Newsletter of the New Zealand Geotechnical Society Inc.

Issue 67
ISSN 0111–6851

NZ Geomechanics News

June 2004

NEW ZEALAND GEOMECHANICS NEWS

JUNE 2004, ISSUE 67

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Cover photo: Placement of new drainage materials at the foot of Cosseys Dam in the Hunua Ranges. To replace the drain – the downstream half of the earth dam – 387,000 tonnes, was removed and stockpiled. The dam was rebuilt with new filter materials and the stockpiled fill was replaced. Construction was completed in early 2004.
Photo Credit: Rees Osborne, courtesy Watercare Services Ltd

CHAIRMAN'S CORNER

Firstly I would like to say how much I enjoyed the 9th ANZ Conference on Geomechanics held in Auckland in February. The ANZ conferences always seem to be fun, catching up with colleagues and acquaintances from around New Zealand and Australia and thankfully free from the stuffiness associated with many overseas conferences. At the same time there were many interesting and relevant papers and technical discussions on offer. The conference dinner at the Museum was a great evening and will long be remembered by many. Even the Auckland weather cooperated making the waterfront venue a great place to be. On behalf of the Society, I would like to say special thanks and congratulations to Geoff Farquhar and his team for making the Conference such a great success.

Having enjoyed the Auckland conference so much it is time to start planning and looking forward to our next NZGS biennial symposium, which is now slated for February 2006 in Nelson. Mark Foley has very kindly agreed to be convenor for this event and is using the event as a prompt to establish a local Nelson group of NZGS members. The two most recent symposia in Tauranga and Christchurch were very successful and with such a popular venue and with your participation we hope to make Nelson 2006 a great event.

All of you should have received a free CD Rom late last year with a compilation of all past issues of *NZ Geomechanics News*. I hope that you, like me, find this a valuable addition to your (probably incomplete) collection of paper versions of *NZ Geomechanics News*. The intention is to supplement this CD Rom in future years with periodic updates. We are also planning to make electronic copies of the proceedings from all ANZ conferences held in New Zealand available on CD Rom and are negotiating with AGS to do the same with those held in Australia.

It is with sadness that I must announce the resignation of Debbie Fellows as Management Secretary of the Society. Debbie has been Secretary since 1998 and in that time has worked enthusiastically on behalf of the Society, putting up with several Chairmen and numerous committees to become, effectively, the face of the Society in many ways. In that time she has been responsible for the day-to-day functioning of the Society and has also provided much of the 'institutional memory' with the rapid turnover in committee members dictated by our present constitution. Debbie's proudest achievement during her time as Secretary I suspect has been the Society's website. She took on additional training to be able to set up and manage our site directly. She has succeeded in making the website the central focus for information about the NZGS and our activities and she has kept it constantly up to date and relevant. Debbie is returning to full-time employment with URS.

Other changes to your committee this year include the retirement of John Marsh as Chair. John worked very hard last year through a series of difficult negotiations to establish a new Memorandum of Understanding with IPENZ detailing the nature of our relationship with them as a Co-operating Technical Society in agreeable terms. This document is important in setting the scene for future relations with IPENZ. Of equal importance perhaps, John has obtained from IPENZ Management recognition that NZGS is the main body representing the wide range of geotechnical professionals within New Zealand. Notably, ours is the only Technical Group to have completed this process so far. On behalf of the Society I would like to thank John for his good efforts. John remains on the Committee this year as Immediate Past Chairman.

Anne Williams remains on the Committee and has kindly agreed to continue as Treasurer. Michael Laws remains co-opted as Young Geotechnical Professionals Representative and Tim McMorran joins the Committee this year. John St George continues as ISRM representative and Grant Murray as ISSMG representative.

Phil Glassey has generously agreed to continue in the role of *NZ Geomechanics News* Editor. A special thanks to Phil for continuing in this time-consuming task and for achieving such a high editorial standard for what is our flagship publication. Please let's all help Phil by keeping those contributions coming.

Steve Crawford leaves the Committee after completing his duties as Immediate Past Chairman, and after many years serving on the Committee and as Convenor for the Tauranga Symposium.

I look forward to working with the incoming Committee to help in keeping the Society the vibrant and successful organisation it is today. If you have any issues you wish to have addressed on your behalf, please feel free to contact any of us.

Kevin McManus
Chairman

EDITORIAL

A Healthy Society

The Geotechnical Society is in a healthy position financially, despite trying hard to spend money by subsidising conferences and events for the benefit of members. Whatever we run is so well organised and attended that it generally makes a profit. It seems that the members are craving professional development. Hence the society is looking to increase support for students and professional development of the members.

