccore/cgs/tc2) and is actively maintained. Forthcoming conferences organised under the aegis of TC2 include:

- International Symposium on Physical Modelling and Testing in Environmental Geotechnics, France, May 15-17, 2000.
- International Conference on Centrifuge and Physical Modelling in Geotechnics, St John's, Newfoundland, 10-12 July, 2002.

Technical Committee TC14
Offshore Geotechnical Engineering

This Technical Committee is hosted by Norway, chaired by Dr Suzanne Lacasse, Norwegian Geotechnical Institute (NGI), with Dr Knut Andersen (NGI) as secretary. There has been no specific activity of the Technical Committee, other than an agreed intention to organise one of the discussion sessions at the forthcoming XVth ICSMGE in Istanbul (August, 2001). In the meantime, NGI are co-organisers of a conference involving offshore geotechnical engineering to be held in India later this year:

- International Conference, Geo-Shore, on Offshore and Nearshore Geotechnical Engineering, Panvel (Navi Mumbai), 2-3 December 1999.

IAEG ACTIVITIES: FROM NEPAL

Between its 4-yearly international congresses (the last in Vancouver in 1998), the IAEG Executive Committee, Council and Commissions meet annually at the venue of a regional engineering geology symposium. This year's venue was in September in Nepal, and the following account is of the various activities I took part in:

1. Executive Committee & Council

Meetings were held in Kathmandu on 26 & 27 September, 1999, preceding an IAEG co-sponsored international symposium organised by the Nepal Geological Society. I presented a report on activities in the Australasian region. Meetings were also held of the commissions on waste disposal, building stones and aggregates. Matters discussed included the need for Commissions to be strengthened to provide members with technical information more readily.

The Executive and Council meetings reinforced the commitment of IAEG to supporting increased technical activities for members via commissions, committees and working groups. Regional activities are being held more frequently under the aegis of IAEG, viz. the 2nd Asia Symposium on Engineering geology and the Environment last September. The European Region is now holding 4-yearly meetings, the year following each IAEG congress.

The Editor of the "Bulletin of Engineering Geology and the Environment" Dr Brian Hawkins, spoke of the need for members to submit good quality articles for publication and so increase the transfer of engineering geological knowledge. To facilitate this, editorial assistance may be available to transpose exceptional unpublished reports, such as case histories, into journal articles. Short articles of topical interest are also welcomed from members for inclusion in "IAEG News".

The 2000 Executive and Council meetings are scheduled to coincide with the International Geological Congress in Rio de Janeiro in August, and the Executive will also meet at GeoEng 2000 in Melbourne in November. The next IAEG Congress is in Durban in 2002 .

2. Commissions

- **Commission C17: Aggregates**
  This is a new Commission which has a good web site explaining its activities (www.sgu.se/hotell/iaeg_e.html). The Commission is keen to receive information from New Zealand and Australian members about recent research or project work on such aspects as geological assessment of aggregate resources, production techniques, materials testing, pre-hydraulic evaluation of durability, environmental influences, and national economic aspects. Please contact commission chairman Lars Persson, persson@uppsala.mail.telia.com, or visit the web site.

  It is proposed to make the web site useful to members by listing key references and standards, with a view to working towards world-wide standardisation of assessment methods.

- **Commission C10: Building Stones and Ornamental Rocks**
  World production of building stones is growing at a considerable rate, reinforcing the need for uniform and relevant assessment standards globally on such aspects as durability, restoration fixing for earthquake resistance.

  Inventories of stone production in New Zealand and Australia are required and members who would like to contribute to this or any other aspect of the Commission work are invited to contact the Chairman, Asher Shadmon, ashstone@netvision.net.il.

3. International Symposium on Engineering Geology, Hydrogeology and National Disasters, with emphasis on Asia, September 28th-30th, 1999

With more than 300 paper or poster presentations from the world, there was something for everyone at this symposium, which was well organised by the Nepal Geological Society. Abstracts are published in a

Special Issue of the Journal of the Nepal Geological Society, Vol 20, September 1999, and full papers are to be published in about 12 months time.

The following abstract should be of particular relevance to IAEG members:

ENGINEERING GEOLOGY FOR THE NEW MILLENNIUM: STICK WITH THE BASICS

James V. Hamel & William R. Adams, Jr.
Hamel Geotechnical Consultants,1992 Butler Drive, Monroeville, PA 15146-3918, USA
Adams Geotechnical Consultants, 394 Burton Avenue, Washington, PA 15301, USA

ABSTRACT

Our collective experience of more than fifty years in geotechnical practice, primarily in the United States of America, indicates that problems and difficulties in this area of practice typically result from failure to apply available information and existing knowledge rather than failure to analyze precisely, use computers or other high technology, or implement the latest cutting edge research techniques. Most such problems and difficulties result from failure to techniques of engineering geology. As we approach the next millennium with its anticipated high level of geotechnical activity on new projects in Asia and elsewhere as well as infrastructure rehabilitation projects in developed countries, it is appropriate to reflect on our experience in the United States and offer certain suggestions in the hope that some of the mistakes made here in the past can be avoided here and elsewhere in the future.

The fundamentals of geotechnical engineering practice - geology, geometry, geomechanics (soil and rock mechanics), observation, imagination, common sense, precedents (experience), construction/constructability, communication (oral and written), and diplomacy - have been outlined previously (Hamel, 1983) but they require continual emphasis. Application of these fundamentals has two basic objectives in terms of engineering geology (Adams, 1986):

- Determination of the effects of existing natural features and processes on proposed construction and other activities

- Determination of the effects of proposed construction and other activities on geologic conditions and future geomorphic processes in the area

The essence of engineering geology is development of the geotechnical framework of a site or problem. This framework consists of those key elements of geology and geometry relevant to the life cycle of a project, structure, or facility; i.e., investigation, design, construction, operation, maintenance, and abandonment or rehabilitation/replacement (Hamel, 1997).

We have found an observational engineering geology approach to be the most efficient, economical and reliable one for developing the geotechnical frameworks of a wide variety of sites and problems. This approach is field-oriented with heavy emphasis on field reconnaissance and interpretation of observations within the contexts of (1) basic processes of physical geology relevant to the area and (2) anticipated construction procedures and land use changes.

Before going to the field, available background information on the region and the site and on the project or problem of concern should be reviewed and assimilated. This is second nature for experienced and competent geotechnical and geological engineers and engineering geologists but not always so easy for less experienced personnel. The latter may find check lists and procedural forms, e.g., the SGH Form (Adams and Ruppen, 1996), useful in this regard. Such forms ensure structure and uniformity in developing portions of the geotechnical framework. These forms should be modified as necessary for regional and local conditions to ensure that they provide an adequate format for compiling basic data.

Field work includes reconnaissance and mapping of the types applied by many engineering geologists. In this regard, sketches are still useful and highly recommended for recording observations and derivative interpretations. The old-fashioned art of sketching forces the

observer/recorder to think through the geologic and geometric relationships of features, at least to the extent they can be sketched on paper.

Most geotechnical investigations, particularly those producing information for design and construction, involve borings and, in many cases, exploratory excavations. Experienced geotechnical personnel should plan, direct, inspect, and log borings and exploratory excavations to the extent practicable. Where experienced personnel can not perform all this work personally, they should, as a minimum, plan all exploration programs and inspect all soil samples and rock cores from borings and sufficient soil and rock exposures, both natural and excavated, to (1) ensure uniformity and consistency in soil and rock logs and descriptions and (2) have reasonable certainty that critical soil and rock details and discontinuities are not overlooked.

Relevant information from the above-mentioned background review and field work should be summarized on geotechnical plan and cross-section drawings. The emphasis in these drawings should be on substance and clarity relevant to the geotechnical framework of the site or problem, not fancy graphics or CAD wizardry. Production of high-quality geotechnical plan and cross-section drawings has been treated elsewhere (Hamel, 1997, 1998) but, like other fundamentals, requires continual emphasis.

In summary, our message regarding geotechnical practice, particularly engineering geology practice, for the twenty-first century in developing countries and elsewhere is a simple one.

Stick with the basic, traditional concepts and procedures related to development of the geotechnical framework of a site or problem. These basic concepts and procedures can be relied upon.

References

Adams, W.R.Jr, (1986). "Landsliding in Allegheny County, Pennsylvania - Characteristics, Causes, and Cures," Ph.D. Dissertation, University of Pittsburgh, Pittsburgh, Pennsylvania.
Adams, W.R., Jr. and Ruppen, C.A. (1996). "SGH Form: Format for Early Collection of Essential Geotechnical Data," Proc. 47th U.S. Highway Geology Symposium, Cody, WY, 16 pp.
Hamel, J.V. (1983). "Fundamentals of Geotechnical Engineering Practice," Geotechnical News, Vol. 1, No. 2, pp. 12-13.
Hamel, J.V. (1997). "Geotechnical Framework of Waste Disposal Sites," Engineering Geology and the Environment P.G. Marinos, et al., eds., Balkema, Rotterdam, Vol. 2, pp. 1883-1888.
Hamel, J.V. (1998). "Geotechnical Cross-Sections Re-Visited," Geotechnical Site Characterization, P.K. Robertson and P.W. Mayne, eds., Balkema, Rotterdam, Vol. 1, pp. 159-164.

Work of particular interest from Nepal itself included results of co-operation between the Department of Mines and geology, Nepal, and Department Analyse at Surveillance de l'Environment, France on various aspects of the local and regional seismicity of the Nepal Himalayas.

A 4-day post-symposium tour provided a good insight into various aspects of geological hazards and conditions that severely challenge road and hydro-power engineering in the magnificent foothills (up to 2000m) of Central Nepal. Unfortunately the Himalayas did not reveal themselves owing to the lingering monsoon.Please contact me if you would like further information or have ideas on how IAEG could improve its service to members in the Australasian region.

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Vice President for Australasia

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ISRM Vice President's Report

1. Introduction

This report will provide an overview of ISRM matters over the period of April 1999 to the end of my term as regional Vice President on 28th August 1999. The Tokyo's Board's final meetings were in Paris, the major outcomes of the Board and Council meetings are reported in the sections that follow. A/Prof Haberfield will report on activities since that meeting.

2. 1999 Congress - Paris

The Paris Congress was held at the Palais des Congres between Wednesday 25th and Saturday 28th August, 1998. The congress was very good technically with a good representation from the region. Over 500 registrations and 290 papers.

3. Rocha Medal

The Rocha Medal 2000 was awarded to Dr Phillippe Cosenza for his thesis entitled *"Coupled effects between mechanical behaviour and mass transfer phenomena in rock salt"*. Nominations for the 2001 award are due with A/Prof Haberfield at 31st December 1999.

The mail vote on Interest Groups was held in May and the proposal was carried 23 to 3. It appears that mining may be the first interest group in the ISRM with a strong representation from Australia organised by Profs Jim Galvin and Bruce Hebblewhite of UNSW.

5. Language

The proposed changes to the Language Statutes were voted on at Council, and carried 32 for and 2 against. This represents a significant reduction in the cost of a group organising a congress.

6. Financial

Apparently Australia's fees for 1999 have not been paid.

The AGS should not forget the US$5000 (?6000) loan from ISRM which was seed money for GeoEng2000.

7. Other

The 2003 Congress has been moved from Sun City to Johannesburg. Organisation is proceeding very well.

The 2000 international symposium is at GeoEng2000 and the 2001 international symposium (ie Board and Council meetings) will be at the 2nd Asian Rock Mechanics Symposium in Beijing in August.

The ISRM directory will be printed before the end of the year.

A/Prof Chris Haberfield was elected regional Vice President.

Garry Mostyn
Vice President for Australasia, 1995-1999
International Society for Rock Mechanics

Auckland Branch

To date, the Auckland Branch of the NZ Geotechnical Society has held about 6 meetings. All meetings have been well attended with numbers ranging from 20 to 50 people. The presenters efforts have been well received by the audiences. Many thanks to our sponsors Ground Engineering Ltd and Maccaferri NZ Ltd for their continuing support.

Recent meetings held are as follows:-

Pavement Maintenance and Rehabilitation at Auckland International Airport.
Dr John March, Beca Carter Hollings and Ferner.
4th August 1999

Segmental Retaining Walls
John Turgeon-Schramm. Anchor Wall Systems,USA
9th August 1999

Digital Geological Data and its application to the Geotechnical Community.
Colin Mazengarb, Institute of Geological and Nuclear Sciences.
29 th September 1999

ICE Rankine Lecture - Anisotropy of soft clays.
Dr David Hight, Geotechnical Consulting Group, UK
4th November 1999

By the time this goes to print one event further will be complete for November 1999-

Northern Region Student Prize Evening
24th November 1999.
Four entries for this evening were received and the evening will be held at the Auckland University.

I will not be continuing as the Auckland Branch Co-ordinator in 2000. If anyone is interested in taking over this task please do not hesitate to get in contact with me.

Jamie Bevin
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Email: bevin.fel@clear.net/nz

Bay of Plenty Branch Activities

The inaugural meeting of the BOP branch was on 22nd Sept 99 at the Bay of Plenty Polytechnic in Tauranga. Maurice Fraser from Tonkin + Taylor Ltd presented a talk about Pile Dynamic Analysis (PDA). 22 people attended from around the area with even a few Aucklanders crossing the Bombay Hills and even one Hamiltonian. The talk was well attended, due to the beginning of the PJK roading project. There were many attendees interested in the application for the aforementioned project.

Refreshments were provided by Geotechnics Ltd due to my connections but other sponsors are welcomed as are future speakers.

(The management committee would like to thank and congratulate Paul for volunteering to co-ordinate a Bay of Plenty branch. The feedback received has been favourable and more meetings will be planned for 2000).

Paul Burton
Bay of Plenty Branch Co-ordinator
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Wellington Branch

The Wellington Branch has had two meetings since the last Geomechanics News. Tim Sinclair presented the 10th Geomechanics Lecture on 26 April and in August Mike Crozier of the Earth Sciences Department of Victoria University gave a talk on landslides and research relating to antecedent rainfalls and trigger rainfall levels at which landsliding could be expected to occur. The meeting was well attended with 14 people coming along.

No specific talks have been arranged at this stage although several potential speakers have been identified. I will try and organise one last meeting for the year.

A significant number of anchored cuts in have constructed around Wellington over the last few years with varying degrees of success. One society member has suggested an informal meeting to share ideas on such walls. Areas that could be covered include soil/rock strength parameters, shape of failure surface (Bi-linear, wedge, circular), design earthquake acceleration, and whether anchors should be stressed or unstressed. If people are interested in pursuing this idea please contact me and I will arrange a time and place. (My phone number is 472 9589 and my e-mail idm@wel.conwag.co.nz).

I have carried out a number of anchor load tests in Wellington over the last year or two. I am considering tidying these up and publishing them in the Geotechnical magazine. Some of them are of uncertain value but they do give lower bounds. Do other people have other test results that could be included in a technical paper? If so please contact me.

Ian McPherson
Wellington Branch Co-ordinator
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Fax: 04 472 3322
Email: idm@wel.conwag.co.nz

Christchurch Branch

We have had one meeting since last publication of GN, being the Rankine Lecture by Dr David Hight last Thursday 11 November.

It seems that there will be no Southern Zone Student Prize meeting this year. The problem this year at both Canterbury (Civil and Geology) and Lincoln (Natural Resources Engineering) seems to be that most of the post graduate students are not yet sufficiently far advanced with their research to be in a position to present results. Obviously there should be plenty of scope next year.

Guy Grocott
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Otago Branch Activities

The Otago Branch has held no formal gatherings over the winter period, and we are looking or ideas for field trips and branch activities over the coming summer. Some possible trips include: Homer Tunnel, Manapouri Tailrace Tunnel, Fairfield Motorway, Macraes Mine. Speakers over the summer are planned, and include Ian Walsh - Fairfield Bypass Risk Issues, Tim Browne - Rockfall Hazard Assessment, P Brabhaharan - Asset management for metal roads, a risk management approach.

As noted in earlier newsletters, I am very interested in getting geotechnical/geological people in Dunedin or passing through the city to give a short talk. This can be organised with little advance notice via the established email network.

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Section 36 in the headlines again

This article is reproduced from BIA News No. 95 September 1999

Section 36 of the Building Act recently came to national attention in a* Fair Go *television programme, and it has been featured in the local press in several districts. Section 36 was discussed in two recent determinations by the Building Industry Authority, one of which is now under appeal.

General

Section 36 applies to building consents for building work on land subject to certain natural hazards such as flooding or slippage (usually called "hazard-prone land"). It provides that in certain circumstances an entry is to be made on the certificate of title to the effect that a building consent has been issued under section 36(2). Once the entry is on the title, the territorial authority is protected from civil liability in respect of the building consent.

There are some differences of opinion as to the legal interpretation of section 36 (see below), but it is not disputed that it serves a useful purpose by allowing owners to choose to build on hazard-prone land at their own risk.

In the first 5 years since the Act came into full force, at least 3,000 building consents were issued under section 36(2).

Consequences

A section 36(2) entry on the title could well reduce the value of the property.

Furthermore, insurers might be entitled to refuse to cover damage to any buildings on the land concerned. That is certainly the case for the statutory natural-hazard insurance under the Earthquake Commission Act, and depending on the circumstances might well be the case under a private insurance policy.

As stated in a previous article (*BIA News* No. 88, January/February 1999) most people are aware that when they insure their houses against fire with the insurance company of their choice, that company collects a premium for separate insurance with the Earthquake Commission against natural disaster. What is not so generally realised is that there are various circumstances in which that insurance does not apply. Most of those circumstances are set out in the Third Schedule to the Earthquake Commission Act 1993. In respect of section 36, it says:

3. Circumstances where Commission may decline a claim – The Commission may decline (or meet part only of a claim . . .) where:

> (d) The certificate of title of the land comprising the property, or on which the property is situated, contains an entry under section 36(2) of the Building Act 1991.

Concerns

The implications of section 36 do not seem to be generally understood, particularly by applicants for building consent. That can lead to considerable distress when the building comes to be sold or is damaged.

The Authority as well as the Earthquake Commission, the New Zealand Mutual Liability Risk Pool (which insures many territorial authorities), and the Insurance Council of New Zealand are concerned about this apparent lack of understanding. Accordingly, these organisations intend to cooperate in an attempt to increase awareness of the consequences of section 36 and of what can be done about it.

Further information will be announced in due course.

Interpretation

The legal interpretation of section 36 is in dispute. However, that dispute essentially relates to the circumstances in which an entry must be made on the title, it does not affect the concerns about the effect of such an entry.

The Authority's view as to the interpretation of section 36 was outlined in *Building Industry Authority News* No. 32, April 1994. The article said in its summary that:

> an entry on the certificate of title under section 36(2) is required only when:

- The building work is to take place on land subject to the natural hazards listed in section 36(1)(a), and
- The building work will not comply with the building code, so that the building consent is granted on the basis of a waiver or modification of the building code.

That view was applied in Determinations 98/003 and 99/004. A different view is taken by some territorial authorities and their legal advisers.

Determination 99/004 has been appealed to the High Court under section 86. The appeal raises several questions of law, including the interpretation of section 36. No date has yet been set for the hearing of the appeal. It is not possible to say when a final judgment will be handed down.

The Authority will be very glad to see the uncertainty about the proper interpretation of section 36 authoritatively settled by the Court.

Binding interpretations of the Building Act and Regulations can be issued only by the courts. Indications and guidelines issued by the Building Industry Authority, either in BIA NEWS or other communications, are provided with the intention of helping people to understand the legislation. They are, however, offered on a "no liability" basis, and in particular case those concerned should consult their own legal advisers.

Producer Statements

This article is reproduced from BIA News, No 92, June 1999.

Six years on and producer statements are still causing headaches for some in the industry. Here, we will look at the intent of the Building Act and offer some guidelines.

What are producer statements?
Section 2 defines a producer statement as:

> any statement supplied by or on behalf of the applicant for a building consent or by or on behalf of a person who has been granted a building consent that certain work will be or has been carried out in accordance with certain technical specifications.
>
> In other words, a producer statement relates to technical specifications and is not simply a statement of compliance with the building code. A producer statement may be made by anyone. Indeed, the Act does not even require a producer statement to be in writing, although it would be only in exceptional circumstances that a territorial authority would consider it reasonable to rely on a verbal assurance in any matter of significance. Of course, the author of a producer statement will be responsible for the honesty and accuracy of that statement to the full extent required by the law (see particularly section 80 and the Fair Trading Act).

A producer statement will usually be in the form of a certificate signed by a recognised specialist such as an architect, engineer, clerk of works or contractor.

The producer statement system allows territorial authorities, especially those with limited resources, to recognise the assurance of qualified people that the work will be technically acceptable.

Producer statements are similar to the various documents listed in section 50 of the Act that a territorial authority shall accept as establishing compliance. The difference is that a territorial authority may, not shall, accept a producer statement. In practice a territorial authority should be expected to accept a producer statement if it reasonably considers that the statement establishes that:

plans and specifications (for building consent purposes),
- or completed building work (for code compliance certificate purposes)
  comply with the building code.

A building certifier may accept a producer statement within that certifier's scope of approval on a similar basis.

Acceptance guidelines
Section 33(5) says that

> a territorial authority may, at its discretion, accept from the applicant [for a building consent] a producer statement establishing compliance with all or any of the provisions of the building code.

Section 56(3a) is a similar provision in respect of building certifiers. This means that a territorial authority

- is entitled to take account of producer statements, but cannot demand them;
- is not obliged to accept producer statements without further consideration, but neither is it entitled to reject all producer statements out of hand.

Many territorial authorities have a pre-determined policy on the acceptance of producer statements. They have established clear sets of guidelines based on a mix of criteria such as credibility of the author, reasoned judgement and common sense.

A territorial authority needs to know that the author is suitably qualified or experienced to certify the design or construction. What are the author's qualifications and does he/she have a proven track record?

The policy should also:

- identify who in the territorial authority has the delegated authority to accept producer statements;
- on what grounds the territorial authority will commission a peer review (at the applicant's expense). Such grounds might be an unknown author or a questionable solution from a recognised author;
- provide for an audit process, e.g., 5-10% of statements are randomly audited each year, and whenever there is any doubt over the author's credibility or competence.

There must also be a final check prior to the issue of the code compliance certificate to ensure that all building certificates and producer statements are provided. It is essential that territorial authorities' policies are guidelines not rules. The law does not permit a territorial authority to decide that any particular producer statement will be effectively accepted or rejected sight unseen. A reasoned and reasonable decision must be made in each case, and the policy may facilitate but may not pre-determine that decision.

Benefits

A producer statement is a very useful tool when the territorial authority does not have in-house expertise, e.g., to check a specific fire engineering design or the design or installation of a feature or system that is subject to a compliance schedule.

On a smaller scale, a territorial authority may be very happy to accept a producer statement in place of an inspection when the statement is made by an experienced tradeperson with a good track record. For example, at the time of consent application a rural territorial authority can accept that a drainlayer working on a job 3 hours from the office will submit a producer statement on completion of the drainage system along with the as-built plans.

Savings in time and money for both parties may be achieved by the producer statement system.

TA responsibilities.

A territorial authority is not permitted to demand a producer statement. In practice the territorial authority will have based its request on its ability to process the building consent application or to streamline checking procedures. Without the producer statement the territorial authority will have to verify compliance in other ways, eg, use its own staff, engage a consultant, or obtain a peer review. There will be costs associated with this, which the territorial authority can recover from the building consent applicant.

The applicant is expected to provide all the necessary information to demonstrate compliance with the building code so that the territorial authority, or building certifier, can process the application or issue the code compliance certificate.

It is up to territorial authorities to be flexible in their consideration while taking reasonable care in their judgement. The Act recognises that competence in the industry is widespread and the producer statement system enables that competence to be put to good use.

Territorial authority liability in accepting producer statements becomes an issue only if it is negligent in its decision-making process. A policy spelling out a territorial authority's guidelines for accepting producer statements and staff adherence to that policy removes the chance of negligence. Like most decisions made under the Act, it all boils down to taking reasonable care in judging each producer statement on its merits.

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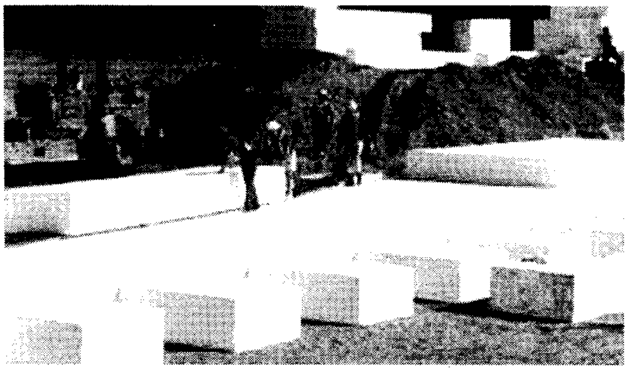

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- **Polyrock™** is easily transportable due to its light weight.
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For further information on James Hardie Polyrock™, or any James Hardie Building Systems products, please phone Wendy Buck 025 431 739 or James Ewart 025 783 616.

UPDATE ON TUNNEL PROGRESS

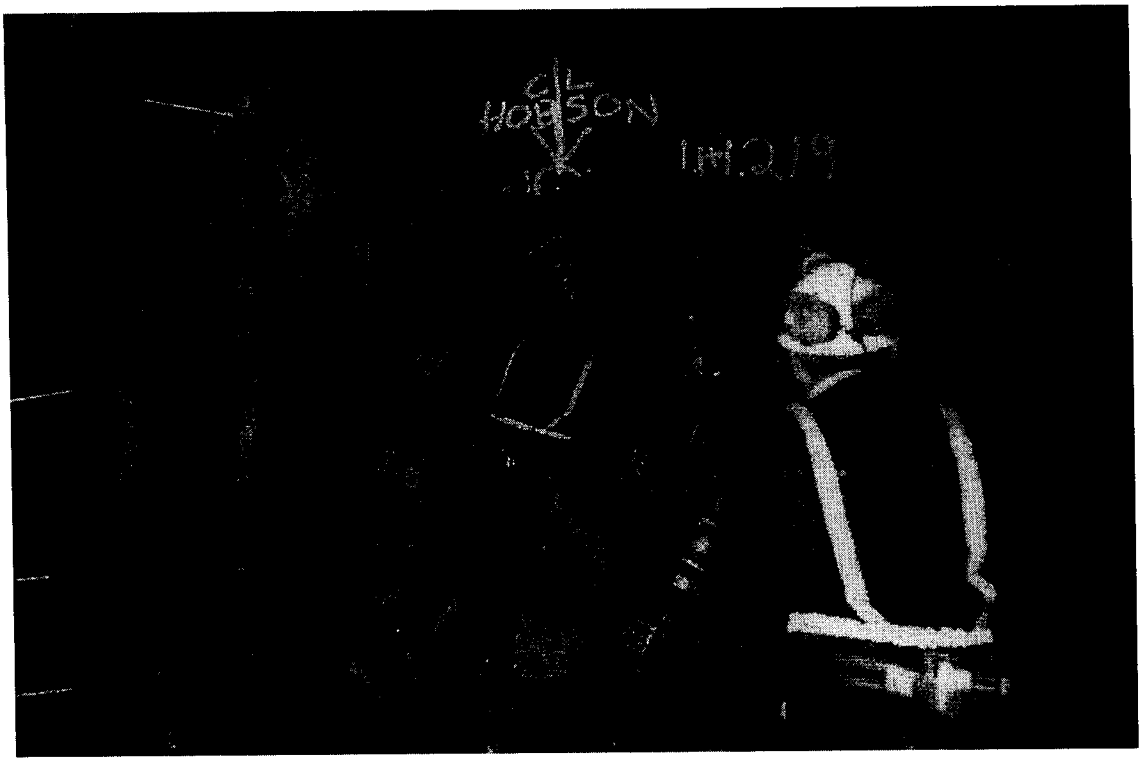
Ted Millan
Tonkin and Taylor

At the end of October 1999 the overall progress on excavation and lining of the tunnels was about 75% complete, excluding the mechanical, electrical and communications services fit-out. Completion of the fitted out tunnel ready for the main power cables is expected in September 2000.