Support for students is likely to be in the form of travel grants to the bi-annual symposium, awarding prizes for papers and presentations. We could take a leaf out of the Geological Society's book, as they do this very well. In addition the society may fund or co-fund a post-graduate student. In this way we invest in attracting new blood to the society and maintaining membership.

For the existing members professional development includes the like of the most successful (and enjoyable) ANZ conference recently held in Auckland, and the bi-annual symposia to be held in Nelson in February 2006. In addition the society will be trying to provide other professional development opportunities. For example the Society is supporting eight young geotechnical practitioners to the Young Geotechnical Professionals (YGP) conference in Brisbane in Queensland in July. As part of the agreement to support the YGP's, they are available to give talks at the branches based on the papers they are going to present in Queensland. The Abstracts of these papers are included in this issue.

Other possibilities might include a ground anchors course in spring, a landslide roadshow hosted by Gary Mostyn, and a tour to present the proposed new Soil and Rock description guidelines. The committee has invited Mark Randolph to New Zealand to give the Rankine Lecture and will invite Prof Scott Sloan to give the E H Davis Lecture. Laurie Wesley is currently touring the country with the 2004 Geomechanics lecture. Be sure that you catch up with it at your branch.

It is with these kinds of events, along with the socialising that goes along with them that makes for a healthy professional society – not just the balance of the bank account. Hence it is up to the members to continue to support these activities and maintain the society's healthy condition. See you at the next event.

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Editor

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EDITORIAL POLICY

NZ Geomechanics News is a biannual newsletter issued to members of the NZ Geotechnical Society Inc. It is designed to keep members in touch with matters of interest within the Geo-Professions both locally and internationally. The statements made or opinions expressed do not necessarily reflect the views of the New Zealand Geotechnical Society Inc. The editorial team is happy to receive submissions of any sort for future editions of *NZ Geomechanics News*. The following comments are offered to assist potential 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 international journals and conferences.
- technical notes
- comments on papers published in *NZ 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
- industry news.

Submission of text material in camera-ready format is not necessary. However, typed copy in Microsoft Word is encouraged, particularly via email to the Editor or on floppy disk or CD. We can receive and handle file types of almost any format. Contact us if you have a query about format or content.

Diagrams and tables should be of a size and quality appropriate for direct reproduction. Photographs should be good contrast, black and white gloss prints or high resolution digital images. Diagrams and photos should be supplied with the article, but also saved seperately as 300 dpi JPGs. Articles need to be set up so that they can be reproduced in black and white, as colour is limited.

NZ Geomechanics News is a newsletter for Society members and articles and papers are not necessarily refereed. Authors and other contributors must be responsible for the integrity of their material and for permission to publish. Letters to the Editor about articles and papers submitted by members will be forwarded to the contributing member for a right of reply.

Persons interested in applying for membership of the Society are invited to complete the application form in the back of the newsletter. Members of the Society are required to affiliate to at least one International Society and the rates are included with the membership information details.

REPORT FROM THE SECRETARY

Many of you may well be aware that I have decided to move on from being the Society Secretary. I have been doing the job since 1998 when I was on maternity leave from URS. My daughter is now six (my, doesn't time fly) and I have been progressively increasing my hours at URS. I now feel that I cannot do my best for the Society any more. It is probably time for a fresh pair of hands to take over the job.

I have enjoyed the work, the people and the Society and will miss it very much. Thank you to all the members for the support you have given me. I will continue as a member of the Society and I am sure that I will see some of you at branch meetings from time to time.

New Members

It is a pleasure to welcome the following new members into the Society since the last issue of *NZ Geomechanics News*:

Simon Humprhreys	Melanie Henry
Shamus Wallace	Iain Haycock
Sally Wyatt	Ross Paterson
Krish Shekaran	Todd Fraser
Jacqueline Coleman	Eyal Sagy
Brent Clough	Richard Cole
Kane Inwood	Gustav Nortje
Brian Warburton	V Hargreaves
David Anstiss	V Peterson
D Reeve	James Beaumont
CJ Griffiths	Moss Keeran
C Dyet	Clinton Every

Resignations

Smith N A	Boswell G B
Perry R C	Moon S K
Croft S F	Couch R L
Ander G J	Moss P J
Galloway G A	Douglas N J
Abid AJM	Van Barneveld J H
Lornie G M	Lush A M

Subscriptions

Your subscription invoices for the 2003/2004-year have now been sent out. Please don't file them in the pay sometime later file. PLEASE PAY YOUR SUBSCRIPTIONS PROMPTLY. Thank you.

Debbie Fellows
Management Secretary
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INTERNATIONAL SOCIETY REPORTS

ISSMGE Australasian Vice President's Report, May 2004

Board Meetings

A Board Meeting was held in Auckland after the ANZ Regional Conference. The next Board Meeting will be in Costa Rica in July (it's a tough job but someone's got do it). Issues that have been hotly debated and continue to occupy the attention of the Board are:

- The ISSMGE constitution on voting procedures.
- The Member Society subscriptions.
- Cooperation between the International Society's and a joint Secretariat.

Some action items and alternate options for resolution of these issues were discussed in February. Whilst this is still work in progress there is expected to be some progress at our next Board Meeting.

Policy Document – Nr 1

The Board of the ISSMGE have initiated the drafting and publication of a series of Policy Documents. The first has been prepared and was recently published on the ISSMGE website. The Guidelines for Professional Practice are included with this report.

Technical Committees

I shall be writing to the Australasian Representatives on the various Technical Committees in June and with the expectation that I can submit a short report on TC activities to the Australasian membership in the AGS and NZGS publications before the end of the year.

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International Society for Soil Mechanics and Geotechnical Engineering

Société Internationale de Mécanique des Sols et da la Géotechnique

POLICY DOCUMENT NO. 1
GUIDELINES FOR PROFESSIONAL PRACTICE

INTRODUCTION

As the peak body for geo-professionals concerned with soil mechanics and geotechnical engineering, ISSMGE has a responsibility to set out guidelines by which such geo-professionals should practice.

These guidelines are set out herein two categories:

(a) General professional ethics which apply to all engineering professionals

(b) Specific issues foe geotechnical professionals.

(a) GENERAL PROFESSIONAL ETHICS

Geotechnical professionals shall:

1. Place their responsibility for the welfare, health and safety of the community before their responsibility to sectional or private interest.
2. Act with honour, integrity and dignity to merit the trust of the community and the profession at large.
3. Act only within areas of their competence and in a diligent and careful manner.
4. Apply their skills and knowledge in the interest of their employer or client for whom they act, without compromising any other obligations they may have to act in an ethical manner.
5. Take reasonable steps to inform themselves, their clients and employers, of the technical, social, environmental and other possible consequences which may arise from their actions.
6. Express opinions, make statements, or give evidence, with fairness and honesty, and only on the basis of adequate knowledge.
7. Continue to develop relevant knowledge, skill and expertise throughout their careers, and shall actively encourage those with whom they are associated to do likewise.

(b) SPECIFIC ISSUES

Geotechnical professionals:

1. Shall take steps to be Aware of the context (the 'larger picture') in which their work is carried out and endeavour to participate in the project from beginning to end.
2. Shall make themselves aware of the geological, hydrogeological and environmental context of the project in which they are involved.
3. Shall, when acting as designers, take all reasonable steps to visit the site during construction and satisfy themselves that the construction satisfies the design intent.
4. Shall avoid price competition at the expense of technical quality.
5. Shall endeavour to cooperate with professionals of other disciplines who are involved in the same project.
6. Shall endeavour to explain to their clients and to the community at large the significance of their work.
7. Shall, when asked to review or critique the work of fellow professionals, advise them accordingly.
8. Shall avoid unnecessarily definitive statements in relation to geotechnical, geological and environmental issues which are uncertain.

March 2004

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ISRM Australasian Vice President's Report, May 2004

Introduction

There have been no formal meetings of the ISRM Board since my last report in September 2003. The Board is in regular contact through email and have discussed a number of issues. These include:

- ISRM-Symposia, surcharges for ISRM. We are currently reviewing the surcharges for regional and international symposia so they can be rationalised.
- ISRM-Membership and Corporate Members.The Board is looking at initiatives to increase membership of ISRM. Australasia currently has 3 corporate members and it is hoped that this can be increased to about 20. It is recognized there needs to be some tangible benefits to corporate members to encourage them to join.
- Annual fee for National Groups (NG). Some small NGs have difficulty justifying the annual national group fee as it is passed on to members. At present it is a fixed amount but there is a proposal to include a sliding scale for the small national groups.

I recently attended the Australian Geomechanics Society management meeting in Melbourne. I was encouraged by their committee's enthusiasm to cooperate with the NZGS.

News Journal

The next issue of the News Journal was to be ready at the end of last month as a postscript document available from the ISRM web site. Unfortunately there have been some computer problems which have delayed the publication.

Rocha Award

Four applications have been received for this prestigious award from the region. From these, our panel will have to select two to go forward to the final judging which will take place in November at the ISRM meeting to be held in Kyoto. Unfortunately there were no candidates from New Zealand.

Technical Commissions: Commission on Case Histories in Rock Engineering (CCHRE)

This is a new commission which has been set up by ISRM to provide a forum for exchanging and documenting observed behaviour of rock masses and structures and, hopefully, to establish a database of rock engineering case histories. The development of rock mechanics depends not only on the advances of theoretical and experimental studies but also on feedbacks from practice. The performance of rock masses and structures, both successful and unsuccessful ones, provides valuable information to validate theory and avoid catastrophic failures in the future. The commission is under the Chairmanship of Professor Shen Fengsheng. Anyone who has an interest in contributing to the Commission please contact Tony Meyers (Anthony.Meyers@unisa.edu.au), as he is the Australasian nominee.