By 31 October, the TBM had placed 5397 m of pre-cast lining rings with 1209 m to go to the hole-through located under the Khyber Pass overbridge. Peak daily excavation was 42 m on 2 September 1999 and the TBM has been averaging recently about 20 m/d in consistent East Coast Bays Formation interbedded sand and siltstones of varying strength. Ground strengths have ranged 1 – 3 MPa. There have been some intermittent inflows of water as faults have been crossed and total infiltration into the tunnel is approximately 2 l/s which is within the resource consent limits. The pre-cast lining is being grouted with a 50/50 cement /flyash mix to fill the annular space between the lining and country with injection pressures up to 40 psi. On 7/10/99 the TBM broke into and transited the Newmarket junction over a period of 5 days before re-launching at the northern end to continue to hole-through. Final hole-through is expected just after Christmas 1999 dependent on the rates of excavation that can be averaged. In August the main thrust bearing seal flushing system was modified to a grease flush system using vegetable based bio-degradable products with positive effects on performance.

The Hobson road header excavation finished in early May 1999. Rails were uplifted, sub-invert concrete placed and the rails relaid. Permanent invert concrete has now been placed from the hole-through at Khyber Pass back to the Liverpool junction and should reach the Hobson shaft by late January 2000 after which the arch lining will follow. Completion of the tunnel between the Hobson shaft and the Liverpool enlargement is expected by mid-June 2000, when the main cable contractor Olex will start laying the high voltage power cables.

"At the TBM Force, from left to right - Downer employee, Downer shift boss, & Vector Project Manager, Murray Hood.



Liverpool Englargement looking towards Hobson Street

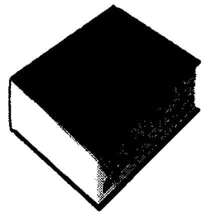
First contact – TBM hole through from Penrose to Newmarket

-V9

WEB SITES OF INTEREST

Organisation / Author	Notes	Address
Canadian Geotechnical Journal	Full Text On-Line	www.cnrc.ca/icist/journals/tocgeo.html
Multidisciplinary Centre for Earthquake Engineering Research	Home page for an organisation which develops and applies knowledge and advanced technologies to reduce earthquake losses. The site provides access to various publications and links to other sites. Based at the University of Buffalo, US.	Mceer.buffalo.edu/default.asp
Australian Centre for Geomechanics	Home page for an organisation which facilitates coordinated research, technology transfer and improved education and training in the geomechanics disciplines. Based at the University of Western Australia	www.acg.uwa.edu.au
World Wide Web of Geotechnical Engineers	Provides links to -The Internet Geotechnical Engineering Magazine -The Electronic Journal of Geotechnical Engineering - The World Wide Web Virtual Library of Geotechnical Engineering	Geotech.civen.okstate.edu/
US Bureau of Reclamation	Access to the USBR Engineering Geology Field Manual and other useful links	www.usbr.gov/geo
US Geological Survey	Access to publications and other links	www.usgs.gov/
US EPA	Access to various publications, databases, software and other links	Earth1.epa.gov/
Links 2 Go	Numerous US and International groundwater links	www.links2go.com/topic/groundwater
Geological Resources	Numerous US and International Geological Links	Ucsu.colorado.edu/~sauerr/Geological_Resources.html
Geojobs International	Access to worldwide employment opportunities in the geosciences for both job seekers and employers	www.geojobs.com/

Wanted - Book Reviewers



NZ Geotechnical Society has a number of recently published books available for review. These books have been supplied free to the Society, by the Publishers, for review purposes. We are looking for eager volunteers to review the following books:-

The Geotechnics of Hard Soils – Soft Rocks. (A Evangelista and L Picarelli (eds)) A 2 volume publication. Proceedings of the 2nd International Symposium on Hard Soils-Soft Rocks 1998. Volume 3 still to come.

Landslide Risk Assessment. (Cruden and R Fell). A book recommended at the QRA seminar.

Dynamic Soil-Structure Interaction. (Zhang and Wolf) Developments in Geotechnical Engineering, Vol. 83

The reviews are to be succinct and critical appraisals of the books in the order of 1 or 2 A4 pages in length. Reviews will be forwarded to the publishers. Upon completion of the review the book reviewers can keep the book. (Now there is a good incentive for you!!).

If you are interested please contact Debbie Fellows, Management Secretary,
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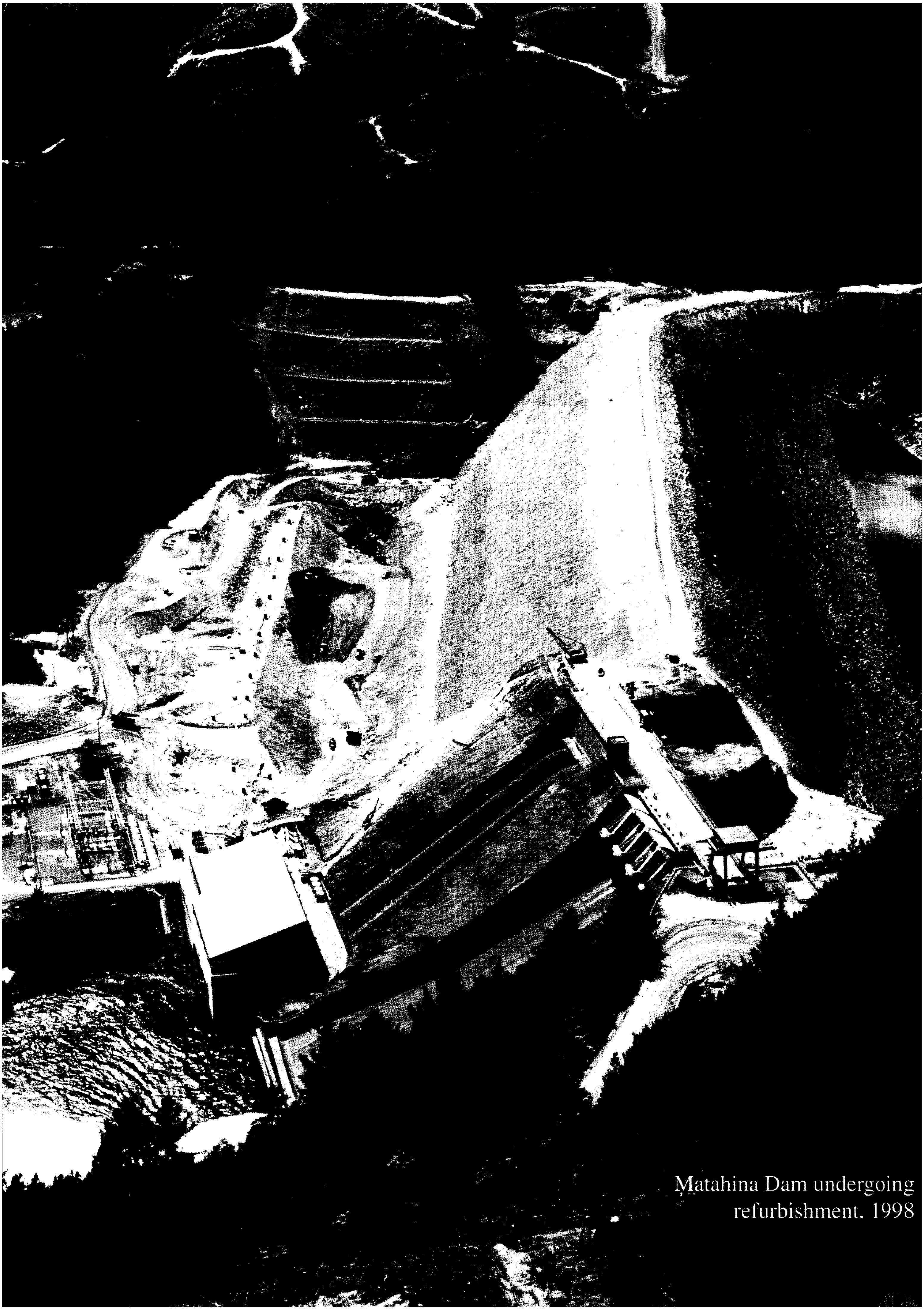


Matahina Dam undergoing
refurbishment. 1998

SOIL BEHAVIOUR IN EARTHQUAKE GEOTECHNICS
Author:- Professor Kenji Ishihara

Reviewed By: Dr Trevor Matuschka, Director, Engineering Geology Ltd

Professor Kenji Ishihara has had an active and prominent career in the field of earthquake geotechnical engineering and is a respected international authority in this subject area. He graduated from the University of Tokyo going on to obtain his PhD. Following a short time in the USA he was appointed to the staff at the University of Tokyo where he has held a number of positions, rising to a full Professor in 1977. He has published many papers in his areas of expertise: constitutive behaviour of cohesionless soils subjected to dynamic loading, liquefaction analysis and earthquake stability. He has travelled extensively to document the effects of earthquakes and to collaborate with other researchers and has participated fully in the International Society of Soil Mechanics and Geotechnical Engineering where he has held various senior positions.

He published his first book entitled 'Fundamentals of Soil Dynamics' (in Japanese) in 1976. Since then there have been significant developments in techniques for measuring dynamic soil properties and a lot more data has been obtained. This book follows on from the 1976 book, but includes developments since that time.

The book consists of 16 chapters and follows a logical structure. The first three chapters provide an introduction by way of a review of the nature of dynamic problems, the characteristics of dynamic loading and the representation of stress-strain relations in cyclic loading. Chapter 4 provides a summary of laboratory methods for determining dynamic characteristics of soils (cyclic triaxial, simple shear, torsional shear, resonant column, bender elements and special transducers for accurate measurement of deformations at very small strains).

Chapter 5 reviews methods for the in situ measurement of seismic waves (reflection, refraction, uphole and downhole, cross hole, suspension sonde and spectral analysis of surface waves). Chapter 6 covers the evaluation of low amplitude shear moduli from the results of laboratory and in situ tests.

Shear modulus and damping of soils vary significantly with strain. The evaluation of this dependancy, from laboratory and in situ tests, for both sands and clays is covered in Chapter 7. The effect of loading speed and stiffness degradation of cohesive soils is covered in Chapter 8. Chapter 9 covers the strength of cohesive soils under transient and cyclic loading conditions.

The resistance of sands, including silty sands and gravels to cyclic loading is covered in Chapter 10. This includes the basic mechanism and definition of liquefaction and the effects of K_o conditions, confining stress, initial stress and irregular seismic loading. In Chapter 11 the behaviour of sand under monotonic loading is presented. The differences leading to dilative (non-flow) and contractive (flow) behaviour are presented together with steady state and quasi-steady state behaviour of sands and silty sands. The residual strengths of dense and silty sands are important for assessing the stability of post-earthquake conditions and this is also covered in Chapter 11.

The evaluation of liquefaction resistance from SPT and CPT soundings is presented in Chapter 12. This includes the effect of fines on cyclic strength and correlations for gravelly materials. A brief overview of the procedure for calculating the cyclic shear stress induced in the ground by earthquake shaking and the factor of safety for liquefaction is presented in Chapter 13. Factors affecting settlements in sand deposits following liquefaction and some methods for calculating settlement are described in Chapter 14. Chapters 15 and 16 cover flow and non-flow conditions and residual strength. Useful correlations between SPT and CPT values with residual strength are provided. Boundary curves based on SPT N are presented for identifying conditions for flow, liquefaction with non-flow and no liquefaction for a clean sand.

The Japanese have undertaken extensive research on the response of soils to earthquake shaking and particularly liquefaction problems. Although much of this work has been published in scientific journals it is helpful to have it presented in one text. However, the book is not unduly biased by this. In fact the author has done a good job drawing together information from a wide range of sources to present a balanced view. This book will be a useful reference text for both postgraduate students and practitioners on the behaviour of soils subjected to earthquake shaking.

SOIL BEHAVIOUR IN EARTHQUAKE GEOTECHNICS

Author:- Professor Kenji Ishihara

Published by:- Oxford University Press

Date: 1996

Web shopping on: www.oup.co.uk

Price : £ 65 Hardback only

"Karl Terzaghi – The Engineer as Artist"
Richard E Goodman

Publisher: *ASCE Press (1999)*
Review by: *Prof. Mick Pender*

The writing of a biography of a famous engineer is no simple task. Earlier this year I started reading a biography of Thomas Telford – I have yet to reach the half way point as the book is simply boring, being more hagiography than biography! I am delighted to say that Dick Goodman has succeeded admirably in producing a 340 page biography of Karl Terzaghi that I found hard to put down. Time and again I found myself wanting to read on when the end of a chapter had been reached. Although we have been well served in the recollections of Terzaghi's colleagues, particularly Ralph Peck, and consequently know much of Terzaghi's professional life and methods of working, Goodman has, nevertheless, been able to unearth much hitherto hidden information, particularly about his early years.

Fortunately for Goodman Terzaghi was a dedicated keeper of diaries, even if they were in German, in longhand, and in a difficult script! The book is liberally laced with quotations from these diaries which Goodman has deciphered and translated. I have the book beside me as I write with many "stick-it" labels poking from pages on which there is an interesting quote. One I particularly liked, which comes from a courtroom encounter, is about factors of safety for the stability of slopes. He was asked how he would regard a categorical statement that, in a clay embankment, a theoretical factor of safety of 1.5 should be regarded as a minimum. Terzaghi responded with: "I always explain to my students ... that a factor of safety of 1.5 is a factor of safety which you have to demonstrate in order to get permission to build, then it is your business how you demonstrate it."

Terzaghi's work in the early 20's leading up to the publication of *Erdbaumechanik* is described, as are the clever experimental methods he developed in those pre-electronic days. Also covered the background to the large scale retaining wall tests at MIT in the late 1920s, prior to his return to Vienna for about a decade, towards the end of which he was nearly ensnared to work for the Nazis in Germany. In the 1940s he was a consultant in the construction of the Chicago subway, I found particularly notable the considerable effort devoted to soil testing during this project; perhaps we have something to learn from this. From the late 1940's onwards he was involved in extensive traveling as an international consultant much in demand. He must have been blessed with an iron constitution to undertake such arduous travels in the days before the jumbo jet.

The application of geological insight to the solutions of engineering problems, was the lifelong passion, right up to his last days. Goodman documents several examples of these. One solution, which I thought to be rather daring, was a scour protection scheme for the cofferdam at a dam construction site on a very wide river in Southern India. This involved a double thickness mattress of large concrete blocks chained together which were expected to become draped in a protective manner should scour occur. I found myself wondering how such a scheme would fare under peer review today, only to hear a few days ago that a modern day version of the same idea is currently in use in Bangladesh.

Recently I was discussing a job with someone who described it as an engineering geology problem. Later it occurred to me that this was not correct, the problem was one of geotechnical engineering and involved much more than engineering geology. A fascinating feature of our profession is that it requires an holistic approach so that all the essential features of the geology, soil mechanics, rock mechanics and other disciplines are synthesised in reaching a solution to the problem in hand. I have always thought of Terzaghi as being the great exemplar of this. He is not only the author of *Theoretical Soil Mechanics*, which I frequently consult, co-authored *Soil Mechanics in Engineering Practice*, and made important contributions to rock mechanics, but also had great insights into the significance of geological factors in geotechnical works. Unfortunately a planned book on engineering geology never materialised. I mentioned *Theoretical Soil Mechanics* above, but one must not get the idea that Terzaghi was a mainly theoretician, although it is clear that he did have some epoch making theoretical insights from which soil mechanics developed. He was critical of those who wished to push theories too far and always recognised that the difficulties imposed by natural deposits and the vagaries of geological processes meant that too theoretical an approach would cloud rather than clarify the picture. I have to admit, though, being somewhat aghast to read that Peck, abetted by Terzaghi, was critical of the book by D. W. Taylor which, like *Soil Mechanics in Engineering Practice,* was first published in 1948. I have always regarded *Fundamentals of Soil Mechanics* as a model of clear exposition. It would indeed be interesting to have Terzaghi and Peck review some more recent texts!

As the story unfolds we get some insight into this century now drawing to a close; a century of tears it has been called. Both World Wars impacted on Terzaghi's life. In the first he was in the Austrian army for a brief time and eventually ended up at the Royal Ottoman College and, after the war, at Robert College in Istanbul. He and his family departed from Austria in 1938. Not an easy escape, with expediency requiring that he, his wife, and toddler son all leave separately, and not without involving eventual loss of savings and household effects.

I found it interesting to track some of the ideas which are much broader than engineering, in the quotations. Goodman relates how in his early years Terzaghi developed an extensive thirst for knowledge seeking to discover the purpose of human existence through the study of religion. The following comment is extracted from the diaries of his middle years: "...the humble religious leader who lives and teaches ethical heritage, and the layman who will stand up in its defense are the more beneficial in human society than an artist or scientist with a brilliant name, because religion is wisdom and wisdom ranks higher than science and art." I was expecting this theme to be developed further, however I was disappointed. A diary entry from the year before his death reads: "Yet what a blessing to approach the end without being haunted by religious superstitions, knowing that that end *is* the end." I take from this change in attitude to the human instinct for religious and spiritual experience that Terzaghi the young man had very wide interests which he was keen to foster, but as time went on he became more and more involved with his professional work to the exclusion of all else. He was actively involved in consulting work right up to the time of his death, and it seems very successfully. Yet shouldn't life, and particularly the later years, be more than the single minded pursuit of one's profession?

Dick Goodman could himself lay claim to the subtitle of the book: "The Engineer as Artist". He is he a talented geotechnical engineer to whom we are indebted for the joint element in finite element analysis, the presentation of block theory, and excellent textbooks in rock mechanics and engineering geology. Also in his PhD work he developed in parallel with Newmark what we now refer to as the Newmark sliding block analysis. In addition to this he is a superb musician – an opera singer and pianist. Whilst in Berkeley in 1989 I heard him sing the part of Leporello in Don Giovanni and parts in two other operas he produced. I wonder if it is this artistic flair, in conjunction with his technical understanding, that have enabled him to write such an engaging biography.

"Geohazards in Engineering Geology"

Edited by J G Maund and M Eddleston

Reviewed By: R D Beetham, Institute of Geological & Nuclear Sciences, Lower Hutt

This book immediately caught my attention because of the title, *and* the remarkable front cover photograph of a billowing eruption cloud from snowy Mount Ruapehu towering over the familiar and classical building shape of the Grand Chateau bathed in sunshine. The hazards of Mount Ruapehu eruptions have been very much in the news in New Zealand over the last several years, not least because of the disruption the eruptions caused to skiing and associated support towns located near the mountain.

Geohazards is a word with special significance that is in common use these days. It was the theme of the 31st annual conference of the Engineering Group of the Geological Society, held at the University of Coventry from 10 to 14 September 1995. The Geohazards theme was chosen as it was mid-way through the United Nations designated International Decade for Natural Disaster Reduction. The conference itself attracted a wide range of papers on geohazards from all over the world. The papers are presented in the book, together with additional material from eminent practitioners and academics in respective areas of geohazards, that have been added to provide an authoritative volume on the *charcterisation* and *mitigation* of geohazards.

As the range or scope of geohazards is large, the book is separated into eight related geohazards Sections, each Section containing papers of interest written by independent authors. The eight Sections are:

1. Coastal and fluvial geohazards (8 papers)
2. Volcanic and seismic geohazards (4 papers)
3. Slope stability hazards (9 papers)
4. Hazard mapping (5 papers)
5. Geohazards associated with underground subsidence and cavities (4 papers)
6. Urban geohazards in developing countries (4 papers)
7. Geohazards associated with contaminated land (3 papers)
8. Planning and geohazards (6 papers) - giving a total of 43 papers in the book.

While not claiming to be completely comprehensive, the book focuses on natural geohazards and gives an excellent indication of their range and variety, and importantly offers suggestions for their mitigation.

The coastal and fluvial geohazards Section contains a wide selection of papers dealing with examples of flooding and its possible means of mitigation, lab and field prediction of liquefaction potential, GLOF's (glacial lake outburst floods) and their mitigation, control of fluvial hazards, and coastal cliff and beach erosion and their management. These papers provide insights that are all relevant to a wide range of civil engineers and geologists.

Volcanic and seismic geohazards are of course of intense interest to New Zealand based practitioners, and they won't be disappointed by this selection. Apart from the direct impacts of a range of volcanic hazards, what are the best mitigation measures when there is an active land-building process involving huge volumes of volcanic sediments, such as at Pinatubo? Who of us realises the full consequences of volcanic gasses releases during major eruptions? Answers to these questions are presented along with two general and forward thinking papers on earthquake hazards.

A comprehensive range of slope stability hazards in different countries, and in some cases their possible mitigation, are presented in this, the largest Section of the book. A highlight to me is the inclusion of a paper that outlines a method for inspection and risk assessment of man-made slopes in the UK. Other papers deal with assessment of rock and soil slopes, the effects of mineralogy, probabalistic slope stability analysis using geostatistics, and use of landslide inventory data. This wide ranging Section will be of use to practitioners who live in hilly countries where landslides are a ubiquitous and prevalent hazard.

The Section on hazard mapping inevitably includes much additional information on landslide hazards as well as reference to other less well known geological hazards, such as solution cavities. It thus ties in extremely well with the immediately following Section on geohazards associated with underground subsidence and cavities, most of which is new but interesting ground to me.

Globally there is a huge migration of the worlds rapidly increasing population from rural to urban environments, thus geohazards in the urban environment are becoming increasingly important. Apart from the geohazards already covered earlier, the urban geohazards relate often to high population growth, industrialisation, and the consequent pollution caused by the wastes generated by each of these, and the effect these wastes can have on a scarce resource, the water supply.

Geohazards associated with contaminated land deals with different types of contamination and subsequent investigations and remediation. It leads into the important final Section of the book, planning and geohazards, which illustrates ways of presenting geohazards information, including GIS.

Overall I enjoyed reading this book. Initially as a casual reader I found it easy to pick up and flick through to a topic which grabbed my interest. In this respect the layout of the book is good, having Sections with a common theme, each consisting of a collection of papers. The format of the papers beginning with an abstract and ending with references, provides a familiar and useful format for the serious reader who is looking to expand their knowledge with further reading on a selected topic. Would a casual reader or layperson be deterred by the books format or its content? In my view some background technical knowledge, and knowledge of terminology would be helpful to a reader, although a determined layperson could obtain much of value from the volume. The book is primarily of relevance to academic and practising engineering geologists, civil and geotechnical engineers, and students, although the papers will be of interest to planners and government authorities in areas where geohazards impose financial and social costs associated with loss of property, livelihoods, and life.

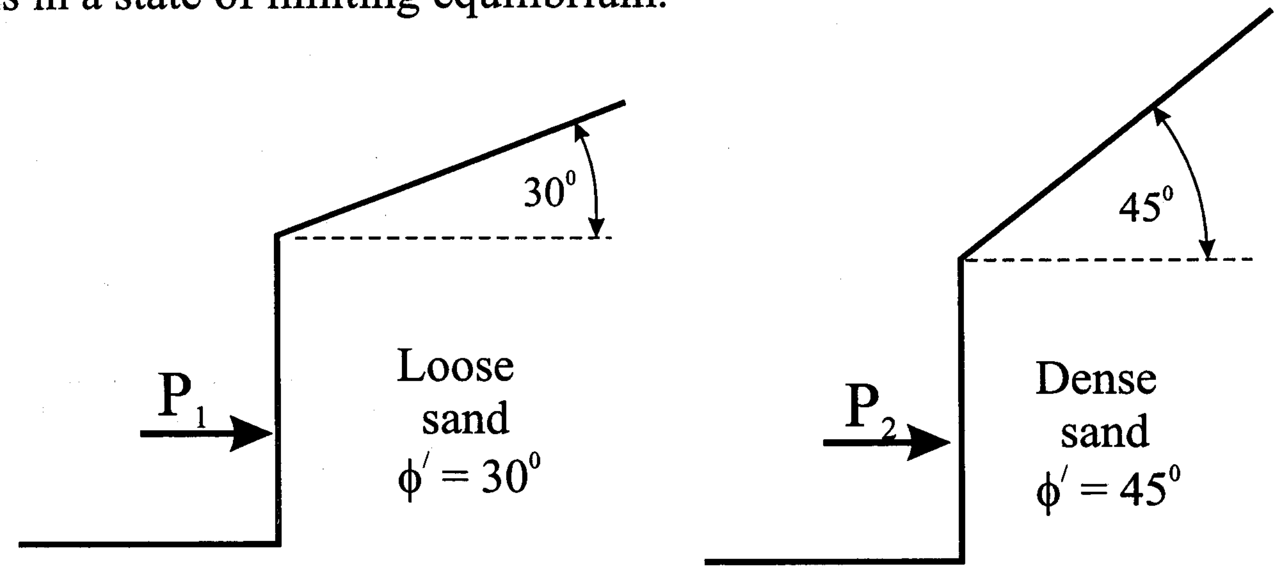
As a professional who works regularly with geohazards, I found the book a stimulating blend of research and practical applications. As professionals we can learn much from our peers work experiences in a range of situations that we would not often encounter. The presentation of case histories is an important component of our continuing education. I am certain that both students, and professionals with many years experience, will find this book a rewarding read, as well as being a useful reference volume to have on their shelf.

GEOHAZARDS IN ENGINEERING GEOLOGY
Editors:- J G Maund and M Eddleston
Geological Society Special Publication No. 15
Published by:- Geological Society of London
Date: October 1998
Web shopping on:www.bookshop.geolsoc.org.uk
Price : £ 79 Hardback only

Geo-Brain Teaser

Geo-teaser for an idle moment:

The drawing shows two retaining walls, one retaining loose sand and the other retaining dense sand, in each case the slope behind the wall is in a state of limiting equilibrium.



(a) wall retaining loose sand

(b) wall retaining dense sand

Which wall needs to be stronger?
(ie Which is greater - P_1 or P_2?)

Answer to be published in March 2000 Supplement

SUMMARY OF TECHNICAL PAPERS

- THE 1999 GEOMECHANICS AWARD
  Some lessons from geotechnical engineering in volcanic soils
  LD Wesley

- Landslide Tsunami Generation
  Willem de Lange and Vicki Moon

- Geotechnical Data at your fingertips
  Colin Mazengarb and Dick Beetham

- Current Research in Geotechnical Engineering at Canterbury University
  JB Berrill, RO Davis and KJ McManus

- Current Research in Geotechnical Engineerin at Auckland University
  T Simpson, D Wise, Prof M Pender

- New Zealand Abstracts for Young Geotechnical Professionals Conference
  (February 2000)

- Northern Region Student Prize Abstracts

Some lessons from geotechnical engineering in volcanic soils

L.D.Wesley
Department of Civil and Resource Engineering, University of Auckland, New Zealand

ABSTRACT: An account is given of some experiences and research involving soils of volcanic origin, namely tropical red clay, volcanic ash clay (andosol), and pumiceous sand. It is shown that the engineering properties of these soils are often very good, despite indications to the contrary from standard index or classification tests. Data on field behaviour, as well as on shear strength and compressibility of the first two soils is presented, and is related to their unusual mineralogical composition. Data on compressibility, specific gravity and penetration resistance of the pumiceous sand is presented, and the difficulties in interpreting test results because of the vesicular nature of the grains are analysed and discussed. It is suggested that these soils are "problematic" primarily because their behaviour does not conform well to standard or expected patterns, and not because their engineering properties are necessarily poor.

1 INTRODUCTION

Many geotechnical engineers, in the course of practising their profession, encounter soils which do not appear to behave in a manner compatible with normal expectations or "conventional" concepts. Such soils give rise to questions about their suitability for engineering projects, and to quests to explain their unusual behaviour. These soils are not necessarily problem soils in the sense that their engineering properties are poor, but they are "problematic" because they confront the engineer with unanswered questions as to their nature and how best to evaluate them.

This paper describes experiences with three soils in this category, namely tropical red clay, volcanic ash soil (or "andosol" according to the terminology used by some pedological classification systems), and a pumiceous sand. The tropical red clay and volcanic ash soil are found in various parts of the world, but the focus here is primarily on those found in Java, Indonesia. The pumiceous sand is found in New Zealand. The first two soils have been described in considerable detail elsewhere (Wesley, 1973 and 1977, Wesley and Matuschka, 1988) and only selected properties of special interest will be discussed here. (The term andosol actually originates from Japan, and the author feels somewhat out of place addressing an audience which may know more about this soil than he does).