Commission on Education

The Chairman of the ISRM Commission on Education, Professor Marek Kwasnieski, who had served as such since 1993, has stood down as chairman. The ISRM NG of China has nominated Professor Meifeng Cai, Dean of the Faculty of Civil and Environment Engineering of the University of Science and Technology of Beijing, as new Chairman of the Commission. This nomination has been approved by the Board.

Forthcoming Meetings

EUROCK 2004 to be held in Salzburg, hosted by the ISRM National Group Austria, in October 2004

ISRM International Symposium will be held in Kyoto, Japan on November 30 to December 2 2004

ISRM-Regional Symposium, Moscow, January 2005

EUROCK 2005 May 18-20 Brno, Czech Republic is the 2005 ISRM International Symposium.

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IAEG Australasian Vice President's Report, April 2004

Introduction

This is the IAEG Australasian Region report to April of 2004. The report is by VP, Dr Fred Baynes for submission to the Australian Geomechanics Society and the New Zealand Geotechnical Society. Unfortunately I could not attend the committee meeting as I will be teaching the AGS 'Geology for Engineers' course in Adelaide.

IAEG Issues

There was a small discussion between the IAEG, ISRM and ISSMGE regional VP's at the Auckland conference in February 2004 regarding developments in the relationship between the sister societies. ISSMGE president Van Impe's presentation to the Auckland conference was interesting but may not entirely reflect the kinds of changes that the IAEG wishes to pursue.

I am leading a task force that has to review the workings of Technical Commissions and relating them to core values. Attached is a document that was distributed throughout the IAEG for comment although none has been forthcoming.

Australasian Region Issues

Activities to Date:

- I attended the Australia New Zealand Conference on Geomechanics in Auckland in February 2004.
- Registration issues continue to be an agenda item in Australia although I have achieved nothing.
- I helped organize the content for two issues of the Australian Geomechanics Journal and a one day symposium in Perth in March 2004 devoted to 'Ground engineering and geology in Perth'.

Planned Activities:

- The New Zealand Geotechnical Society is considering nominating for the IAEG Congress in 2010. Discussions are continuing.
- A geology for engineers training course is to be held in Adelaide, Australia in April 2004.
- A survey of teaching at an under-graduate and post-graduate level in Tertiary Institutions throughout Australia and New Zealand is planned to find out what courses are available for engineering geology and geology for engineers is throughout the region. No progress has been made (I have not had contact with Tony Meyers who was going to be involved in this).
- Planned succession for the Australasian Group IAEG VP is to be addressed.

Fred Baynes
IAEG VP Australasia

National Network of Technological Societies (NNTS)

NNTS exists for the following purposes:

- Facilitating the presentation of the informed views of New Zealand's technological 'community of expertise' on issues of the day (by creating mechanisms for endorsement of non-aligned and learned contributions on technological issues affecting the wider community when they are presented to Government, the media, community leaders and the general public).
- Development of wide-ranging expertise listings as a resource for those in the community seeking informed comment on technological issues.
- Sharing of best practice and cooperation amongst Chief Executives/Executive Officers of member organisations e.g. development and operation of codes of ethics, shared publishing possibilities, wider advertising of meetings/seminars/conferences etc.
- Possibly developing a national Technology Events calendar, sharing administrative service experiences e.g. database developments.

NZGS is now a member – so check out the website
www.nnts.org.nz

Core Values of IAEG and Technical Commissions Review
A Working Plan Produced For Discussion

Introduction

At the IAEG Executive Meeting on 13 September 2003, it was decided to establish a task force to review the workings of the IAEG Technical Commissions. During further discussions it was suggested that the same task force could also consider the issue of 'core values' raised by Sir John Knill in his Hans Cloos lecture.

At the request of Niek Rengers, Fred Baynes became the Chair of the task force, to be assisted by Lars Persson, Jorge Bejerman and other members of the Executive as requested. The task force is to report at the 2004 Council meeting.

What Is A Core Value?

The Hans Cloos lecture by Sir John Knill in Durban challenged the IAEG to identify core values for engineering geology. There was a lively discussion of this issue in Durban at a special meeting following the Hans Cloos lecture. Notes on that discussion by Baynes & Rosenbaum will be published in the Bulletin.

The Executive considers that 'core values' are *those discrete areas of knowledge that are the essence of engineering geology.* The identification of IAEG core values will clearly assist in reviewing the workings of the Technical Commissions.