2 TROPICAL RED CLAY AND VOLCANIC ASH SOIL

2.1 Origin and General Nature

Red clays and volcanic ash soils ("latosols" and "andosols" in the classification system used by Indonesian soil scientists) are very widely found in Java on the slopes of the volcanoes and volcanic ranges that make up a large part of the island. They are formed by in situ weathering of the underlying parent material, which is generally basic in nature, and may consist of lahar flow material, tuff, tuffaceous sandstone, ash and occasionally lava. The red clays are formed on the lower slopes and the volcanic ash soils at the higher levels; the transition zone between the two types being an elevation of about 1000m. The term volcanic ash soil is a rather loose term and could include a wide variety of soil types. In this paper it refers to the allophane rich soils formed from the weathering of mainly basic (andesitic) volcanic ash.

Observation of these soils in the field demonstrates very clearly that they have quite remarkable stability characteristics. Much of the area covered by these soils in Java is terraced rice fields; at the higher elevation the slopes are frequently over 30° and may approach 45°. They are often permanently saturated by irrigation water flowing from one terrace to the next. The question can

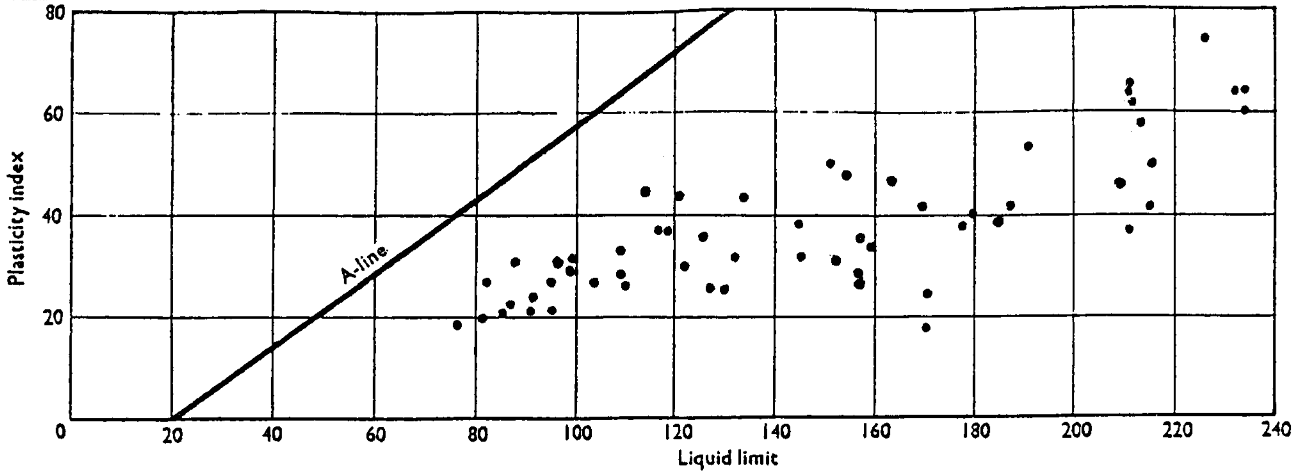


Figure 1. Atterberg limits for volcanic ash soils

rightly be asked as to why these soils should be regarded as problematic. The answer lies primarily in the fact that they do not conform to "conventional" behaviour.

In the case of volcanic ash soils the extraordinarily high water contents and Atterberg limits of these soils (shown in Fig 1), the irreversible changes they undergo on drying, and the "flat" shape of their compaction curves, makes them unlike any other soil, and for this reason alone they are perhaps rightly regarded as problematic soils. The writer's experience while working in Indonesia was that Western geotechnical engineers, especially those from Europe and North America, tended to believe that such soils had to be problem soils, simply because of their abnormally high water contents.

Terzaghi (1958) and those associated with the design and construction of the Sasamua Dam in Kenya clearly regarded the red clay they were dealing with as problematic, because they went to quite unusual trouble to check the nature of the soil before proceeding with the construction of the dam. Their concern arose simply because the soil did not fit in with normal expectations. It had a much higher strength than "normal" clays of comparable particle size. Amongst the measures they took to check the suitability of the soil was the identification and examination of precedents, one of which was the Tjipanundjang dam in West Java, Indonesia.

Gidigasu et al (1973) and Morin and Todor (1975) refer to these soils respectively as "troublesome" and "problem" soils. Aspects of the problematic or "non-conventional" aspects of the soils are discussed below.

2.2 Consolidation Behaviour

The writer's first experience with what might be called the "problematic" nature of these soils was in carrying out site investigations and foundation design for structures in red clay areas while working for the Indonesian Public Works Department. Consolidation tests on red clays showed two effects which did not conform to what could be described as conventional behaviour. Firstly, the void ratio versus log of pressure (e-log p) graphs did not show any clearly defined preconsolidation pressure. Typical

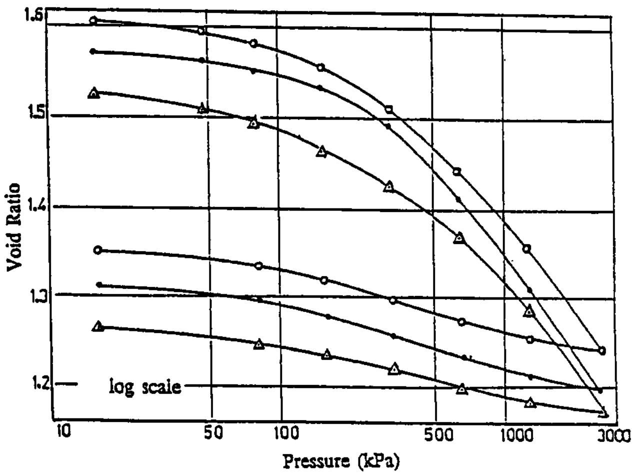


Figure 2. Consolidation tests on red clays

examples are shown in Fig.2. Secondly, the square root of time versus compression curves did not produce the initial straight lines corresponding to the conventional Terzaghi consolidation theory. A typical example is shown in Fig.3 along with a similar curve from a volcanic ash soil. With graphs of this form, the determination of the coefficient of consolidation, c_v becomes very problematical.

Consider first the e-log p graphs. In the absence of a clearly defined preconsolidation stress and no

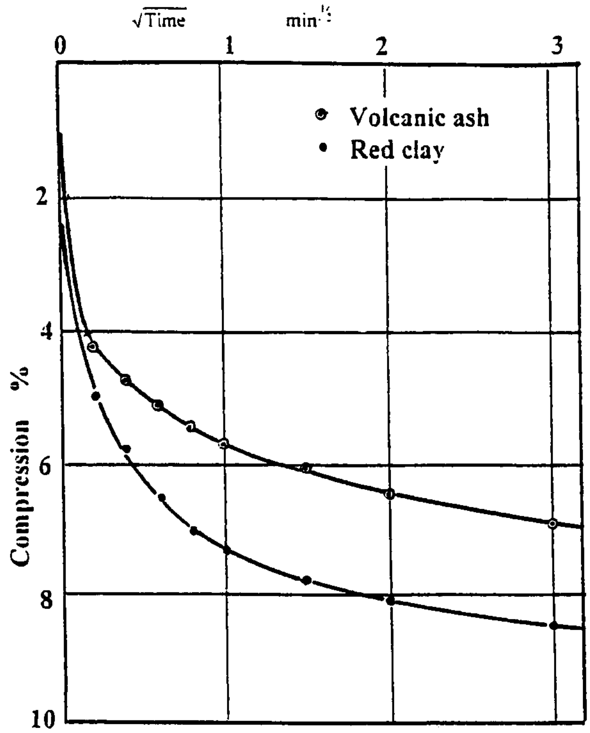


Figure 3. Root time consolidation curves

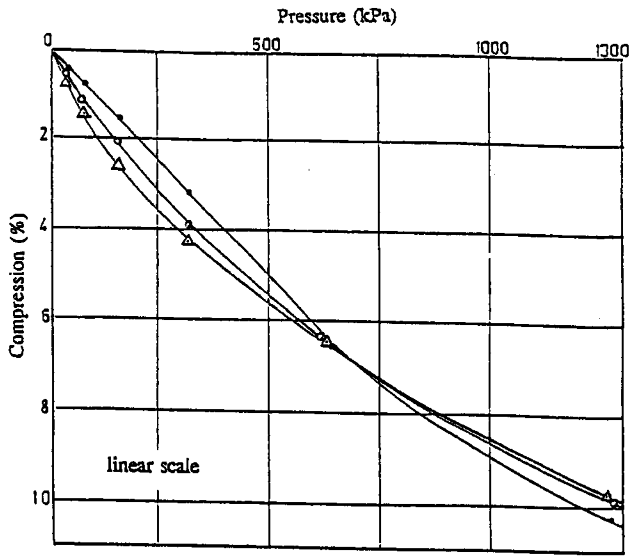


Figure 4. Red clay consolidation curves using a linear scale for pressure

approximate straight lines from which to determine C_c or C_s parameters, it is questionable whether the use of the log plot serves any useful purpose. The use of the log scale arose in the early days of soil mechanics because the virgin consolidation of a soil formed by a sedimentation process follows an approximate straight line on such a plot. Also when unloaded the rebound curve follows a straight line, albeit at a much flatter slope. This behaviour gives rise to the stress history framework within which sedimentary soils are described and evaluated.

With residual soils, such as the tropical red clay discussed here, the formation process is totally different from that of sedimentary soils, and there is no reason at all to expect their consolidation behaviour to conform to that of such soils. In Fig.4 the results from Fig.2 are redrawn using a linear scale for pressure, over a more limited pressure range, but still encompassing a range wider than is likely to be of interest in most engineering situations. It is seen that when re-plotted in this way the curves are reasonably linear. They approximate to straight lines much better on this plot than they do on the log plot, and it makes more sense to interpret the behaviour from the linear graph than the log one. There is no point in trying to assign C_c or C_s values to the soil when a single m_v value clearly and more accurately defines the whole curve. It often seems preferable to use the linear parameter m_v when dealing with residual soils than work in terms of the C_c or C_s parameters.

There is thus good reason to be wary of the standard e-log p plot when dealing with soils not of sedimentary origin. At the very least the consolidation test results should be evaluated using both a linear and log plot. The continued use of the e-log p plot often has a detrimental effect on the interpretation of consolidation test results since it encourages their interpretation in terms of two zones separated by a "preconsolidation" pressure, when in fact no such zones may exist. Its use is really an attempt to force the soils to conform to a behaviour pattern to which they do not belong.

The behaviour demonstrated by the red clay is not intended to be representative of all residual soils. Some residual soils behave in this way; others behave quite differently, and show clear "pseudo" pre-consolidation pressures or yield pressures, but to establish whether this is the case it is still necessary to plot the consolidation curve on both log and linear plots.

An interesting feature of the compressibility of the volcanic ash soils is the absence of any relationship between their m_v values and water content or void ratio, at least over the stress range of interest in foundation design. This is shown in Fig 5, for m_v values between 0 and 200kPa.

Turning now to the question of the consolidation rate, and the absence of an initial straight line on the root time plots, the first explanation which came to the writer's mind at the time of encountering this phenomena was that the soil was not fully saturated, and the rapid compression was instantaneous compression of air rather than expulsion of water. Later investigations using dissipation tests in triaxial cells with back pressure to ensure full saturation

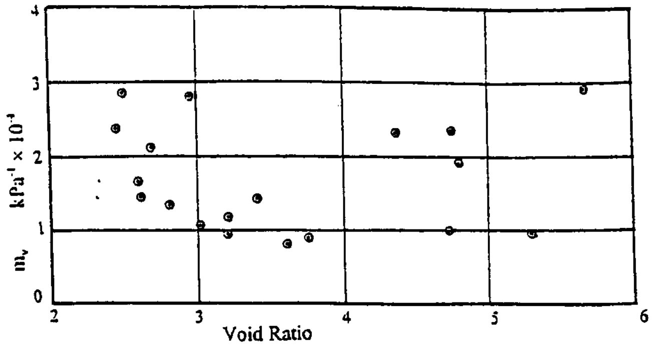


Figure 5. Coefficient of compressibility versus void ratio for volcanic ash samples.

confirmed that the soils do indeed consolidate very rapidly, and the absence of the straight line on the root time graph is primarily because consolidation is too rapid to allow recordings of those parts of the graph which would lie on such a straight line.

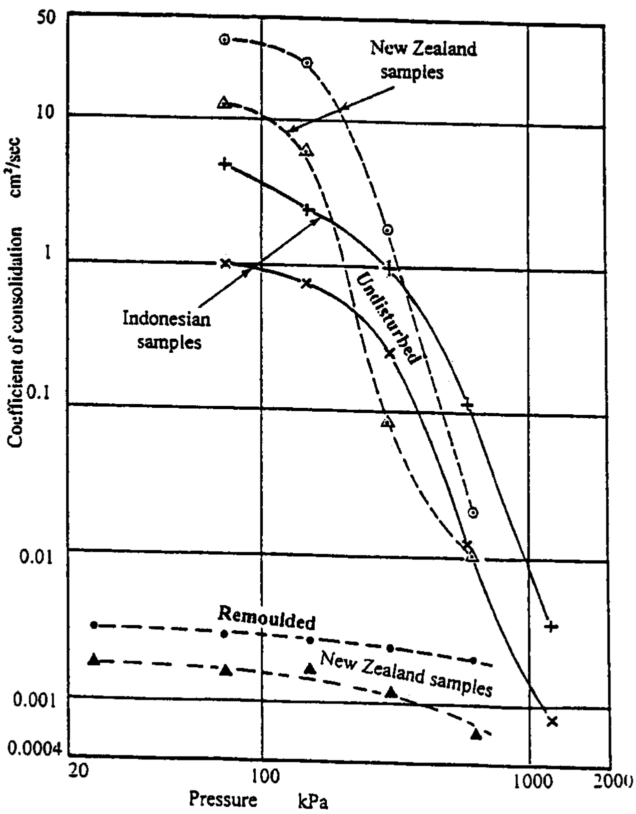


Figure 6. Coefficient of consolidation (c_v) versus stress level for a volcanic ash soil.

The results of a series of tests of this type on volcanic ash samples are shown in Figure 6. Two samples from New Zealand and Indonesia respectively were tested, using isotropic consolidation in a triaxial cell. Drainage was allowed from the top of the sample and pore pressure was measured at the base. Back pressure of 700 kPa was used to ensure full saturation. The tests were carried out in stages with increasing stress levels, and were done on both the undisturbed and remoulded soil. The c_v value was determined from the t_{50} values given by the pore pressure measurements.

The undisturbed samples show extremely high values of c_v at low stress levels, and a steep decline in values as the stress level rises. The value of the coefficient of consolidation actually changes by three orders of magnitude over the stress range involved. The remoulded samples all show quite low values, substantially below those for the undisturbed soil, and not greatly influenced by stress level. It appears that the natural structure of the soil gives it a high permeability which is destroyed by high stress levels or remoulding. With the two samples from

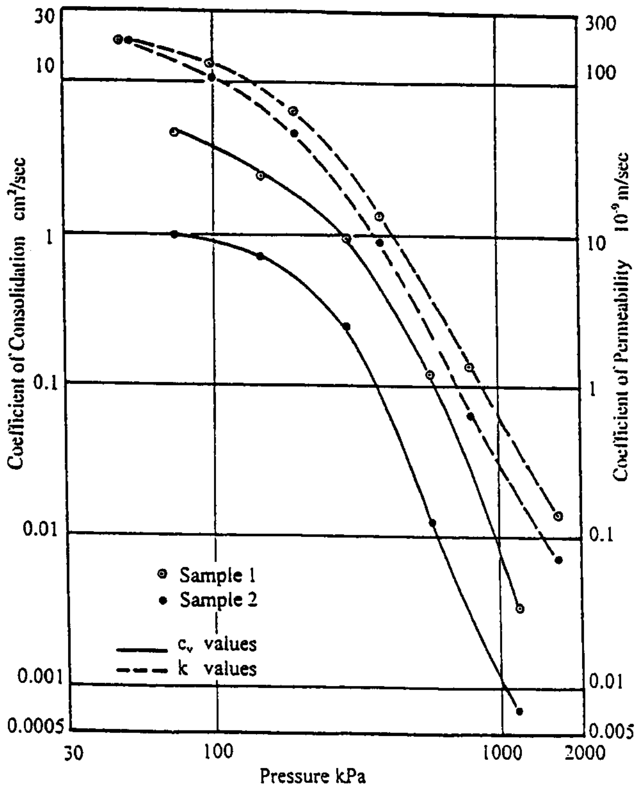


Figure 7. Coefficient of consolidation and permeability for volcanic ash soil.

Indonesia, the permeability of the soil was measured at each stage of the test by subjecting the samples to small pressure gradients. The results of these measurements are shown in Figure 7 on the same graph as the coefficient of consolidation values. It is seen that the shape of both curves is very similar, confirming that the high c_v values are a reflection of the high k values.

2.3 *Strength Behaviour*

Strength characteristics of importance demonstrated by laboratory measurements include the following:

(a) high peak strength
(b) small difference between peak and residual strength
(c) a real and substantial c′ intercept in both the undisturbed and remoulded state

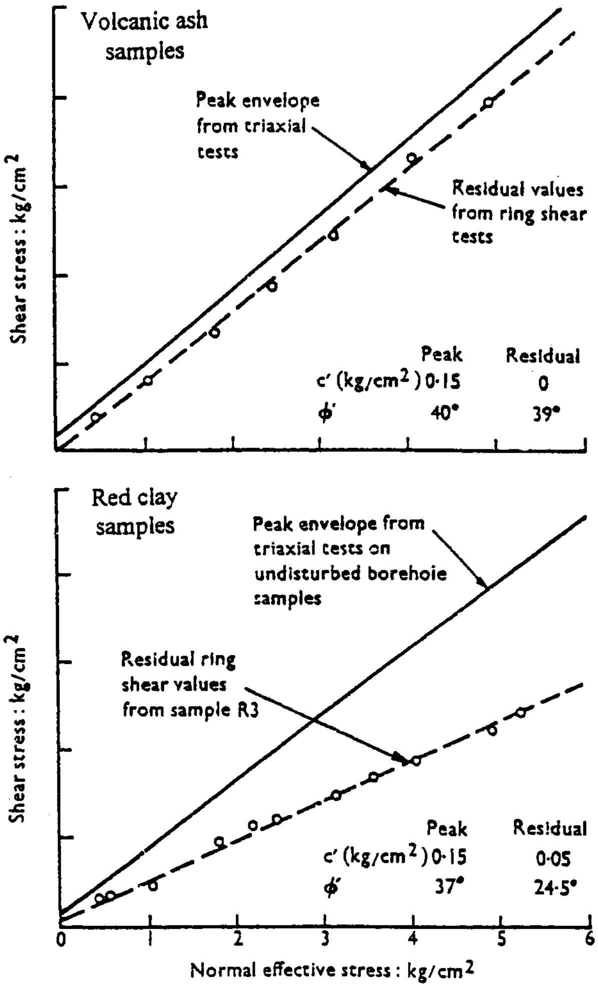


Figure 8. Shear strength behaviour.

Fig 8 shows shear strength data for both clays. The peak strength is from triaxial tests and the residual values from ring shear tests. The high values for both peak and residual strength are immediately apparent. The residual ϕ'_r values from the volcanic ash are extraordinarily high and bear no relationship to those from sedimentary soils of similar plasticity or particle size. Fig 9 illustrates this point. There is something quite unique in the nature of the clay mineral allophane which gives the soil a high ϕ' angle, and very little change in its value with displacement on a shear plane.

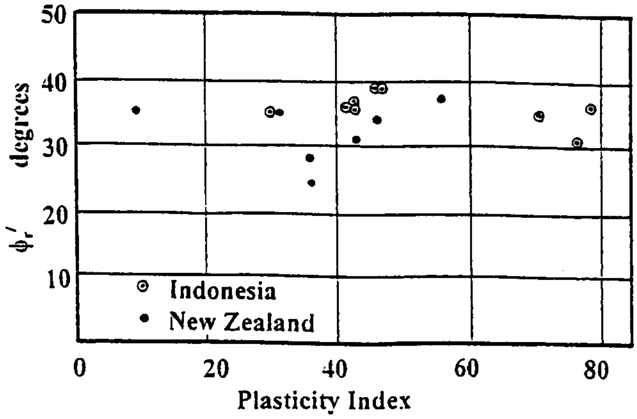


Figure 9. Residual strength of volcanic ash

Triaxial tests show significant c′ values, from both undisturbed and remoulded samples, and field behaviour of the soils clearly demonstrates that comparable values apply in the field. Consider the behaviour of irrigated terraced rice fields, such as shown in Fig 10, together with an assumed flow net.

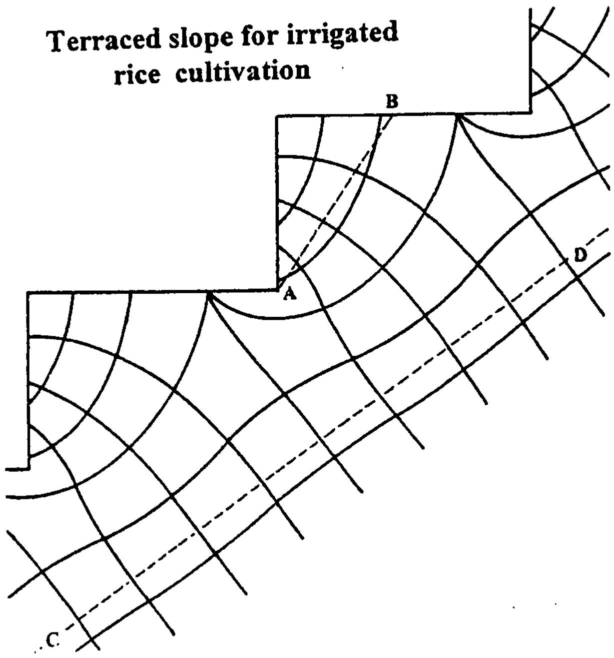


Figure 10. Terraced rice field cross section.

Back analysis can be used to obtain estimates of the value of c′ necessary to maintain stability. Two failure modes are possible; the first is wedge failure of an individual terrace on a plane such as A-B, and the second is failure as an infinite slope on a plane such as C-D. The overall inclination of the slope is taken as 35°, which is reasonably conservative as some slopes are steeper than 40°. The ϕ' value is taken as 35° and the soil density as 16 kN/m³. Analysis of a series of trial wedges with failure planes such as A-B leads to the expression:

c' (kPa) = 2.8H where H(m) is the terrace height.

Analysis of failure as an infinite slope leads to the expression:

c' (kPa) = 5.1D where D(m) is the average vertical depth to the failure plane.

The terraces are usually between about 0.5m and 2m in height, but occasional terraces may be up to about 3m. The average depth of soil (before rock is reached) is unlikely to be less than about 3m. Using the figure of 3m in each case, the above relationships give respectively:

c' = 8.4 kPa and c' = 15.3 kPa.

It should be noted that terraced rice fields are made up of both undisturbed and remoulded soil. In fact, observation of the way they are worked by farmers suggests that they are probably mostly remoulded soil.

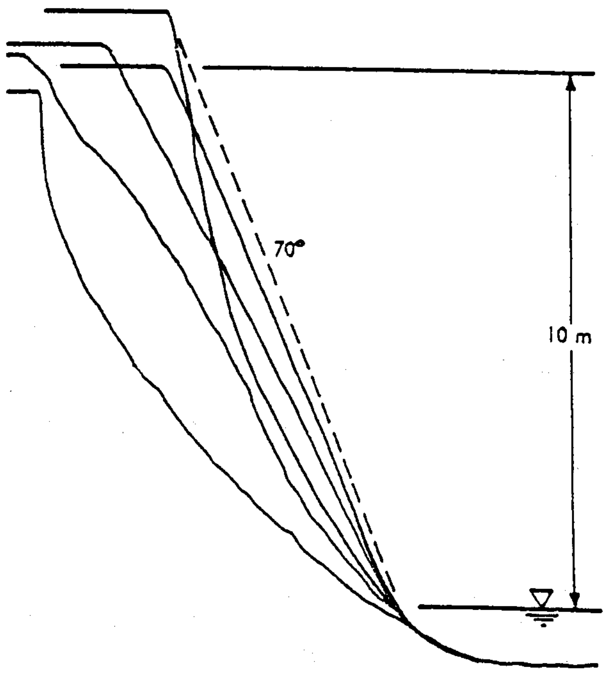


Figure 11. River bank slopes in red clay.

Consider also the natural slope shown in Fig 11 which has been described previously (Wesley 1977). Triaxial tests on this soil gave:

c' = 14 kPa and ϕ' = 37°

Back analysis of the slope showed it would fail with an r_u value of only 0.1. It is hard to believe that with the intense rainfall the slope receives the r_u value can remain as low as this, so the c' value to maintain stability needs to be at least as high as the measured value. There is therefore no reason to doubt the reality of the cohesion intercept value measured in laboratory tests. The slopes on which these soils exist would not remain stable without the c' component of strength.

2.4 Compaction Behaviour

In the writer's country (at least until quite recently) there has long been a view that allophane soils have bad engineering properties and should be avoided if possible. The origins of this view are uncertain, but appear to be associated with difficulties encountered in compacting the soils, and possibly also with some recent failures involving small hydro schemes in areas of volcanic soil. Red clays seldom present problems in compaction and the comments here apply only to the volcanic ash soils.

Problems encountered in carrying out earthworks have been described by Parton & Olsen (1980) and by Moore & Styles (1988). It is probable that there have been other instances not reported. The problems arise from two factors:

(a) The soils may progressively soften as compaction is carried out, an effect often referred to as "over-compaction".

(b) Contractors or those compacting the materials find they are unable to achieve specified densities, which have been established from conventional compaction tests.

Both problems arise because of inadequate understanding of the way the soils behave and consequently inappropriate evaluation of their compaction characteristics. The softening effect is almost certainly due to the fact that higher levels of compaction and hence of remoulding occur in the field than is the case in laboratory testing, assuming laboratory testing is used to identify an appropriate water content at which to compact the soil. Many, though not all, volcanic ash soils are sensitive to some extent and consequently soften as compaction proceeds. Fig 12 (from Kuno et el, 1988) illustrates

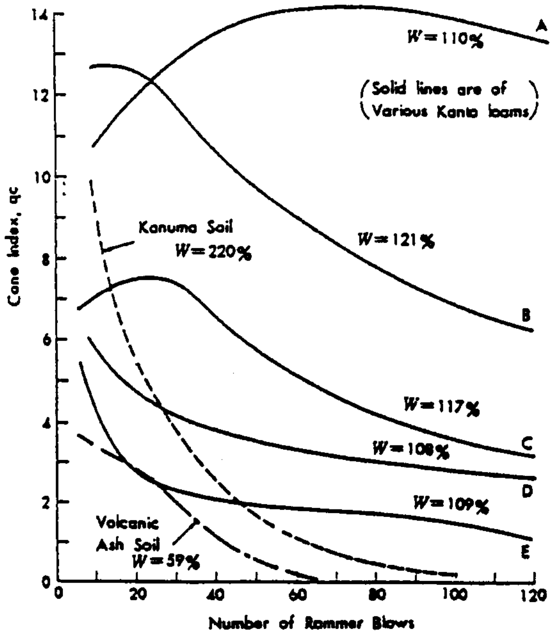


Figure 12. Influence of repeated compaction on strength of a volcanic ash soil.(after Kuno et el, 1988)

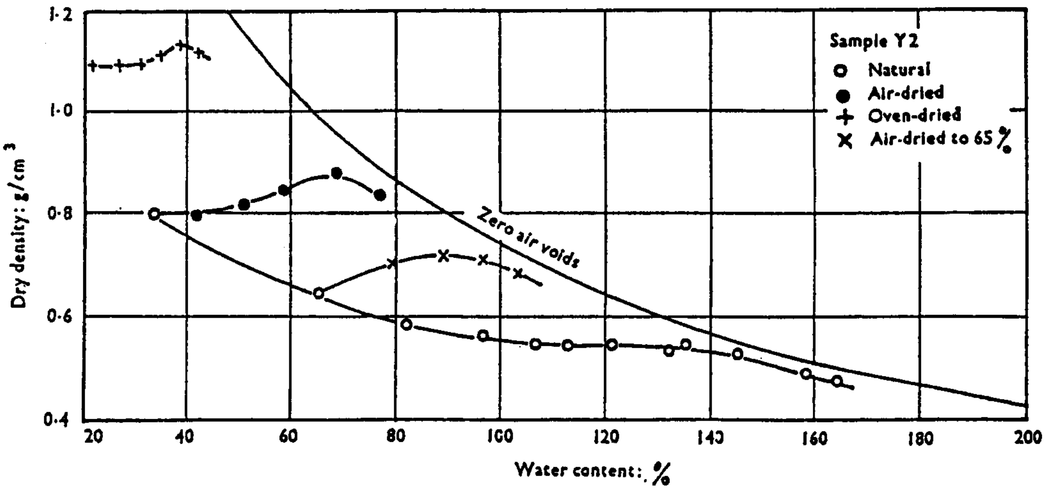


Figure 13. Typical compaction behaviour of volcanic ash sample from Indonesia.

this effect for samples from a number of sites in Japan. The solution to this problem is not necessarily to dry the soil; it may be possible to produce a perfectly satisfactory fill provided careful trials are carried out to establish an appropriate level of compactive effort.

The second problem arises when laboratory compaction tests are carried out on samples that have been excessively dried before testing. Fig 13 shows the compaction behaviour of a volcanic ash soil. It is clear from this that the values of the "optimum" water content and peak dry density are arbitrary and any value can be obtained depending on how much drying occurs before testing. If specified dry density and optimum water content values are obtained after the soil has been substantially dried, then it will not be possible during compaction to achieve the same dry density if the soil is dried back only as far as the specified water content. In other words the laboratory test can produce a particular compaction curve but the contractor may be operating on a different curve.

3.0 PUMICEOUS SOILS

3.1 *Background*

In addition to the volcanic ash soils described above, some parts of New Zealand contain significant deposits of pumiceous soils. These are characterised by particles containing an intense network of small holes or vesicules. Compared to most soils their particles are soft and the crushing of them under load has a significant influence on their behaviour. Some of these soils are medium to fine grained sands, others are low plasticity silts, and some are coarse gravels

3.2 *Pumiceous Sand*

These materials present the engineer with various problems. One problem of immediate practical interest is how to interpret the results of cone penetrometer (CPT) tests. Sand composed of soft grains is likely to behave rather differently under such tests to conventional hard grained sand. A second elementary problem is how to define and

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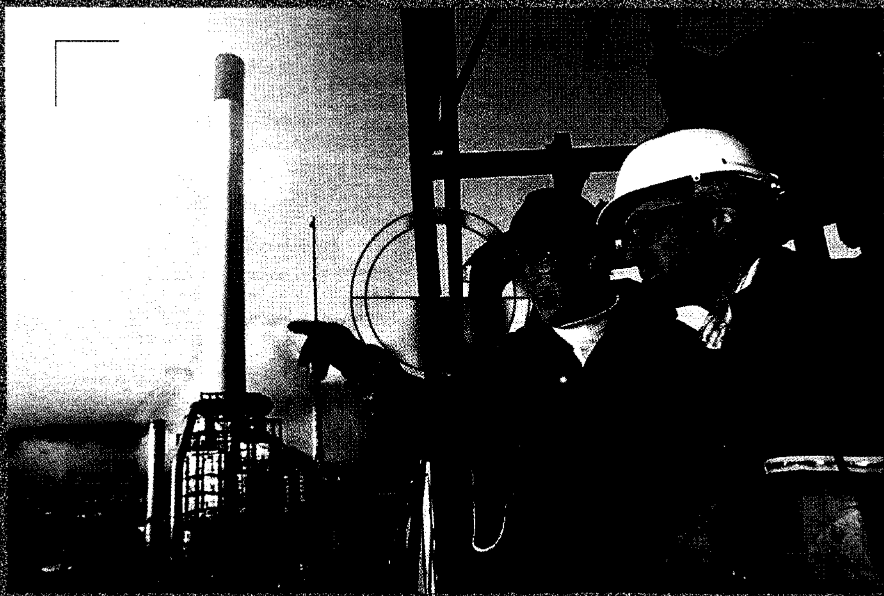

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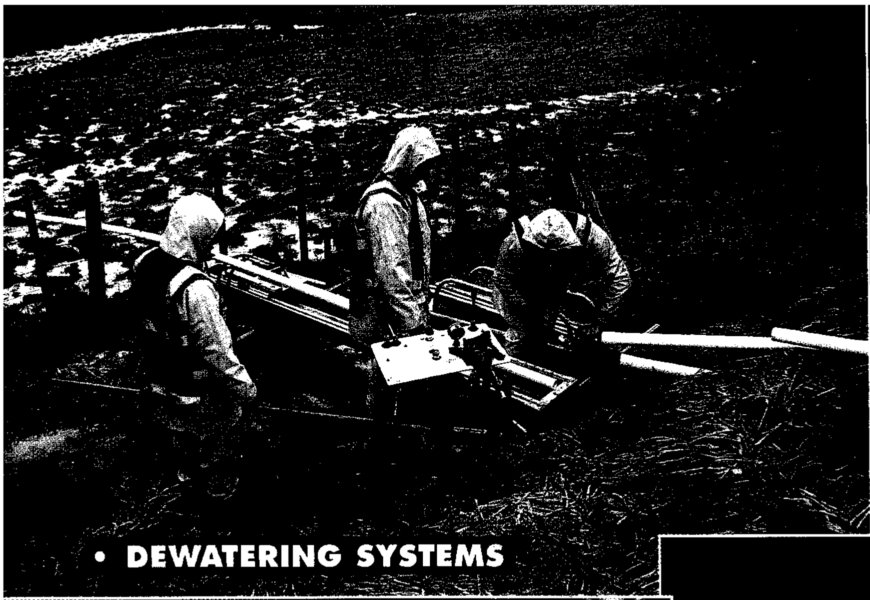

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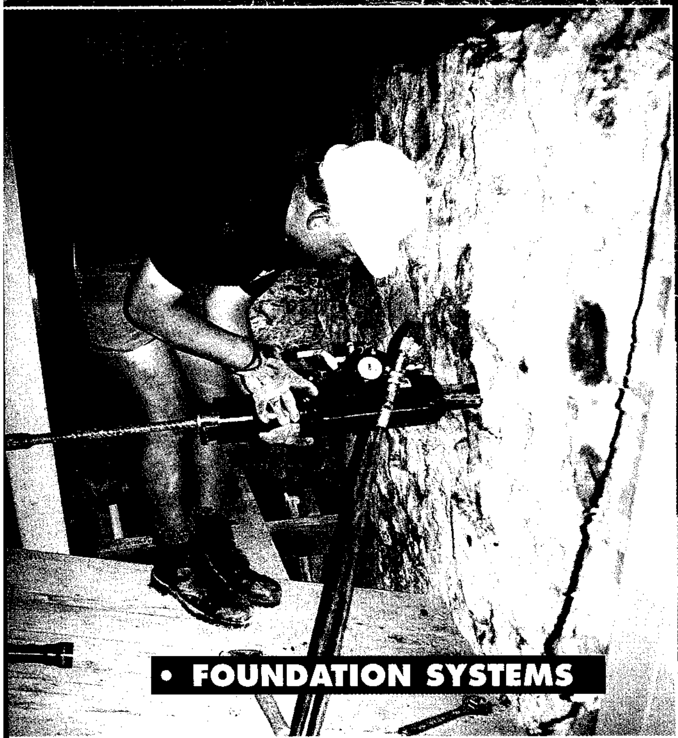

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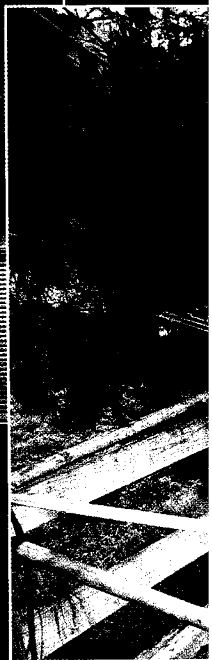

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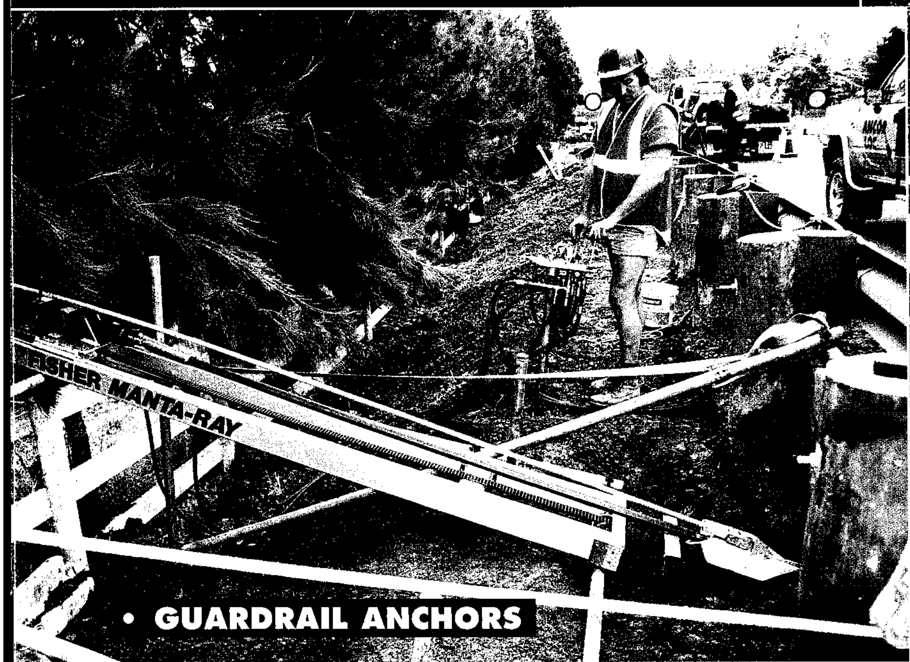

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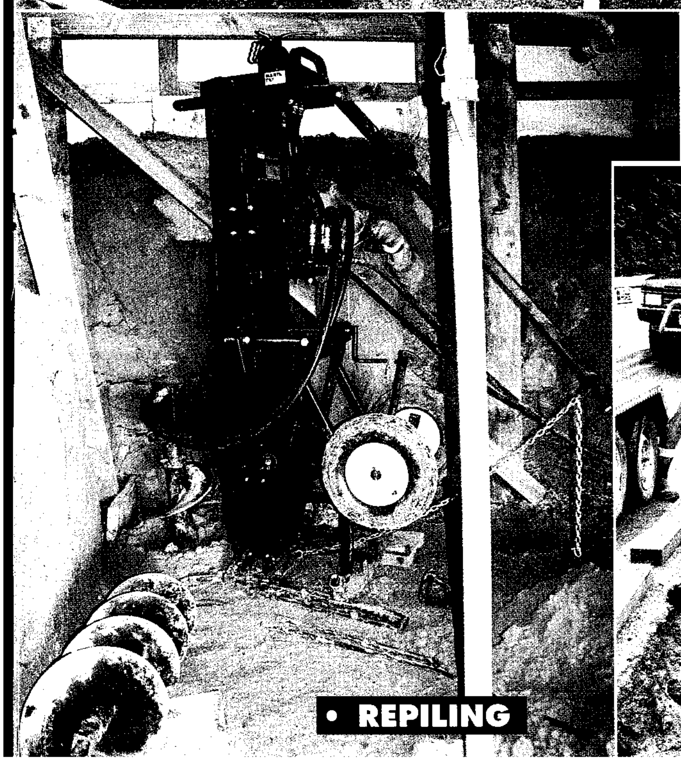

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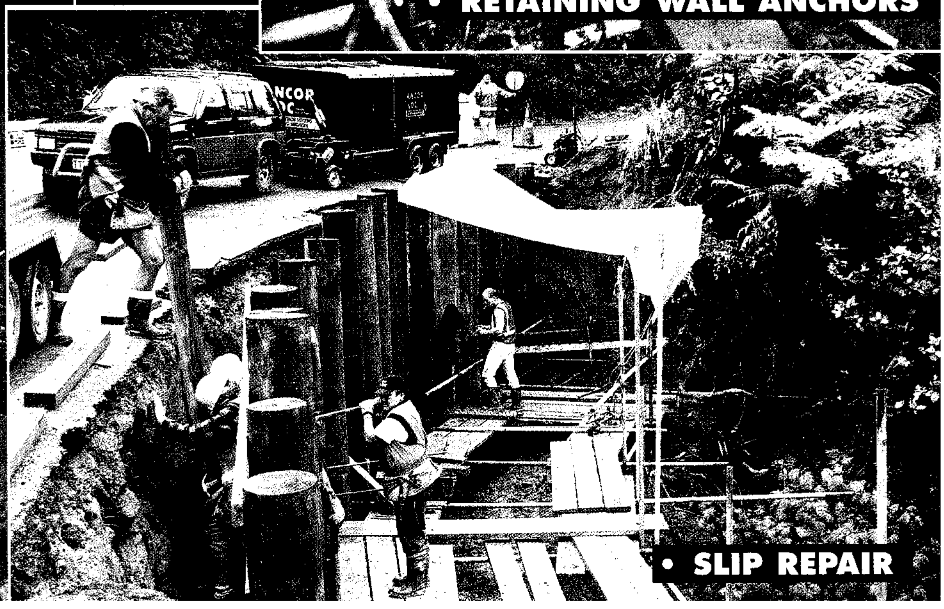

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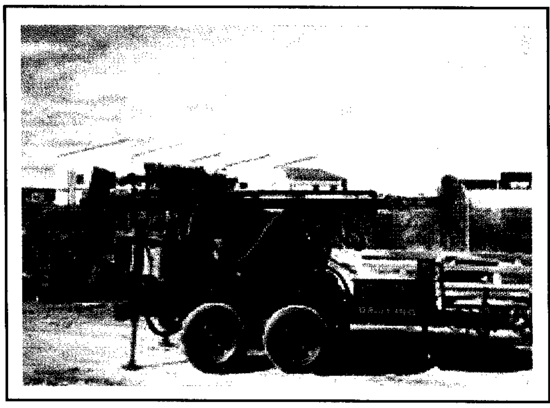

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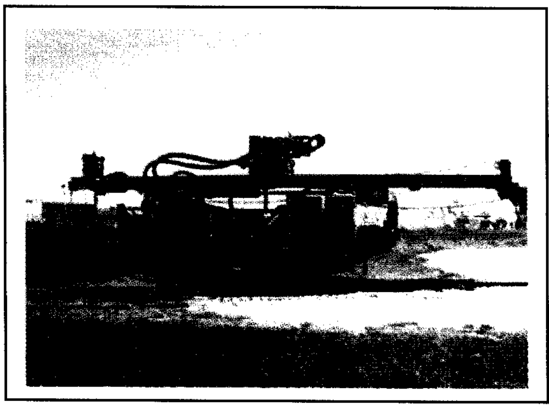

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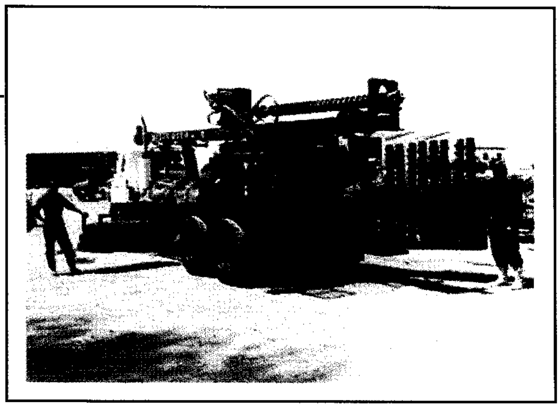

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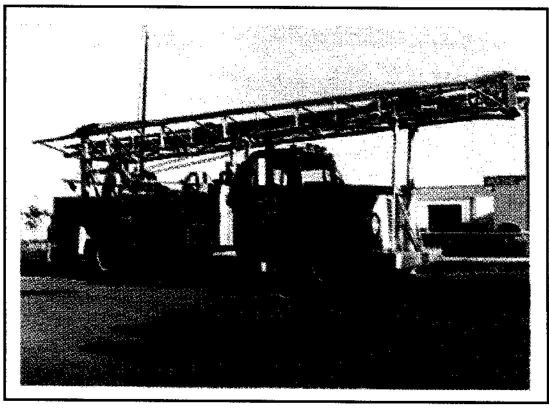

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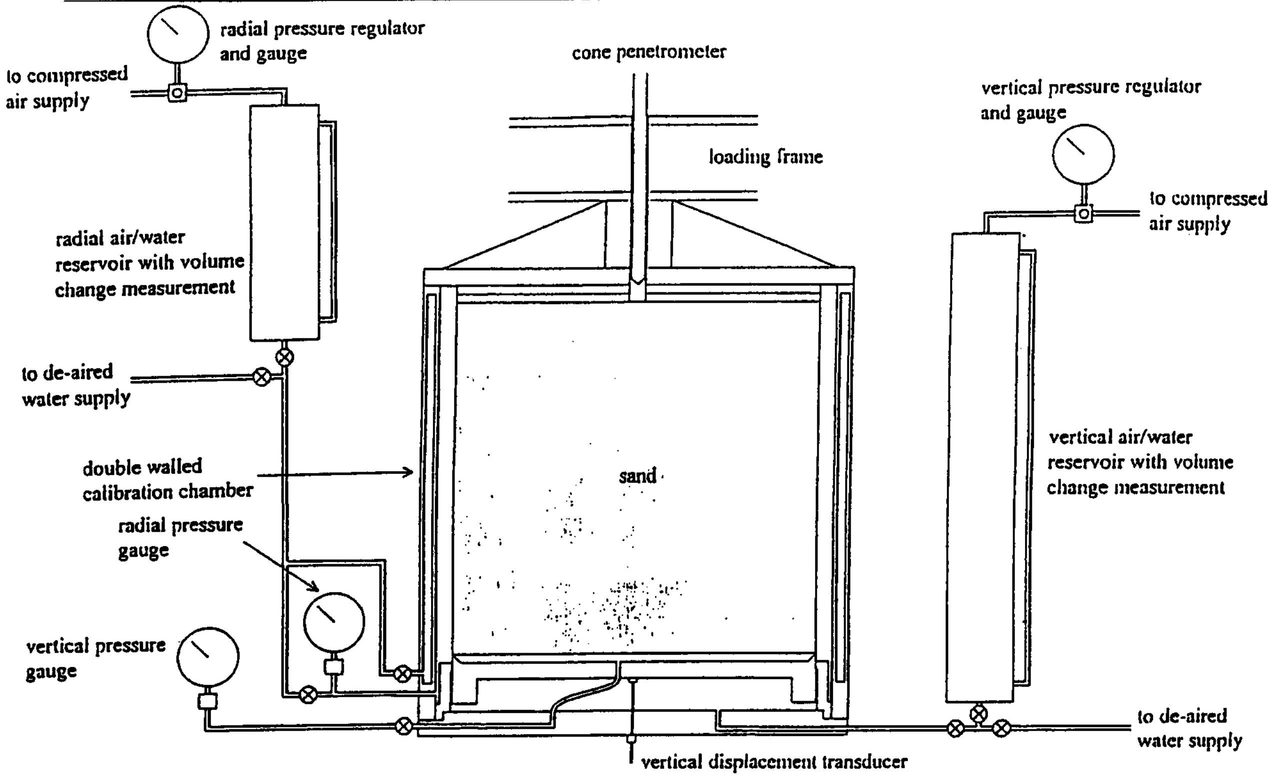

Figure 14. Schematic view of the calibration chamber

measure the void ratio of such soils when their voids content consists of "free" voids between the particles as well as "trapped" voids within the particles. These problems are described briefly in the following sections.

3.2.1 Penetrometer tests

To investigate the influence of soft grains on penetration resistance, a series of tests was carried out using a calibration chamber. The chamber used was the original Australian Country Roads chamber described by Holden (1997). A schematic view of the chamber is shown in Fig 14. The chamber allows the sample to be subjected to a controlled vertical stress as well as controlled lateral test conditions.

Table 1. Basic properties of the two sands

		Pumice	Quartz
Dry Density	Max	730	1520
kg/m^3	Min	620	1320
Void Ratio	Min	1.42	0.71
	Max	1.85	0.97

Two parallel sets of tests were carried out, one on the pumiceous sand and the other on a hard grained quartz sand, to ensure that valid comparisons of behaviour could be made. The sands were selected to have particle size curves as similar as possible; these are shown in Fig 15. Maximum and minimum density tests gave the results shown in Table 1.

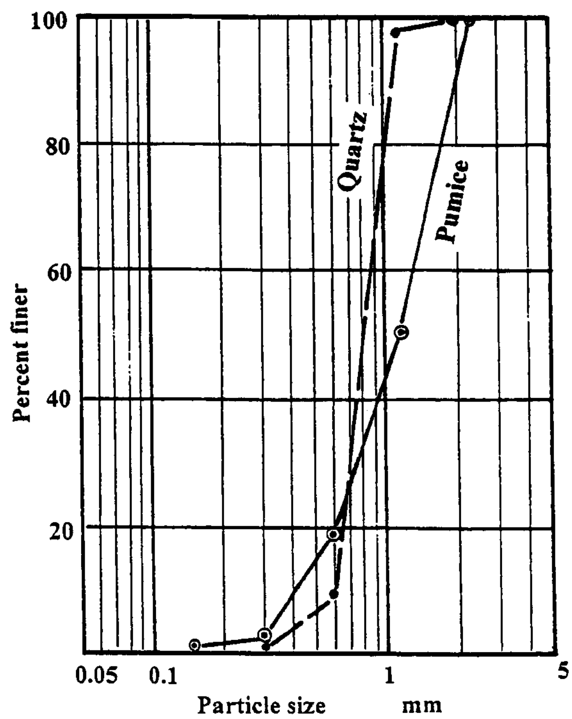

Figure 15 Particle size curves of the sands

The test programme consisted of six tests on each sand, three at the minimum density and three at the maximum density, with vertical confining stresses of 50, 100, and 200 kPa at each density. All tests were done on dry samples. The results are illustrated in Figs. 16 to 19. Fig. 16 shows the results of tests on the pumiceous sand in the loose and dense state, and Fig. 17 shows similar results from the quartz sand.

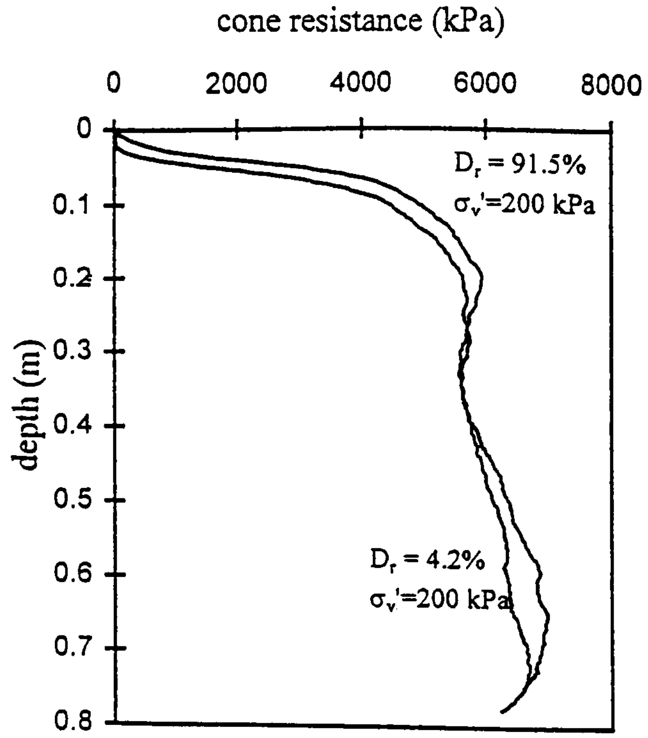

Figure 16. Tests on the pumiceous sand in the loose and dense states.

Fig. 18 shows the difference in behaviour of the two sands at the same value of vertical stress, and Fig. 19 summarises all of the results on a graph of the usual type relating cone resistance to relative density and effective vertical stress.

The dramatic difference in behaviour of the two sands is immediately apparent. The quartz sand behaves as expected, showing large differences in cone resistance between the loose and dense states, and steadily increasing values with increase in confining stress. The pumice sand however shows two very surprising characteristics:

1. Its penetration resistance is a little higher than that of the quartz sand when both are in the loose state.
2. There is very little change in resistance between its loose and dense states, and the increase in resistance with vertical stress is more gradual than with the quartz sand.

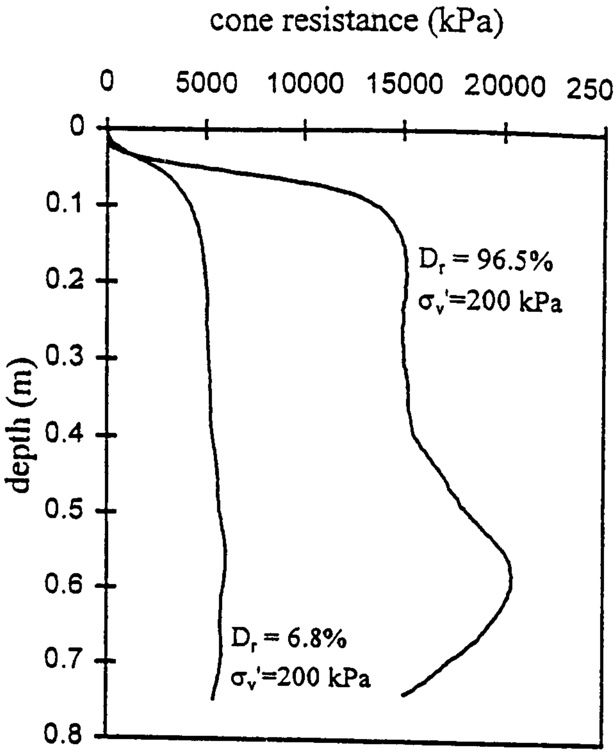

Figure 17. Tests on the quartz sand in the loose and dense states.

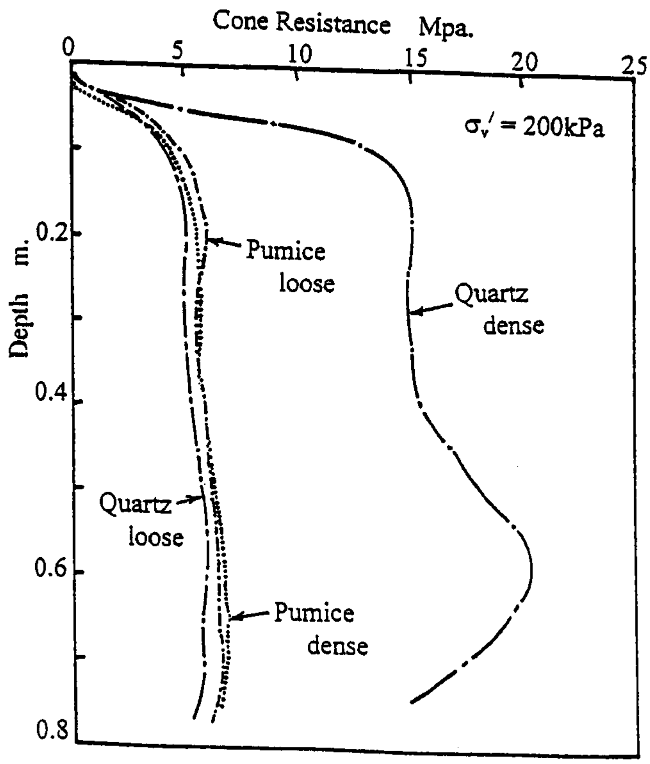

Figure 18. Comparison of results for the two sands in the loose and dense states.