Terms of Reference for the Task Force

The terms of reference for the task force will be as follows:

- To consider what are the core values of Engineering Geology and how these relate to the development of a strategic plan for the IAEG - a 'vision for the future'
- To investigate if those core values can be used to provide a framework that will establish fundamental objectives and specific topics for the IAEG Commissions.
- To establish more formal terms of reference for the IAEG Commissions, consider how they should be managed and whether it is it is possible to reorganise, formalise and/or improve them.
- To strengthen the role of the Executive Committee and Council in the appointment of chairpersons and core-members for the IAEG Commissions
- To have the IAEG Commissions reporting in a standard format that can be submitted for consideration, review and approval by the Executive Committee and Council every year
- To establish if bye-laws relating to IAEG Commissions have to be changed
- To establish if there should be any new IAEG Commissions
- To relate the activities and output of the IAEG Commissions to the IAEG website as a platform for communicating technical knowledge.
- To consider if industrial partners or sponsors for IAEG Commissions should be established.
- To consider the need for a regional representation in IAEG Commissions

Starting the Discussion

The stated aims of the International Association for Engineering Geology and the Environment are:

- to promote and encourage the advancement of engineering geology through technological activities and research;
- to improve teaching and training in engineering geology;
- to collect, evaluate and disseminate the results of engineering geological activities on a world wide basis.

If we are to meet these aims then we must identify our core values and plan to actively develop them via the Technical Commissions. Although some core values are described in Sir John Knill's lecture, it is hoped that through interaction with the IAEG membership across the globe we can find out what our core values really are.

To start this process an attempt to summarize IAEG 'core values' in terms of *those discrete areas of knowledge that are the essence of engineering geology* is provided in Table 1. This first attempt must clearly be elaborated and we welcome your comments.

It is hoped that we can use the core values to develop a strategic plan to formally manage the technical commissions to produce knowledge. The production of knowledge then would form a source of papers for the Bulletin, symposium themes, website content and ultimately will promote the good works of the IAEG.

We realize that the IAEG Commissions must be driven by enthusiastic, energetic, voluntary contributors. There must have a quick turn around of ideas. We do not want to have prolonged Technical Commissions spending years not producing anything. We need to identify individuals willing to drive Technical Commissions.

Table 1 – IAEG Core Values	
Discrete Areas of Knowledge	Typical Examples
Site specific engineering geological descriptions (local or project related) of stratigraphy, structure, groundwater, processes, and the related engineering or environmental performance.	Persson L (1998) Engineering geology of Stockholm, Sweden. *Bull. Eng. Geol. and Environment*, Vol 57 No 1 p 79–90.
Universal engineering geological syntheses (applicable throughout the world) of properties, parameters, engineering performance of geological materials or processes, soil/rock/water systems, environmental systems, especially inhomogeneous and/or fractured materials and/or active processes.	Marinos P & Hoek E (2001) Estimating the geotechnical properties of heterogeneous rock masses such as flysch. *Bull. Eng. Geol. and Environment,* Vol 60 No 2 p 85 –92.
Investigation and characterization methods, surface and subsurface field techniques especially to investigate and describe spatial variability, capabilities and limitations of investigation techniques.	Kosaka K (2000) Evaluating landslide deposits along the Tsurukawa fault zone, Japan, using magnetic susceptibility *Bull. Eng. Geol. and Environment*, Vol 58 No 3 p 179 –182.
Engineering geological models as representations of site specific and anticipated engineering geological conditions, preparation protocols, metadata requirements, descriptions of geological uncertainty, visualization of models, methods of transforming into ground engineering models, use of models for risk management and geohazard engineering	Fookes P. G., Baynes F.J., and Hutchinson J.N., (2000), Total Geological History: A model approach to the anticipation, observation and understanding of site conditions, Invited Paper, *Geoeng 2000 Conference*, Melbourne Australia.
Management and communication of engineering geological information, reporting, engineering geological terminology, defensible reporting standards, codes of practice, communication with end-users, education and training.	IAEG Commission on Engineering Geological Mapping 1981 Recommended symbols for engineering geological mapping *Bull. Int. Ass. of Eng. Geol.* No 24 p 227– 234.

The Technical Commissions approved by IAEG will focus on the IAEG core values. Joint Technical Commissions can also be established dealing with subjects that are not core values and where the sister societies are equally involved. IAEG will produce a strategic plan for both types of Commissions.

Some possible Joint Technical Commissions together with ISRM and ISSMGE:

- Develop standards for basic geotechnical parameters and testing procedures
- Develop standards for risk management in ground engineering

Associated Issues

The Executive considers that any review of the Technical Commissions must take into account specific contemporary issues that challenge members of IAEG:

- In his Hans Cloos lecture Sir John Knill suggested that engineering geology as a discipline needs to be defined and that a scientific rationale for the subject has not developed - this is the reason for trying to identify the core values!
- The aim of improving teaching and training in engineering geology may require practical assistance to the IAEG membership in the form of worked examples of good practice, thematic text books and reports, materials for refresher courses, field practical courses, etc.
- Concerns about professional status may require us to move into the direction of a professional organization (in addition to being a learned society), which might involve promotion of our profession and plans to assure our professional involvement in engineering works.
- The membership decline suggest that young professionals need to be attracted to IAEG members, perhaps by offering them (free of charge?) knowledge based facilities (on a website?) while at University and establishing awards for young researcher publications by National Groups and during Congresses and Symposia
- The growing co-operation between the IAEG and the ISRM and ISSMGE means that it is opportune to:
  - Identify specific roles within the different expertise fields in ground engineering (this relates to the work of the JEWG).
  - Define curricula for University level education programs and refresher courses for practitioners in ground engineering.

Implementation Of This Working Plan

The President and Executive agreed to the Terms of Reference of this Task Force during November 2003. This working plan will be published in a special copy of our Newsletter, and also sent explicitly to all National Groups with an invitation to discuss it at their national level and report about the outcome of that discussion.

We hope that the Executive and IAEG members that show an interest can identify the core values by early 2004. We will then establish the relationship between the core values and the Technical Commissions by March 2004 and develop a strategic plan to meet the agreed Terms of Reference by June 2004.

Contact The Task Force

If you are at all interested in the concepts presented in this working plan please contact me: with comments, suggestions or criticisms.

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NZGS BRANCH ACTIVITIES

Auckland Branch Activity Report

Our meetings continue to be well-attended, varying between 50 and 80. We are grateful for the support from the engineering community.

April saw the 12th NZ Geomechanics Lecture by Laurie Wesley. As always, Laurie's talk demonstrated his uncanny ability of applying theory to practical problems.

May's presentation was an interesting topic on the recent upgrade at Cosseys Dam. Neil Jacka explained the thought process during the feasibility study, followed by actual construction photos and problems encountered.

End of June will see Prof Mick Pender speaking on Auckland Residual soils. July will probably be selected topics by winners of the Young Geotechnical Professionals Awards.

Some topics in our preliminary programme have been cancelled and we are working on alternative options. As before, we will probably hold a special meeting towards the third quarter of 2004 to discuss the following year's topics. Anyone who has ideas of future topics is very welcomed to contact Damir Soric or me.

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Bay of Plenty Branch Activity Report

We were fortunate to be included on Laurie Wesley's tour of NZ to present the 2004 Geomechanics Lecture. The BOP branch members showed their support with 10 people attending. Unfortunately, there was a clash with an IPENZ meeting but the show still went on. The lecture was very informative and due to its size became interactive at the end.

We hope to have a couple of meetings through the quieter (????) winter time. Anyone wishing to brag or convey information about a project they are working on, or previously been involved in, can contact me to book a time. As it seems that free beer and food are not that enticing, feedback is welcome on how to make meetings more appealing.

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Waikato Branch Activity Report

The 2004 Winter Lecture Series started well with the 12th New Zealand Geomechanics Lecture *Geotechnical Engineering in and out of the Ivory Tower*, by Dr. Laurie Wesley on 22nd April 2004. Dave Dennison, of Opus International Consultants, followed in May with an inspiring discussion on the construction of embankments on soft ground. The series, of four lectures, aims to cover a range of areas of interest to whet the appetite of the local geotechnical community. Held in an informal atmosphere, with refreshments provided, the aim is to inspire and encourage interaction. The remaining lectures in the Series are:

– **20 July 2004**
Gordon Stevens
International Projects involving innovative use of geotextiles

– **21 September 2004**
Bob McKelvey
Risk? What Risk?

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Wellington Branch Activity Report

The proposed programme for June 2004 – December 2004 is as follows:

- **Thursday 17 June 2004**
  12th New Zealand Geomechanics Lecture
  Geotechnical Engineering in and out of the Ivory Tower
  Dr. Laurie Wesley, University of Auckland

- **Thursday 15 July 2004**
  Young Geotechnical Professionals
  Three 20 minute presentations

- **Thursday 19 August 2004**
  GNS Landslide Research
  Three 20 minute presentations

- **Thursday 21 October 2004**
  TBA – anyone in the Wellington area interested in making a presentation contact Grant Dellow, Phone: (04) 570 4755, or email: g.dellow@gns.cri.nz

- **Thursday 18 November 2004**
  Belmont Quarry Visit – details to be advised

- **December 2004**
  Christmas Get-together (Hopefully a week-day evening BBQ at Harcourt Park in Upper Hutt)