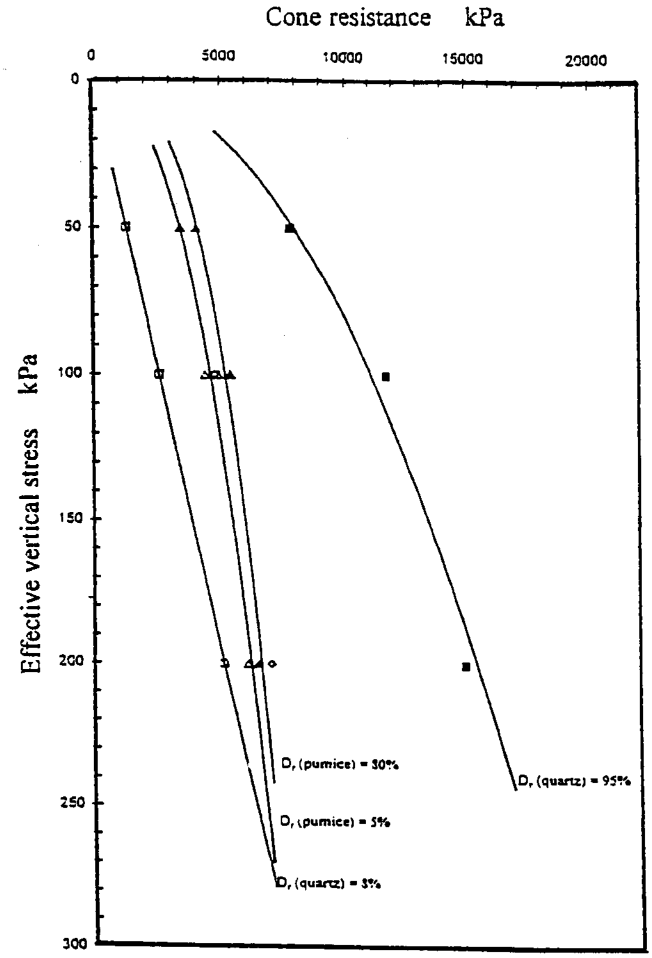

Figure 19. Summary of results

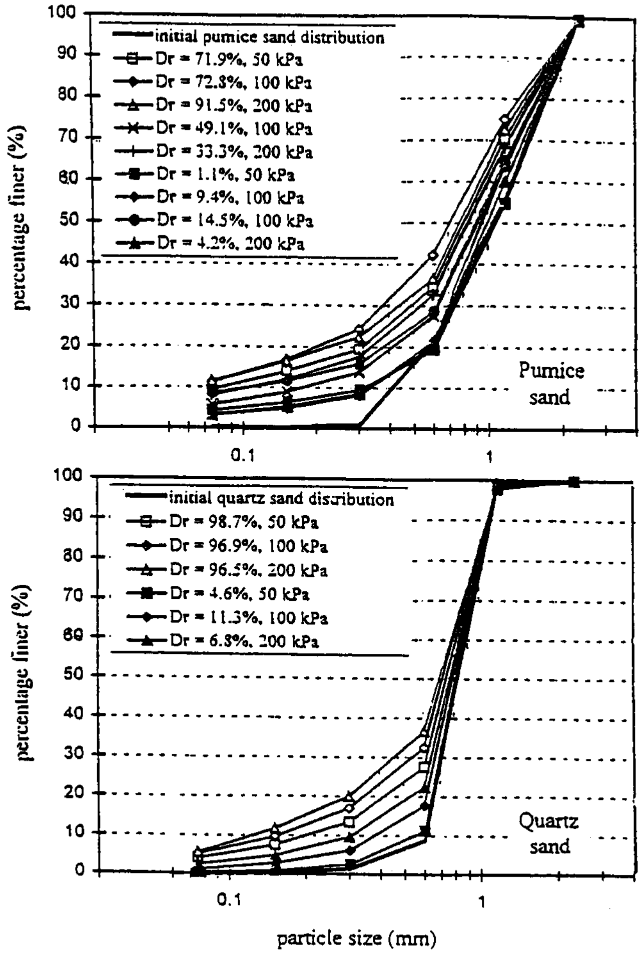

Figure 20. Particle size curves showing extent of particle crushing.

The difference in behaviour is clearly related to the different crushing strengths of the two sands. The initial interpretation put on the results was that the quartz sand mode of failure was predominantly by shear displacement, while that of the pumice sand was predominantly by crushing. To investigate the extent of particle crushing, samples were taken from the immediate vicinity of the cone when emptying the chamber, and particle size measurements made. The results are given in Fig. 20. These show a surprising amount of crushing with the quartz sand as well as the pumice sand, especially in the dense states, and the proper interpretation to put on the results is unclear. Perhaps the best interpretation with respect to the mode of failure is that failure with the pumice sand is primarily by "punching", while for the quartz sand it is primarily by displacement, and that both modes involve considerable particle crushing.

The tests clearly demonstrate the difficulty of attempting to assess the relative density of the pumice sand from the results of cone penetrometer tests. There is too little difference in resistance between the loosest and densest states for evaluation of these states to be possible.

3.2.2 *Specific Gravity and Void Ratio Determination*

To calculate the void ratio of this material it is necessary to know its specific gravity. If the specific gravity is measured in the standard way using vacuum extraction to remove air, it will almost certainly mean that air is removed from the holes inside the particles as well as from between the particles, and the calculated specific gravity will apply to the material of which the particles are composed rather than to the particles as a whole. The void ratio calculated on this basis would then be likely to represent the total void volume, made up of both the free voids between the particles and the voids trapped within the particles themselves.

To investigate this issue and to try to arrive at an appropriate value of specific gravity for use in void ratio calculations a series of specific gravity tests was carried out on a range of pumice samples consisting of fractions of different sizes. The material was crushed and sieved to obtain these fractions. The tests were done in two ways. Firstly, a simple displacement technique was used without air extraction, and secondly the standard procedure was used. The belief was that the first tests would minimise penetration of water into the internal voids and would thus give the particle specific gravity, while the second tests would maximise penetration into the internal voids and would give specific gravity values approaching that of the material of which the pumice was composed, assumed to be quartz. The results are shown in Fig 21.

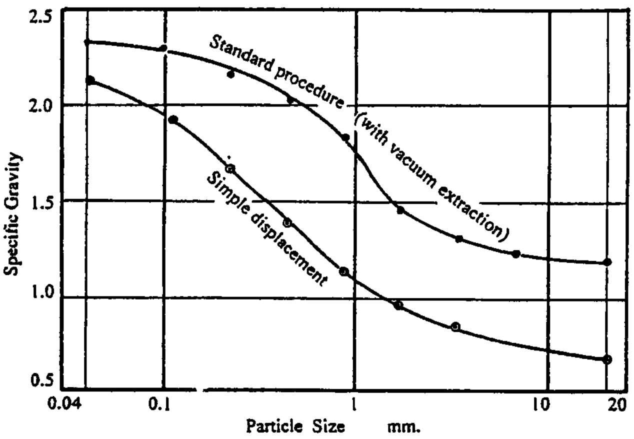

Figure 21 Specific gravity measurements on pumiceous sand

It is seen that there is a substantial difference between the two values for all particle sizes, as would be expected, and that both values steadily increase as the particle size decreases. It appears that as the particle size is reduced the proportion of the internal voids into which water penetrates during the tests increases and the measured specific gravity increases. It seems surprising that even with the very fine fraction the specific gravity value does not approach that of quartz, so that even the very fine particles contain internal voids into which water cannot penetrate. The tests confirm that the internal voids in the particles are not all interconnected.

The tests throw some light on the nature of the material but they do not entirely resolve the question of the appropriate specific gravity value to use in calculating the void ratio. The changing specific gravity value with particle size suggests that even when using a simple displacement procedure and no vacuum extraction of air, some water penetrates the internal voids, and that the proportion increases as the particle size decreases, as already noted. Using the specific gravity from the simple displacement technique appears likely therefore to still lead to an overestimate of the true void ratio.

3.3 Pumiceous silt and gravel

Pumiceous silts and gravels occur in various parts of the North Island, and are often encountered in road construction, where they may form the subgrade or be used for embankment construction. One of their "problematic" characteristics is a strong tendency to soften during compaction, but to "harden" quite rapidly when compaction ceases. This hardening is thought to be a chemical effect in some quarters and a purely physical pore pressure effect in others. Laboratory tests have been carried out to investigate this hardening effect. Samples of typical pumiceous silt and gravel were obtained and particle size and standard compaction tests carried out initially. The results are shown in Figs 22 and 23.

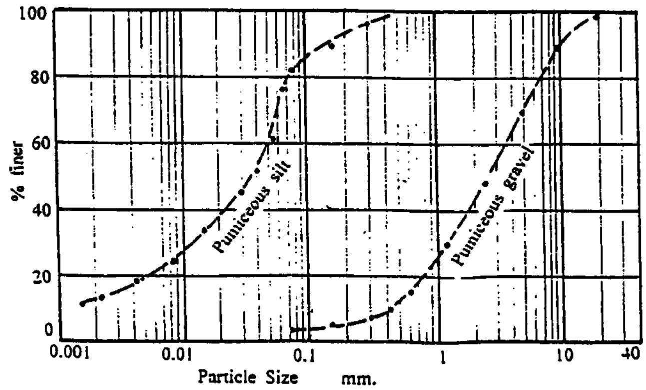

Figure 22. Particle size curves for the pumiceous gravel and silt.

A number of compacted samples of each material were then prepared by compacting them at identical water contents. The water content was about 2% wet of optimum in each case, this value being chosen so as to produce samples of relatively low strength comparable with those often produced during compaction in the field. The samples were compacted in brass tubes. Strength measurements were made immediately on two samples of each material to determine the initial, or "as-compacted" strength. The strength measurements were made using unconfined compression tests for the gravel, and undrained triaxial tests (without a confining stress) for the silt.

One set of samples was then sealed by carefully waxing the tubes, and stored for testing later at specific time intervals. In this way any changes in strength in these samples could only result from

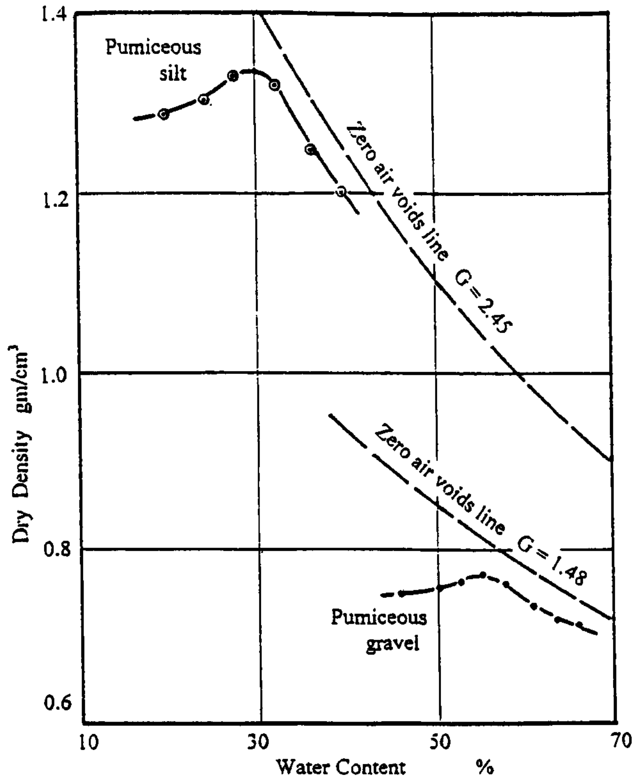

Figure 23. Compaction test results for the pumiceous gravel and silt.

chemical effects. The second set of samples was used to investigate changes in pore pressure. With the silt samples this was done by setting up the samples in a traxial cell and connecting the porous stone at the base of the sample to a suction pump via a water/air interface. This induced negative pore water pressure (pore water tension) within the samples. Tests were done at pore water tensions from 25 kPa to nearly 100 kPa, this being the maximum value feasible with this technique. Ignoring a small correction because of incomplete saturation, this produced effective stresses in the samples equal to the applied suction. This procedure was used as it was considered to most closely replicate the situation in the field. With a low water table, as is often the case in well drained pumiceous areas, the material compacted at the surface will be subjected to a negative pore water pressure governed by the depth of the water table. To continue the investigation to higher stress levels, several more tests were carried out using cell pressure in the usual way to consolidate the samples.

The compacted gravel samples were very coarse, open materials, containing considerable air, and the technique used with the silt samples was not considered appropriate for the gravel samples. Instead these samples were simply extruded and left open to the air, so that evaporation took place and

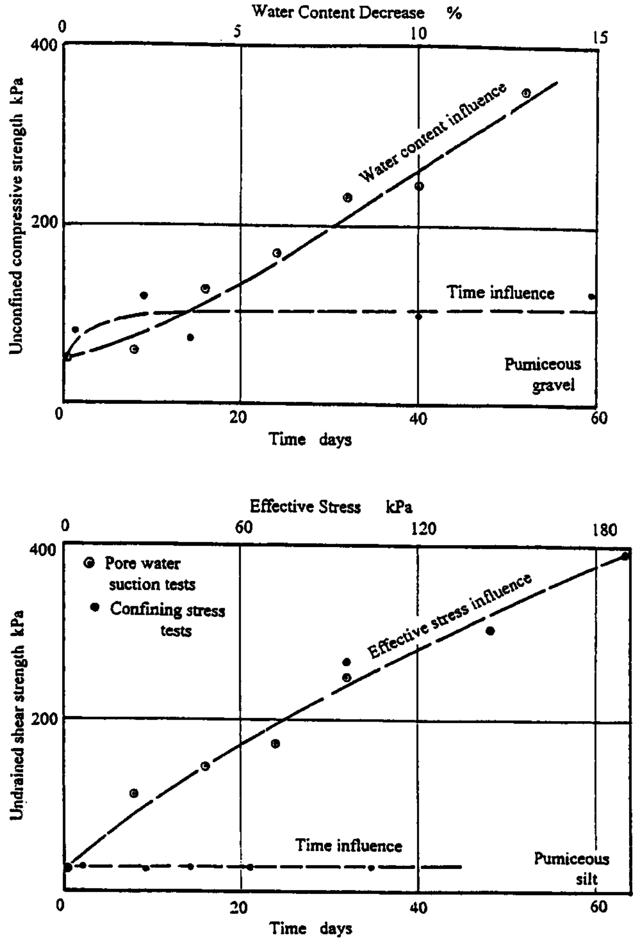

Figure 24. Strength changes in the pumiceous silt and gravel.

presumably induced increasing pore water tension within the gravel. Unconfined strength measurements were then made when weight measurements indicated moisture content reductions at 2% intervals. The two sets of sealed samples of both materials were opened at specific time intervals, and tested immediately after opening to ensure no loss of moisture. The results of the tests are shown in Fig 24. in the form of graphs of strength versus time and strength versus either pore water tension (for the silt) or water content reduction (for the gravel).

The results clearly show that strength changes only occur as a result of change in pore water tension or change in water content. The sealed samples tested at time intervals of up to 60 days show no significant or consistent change in strength with time. Hence the hardening characteristic is clearly a purely physical one resulting from changes in effective stress and not from chemical processes. In practice, it is likely that quite high pore water tension occurs in both the silt and the gravel. The silt is frequently a subgrade material lying above a deep water table, so that the pore water tension will be approximately equal to the depth of the water table. The gravel, on the other hand, is often used on forest roads as the main pavement material, and is thus open to the atmosphere. Hence evaporation can occur which would be expected to create high pore water tension within the material.

4.0 CONCLUSION

If there are lessons to be learnt from the above experiences, they are probably the following:

1. Geotechnical engineers ought to have open minds about how soils may behave, and not assume they will conform to preconceived patterns, especially when working with residual soils.
2. In evaluating the engineering properties of soils we ought to first observe carefully their behaviour in the field, before looking at their behaviour in laboratory tests.
3. While every effort should be made to develop theoretical or behavioural frameworks to assist us in understanding and interpreting soil behaviour, we ought to recognise the limitations of such frameworks, and not seek to make all soils fit into these frameworks.
4. Some well established procedures, such as the use of the e-log p plot for analysing consolidation behaviour, are not necessarily appropriate for all soils, especially residual soils.
5. With residual soils, the mode of formation is so varied that it is unrealistic to expect them to fit into a single behavioural pattern.

5.0 ACKNOWLEDGEMENTS

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Landslide tsunami generation

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The Saundaun Tsunami that struck the northern coast of Papua New Guinea near Sissano Lagoon on 17 July 1998 has generated considerable interest in tsunami. In particular, there has been extensive international debate over the relative roles of different generation mechanisms for large tsunami. Science News Online went so far as to claim that there is a paradigm shift underway comparable to the introduction of Plate Tectonics. This appears to be hyperbole, but a shift in tsunami research focus does appear to be underway with increasing interest in landslide tsunami generation.

Conventional lore states that almost all tsunami are generated directly by seismic ground motions. This belief stems from detailed analysis of historic events undertaken during the 1960s and 1970s (*viz.* Iida, 1969). In hindsight, it is now evident that the databases used were heavily biased towards large distantly generated tsunami, or teletsunami. Localised tsunami events were largely omitted for two main reasons: the databases were largely derived from records in Japan, Korea and China, and therefore did not record local tsunami in other countries (some of which have very short records, such as New Zealand); and large waves with no obvious source mechanism were rejected as unreliable. The only obvious source mechanisms that were normally considered were earthquakes and sub-aerial landslides, although some volcanigenic events were included.

The last three decades of this century have experienced very few large teletsunami events, with the last significant one being the 1964 Alaskan Tsunami. The 1990s, in particular, have involved tsunami whose effects, while devastating, have been restricted to small sections of coast (up to 200 km). Most of these events have involved tsunami magnitudes considerably greater than those expected by standard relationships between earthquake and tsunami magnitudes (*viz.* Kanamori, 1977; Abe, 1995). This discrepancy was most pronounced for the 1998 Saundaun Tsunami (Kawata, *et al.*, 1999).

Several possible mechanisms have been suggested as the cause of the larger than expected wave heights. However, there is growing consensus that this event was probably the result of a submarine landslide (Tappin, *et al.*, 1999). There are several strong lines of evidence pointing towards this source mechanism, including:

1 The tsunami is much larger than can be accounted for by any direct seismic mechanism.

2 The two earthquakes associated with the tsunami did not show any of the characteristics of a *slow* or *tsunami* earthquake. These are typically subduction thrust events, which rupture soft sediments on the continental slope, enhancing tsunami generation.

3 The tsunami was highly directional, displaying a wave decay pattern consistent with known slump generated tsunami, and inconsistent with a seismic source.

4 The tsunami arrival time distribution indicates that the tsunami was generated 8-10 minutes after the main earthquake, and 10-12 minutes before the large after-shock.

5 The flow velocity data obtained from bedforms and damage indicate a higher tsunami phase speed than normally produced by seismic sources.

6 Seismic, side-scan and ROV examination of the seabed offshore have revealed the presence of a fresh submarine slump of sufficient size to account for the tsunami.

Subsequent numerical modelling of landslide generated tsunami has managed to replicate the features observed during the event (Phil Watts, pers. comm., 1999).

These findings are of interest to New Zealand because there a quite a few similarities between the tectonic setting of northern Papua New Guinea and New Zealand. In particular the region between Hawke Bay and East Cape shows the same features as that recently observed off Sissano Lagoon, including shore normal submarine canyons, large slumps, thick sedimentary deposits, and gas/mud diapirs. In 1947 the coast north of Gisborne experienced two tsunami with the same characteristics as the Saundaun Tsunami (Eiby, 1982a;

Eiby, 1982b). These events were associated with even smaller earthquakes (5-5.5). Numerical modelling indicated that the tsunami were generated near a series of large diapirs on the continental shelf (de Lange & Healy, 1997).

However, the numerical modelling assumed the same phase speed as seismic tsunami. The recent research into the Saundaun Tsunami indicates that the waves may travel up to 1500 $km.h^{-1}$, roughly double the normal phase speed of tsunami waves. If the revised values are adopted, the source of the 1947 tsunami would be near the base of the continental slope. Recent surveys along the eastern margin of New Zealand indicate that there are many submarine slumps that could have produced the 1947 events (Lewis, *et al.*, 1997). Work is presently starting at the University of Waikato to remodel the 1947 tsunami to see if submarine slumping is a valid source mechanism.

Beyond the Gisborne region, submarine slumps appear to be a ubiquitous feature of the continental slope around New Zealand. It seems reasonable to assume that those associated with high terrestrial sediment supply adjacent to subduction zones are active features. If this is true, they represent a significant hazard for the New Zealand coast. Any event that triggers a slump may cause a tsunami. As occurred here in 1947, and at Sissano Lagoon last year, the tsunami are likely to be large and the warning minimal. Therefore, we need to better understand the processes involved.

Landslides entering water have always been known to generate large waves and numerous examples have been documented worldwide (Heinrich, 1992). Landslide generated tsunami can be extremely large at source. For example, the 1958 Alaskan earthquake triggered a medium rockslide (0.03 km^3) in Lituya Bay, Alaska. The rockslide pushed the water up to a height of 525 m above sea level on the opposite shore of the fjord. This immediate wave then collapsed to generate a tsunami ~30 m high at the entrance of the fjord (Miller, 1960; Harbitz, *et al.*, 1993). Large landslides (1000-5000 km^3) from the flanks of the volcanoes of the Hawaiian Ridge have generated tsunami waves 300-400 m high along the coasts of the adjacent islands (Moore, *et al.*, 1989; Moore, *et al.*, 1994). Numerical modelling indicates that the resulting tsunami would have had a zero-to-peak amplitude of ~4 m on reaching New Zealand (Jones & Mader, 1996). Quite small landslides may generate locally catastrophic waves, such as occurred at Skagway Harbour, Alaska, in November 1994 (Kulikov, *et al.*, 1996; Rabinovich, *et al.*, 1999).

Predicting the magnitude of a tsunami produced by a landslide is complicated by the lack of understanding of the processes involved. Most simulations of wave generation by landslides have considered predominantly 2 dimensional conditions that do not realistically reproduce the wave forms produced (Jiang & LeBlond, 1994). The simplest approach is to assume that the tsunami generated is approximated by a solitary wave. The solitary wave energy equates to the potential energy of the landslide multiplied by an efficiency factor, giving the height within the source region. An analysis of landslide generated tsunami in the Mediterranean Sea suggests that the efficiency is of the order 1-2% (Striem & Miloh, 1976). This method has been used to provide useful predictions of tsunami height for small landslides along the West Coast of North America (Murty, 1979; Kulikov, *et al.*, 1996).

This method ignores the velocity of the landslide, which intuitively should influence the characteristics of the generated tsunami wave. Slingerland and Voight (1982) determined that the main factors affecting the generated wave characteristics are: the landslide dimensions and flow velocity; the water depth at the end of the landslide; and the relative density of the landslide material and the receiving water. This has been supported by more recent investigations (Heinrich, 1992; Harbitz, *et al.*, 1993; Pelinovsky & Poplavsky, 1997).

Watts (1998) examined the behaviour of sliding solid blocks to determine non-dimensional wavemaker curves to permit the prediction of the tsunami amplitude generated by landslides. He found that the initial acceleration and terminal velocity of the landslide are important factors controlling the tsunami wave height. Further, larger waves will be produced as the landslide size increases, and the initial depth at the head of the landslide decreases.

The sliding block relationships of Watts (1998) can be modified to apply to more realistic landslide shapes than triangular blocks. These were applied to the Saundaun Tsunami, where it was found that a landslide thickness of 50 m, with a length of 5 km, and initial depth at the middle of the landslide of 200 m, yields an initial maximum amplitude of 7.2 m. This is consistent with numerical modelling hindcasts, which indicate an initial height of 7-8 m is required to produce 15 m waves seen at the shore. A longshore width of 20 km would be necessary to account for the observed wave height distribution, resulting in a landslide volume of

5 km^3. This is quite modest compared to other known submarine landslides (Moore, *et al.*, 1989; Harbitz, 1992; Dawson, *et al.*, 1993; Moore, *et al.*, 1994).

Most studies of tsunami landslide generation have been largely based on physical and numerical simulations involving sliding solid blocks on inclined planes. Other studies that analysed more realistic sediment/water mixtures indicate that the generation of waves by landslides is too complex to simulate by a solid block (Jiang & LeBlond, 1992; Jiang & LeBlond, 1993; Rzadkiewicz, *et al.*, 1997). As the landslide moves down-slope while underwater, extra water is entrained into the flow, thereby changing the rheology of the landslide as it moves. If sufficient water is entrained, a separate, faster turbidity current can also be produced that increases the complexity of the tsunami generation (Piper, *et al.*, 1999).

Numerical and physical simulations have also demonstrated that there is a coupling between the landslide and the overlying surface waves as the landslide moves underwater (Rabinovich, *et al.*, 1999). This means that landslide generation by tsunami must be simulated dynamically, and not by the static methods normally employed for numerical modelling of earthquake tsunami generation. Further, the landslide flow duration is an important parameter controlling tsunami generation as it determines the extent of coupling. Coupling between the landslide and surface waves results in a higher efficiency and more energy is transferred to the tsunami producing larger waves (Jiang & LeBlond, 1992).

Numerical and physical simulations indicate that landslides generate a limited number of waves that are not periodic, so they propagate independently. Jiang and LeBlond (1992) identified three main waves produced by landslides. The first is a solitary wave (crest) that propagates offshore from the landslide. This wave is followed by a forced wave trough that propagates at the speed of the landslide front. The third wave was a trough that propagates shoreward as a leading depression wave. A leading depression wave is a common feature of historical landslide tsunami. Most models of landslide tsunami indicate that the largest waves travel offshore, which disagrees with many observed events. However, it appears that the initial depth over the landslide may affect the distribution of energy, so that shallow submarine and subaerial landslides produce a large offshore wave, while deeper submarine landslides produce a large onshore wave.

The large onshore wave is generated by the initial drawdown that occurs over the head of the landslide. This is similar to the cratering produced by submarine explosions (Le Méhauté & Wang, 1996). As the crater collapses, the water rushes in and may produce a central spout. One eyewitness account of the Saundaun Tsunami reports a vertical jet of water offshore some minutes before the water receded (Davies, 1999). The water infilling the crater forms the large wave. With submarine explosions, the large wave disperses radially. However, limited physical simulations suggest that for submarine landslides the wave is concentrated along the axis of the landslide. It has been suggested that the head scarp of the landslide may cause this restriction (Tappin, *et al.*, 1999), or it is due to the dynamics of the landslide coupling with the water.

Improved seabed mapping over the last decade has indicated that much of the New Zealand coast is near to recognised landslide features on the continental slope. Further, much of the steeper coast around New Zealand displays evidence of subaerial landslides. Databases of tsunami events for New Zealand (de Lange & Healy, 1986; Fraser, 1998; de Lange, in prep) include tsunami that have clearly been associated with subaerial landslides, and some that may be associated with submarine landslides. There have also been reports of unusual waves that have yet to be included in the tsunami database, because no obvious source has been identified. Submarine landslides represent possible generation mechanisms for these unexplained events. Data on the frequency of submarine landslides is very sparse. However, observations in the Atlantic (Alibés, *et al.*, 1999) suggest that the annual probability may be >1%, but not all submarine landslides need necessarily generate an observable tsunami.

Several questions need to be answered in order to assess the local tsunami hazard:

1 What is the distribution of submarine landslides around the New Zealand coast (location, size and frequency of occurrence)?

2 How are the tsunami generated by submarine landslides (so far most models are based on simple, possibly unrealistic, assumptions)?

3 What characteristics of submarine landslides will allow events to be detected, or better predicted, in sufficient time to allow response by emergency services?

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Tsunami Damage from the Sissano Lagoon in Papua New Guinea.

GEOTECHNICAL DATA AT YOUR FINGERTIPS

Colin Mazengarb and Dick Beetham
Institute of Geological & Nuclear Sciences Limited

A huge range of urban geological and geotechnical information that was once hard to obtain may soon just a mouse click away for members of the geotechnical community. The Institute of Geological & Nuclear Sciences Limited (GNS) is developing an internet-based service that will see engineers, planners, and others obtaining a raft of urban geological data without leaving their offices or homes.

Recently GNS staff met some engineering consultancies in Auckland to explore ways of making the data accessible. From these discussions it became clear that there is strong interest in obtaining on-line data.

"It also became obvious that these companies faced real difficulty finding and accessing relevant information," GNS geologist Colin Mazengarb says. "The need for on-line geological data is strong and getting stronger all the time. People want to have direct access to a living database and want to pay on a project basis," Mazengarb says.

At present urban geological and geotechnical information resides in various forms in multiple locations including council offices, universities, GNS, municipal libraries, mining companies, and with engineering consultancies. Accessing the data can use up valuable time. " The case for bringing all the information into a central database is compelling. We anticipate that savings in time and expense will be substantial," Mazengarb says. The advantage of electronic data is that it can be made available as soon as it is captured, whereas conventional printed maps and other printed material can take years before becoming available.

The range of information that could be available over the internet is impressive. Users will be able to put their cursor on a faultline, river, volcano, or any other geological feature and with a single click all the references relating to that feature will appear.
GNS has years of accumulated information that is available digitally, and is continually adding to it. Databases that are likely to be available include active and potentially active faults, a bibliography (with keywords and geographically referenced), outcrop information, landslides, drillhole information and more -- all useful to the engineering community. Being internet-based, unfamiliarity with GIS software is no longer a disadvantage

A move into the urban environment is a conscious shift for GNS and means producing more detailed maps that bridge the gap between conventional geological maps and site investigations. GNS will shift its traditional mapping philosophy to show superficial materials in separate layers from bedrock. The aim is to provide a platform for better site investigations.

Mazengarb says revenue generated from the on-line "Geoinformation Service" will be used to improve GNS databases and help steer the project in the direction of demand. "The scope and nature of the service will be driven by the Auckland geotechnical community. We'll be listening closely to what users want." He adds that pricing for the new internet-based service has yet to be finalised. Initially, the focus will be on supplying on-line data to Auckland, but eventually GNS hopes to provide a nationwide service.

CITYMAP PROJECT HERALDS NEW DIRECTION IN MAPPING

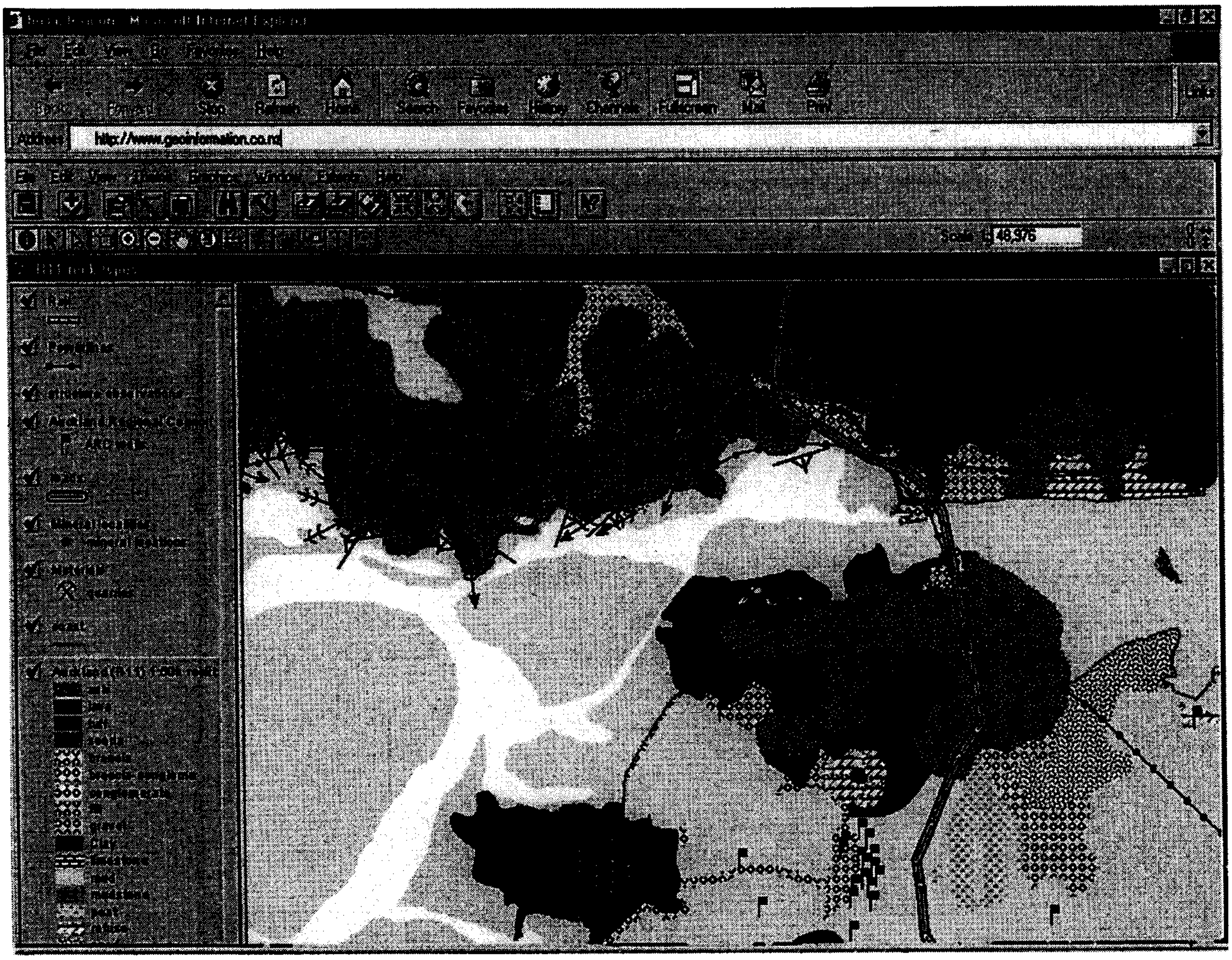
GNS is working with the Manakau City Council to produce a large colour wall poster showing a wide range of geological information in South Auckland. The three-fold aim of the CityMap project is to demonstrate diverse data types and sources, show how the data can be used for a wide range of practical applications, and use the poster as a means of generating support for more urban mapping projects. The poster will not be the only output – the information will be available via the internet.

On the 130cm by 90cm poster there will be no fewer than nine separate panels showing features such as a geology map and rock descriptions with photographs, earthquake and liquefaction hazard, and soil types. Other aspects highlighted will be faults and ground-shaking hazard, slope stability, volcanic hazard, flood and sea level rise hazard, and groundwater and aquifers. Drillhole data from the Auckland Regional Council will be used to produce subsurface maps. Information in each of the panels will also be available separately on the Internet. The poster is scheduled for completion in August 2000.

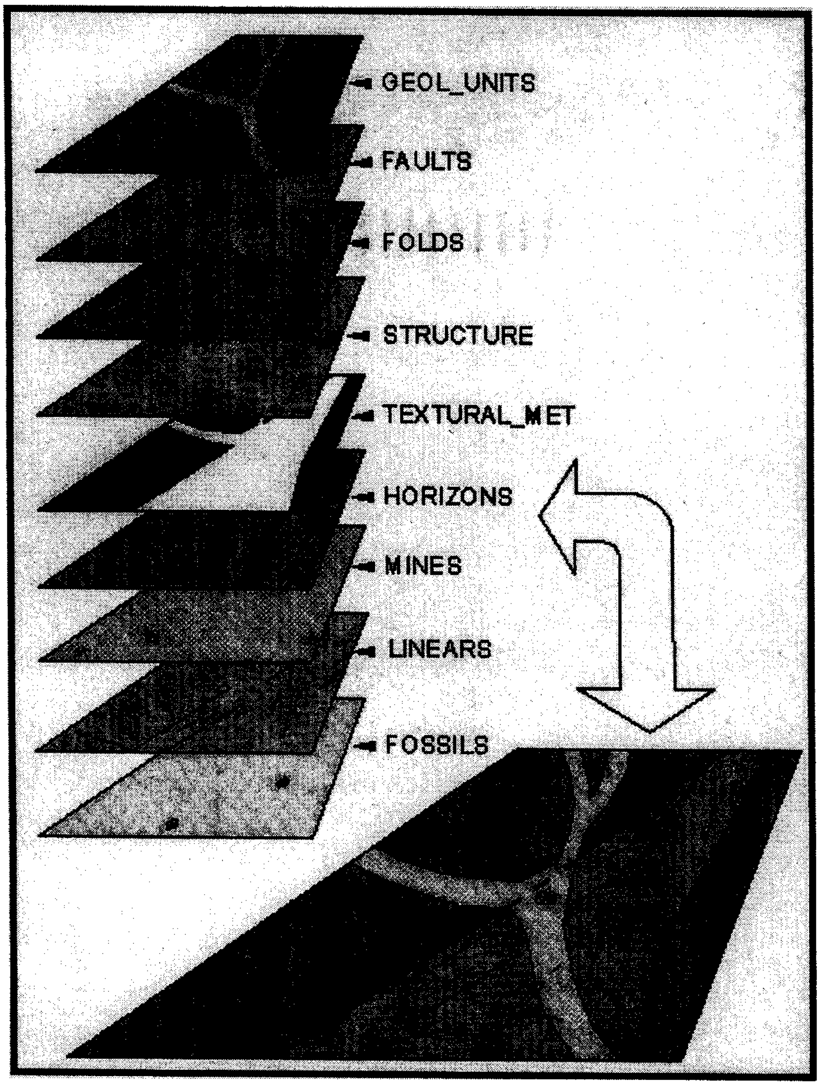
A fundamental principle behind the CityMap project is the collation of data into a single platform from which a variety of applications can be undertaken. GNS believes it is imperative that data underpins interpretation wherever possible. As new data is added, interpretation should be automatically updated.

Data design is critical. GNS is using international standards that have been tailored to New Zealand conditions. The careful design of a generic data-structure will follow international examples and optimise the efficient use of the information. As GNS makes progress in data design we invite interested organisations to work together in coming up with agreed standards.

Feedback to c.mazengarb@gns.cri.nz



A simulated view of how the GeoInformation Service data would appear on a web browser. The example shows the Manukau area with layers of geological information (drillhole localities, structural measurements, quarries and rock types) with major powerlines, roads and railway lines.



Data layers in QMAP, an example of multiple layered GIS information that would be part of the CityMap project and the GeoInformation Service.

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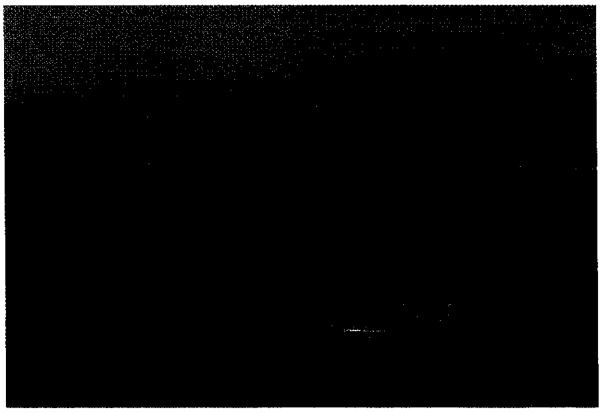

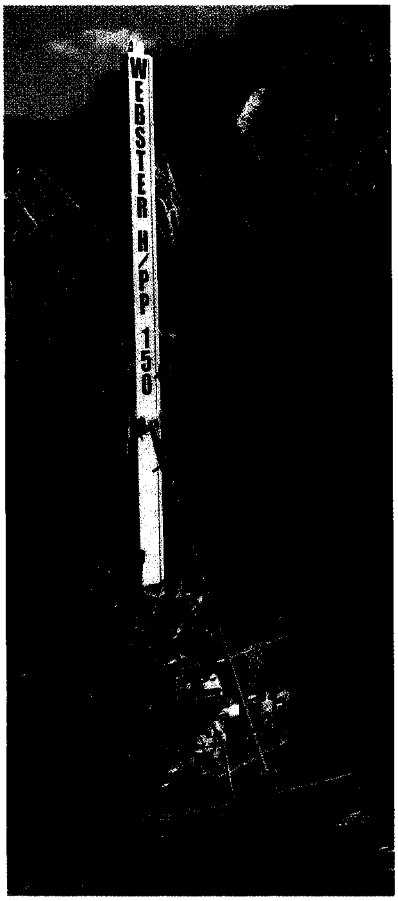

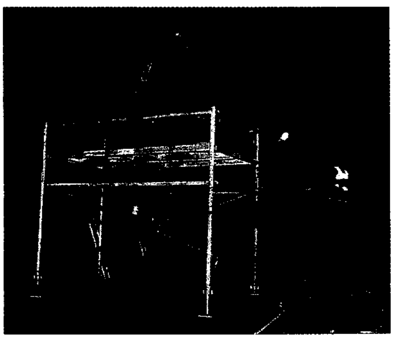

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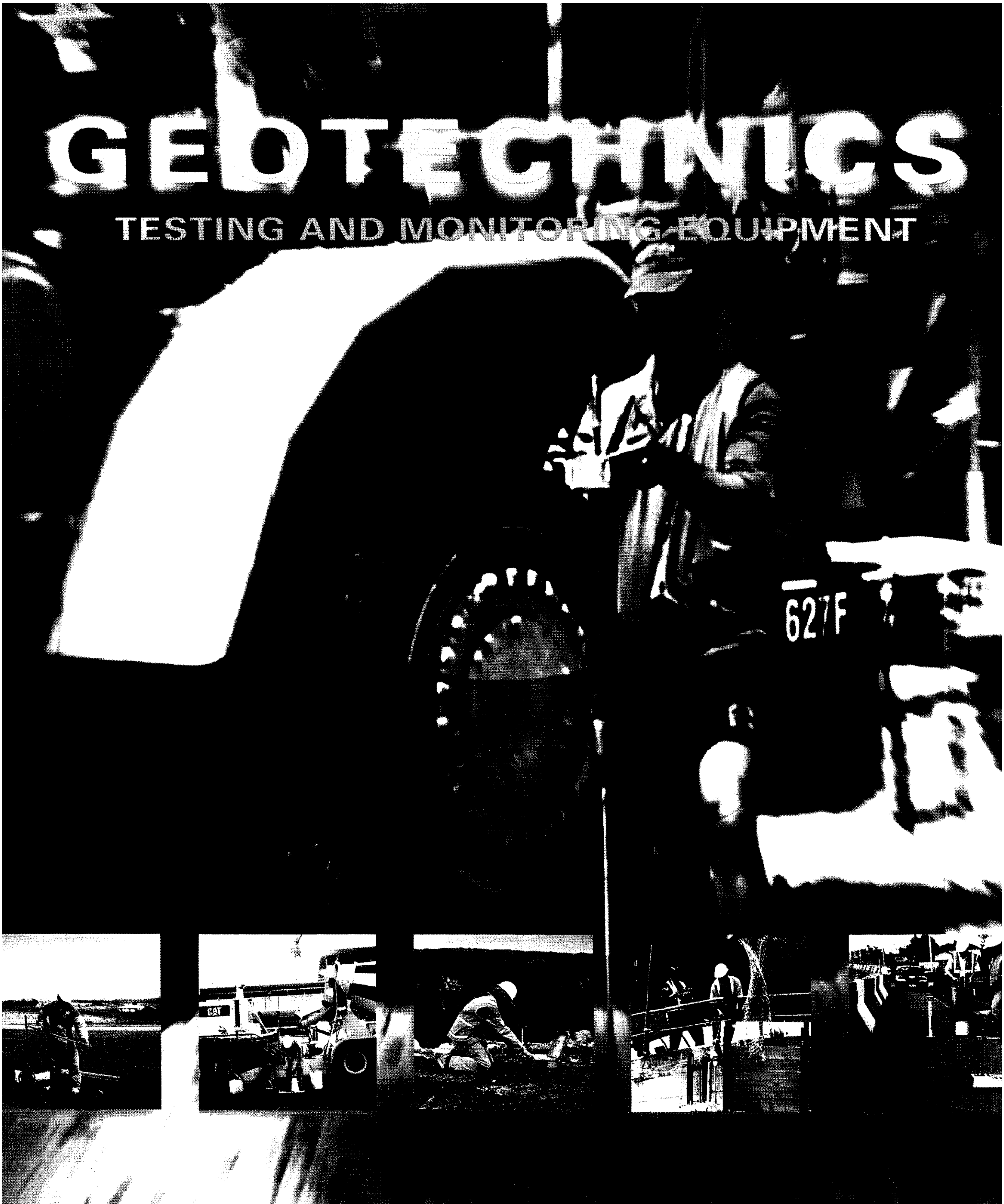
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Current Research in Geotechnical Engineering at Canterbury University

J B Berrill, R O Davis and K J McManus

Introduction

The Geomechanics Group within the Department of Civil Engineering at Canterbury University has a variety of research projects in progress, generally to do with the seismic response of soil structures. The group comprises Prof. Rob Davis, Dr Kevin McManus and Dr John Berrill together with five masters, one doctoral student and two exchange students from Grenoble, France. Current projects include the seismic resistance of both piled and shallow foundations, lateral spreading, seismic hazard in Christchurch, the basin-edge effect in the Hutt Valley, aging effects in sands, and site response at key lifelines sites in the City of Christchurch. In addition, members of the group are involved in projects in other departments of the University, most notably a paleoseismic study of the Alpine Fault and the development of a low-cost strong-motion accelerograph. The setting up of a rock mechanics laboratory in conjunction with the Department of Geological Sciences is another recent development.

We will describe some present and recent projects in more detail below, and give a list of recent publications.

Estimation of Soil Shear Modulus Softening Based on Downhole Acceleration Data – R.O. Davis and J.B. Berrill

The aim of the work is to better identify how softening proceeds in soil sites under strong shaking. Data from existing downhole accelerometer arrays is available for analysis. Presently used methods revolve around cross-correlation of downhole and surface records. If shaking is sufficiently strong to result in significant softening, correlations must be confined to small segments of the records, and questions arise as to segment size and placement. A new method involving artificial time compression of the upper record is proposed in this work.

A computerised algorithm for time compression of the surface record at a downhole site has been developed. The amount of compression is decided by optimising the cross correlation of the surface and downhole acceleration records. The algorithm sweeps through the surface record using time steps of constant size, continuously optimising the cross correlation peak by compressing (or stretching) the time scale of the surface record.

The algorithm has been tested extensively on the Kobe Port Island downhole array data set. It appears to be robust and gives consistent results for trials with different time steps and different optimising schemes. The overall results for Kobe show marked softening, most probably coincident with the onset of liquefaction in the upper soil layers.

Subsequent to the Kobe work, the algorithm is being trialed on records from the Elmore Ranch and Superstition Hills earthquakes measured by the downhole array at the Wildlife Refuge site in Imperial Valley.

Prediction of Pore Pressure Increase Based on Dissipated Energy – Field Verification from Downhole Records - R.O. Davis and J.B. Berrill

The research is based on a recently formulated method for continuous estimation of shear stress and shear strain from downhole acceleration measurements. Integration of stress **versus strain** gives the time history of dissipated energy density at any depth within the soil column. This quantity can be compared with measured pore pressure data from downhole arrays that incorporate pore pressure transducers. Data from two earthquakes have been fully analysed to produce continuous estimates of dissipated energy density at selected depths.

The first earthquake studied is known as Event 16 in the SMART1 catalogue from the Lotung downhole array in Taiwan. This was a magnitude 7.0 earthquake located approximately 78 km from the site. Soils at the Lotung site consist of interbedded silty sands to a depth of 30 m. The water table is found approximately 1 m below ground surface. A total of five pore pressure records at depths ranging from 5 m to 15 m are available. Ground motion at the site was not severe and the maximum pore pressure increase was on the order of 10 percent of existing overburden effective stress. Pore pressures were predicted based on dissipated energy density for comparison with all five measured records. Remarkably good agreement was found in three of the five cases. Plots of the five records with the corresponding predicted values based on dissipated energy are shown in Figure 1.

The second earthquake we have considered is the Chiba-Toho-Oki earthquake, recorded at the Sunamachi test site near Tokyo. This was a magnitude 6.7 earthquake with epicentral distance of approximately 60 km. The Sunamachi test site rests on interbedded sands and silts to a depth of 13 m. Four pore pressure records were obtained at depths between 7 m and 13 m. As in the case of the Lotung records, the pore pressures generated at Sunamachi did not exceed about 10 percent of existing overburden effective stress. Reasonably good agreement between measured and predicted pore pressure was found for this earthquake as well.

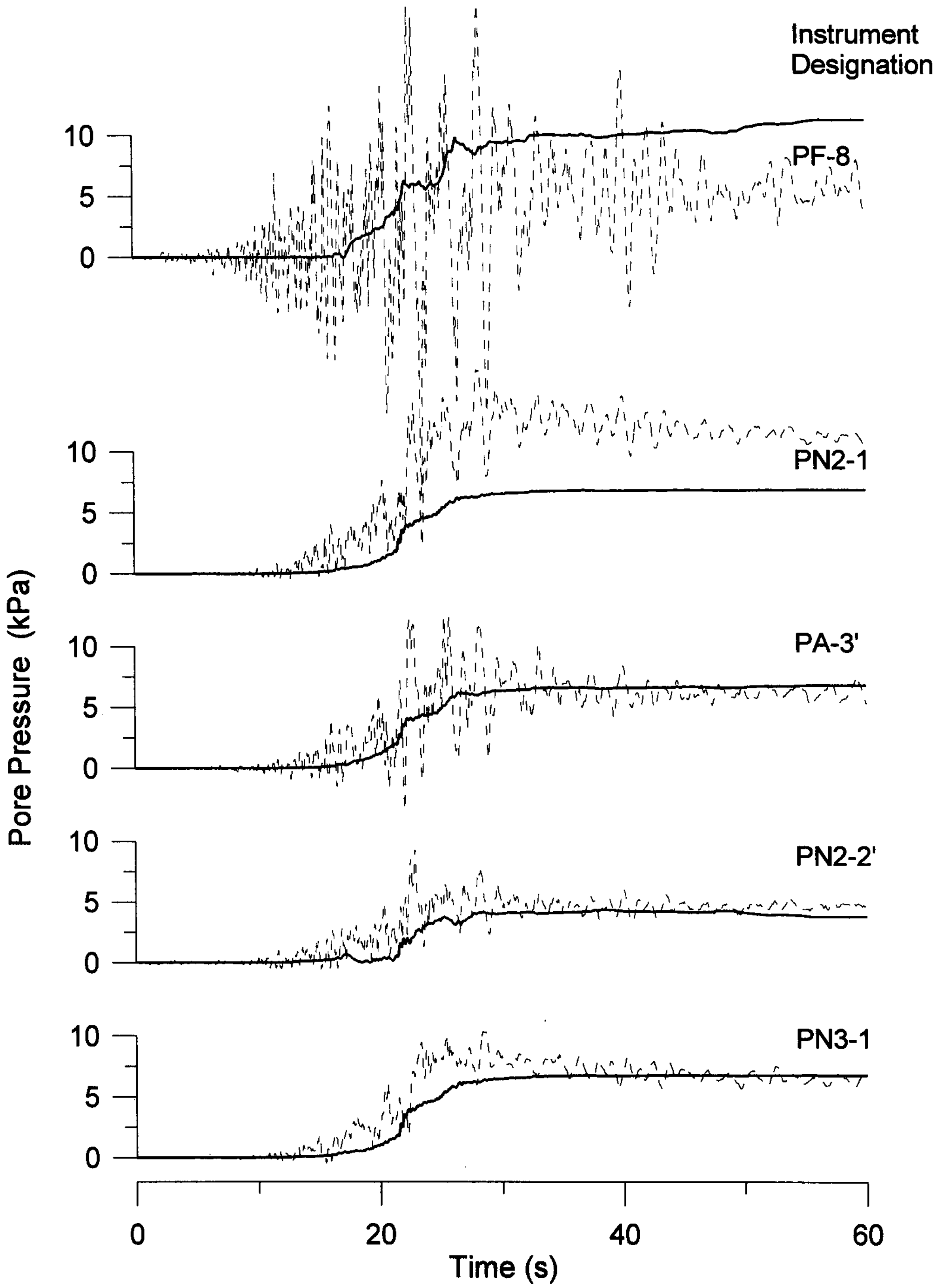

Figure 1. Lotung pore pressures: Dashed lines are measured, solid lines are predicted

Experimental Study of the Effect of Layer Thickness on Cone Resistance –
John Berrill, Jean Canou and Pierre Foray

Analytical work by Vreugdenhil et al. (1995) has shown that in layers less than about 10 to 20 cone diameters thick (360 to 720 mm for the standard CPT), cone resistance may not reach the characteristic value for the layer but be underestimated in dense layers and overestimated in loose layers. While Vreugdenhil's solution agreed well with the few experimental result that could be found in the literature, these were all for two-layer soil systems only. To test the solution for thin layers included between thick strata, a series of tests was undertaken on three-layer systems of sand using a miniature cone in a small calibration chamber at the Ecole des Ponts et Chaussees in Paris. One test was made with a full-sized cone in a larger chamber in Grenoble. A typical result is shown in Figure 2. For dense layers, the peak value of q_c predicted by the analytical model was within 10 percent of the experimental result; for a loose included layer, the difference was about 20 percent. These results give us confidence to use Vreugdenhil's solution to estimate the characteristic q_c for a thin layer from the peak raw q_c value. The next step is to compute tables of correction factors.

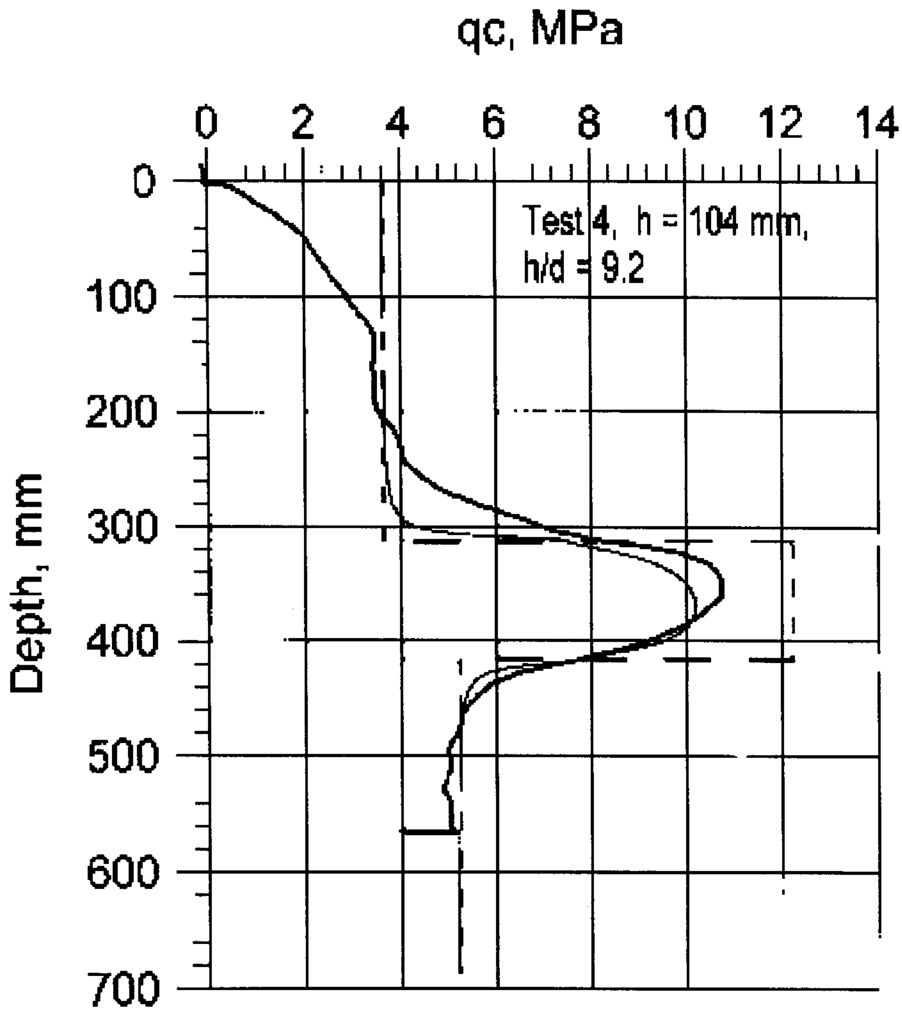

Figure 2. Calibration chamber test in layered sand using 11.3 mm diameter miniature cone penetrometer. The thick line shows measured q_c; thin line, the analytical solution and heavy dashed line, the characteristic values.

The Response of Pile to Cyclic Axial Loads – K J McManus, A D Chambers and Jianxun Yang.

In some recent earthquakes, most notably the 1985 Mexico Earthquake, pile foundations have failed by pulling out under cyclic loads induced by the earthquake. An extensive series of tests has been carried out on large model piles subjected to axial cyclic loading in both static soil masses and in soil undergoing cyclic shear deformation on a shaking table. In general, the results are well interpreted in the Cyclic Stability Diagram of Poulos.