Other Events

- **August 2004**
  Urban Search and Rescue (USAR) Level 1 Engineer Course
  Tentative dates: 23 (5–10 pm) & 24 August (8.30am–5.00 pm)
  Anyone interested in knowing more contact
  Grant Dellow, Phone: (04) 570 4755,
  or email: g.dellow@gns.cri.nz

- **September 2004**
  LaNZlides Workshop, Pohangina Valley, Manawatu
  Anyone interested in knowing more contact
  Grant Dellow, Phone: (04) 570 4755,
  or email: g.dellow@gns.cri.nz

Grant Dellow
Wellington Branch Co-ordinator
Geological & Nuclear Sciences
Work: 04 570 4755
Mobile: 027 221 8850
Email: g.dellow@gns.cri.nz

Nelson Branch Activity Report

Formation of a Nelson branch of the NZ Geotechnical Society is in progress with Tim Coote as the designated branch coordinator. A preliminary meeting was held at a local pub on the 6 April to discuss ideas for the upcoming Geotech Society symposium to be held in Nelson in March 2006 and formation of a local branch. This produced some good ideas and planning for the symposium is well underway with Mark Foley the conference convener. The first official branch meeting will be for the Geomechanics lecture by Laurie Wesley on the 16th of June with meetings to be scheduled at 3 monthly intervals after that.

Tom Coote
Nelson Branch Co-ordinator
Tonkin and Taylor Ltd
Work: 07 839 9863
Email: tcoote@tonkin.co.nz

Canterbury Branch Activity Report

Talks in the first half of 2004 have included Professor William Van Impe (ISSMGE President) speaking on Developments in Screw Piling Technology. The talk was based on developments of screw piling technology and design concepts over the last 30 years; showing the most relevant outcome of it in today's state of progress overview. The twenty or more years of screw pile research that Prof Van Impe has directed in Belgium allows him to draw quite distinctive and well-supported conclusions on the displacement screw pile capabilities. Prof Van Impe's power point presentation is available from the Management Secretary.

In May, the Canterbury branch was presented a lecture on Three International Projects incorporating the use of Innovative Geosynthetics. Gordon Stevens, Technical Manager of Maccaferri NZ Ltd will present three case studies of projects in Germany where specialist Geosynthetics have been used to solve some unique problems.

In June, Dr. Laurie Wesley presented the NZ Geomechanics Lecture for 2004 in Christchurch as part of his national lecture tour. His lecture was entitled *Geotechnical Engineering in and out of the Ivory Tower*.

Maccaferri New Zealand Limited continue to sponsor drinks and chips before the meetings. The contact for Maccaferri in Christchurch is Adrian Gardner (349-5600).

The Canterbury branch attempts to hold regular meetings with a presentation every 4-6 weeks. These are usually held in the School Engineering at the University of Canterbury. The format begins with social drinks and chips at 5.30pm in the Staff Common Room followed by the presentation in a nearby lecture theatre between 6.00 and 7.00pm. This is a good time to meet fellow geotechnical practitioners, students and academics. Time at the end of each meeting is allowed for questions and discussion.

Upcoming events are yet to be finalised. See the NZGS Web page for further information. Meetings will be advertised to members in advance by email or post.

Tim McMorran has recently taken over coordination of Canterbury Branch Activities. Tim is an Associate Engineering Geologist at URS New Zealand Limited in Christchurch. For further information on Canterbury branch activities see the NZGS web page or contact Tim as per the contact details below.

Tim McMorran
Canterbury Branch Co-ordinator
URS New Zealand Ltd
Work: 03 374 8506
Email: tim_mcmorran@urscorp.com

Expansive Soils Working Group

The Expansive Soils Working Group has been pretty much dormant, in large part to the Chairman's commercial workload. However, one of the Party's participants, Pat Shorten, of Frazer Thomas, this year completed stage 1 of a research project on expansive soils in Auckland, funded by BRANZ, which has been published on the Web at http://www.branz.co.nz/branzltd/publications/pdfs/SR120.pdf. The upshot of that research, is that an 'alpha profile' has been developed for Auckland soils responding to the local climate. Stage 2 is expected to commence SHORTLY.

Simon Woodward
Chairman
Expansive Soils Working Group

YOUNG GEOTECHNICAL PROFESSIONALS AWARDS

A total of eight awards have been made this year to young New Zealanders to attend the YGP Conference in Queensland in July 2004. The winning abstracts are presented below. A requirement of the award is that each winner makes their presentation to at least one branch meeting in New Zealand during the year. So you can expect to catch up with these presentations in your area.

The Diversity of The Geology In The Auckland Region And Some Of The Associated Problems For Land Development

By James Beaumont
Foundation Engineering, Auckland

The diversity of the geology within the Auckland region presents a range of problems for the geotechnical professional. This paper provides an overview of the Auckland geology and presents case studies of three land development projects within different geological settings, all of which presented a range of geotechnical problems to be addressed. The three lithologies include very soft organic peats within the alluvial lowlands of south Auckland, the Waitemata Group sedimentary deposits on the North Shore, and the Northland Allochthon Onerahi Chaos deposits of Silverdale. This paper also discusses examples of appropriate engineering solutions to some of the problems presented by these lithologies.