The Effect of Lateral Spreading on Buried Foundations – J B Berrill, J R Pettinga, S A Christensen, Richard Keenan and Wataru Okada.

During the 1987 Edgecumbe Earthquake, the left bank of the Whakatane River moved about 1.5 m to the right on an underlying layer of liquefied sand at the Landing Road Bridge at Whakatane. The raked pile foundations of the spans on the left bank resisted this movement and soil mounded behind the buried piers, suggesting passive failure of the 1.5 m non-liquefied crust overlying the liquefied layer. Trenching at piers on the left bank found passive failure surfaces, confirming the presence of a passive failure mechanism. No damage was found to the piles themselves, suggesting that drag forces between pile and liquefied sand were not large. The main result from this study (Berrill *et al.*, 1997) is that *passive pressure* is the correct design load between a fixed structure and the crust of non-liquefied soil overlying the liquefied layer in a lateral-spreading field.

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Current Research in Geotechnical Engineering at Auckland University

T Simpson, D Wise, (Woodward-Clyde Ltd), Prof M Pender (University of Auckland)

Introduction

The Engineering School of the University of Auckland held a colluquim recently on their current research projects. The report presented below is a summary of the presentations.

Laurie Wesley : Calculating the strength of retaining walls in steep slopes.
Laurie Wesley described some work he had done in the back analysis of steep slopes and the loads on retaining walls that might be used to stabilise such situations. Using a wedge analysis, and assuming the slope angle is equal to the friction angle of the material, he found that the largest retention face is obtained when the failure plane is parallel to the slope surface.

Xiaoquing Gong: Computer study of Reinforced Earth Wall Deformation.
He used FLAC and SIGMA/W to model a number of reinforced earth walls, comparing results between the two programs, and also the effects of varying geogrid stiffness, geogrid spacings, soil strengths, facing stiffness and the height of the wall. He concluded that in general, FLAC predicts less deformation than SIGMA/W and that the reinforcing (geogrid) stiffness was the most critical of all the parameters.

Justin Franklin: Orakei Basin Volcano and Kepa Road Landslide.
He showed historical photo's of the Kepa Road Landslide showing the successful revegetation that has occurred. Also discussed the current movements, dating of the slide, slope failure mechanisms and current stability issues. Suggested that the landslide is 7,000 to 10,000 years old. Orakei Basin Volcano was then discussed – used AMS radiocarbon dating to show the volcano to be 20,000 to 29,000 years old. Also discounted the possibility that the eruption was part of a multi-vent occurrence.

Ian Collins: Mathematical Models of the Triaxial Test (Research planned over his upcoming sabbatical).
He discussed the triaxial test in terms of stress and strain using equations and stiffness matrices. He is aiming to make as few assumptions as possible and use mathematical laws to define drained and undrained triaxial tests. He identified 3 critical conditions he will have to model during a triaxial test:
1. Bifurcation
2. Shear band forming
3. 'peak' point.

Graham Twose: Constrained Modulus Testing on a Residual Auckland Clay.
He is using material from the BP Papakura site and looking at its consolidation behaviour. From initial testing, they have observed that: the soil plots above the 'A' line on plasticity charts; a Poisson's ratio of about 0.2; and there is a variation over sample depth of Liquid Limit and water content. Conventional oedometer testing had had the samples consolidating so quickly that Cv is too hard to read. They have done 1-D testing with a Ko cell, which gives better definition of Cv and the compression curve. Initial results show constrained modulus to be in the region of 15-25 MPa. They hope to define this more accurately with future testing. Will also be testing material from the North Shore wastewater Treatment plant.

Tam Larkin and Bavan Muttlingham: Ground Surface Displacements from Seismic Dislocation.
Setting up mathematical models of faults to come up with 3-D estimates of ground surface displacement behaviour. Varying the orientation, depth and type of fault and magnitude of movement to model differing situations. Uses for this type of modelling would include using the ground surface behaviour in the vicinity of a fault to optimise the placement of buildings and infrastructure in order to minimise damage in an earthquake.

Graeme Duske: Performance Testing of Pavement Aggregates.
Spoke about a few of the performance based specifications for the structural design and construction of flexible unbound pavements in NZ. Criteria are often written with little knowledge of the effect that test conditions may have. e.g. the behaviour of the RL Triaxial test with differing test conditions (similarly seen in Dorby et al, 1982). He showed that the permanent strain on samples differs for saturated/drained and unsaturated/drained conditions.
Effects in fully saturated material are:

Matric suction holds samples together.
A development of excess pore pressure.
A rearrangement of the particle skeleton, causing a decrease in total voids.
The effective stress is reduced by an excess pore pressure.

He thus proposes tests should be undertaken at insitu states and not sufficiently saturated with back pressure.

Another criteria changed: The sample shall be tested for 100000 cycles in the permanent deformation range, is now changed to only 50 000 cycles

Sandy Tsopani: University of Auckland Masters thesis student and Commonwealth scholor. Continuing Research into Pumiceous Sand Properties.
Has been conducting a number of laboratory measurements (compressibility, strength, penetrometer resistance) on pumiceous sands taken from Waikato River, and compared results with quartz sand of a similar size. Her objectives were to investigate creep behaviour, degree of crushing during oedometer loading, degree of crushing during normal triaxial testing, and the influence of water on the sands.

Results so far:

- pumiceous sands have almost same ϕ value as quartz sand in a dense state.
- is about 4 times more compressible. CPT tests give compressibility of coarser particles ~15% higher than natural sand.
- the penetration resistance is independent of density

Basically, the higher the dry density, the lower the compressibility. Her results showed sudden increases in compressibility at the time of partial wetting, and no change in crushing at high stress levels (8000 kPa) as previously believed.

Professor Shamil Galiev: Honorary Research Fellow Resonances, Natural Resonators and Non-Linear Resonant Waves in Seismology.
His talk was dominated by a historical review of the evolution of resonant wave theory. He stressed that the amplitude of seismic waves is very dependent on the properties of the resonating materials, the angle of the source to local topography and the wave freqency. Thus real situations

may be very different from that portrayed in 1 dimensional linear experiments. He has been able to model topographic effects in recent earthquake data.

Sulangi Chituta: studying under an OOA scholorship from Zambia.
Geotechnical Practice in Zambia.

He gave a brief review of the local geological materials one can expect to find in Zambia, and the current major geotechnical practices and projects. The traditional source of work for many people, mining in the Copperbelt Province, has died due to copper prices.

No volcanic soils are generally evident in Zambia. The country can essentially be divided according to its geographical area:

In the north, soils are clays, organic soils and wetland deposits.
In the Lusaka area, limestone dominates.
In the Copperbelt area, generally thick (up to 18 m) clay layers.

Historically, the major geotechnical projects were:

Kariba Dam (during the 1940's and 1950's)
Kafue Gorge Powerstation (late 1970's)
Tanzania-Zambia Railway line (throughout the 1970's)
And those involving the copper mines.

The major geotechnical work is currently based around:

Investigation and settlement problems in Lusaka.
The collapsing of houses in peri-urban areas of Lusaka.
Subsidence investigations in the Copperbelt Province due to mining.
The construction of major roading throughout the country (contractors must use local materials therefore providing many restrictions).
The construction of a few earth dams for agricultural use.

Satyawan Pranjoto: PhD student, currently finishing thesis.
Pile Response under Cyclic Lateral Loading.

His research has involved extending many empirical relationships and models developed for piles using a 1 sided spring series, to describe a 2-sided spring series with gapping. They allow for an irregularity in cylic loading, material degradation, and the fact that the deflection shape may change with loading.

The majority of the emperical relationships were developed for piles up to 1.2 m diameter. He studied relationships for piles up to 2.4 m in diameter and found his predictions from his modified empirical formulae were very close to measured results; i.e. the cyclic non-linear soil model with gapping was able to simulate pile behaviour.

John St George: Stress-Shrinkage Effects on Gas Desorption from Coal.

He produced a number of models (mainly FLAC) developed for Huntly mine pillars prior to excavation using some common coal parameters. The models for widely spaced takeouts agreed with the observed geology after extraction. But the extraction method has been altered to use more closely spaced and wider takeouts. FLAC models showed reasonably high strains expected at the edges of two adjacent pillars, yet there was no geological evidence of this. It was only after 3 to 4 adjacent takeouts were extracted that any severe spalling and stressing off the pillars occurred.

These examples showed that some failure in the pillars and septums does not agree with the numerical models. He proposed that shrinkage effects have some role in this, and that the numerical models use a stress driven criteria rather than being strain driven. He would like to know how he can model shrinkage and use a strain driven criteria. Any ideas???

Warwick Prebble: Wairoa North Fault and the Beachlands Fault – an Engineering Geological Perspective.

He presented results from a couple of recent Masters theses coming out of the university's Geology Department. Both theses confirmed Quaternary earthquake activity in the Auckland Region.

Iwan Tejakusuma's thesis (1998) research on the Beachlands Fault was largely aimed at obtaining a date for an offset tephra deposit. He did this using a geochemical correlation of the tephra with ash deposits at Port Waikato, but not before confirming its structural and stratigraphic relationship with the surrounding strata (this was important because of the amount of mass movement present along the shore area). His work showed a displacement rate of about 0.08 cm/1000 years, but Warwick has doubts that the tephra correlation is entirely reliable.

Darryn Wise recently (February 1999) completed a study on the Wairoa North Fault, adjacent to many dams in the Hunua Ranges. A range of geophysical techniques and surface mapping helped to accurately locate the position of the fault. A trench subsequently exposed evidence of Quaternary-age faulting, and a vertical displacement of about 4 m in the near surface gravels. There is no accurate age control for the faulted formation thus an assessment of the fault's displacement rate can not be determined.

Warwick hopes that these theses have raised the awareness of possible active faulting to geologists and engineers working in the Auckland Region.

Mick Pender: Footprints in the Sand- an Example of Implementing a Constitutive Model in FLAC

He wanted to model the drying out of the sand around a footfall on the beach when walking below the high tide level. He has tried modelling dilatancy of the sand using the FLAC program.

He represented the dilatancy using a very simple isotropic dilatant model. Strain increments were adjusted by injecting a dilatant volume change increment and the elastic stress increments generated by these strain increments were then evaluated.

When modelled in this way he found there was a substantial heave of the sand away from the foot. This heave, would take the sand above the water level, and may explain the apparent drying of the sand.

GEOTECHNICAL INVESTIGATIONS AND ISSUES ASSOCIATED WITH THE AXIS FERGUSSON EXPANSION

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Beca Carter Hollings and Ferner Ltd, Auckland

Ports of Auckland Ltd (POAL) are upgrading Axis Fergusson Terminal to increase container handling capacity for their projected increase in trade. The upgrade includes construction of a piled wharf 320m long, mooring dolphins, 1000m length of perimeter bunds and reclamation of approximately 9.4 hectares in area containing 1.5 million cubic metres of fill.

The existing seabed lies between 1 and 12m below Chart Datum, with the surface of the reclamation at around 5.4m above chart datum resulting in fill depths of up to around 18m. The site is located in the Waitemata Harbour which is a drowned river valley system and has significant depths of weak sediments. The existing terminal is constructed along the top of an old ridge. The proposed reclamation is located to the east of the ridge over a valley with thick layers of weak sediments.

The main geotechnical issues associated with this development include stability (static and seismic) of 18m high bunds and reclamation on weak sediments, settlement of the reclamation and bunds, assessment of suitability and method of filling of various reclamation fill materials to obtain a reclamation of relatively low compressibility, reuse of marine dredgings and piling options to support the wharf deck structure.

Geotechnical investigations have been undertaken at various stages of the project from prefeasbility to detailed designed to obtain information about the underlying soil conditions. The investigations comprised a series of machine boreholes and Geonor insitu vane testing undertaken from a barge in the harbour and laboratory testing.

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SEISMIC MICROZONING OF SOME EARTHQUAKE HAZARDS FROM SOIL GEOTECHNICAL PROPERTIES, GISBORNE, NEW ZEALAND

Jamie Bevin*
Foundation Engineering, Auckland

Gisborne is an urban area built upon young, soft, unconsolidated sediments. Geotechnical testing has confirmed these materials are of low strength and variable texture. Studies have shown that the sediment through which seismic waves pass can affect the velocity and amplitude of the waves, particularly for areas of young unconsolidated sediments such as those underlying Gisborne. The extent of damage in the magnitude 6.3 Ormond earthquake near Gisborne in August 1993, and subsequent felt intensity surveys (MM V-VI) confirmed the patterns of shaking and damage were not uniform.

Geotechnical properties were determined by laboratory and in-situ testing of the upper metre of soil, and by CPT testing of 15-20m. The testing revealed the variable nature of Gisborne soils and allowed determination of strength and deformation properties such as shear strength, shear modulus, and shear-wave velocity.

Analysis and modelling of Earthquake Commission (EQC) claims from the Ormond earthquake allowed the determination and construction of a claim density contour map. The map revealed two anomalous areas of high claim density compared to the rest of the city. Overall, claim densities, showed good correlation with geotechnical properties by CPT testing, but did not explain the claim density highs nor their locations.

Investigation of the underlying Neogene basement topography revealed the presence of infilled valleys underneath or very close to each of the two claim density highs. The greater damage and anomalous claim density highs may have been caused by ground motion amplification at frequencies close to natural site periods, enhanced by resonance effects within the infilled sediment.

The liquefaction hazard was assessed by mapping susceptible materials, and by the empirical methods of Shibata and Teparaska (1998) and Sugawara (1989) using modified cone resistance values and cyclic stress rations at 19 sites in Gisborne.

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RISK ASSESSEMENT AND STABILISATION OF RAROA ROAD, WELLINGTON

Bruce Symmans
Tonkin and Taylor Ltd, Wellington

The Wellington region is distinctive in character, rugged hills with steep slopes, cliffed coastline and limited areas of flat land. The region lies along the western margin of the boundary between the Pacific and Indian – Australian Plates, and is intensely folded and faulted. Wellington City lies on a class one active fault. The geology of the area is Mesozoic Greywacke and Argillite.

Wellington City Council engaged Tonkin and Taylor Ltd (T&T) to investigate the causes of observed subsidence in the carriageway of Raroa Road. Raroa Road is one of only two arterial roads linking the city centre with the western suburbs. The subsidence was observed over a 200m stretch of road and became apparent following a period of heavy rainfall. The site is less than 800m from the main Wellington fault.

Raroa Road ascends up the side of a steep valley. The cuttings on the up slope side of the road are near vertical into competent Greywacke rock. The fill slope on the lower side of the road falls at between 30 to 45° to the base of the valley some 30m below the road.

T&T investigated the site using machine boreholes with CPT and Scala probes to define the sub surface profile. Generally the finding were a loose granular fill over lying a steeply inclined interface with moderately weathered rock. The depth of fill was significantly greater than we first anticipated, extending to as much as 15m below the road surface. It became apparent that the centre line of the true valley was in fact under the edge of the road in some locations with the interface between rock and fill as steep as 70°.

Stability analyses confirm that the slopes were marginally stable and were vulnerable under high ground water conditions. Analysis also confirmed that the slope would be likely to fail in even a moderate earthquake event.

Following liaison and discussions were the client with regard to risk, security and cost, it was recommended to stabilise the worst sections of road with a low risk, high comparative cost, structural solution.

Because of the varying fill depth and profiles along the road alignment various solutions were adopted. These included flexible geogrid reinforced fill slopes for the areas where the fill depth was in excess of ten meters depth. For lesser fill depth combinations of concrete, timber and tied back cantilevered walls were adopted.

The final design was highly influenced by the need to keep at least one lane open at all times. The design adopted several resourceful concepts that proved to save the client significant construction costs.

USE OF THE ACOUSTIC SCANNER FOR DEFECT ASSESSMENT IN SCHIST

Paul Horrey*

Riddolls & Grocott Ltd, Christchurch

Acoustic scanning is a relatively new technique for obtaining *in situ* geotechnical information from ultrasonic images of drillhole walls. Originally developed in the petroleum industry, use of the scanner is now being extended to geotechnical applications.

Two cored PQ holes were drilled to 60 m in schist containing well developed defects including crushed and sheared zones and joints.

Acoustic scanning was carried out and the data processed using proprietary software. A detailed comparison was made between the drill core and scanner images. Images were produced which clearly showed the major defects present, enabling their true dip, azimuth and approximate thickness to be determined. In addition, stereograms were generated for all defects over the length of the holes. Caving was also indicated.

Acoustic scanning has subsequently been used successfully at the same site to rapidly and cost effectively determine the presence and orientation of defects in non-cored drainholes.

The acoustic scanning technique has considerable potential for use on geotechnical projects where determination of defect orientation is a prime objective.

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PREDICTION OF DEWATERING RELATED SETTLEMENT IN WAIHI TOWNSHIP, NEW ZEALAND

Anthony Fairclough*
Woodward-Clyde (NZ) Ltd

Between 1995 and 1998, Woodward-Clyde (NZ) Ltd (WCNZ) conducted a settlement and rebound study of the Martha Mine and Waihi township. The objective of this study was to support a resource consent application to extend the Martha Pit.

The Waihi Gold Company (WGC) has operated an open pit mine at the Martha Hill site in Waihi since 1989. The Marth Pit has been progressively excavated and dewatered over the last ten years and in May 1996 the Martha Pit extended to a level (mASL). Since 1989, the groundwater level beneath the Martha Pit has been held at a level approximately 5 metres below the base of the pit by pumping.

Dewatering of the Martha Pit has caused the groundwater level in most soil and rock layers adjacent to the Martha Pit to fall. Lowering of the general groundwater level has resulted in an increase in the level of effective stress within these soil and rock deposits. An increase in effective stress has caused some of the soil and rock layers under Waihi Township to consolidate.

In order to estimate the magnitude of settlement and rebound that is likely to occur in Waihi Township due to operating and decommissioning the Martha Pit, WCNZ completed and extensive program of research, investigation, laboratory testing and modelling. This paper summarises the methodology and results of this work

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CORRELATIONS BETWEEN CONE PENTRATION RESISTANCE AND STANDARD PENETRATION TESTS OF SOME NEW ZEALAND VOLCANIC AND ALLUVIAL SOILS.

P B C Bosselmann*
Senior Geotechnical Engineer

CPT-SPT correlations are useful for the conversions of available field test data into the form appropriate for various foundation analyses and design. It is attempted in this paper to prepare correlations on local materials which should lead to better results than others based on internationally collected data.

The results of cone and standard penetration tests carried out in Tauranga volcanic soils and in Whangarei alluvial soils are graphically correlated using normal arithmetic plots. The linear least square equation relating the cone tip resistance q_c, and the standard penetration N value is in the form $q_c = K * N$, where K is a constant. The ration q_c/N is then used to establish correlations with the type of soil and the results are compared to international findings.

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TIROHIA QUARRY LANDFILL GEOTECHNICAL INVESTIGATION

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Worley Consultants Ltd, Auckland

At Tirohia Quarry, seven kilometres south of Paeroa, New Zealand, andesite rock is quarried for commercial aggregate use. The quarry owner proposes to construct a modern sanitary landfill at the site, filling the pit with municipal refuse. It is proposed that quarrying will continue on the site as landfilling progresses.

The main geotechnical issues considered in the course of investigating the suitability of the quarry for construction of a landfill were,

- the geological environment (rock types, stability, earthworks, seismicity, and potential liner material),
- hydrogeology
- actual and potential effects of the landfill on the environment (effect of leachate on groundwater and surface water)
- the quarry/landfill relationship (potential blasting and vibration effects),
- landfill design (stability and liner)

Investigations comprised 9 drillholes upto 150m in depth, inspection pits, laboratory testing and engineering geological mapping.

The following are concluded based on the investigations undertaken.
The existing quarry site is underlain by a sequence of andesitic volcanic materials that are estimated regionally to be of the order of 800m in thickness.

The principal groundwater system underlies the quarry floor at depth, and flows in a north/north westerly direction. Any leachate that may seep through the liner system will move with groundwater in that direction towards installed monitoring wells.

Colluvium and ash materials present on site do not satisfy the minimum allowable permeability design requirement for a landfill liner and a supplementary synthetic HDPE liner was required.

Colluvium and ash materials tested are of suitable quality and quantity to satisfy the requirements for daily cover and final capping for the landfill.

Seismic hazard assessment indicates significant shaking of the landfill from rupture of a fault passing within 5.5km of the site.
Quarry and landfill slope stability under static and seismic (earthquake and blasting) conditions is acceptable. The integrity of the landfill liner is expected to be maintained during seismic events.

Geological Review of the Open-pit, Eastern Wall Failure, Golden Cross Mine, Waihi, New Zealand.

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Geology Department, Auckland University, New Zealand

During September 1997 a large failure in the eastern wall of the Golden Cross Open-pit resulted in a large mass of Miocene volcaniclastic rocks sterilising the 335m Rl ore bench below. The main mechanisms contributing to the eastern wall failure are as follows:

- Steep easterly dipping bedding in the Whitianga group lithologies with accompanying bedding-parallel shearing.
- Ponding of ground water in local valleys at the Omahine Andesite (large aquifer) basal contact.
- Contrasting hardness, strengths and permeability's (porous versus non-porous, silicic versus argillic) between the volcanic lithologies.
- Rapid weathering of the exposed lithologies, due to the swelling clays and a strong cleavage related to the N-S trending west Mine Fault.
- Run off water entering large tension cracks in benches to the north, east and south of the slide.
- Inadequate drainage away from the horizontal drainage holes on the uppermost benches.
- Batter angles too steep for the less competent lithologies, coupled with too narrow benches.

The pervasively mineralised nature of the volcanic rocks and impending mine closure at the end of 1997 required that this slide be further investigated in order to finalise backfill requirements for the reclaimed pit. The overall permeability of the slide mass needed to be determined to investigate the possibility of ground water moving through the slide mass and percolating through the underlying fractured rock into the underground workings situated vertically below the open-pit.

Measurement of the effectiveness of stabilisation techniques for reducing sediment generation from urban subdivisions.

Jeremy S. G. Bennett
Department of Earth Sciences, University of Waikato,
Private Bag 3105, HAMILTON

Within the Albany basin at a site located in the Albany Regional Centre development an experiment was set up to evaluate and monitor the effect of straw mulch treatment to reduce sediment loss generated from slopes exposed by earthworking within an urban environment. Eighteen approximately 16 m^2 soil plots were set up on a northwestern facing slope on a recontoured surface consisting of bare subsoil, bare topsoil, mulch on subsoil, mulch on topsoil and the present grass cover. Each type of plot except the grass plots has 4 replicates. Only 2 replicates were used for the grass plots as a general comparison. The bare subsoil is classified as a Tipic Truncated Anthropic Soil having been located from another site consisting of weathered clays and sandstone. The mulch was applied by hand until most of the bare soil surface was covered. Topsoil was applied with a thickness of approximately 150 mm. The data collected thus far occurred over a monitoring period from the 27 June 1999 to 3 August 1999 from 8 total rainfall events ranging from 3.3 mm to 27.5 mm.

Data from the experiment demonstrate that less sediment was generated from mulch covered topsoil plots with values of dry sediment loads of 0.0001 - 0.0033 kg/ m^2 than the mulch covered subsoil with values ranging from 0.0021 - 0.0178 kg/m^2. The bare soil plots exhibited typically higher values ranging from 0.0078 - 0.1168 kg/ m^2 for bare subsoil plots and 0.0010 - 0.0479 kg/ m^2 for bare topsoil plots. The grass plots, which were set up to provide a comparison with vegetation that had been established for some time, had values ranging from 0.0005 - 0.0059 kg/ m^2.

At this stage of monitoring the data clearly show that mulch application is effective as a form of erosion protection. Adding topsoil and / or mulch reduces the sediment runoff by approximately 50% for topsoil, 85% for mulch on subsoil and 95% for mulch on topsoil when compared with the bare subsoil. The grass plots showed an approximately 93% reduction in sediment generation compared with bare subsoil, but requires time to become established. A further analysis of the results is to be followed up with a look at time effects on sediment generation and the use of the WEPP model to assess predictive values.

The Apparent Relationship of Subgrade Reaction to Diameter for a Pile Foundation Subjected to Lateral Load[1]

Satyawan Pranjoto

Civil and Resource Engineering University of Auckland

Based on the Winkler spring model, a finite element program to predict the pile behavior under lateral loading has been developed. It has been verified against other methods in a parametric study. The p-y (pressure – displacement) relationship of the Winkler spring is defined as a hyperbolic curve that is governed by three parameters: the initial coefficient of lateral subgrade reaction k_{oh}, the ultimate pressure p_{ult}, and the curvature coefficient.

In a homogeneous elastic medium, the coefficient of subgrade reaction k_o is inversely proportional to the width of the foundation. The initial coefficient of lateral subgrade reaction k_{oh} measures the stiffness at small displacement in which, presumably, the soil behaves elastically. Hence, it is expected that the relationship of k_{oh} versus the pile diameter follows the postulated correlation above.

However, back analyses undertaken on some pile-testing cases demonstrate otherwise. The same appropriate values of k_{oh} for the soil layers embedding the piles should be used regardless of the pile diameter. A set of k_{oh} values with depth is considered appropriate when the resulting predicted initial pile-head stiffness k_H matches the recorded one. The initial pile-head stiffness k_H is a reflection of the configuration of the k_{oh} values and the pile shaft stiffness with depth. The subgrade reaction value at a depth is controlled mostly, among other parameters, by the soil Young's modulus E_s, which is derived from the soil strength

Apparently, the working condition in these pile-testing cases is not like the idealised one. In search to establish what factor(s) is responsible, two steps are taken. Firstly, to establish the relationship of k_H versus diameter resulted from both the theoretical and the empirical/modified relationship between k_{oh} and diameter, in which the soil Young's modulus E_s, hence k_{oh}, is uniform with depth. These two relationships of k_H vs. diameter act as the benchmark. Secondly, to find out the relationship of k_H vs. diameter under each of the following suspected factors: the degree of bondage on the pile-soil interface (fully bonded vs. frictionless), the soil stiffness distribution with depth (uniform, linearly increasing, parabolic) and the soil model (elastic vs. elasto-plastic). These were done by having some 2-D and 3-D finite element analyses as well as reviewing some published equations that predict the pile-head deformation.

Results of the investigation are presented. The relationship of the k_H vs. diameter resulted from the linear soil stiffness E_s distribution with depth is similar to that of the modified correlation of k_{oh} vs. diameter. Hence, it suggests that the use of the modified k_{oh} correlation with diameter is actually simulating a condition where the soil stiffness E_s increases linearly with depth. Recommendation is made that in obtaining the soil stiffness E_s from the soil strength, a distribution function with depth be inserted.

The Kepa Rd Landslide

Abstract for the New Zealand Geotechnical Society Student Prize by Justin Franklin

The Kepa Rd Landslide is located 5 km south-east of downtown Auckland on the northern bank of Purewa Creek, adjacent to Orakei Basin. Three other landslides are located along the northern bank of the creek, and this area is referred to as the 'Kepa Rd Landslide Area'. Other landslides have also occurred on the southern bank of Purewa Creek and on the banks of Orakei Creek. These landslides have all occurred within the surficial volcanic tuff rock erupted by Orakei Basin Volcano. Surficial creep of the landslide debris and occasional deeper-seated slope movements still occur on the Kepa Rd Landslide, and the slope around a particular 100 m section of Kepa Rd has been unstable throughout most of this century due to overloading with roading fill. As slope movement has threatened or affected Kepa Rd, a relatively detailed historical record of the Kepa Rd Landslide exists for the 20th century. The original Kepa Rd Landslide movement was a translational rock block slide which displaced an estimated two million cubic metres of cemented tuff rock. The original movement is believed to have been caused by a favourably orientated, extremely weak layer of clay occurring between two very weak to weak rock masses, removal of the toe of the original northern slope of Purewa Valley by fluvial erosion, and the development of high pore water pressures at the top of the clay layer. Pre-existing slip surfaces within the clay layer may have also been a cause of the original movement. Based on geomorphic appearance, erosional evidence, and climatic evidence it is considered that the Kepa Rd Landslide occurred between 7 000 and 10 000 years ago.

Various types of intermittent secondary slope movements have occurred on the Kepa Rd Landslide since the original block slide (eg. shallow translational and rotational sliding, flows, falls, and topples). The landslide has thus developed into a complex landslide. The original landslide mass has been eroded away by these secondary movements, and the Kepa Rd Landslide now covers an area of 7.2 hectares. The intermittent secondary slope movements occur within the upper soil layers, are generally related to high winter groundwater levels, and are thought to be caused by factors similar to those which caused the original Kepa Rd Landslide movement. Movement of the various soil masses of the Kepa Rd Landslide was monitored by inclinometers between 1994 and 1999. Extremely slow movement of the masses occurred, and the average movement rates varied between 2 and 4 mm/year. Five major engineering lithologic units were identified with the Kepa Rd Landslide, and these units were further divided into sub-units and layers. The engineering lithologic units, sub-units, and layers were described using standard engineering geological terminology, and were characterised in standard geotechnical terms by field strength testing, laboratory strength testing, and laboratory physical property testing. Apart from on the Kepa Rd Landslide, no significant geomorphic changes have occurred within the Kepa Rd Landslide Area since 1940. Small-scale (and occasionally significant) geomorphic changes occurred on the Kepa Rd Landslide over the last 60-odd years, and small-scale geomorphic changes are assumed to have also occurred in other parts of the Kepa Rd Landslide Area during this time. A landslide chronology is suggested for the Kepa Rd Landslide Area based on landscape maturity. It is considered that the other landslides within the Kepa Rd Landslide Area may have been formed by processes and causes similar to those which formed the Kepa Rd Landslide.

Arrows indicate conferences where abstract are due shortly

1999

DECEMBER 15-17, 1999
Bangalore, India
INTERNATIONAL CONFERENCE ON ROCK ENGINEERING TECHNIQUES FOR SITE CHARACTERISATION (ROCKSITE)
Conference themes:-
- Engineering Characterisation of Rock Masses
- Modern Techniques of Rock Mechanics Investigation
- Geophysical Imaging Techniques
- Mapping of Voids and Water Logged Workings
- Probing ahead of Tunnels
- Laboratory Testing Methods
- Numerical Modelling
- Rock Mass Improvement and Support Systems
- Instrumentation and Performance Monitoring
- Case Studies involving Special Geotechnical Problems

Abstracts by December 19 1998

2000

JAN 17-19, 2000
VIENNA, AUSTRIA
LIVING WITH NATURAL HAZARDS (CALAR PROJECT)
Conference topics:-
- Importance of risk assessment to Society
- European state of practice reports on risk assessment and warning systems.
- Coping with risks
- Lessons learned from actual landslide, debris flow, and rock fall and avalanche case histories.

Registration by November 1 1999
http:\\www.arsenal.ac.at
http:\\www.swedgeo.se

30 JAN-4 FEB 2000
Auckland, New Zealand
12th WORLD CONFERENCE ON EARTHQUAKE ENGINEERING
Technical Topic's:-
- Earthquake Risk Reduction in Developing Countries
- Earthquake Engineering in Practise
- International Issues in Earthquake Engineering
- Engineering Seismology
- Geotechnical Engineering
- Structural Engineering
- Lifeline Systems
- Design Criteria and Methods
- Social and Economic Issues
- Lessons from Recent Earthquakes

http://www.cmsl.co.nz/12wcee

FEBRUARY 14-18, 2000
Perth, Australia
4TH AUSTRALIA-NEW ZEALAND YOUNG GEOTECHNICAL PROFESSIONALS CONFERENCE

MARCH 27-30, 2000
Aachen, Germany
ISRM EUROCK 200/14TH NATIONAL SYMPOSIUM ON ROCK MECHANICS AND TUNNELLING
GERMAN GEOTECHNCIAL SOCIETY
Topics Include:-
- Fundamentals
- Underground construction
- Underground storage
- Preservation of natural stone monuments

MAY 12-12, 2000
Parnu, ESTONIA
BALTIC GEOTECHNICS IX
Conference topics:-
- Soil investigation
- Soil Properties
- Foundation Design
- Environmental geotechnics
- Port and Harbour Geotechnical Engineering

Abstracts by 1 May 1999

MAY 18-19, 2000
SINGAPORE
ASIAN CONFERENCE ON UNSATURATED SOILS FROM THEORY TO PRACTICE
Conference topics:-
- Fundamentals and Theoretical advances
- Testing techniques and field measurements , measurement of suction
- Engineering properties of unsaturated soils
- Engineering applications and case studies
- Modelling and Numerical analysis
- Flow analysis and mass transport
- Evaluation and application of moister flux boundary conditions

Abstracts by:- 15 September 1999
http://www.ntu.edu.sg/home/cdtoll/unsat-asia/

MAY 25-28, 2000
Astana, KAZAKHATAN
1st CENTRAL ASIAN GEOTECHNICAL SYMPOSIUM

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GEOTECHNICAL PROBLEMS OF CONSTRUCTION, ARCHITECTURE AND GEOENVIRONMENT ON BOUNDARY OF 21ST CENTURY

JUNE 5-7, 2000

Warsaw, POLAND
GEOFILTERS 2000; 3RD INTERNATIONAL CONFERENCE ON FILTERS AND DRAINAGES IN GEOTECHNICAL AND ENVIRONMENTAL ENGINEERING
Conference topics:-

- Theoretical developments
- Laboratory testing
- Filter criteria and design
- Installations
- Quality control and assurance
- Long term behaviour
- Waste disposal and landfill drainage
- Hydraulic structures drainage
- Tunnelling and mining drainage
- Erosion control and agricultural drainage.

Abstracts by 15 June 1999
http://www.alpha.sggw.waw.pl/konferenceje/gf2000

JUNE 12-14, 2000

Sinaia, ROMANIA
1st INTERNATIONAL CONFERENCE ON GEOTECHNICAL ENGINEERING EDUCATION AND TRAINING
ROMAINAN GEOTECHNICAL SOCIETY AND ISSMGE TC31
Programme Topics:-

- Geotechnical Engineering, curricula at undergraduate and postgraduate level
- Laboratory and field works in Geotechnical Engineering Education
- Innovation and case studies
- Continuous Professional Development
- International co-operation

Abstracts by 15 September 99

JUNE 26-30, 2000

Cardiff, UK
8TH INTERNATIONAL SYMPOSIUM ON LANDSLIDES
BRITISH GEOTECHNICAL SOCIETY
Provisional Programme Topics:-

- Landslide types and mechanisms
- Landslide Causes
- Groundwater and landslides
- UK landslides
- South Wales Landslides
- Parameters and Performance

Abstracts by 31 January 1999
http://www.king.ac.uk/~ce_s011/isl8-000.htm

AUGUST 6-17, 2000

Rio de Janeiro, BRAZIL
31ST INTERNATIONAL GEOLOGICAL CONGRESS
Theme is Geology and Sustainable Development: Challenges for the Third Millennium.

SEPTEMBER 4-6, 2000

Helsinki, FINLAND
ECOGEO 2000
INTERNATIONAL CONFERENCE ON PRACTICAL APPLICATIONS IN ENVIRONMENTAL GEOTECHNOLOGY.
Main workshop themes are :-

- Use of industrial by-products in earth construction
- Contaminated soils
- Environmental legislation
- Barrier structures for landfills and groundwater protection

Abstracts by:- October 30, 1999
http://www.vtt.fi/yki/ecogeo2000

SEPTEMBER 25-26, 2000

SIngapore
3rd INTERNATIONAL CONFERENCE ON GROUND IMPROVEMENT TECHNIQUES
Main workshop themes are :-

- Mechanical and Chemical Stabilisation of Soils
- Accelerating the consolidation of clayey Soils and Electroosmosis
- Soil reinforcement and earth reinforcement
- Grouting techniques
- Dynamic Compaction and micropiles
- Deep compaction

Abstracts by 10 January, 2000

SEPTEMBER 26-29, 2000

Soeul, KOREA
4th INTERNATIONAL CONFERENCE ON HYDROSCIENCE AND ENGINEERING.
The concept of the conference is a forum for disseminating the latest ideas in the field of hydroscience and engineering. This encompasses the scientific aspects of the entire modelling process including conceptual, physical, and mathematical models, field observations, computer science and implementation.
The full list of topics is exhaustive and too long to put in this diary.
Abstracts by:- Oct 31 1999
http://www.iche2000.or.kr

OCTOBER 10-12, 2000

Hanover Germany
INTERNATIONAL WORKSHOP ON ENGINEERING GEOLOGY AND ENVIRONMENTAL PLANNING
Main workshop themes are :-

- Waste Disposal
- Mitigation of Natural hazards
- Water and Mineral Resources Development
- Ethics of Geoengineering

Abstracts by March 31, 200

http://www.bqr.de/iaeg2000

NOVEMBER 19-24, 2000
Melbourne, Australia
GeoEng2000 - INTERNATIONAL CONGRESS SPONSORED JOINTLY BY ISSMGE, IAEG AND ISRM
Main themes are :
- Geotechnical Earthquake Engineering
- Underground Works
- Stability of Natural and Excavated Slopes
- Environmental Geotechnics
- Ground Improvement and Ground Support
- Geoengineering Education

Plus several Invited Lectures
http://civil-www.eng.monash.edu.au/discipln/mgg/geo2000.htm

NOVEMBER , 19 2000
MELBOURNE, AUSTRALIA
INTERNATINAL SYMPOSIUM ON SCOUR OF FOUNDATIONS.
Conference themes:-
- Nature and extent of scour problems in various countries.
- Prediction of scour depth, location, and associated parameters.
- Geotechnical aspects of scour design
- Scour countermeasures
- Case histories.

http://info-civil.tamu.edu/scour-tc33/

2001

MARCH 26-31, 2001
San Diego, USA
4th IINTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS
UNIVERSITY OF MISSOURI-ROLLAAND ISSMGE TECHNICAL COMMITTEES
Main workshop themes are :-
- Dynamic Properties of Soils, Engineering Parameters and Constitutive Relations
- Wave propagation, Engineering vibrations and solutions.
- Engineering Seismology
- Soil amplification
- Stability and displacement performance of slopes, landfills and earth dams under earthquakes
- Soil-structure interaction under dynamic loading
- Seismic analysis and design o0f retaining and marine structures.
- Seismic analysis and retrofit foundations of bridges and other sub-structures
- Model and full-scale tests
- Case Histories
- Seismic Zonation
- Recent seismic Developments in California.

Abstracts by November 30, 2000
http://www.umr.edu/~conted/conf8767.html

JULY 30-AUGUST, 2 2001
EKATERINBURG, RUSSIA
EngGeolCity – 2001- Engineering geological problems of urban areas
Conference themes:-
- Eng. Geology and rational use in urban areas
- Eng. Geology and engineering environmental site investigations on urban land
- Natural hazards and stability of urban areas
- Technogenous changes in the urban geoenvironment
- Protection of historical, architectural and cultural insights
- Geoinformation systems of urban geoenvironment

AUGUST, 6-10 2001
HELSINKI, FINLAND
AGGREGATE 2001:- ENVIRONMENT AND ECONOMY
Conference themes:-
- Geological grounds for aggregate production
- Classification of aggregate and available production techniques
- Prospecting and testing raw materials for aggregate production
- Mineralogical studies and long term durability of aggregate
- Environmental influences of quarrying and processing aggregate
- Importance of aggregate industry for national economies.

Abstracts by:- 30 April 2000
http://www.sgy.fi

AUGUST, 27-31 2001
ISTANBUL, TURKEY
15th INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND GEOTECHNICAL ENGINEERING (ISSMGE)
Conference themes:-
- Testing and property characterisation of geomaterials
- Foundations and retaining structures
- Tunnelling and underground space development
- Ground improvement and reinforcement
- Environmental issues of geotechnical engineering
- Design, construction and maintenance of transportation infrastructure.

The conference includes plenary sessions, discussion sessions, and technical visits.
Abstracts by:- 30 May 200
[redacted]

IS-SCOUR 2000

International Symposium on
SCOUR OF FOUNDATIONS

Melbourne, Australia
19th November, 2000

Reply Form

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(First) (Middle) (Last)

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☐ I plan to submit an abstract.

Tentative title :

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☐ I intent to participate in IS-SCOUR 2000

☐ I wish to receive further information.

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International Symposium on

SCOUR OF FOUNDATIONS

IS-SCOUR 2000

Scour problems, Scour Prediction
Geotechnical aspects of Scour Design
Scour countermeasures
Case history of country practice

MELBOURNE
November 19, 2000

BULLETIN 1

CALL FOR PAPERS

Under the AUSPICES of
The International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE)
TC-33 Scour of Foundations

IS-SCOUR 2000

International Symposium on
SCOUR OF FOUNDATIONS

Melbourne, Australia
19th November, 2000

Invitation

The ISSMGE Technical Committee TC33 on Scour of Foundations takes great pleasure in inviting you to attend the "International Symposium on Scour of Foundations". It is a one day event planned to be held the day before the GeoEng 2000 Conference at Melbourne.

Objective of the Symposium

There is a world wide concern due to damage of structures subjected to scour. As an example in USA, there are approximately 600,000 bridges, 500,000 of which are over water. In the last 30 years 1000 bridges have collapsed with associated loss of life, 60% of those failures were due to scour. The symposium is planned as a part of the program of ISSMGE Technical Committee TC33 to promote and enhance professional activities in geotechnical engineering related to scour of foundations at bridges and other structures.

The goal of the symposium is to gather information from various countries on the scour problem, scour practice, and scour solutions. It is hoped that this exchange of data and ideas will improve the general state of knowledge and further develop the interaction between countries.

TC33 on Scour of Foundations

The ISSMGE Technical Committee TC33 has the following terms of reference:

1. To promote and enhance professional activities in geotechnical engineering related to scour of foundations in general and scour at bridges in particular.
2. To sponsor sessions on scour of foundations at future ISSMGE international and regional conferences.
3. To promote international co-operation in research and dissemination of research results on scour problems.
4. To develop international guidelines for scour design, monitoring, and counter-measures.
5. To facilitate the development of an electronic data base of failures and successes.

Call for Papers

Papers are invited from prospective authors on topics related to scour of foundations as outlined in this announcement. Researchers and professionals working in this area are requested to present papers related to practice in their country on scour prediction and prevention. Authors who are unable to attend the Symposium are also encouraged to send papers to be included in a volume available for distribution at the time of the Symposium.

You are invited to submit a 300-500 word abstract of your paper to Professor Jean-Louis Briaud, Department of Civil Engineering, Texas A & M University, College Station, Texas 77843-3136, USA (Tel: 409-845-3795, Fax: 409-845-6554, Email: briaud@tamu.edu). Abstracts can be submitted electronically or by hard copy and a floppy disk mailed to above address before September 15, 1999.

Session Topics

The symposium will address issues related to country wide scour practice in the following areas:

1. Nature and extent of scour problems in various countries
2. Prediction of scour depth, location and associated parameters
3. Geotechnical aspects of scour design
4. Scour countermeasures
5. Case histories

Tentative Program

The Symposium will be held in Melbourne on 19th November, 2000. The one day event is likely to be split up into four sessions as shown below. The details may however change depending on the papers received for the Symposium.

Tentative Schedule

Submission of abstract	:	September 15, 1999
Preliminary acceptance notice	:	November 15, 1999
Camera ready paper submission	:	March 31, 2000
Final acceptance notice	:	June 15, 2000

9:00 am to 10:30 am	**Session 1:** **The Scour Problem** Types of scour problem in different countries Extent of scour problem in different countries
10:30 am to 11:00 am	**Break**
11:00 am to 12:30 pm	**Session 2:** **Scour Prediction and Scour Practice** Predicting scour for bridge pier, abutment, dikes, and other structures Practice for scour at various structures Scour in rivers, coastal zones, cliffs, oceans
12:30 pm to 2:00 pm	**Lunch**
2:00 pm to 3:30 pm	**Session 3:** **Scour Countermeasures** Countermeasures used in various countries Efficiency of countermeasures.
3:30 pm to 4:00 pm	**Break**
4:00 pm to 5:00 pm	**Session 4:** **Case Histories** Case histories on failure and successes Case histories for bridges, offshore platforms, river dikes and other structures.

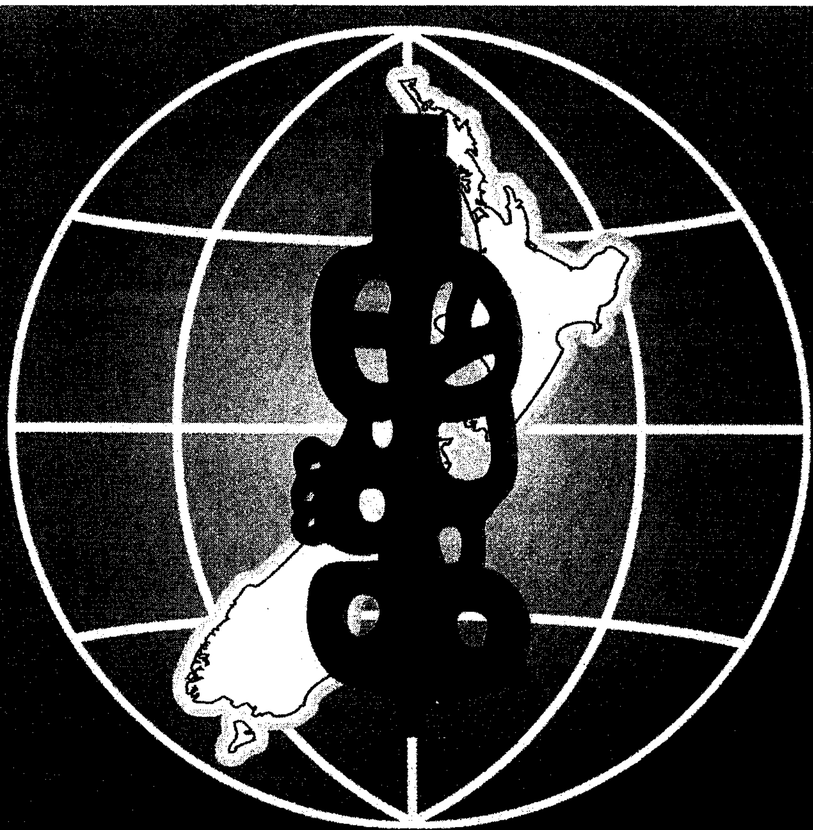
Registration

The registration fees for the Symposium are as follows:

ISSMGE Members	: US $100
Non-members	: US $100

The fees cover attendance at all sessions in the symposium, refreshments, a pre-print volume of the Symposium Proceedings and a copy of the final Symposium Proceedings. A special discount may apply to participants of Geo 2000. The Registration should be sent to Secretariat GeoEng2000 C/-ICMS Pty Ltd, 84 Queensbridge Street, Southbank VIC 3006 Australia.

Websites:
For GeoEng2000 Conference
<http://civil-www.eng.monash.edu.au/discipln/mgg/geo2000.htm
For ISSMGE TC-33
<http://info-civil.tamu.edu/scour-tc33/

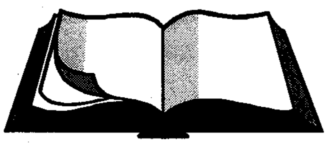


NEW ZEALAND

EQC

EARTHQUAKE COMMISSION

Publication Name	List Price Members	Non Members
New Zealand Geomechanics Society Conferences		
Proceedings of the Alexandra Symposium "Engineering for Dams and Canals" November 1983 (a joint symposia with NZSOLD)	Out of print	Out of print
Proceedings of the Auckland Symposium "Groundwater and Seepage" May 1990	$10	$45
Geotechnical Issues in Land Development Proceedings of Technical Groups Vol 22 Issue 1G Hamilton 1996	$20	$35
Proceedings of the New Zealand Geotechnical Society Symposium - "Roading Geotechnics"98 Auckland 1998	$40	$70
Australia – NZ Conferences on Geomechanics Proceedings of the Sixth Australia – NZ Conference on Geomechanics, Christchurch, February 1992	$50	$100
Proceedings of the Third Australia – NZ Conference on Geomechanics, Wellington, May 1980	$10	$30
Other Publications		
Proceedings of the Second Australia- New Zealand Young Geotechnical Professionals Conference, Auckland, December 1995	$25	$40
Guidelines for the Field Description of Soils and Rocks in Engineering Use	$10	$13
"Stability of House Sites and Foundations – Advice to Prospective House and Section Owners"	$1	$1
Back Dated Issues of Geomechanics News (depending on availability)	$0.5	$0.5



NEW ZEALAND GEOTECHNICAL SOCIETY

OBJECTS

(a) To advance the study and application of soil mechanics, rock mechanics and engineering geology among engineers and scientists.
(b) To advance the practice and application of these disciplines in engineering.
(c) To implement the statutes of the respective international societies in so far as they are applicable in New Zealand.

MEMBERSHIP

Engineers, scientists, technicians, contractors, students and others who are interested in the practice and application of soil mechanics, rock mechanics and engineering geology.

Members are required to affiliate to at least one of the International Societies.
Studies are encouraged to affiliate to at least one of the International Societies.

ANNUAL SUBSCRIPTION

Subscriptions are paid on an annual basis with the start of the Society's financial year being 1st October. **A 50% discount is offered to members joining the society for the first time.** This offer excludes the IAEG bulletin option and student membership. No reduction of the first year's subscription is made for joining the Society part way through the financial year. **Basic membership subscriptions**, which include the magazine, are:

Members ***$67.50***
[IPENZ members receive a $15 rebate on their IPENZ subscription for belonging to the society]

Students ***$28.10***
[IPENZ student members receive a $7.50 rebate on their IPENZ subscription for belonging to the Society]

Affiliation fees for International Societies are in addition to the basic membership fee:

International Society for Soil Mechanics and Geotechnical Engineering	***(ISSMGE)***	*$22.00*
International Society for Rock Mechanics	***(ISRM)***	*$28.50*
International Association of Engineering Geology & the Environment	***(IAEG)***	*$21.00*
	(with bulletin)	*$70.00*

All correspondence should be addressed to the Secretary. The postal address is:
NZ Geotechnical Society, P O Box 12 241, WELLINGTON

Note:
Members of IPENZ now receive their discount on society fees $15 for members, $7.50 for students) directly on their IPENZ subscription.

The Secretary
NZ Geotechnical Society
The Institution of Professional Engineers New Zealand (Inc)
P.O. Box 12-241
WELLINGTON

NEW ZEALAND GEOTECHNICAL SOCIETY
APPLICATION FOR MEMBERSHIP

(A Technical Group of the Institution of Professional Engineers New Zealand (Inc))

FULL NAME (Underline Family Name): ....

POSTAL ADDRESS:

Phone No:........................Fax No.:...........................E- MAIL...................................

DATE OF BIRTH

....

ACADEMIC QUALIFICATIONS:..

PROFESSIONAL MEMBERSHIPS: ....Year Elected......................

PRESENT EMPLOYER:...

OCCUPATION:..

EXPERIENCE IN GEOMECHANICS:..

....

STUDENT MEMBERS:

TERTIARY INSTITUTION:..

SUPERVISOR:...

SUPERVISORS SIGNATURE:..

(**Note** that the Society's Rules require that in the case of student members "the application must also be countersigned by the student's Supervisor of Studies who thereby certifies that the applicant is indeed a bona-fide full time student of that Tertiary Institution". . . ;**Applications will not be considered without this information**).

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

I wish to affiliate to:

International Society for Soil Mechanics and Geotechnical Engineering	(ISSMGE)	Yes/No
International Society for Rock Mechanics	(ISRM)	Yes/No
International Association of Engineering Geology	(IAEG)	Yes/No
& the Environment	(with Bulletin)	Yes/No

DECLARATION: If admitted to membership, I agree to abide by the rules of the New Zealand Geotechnical Society

Signed...

Date...../....../.......

Annual Subscription: Due on notification of acceptance for membership, thereafter on 1st of October. Please do not send subscriptions with this application form. You will be notified and invoiced on acceptance into the Society

Privacy Conditions: Under the provisions of the Privacy Act 1993, an applicant's authorisation is required for use of their personal information for Society administrative purposes and membership lists. I agree to the above use of this information:

Signed ....**Date**...../....../.......

(for office use only)

Received by the Society ....

Recommended by the Management Committee of the Society

Approved by the Council of the Institution ....

NEW ZEALAND GEOTECHNICAL SOCIETY
ADDRESS LIST 1999

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ADVERTISING IN NZ GEOMECHANICS NEWS

NZ Geomechanics News is published at least twice a year and distributed to the Society's 400 members throughout New Zealand.

This magazine is issued to society members who comprise professional geotechnical and civil engineers and engineering geologists from a wide range of consulting, contracting and university organisations as well as those involved in laboratory and instrumentation services.

Advertisement Location	Single Issue	Advert. Size (cm)	
Black & White			
Back Cover	$275	19.5 wide x 27 high	
Inside Cover (Front or Back)	$225	19.5 wide x 27 high	
Full Page Internal	$200	19.5 wide x 27 high	
Half Page Internal	$150	19.5 wide x 13.5 high	
Quarter Page Internal	$125	9 wide by 13.5 high	
Colour			
Full Page Internal	$350	19.5 wide x 27 high	
Inserts			
Insert to be posted with magazine	$100/flyer	Max size A4	1 May 2000

***Note**:

1. All rates are excluding GST
2. Space is subject to availability
3. All margins are 10 mm
4. Advertiser provides all flyers

The deadline for advertising copy for the next issue is 15 May 2000. Arranging artwork for your advertisement can be carried out at a reasonable additional cost if requested. However, advance notice is required for these additional services.

If you are interested in advertising in the next issue of ***NZ Geomechanics News*** please contact:

Management Secretary
Debbie Fellows
6 Sylvan Valley Ave
Titirangi
AUCKLAND

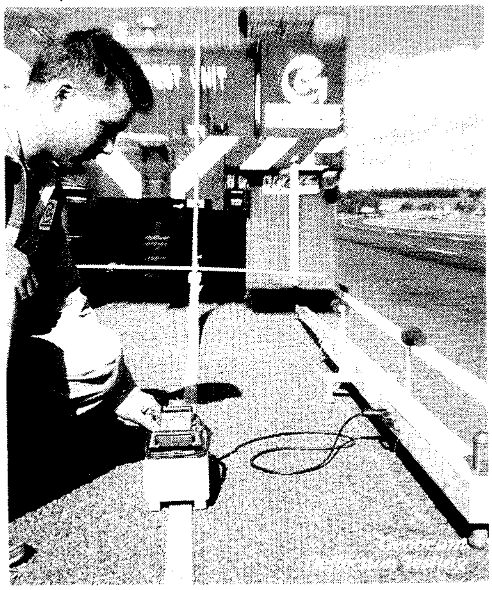
Tel: 09 817 7759
Fax: 09 817 7035
Email: dfellows@xtra.co.nz

GEOTECHNICS LTD
ROAD TESTING UNIT

Geotechnics offers a comprehensive road testing service which incorporates a wide range of testing applications from single lane unsealed rural accessways to multi-lane highways and motorways. The Road Testing Unit is purpose built for a range of IANZ registered services including:

DEFLECTION TESTING (BENKLEMAN BEAM)

This service utilises a standard Benkleman Beam where pavement deflections are measured and recorded with preliminary results issued on site, followed up by a formal test report.



DEFLECTION TESTING (GEOBEAM)

Using our patented Geobeam, deflection measurements are made via an electromagnetic proximity transducer located at the point of test. This system provides for both standard deflection information and detailed bowl shape at every test point if required. The information is automatically recorded and stored on a hand held site computer and can be used to determine subgrade moduli and analysis of pavement component performance.
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The unit has also been designed to perform Californian Bearing Ratio and Plate Bearing Tests and has built in facilities and equipment for the performance of these tests.

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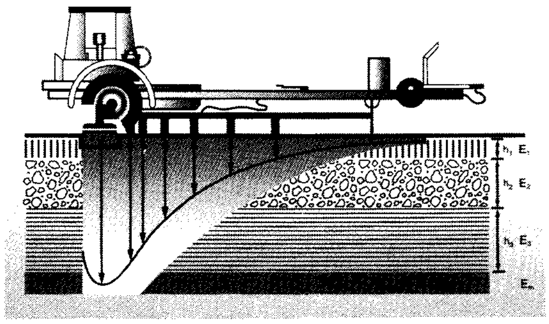

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