Geotechnical Aspects of the New Wellington Regional Hospital Development

By Melanie Henry
Tonkin & Taylor, Wellington

A large new Regional Hospital is to be constructed in the grounds of the existing Wellington Hospital. A number of geotechnical issues have been identified for this project.

- High importance facility in an area of high earthquake shaking hazard.
- Demolition and building work to take place around vibration sensitive hospital equipment and occupied hospital wards.
- Variable ground conditions influencing seismic amplification and complicating pile design.
- A 6 m high cut slope directly beneath an existing hospital building.

This paper discusses the scope of investigation and geotechnical design to address these issues. The investigation included a site-specific seismic study and on site vibration monitoring.

Retaining Wellington's Roads, Chaytor St Case Study

By Hadley Wick
Tonkin & Taylor, Wellington

Roads of Wellington city are often carved around steep greywacke rock terrain. Geotechnical engineers are faced with challenges to provide cost-effective solutions to retain the associated sidling fills, which often have poor stability. This paper presents a case study of a tied back, concrete palisade wall that was constructed to retain a section of Chaytor St in Wellington.

The project was challenging given the significant depth of fill, site constraints and high seismic design accelerations. An approach was adopted that relied on the anchors resisting the majority of lateral load and avoided the more traditional approach of resisting part of the lateral loads through embedment of the wall piles into the underlying rock. The paper discusses the design philosophy and summarises the construction of the tied back concrete palisade wall.

Geotechnical Design of the Rapahoe Bridge No. 1 North Abutment

By Richard Cole
Tonkin & Taylor, Wellington

Tranz Rail Ltd proposes to build a replacement rail bridge over the Grey River to link the Rapahoe Rail Line and Midland Line at Cobden (Greymouth) on the West Coast of New Zealand. The north end of the proposed bridge lands askew to the existing cut rail line bench. Consequently, a pile is required to support the north abutment and retaining walls are required, perpendicular to the railway alignment at the abutment and along the outer edge of the railway formation north of the abutment, to extend the railway bench on fill. The preferred option for the retaining walls consists of precast panels founded on a reinforced concrete beam cast against and anchored to the rock face. The post tensioning of the anchors and friction between the uneven rock face and the concrete beam provides vertical support.

This paper presents details of the geotechnical design of the north abutment include the investigations undertaken, the ground conditions encountered, selection of the abutment location, options considered, selection of design parameters, load cases considered and detailed design. The design included finite element analysis of the retaining wall.

Flexible Solutions in Flexible Ground, Te Ngaere Bay Slip Repair

By Tony Davies
GHD Ltd, Auckland

On Thursday 5th June 2003 a large crack appeared in Wainui Road above Te Ngaere Bay, part of the million dollar view tourist route in the Far North of New Zealand. The crack was initially sealed but continued to open up and by the 10th of June the road had subsided to the extent there was difficulty in traffic traversing the area. Concern was also expressed about the risk to several houses below the road and whether residents needed to be evacuated.

GHD was asked to urgently respond and report on the risk to road users and to properties below the road. The immediate risk was assessed and urgent safety-measures arranged to avoid the road being completely cut.

Site investigations were implemented and a report outlining the causes of the failure, the ongoing risk, recommended remedial measures and estimated costs of repairs was prepared within two days. The recommended repair was a reinforced earth wall and deep subsurface drainage. Design and contract documentation was prepared and issued to selected tenderers and awarded 10 days after the initial crack had appeared in the road. Due to the rapid response and limited investigations undertaken a flexible solution was chosen to allow modification and fine tuning of the design during construction resulting in an innovative and efficient solution.

Liquefaction Maps for Christchurch

By Brent Clough
Beca Carter Hollings and Ferner, Christchurch

Earthquake induced liquefaction is recognised as a potential hazard for hazard for some areas of Canterbury, and in particular Christchurch. Liquefaction maps have been previously published that show the hazard as a function of soil distribution but did not take into account the strength of soils. This would likely have exaggerated the hazard (as some soils of liquefiable grading may have been too dense to actually liquefy).

A liquefaction study was undertaken for the Regional Council to utilise the actual strengths of soils in Christchurch using data already obtained within the city boundary. The study required research of records held at local Regional and City Councils, as well as research into contractor/consultancy information to obtain permissible borehole and CPT records. A database was created to store key liquefaction information (such as soil type, soil strength and water table levels) and the key information was entered into the liquefaction database.

Calculation of the liquefaction hazard for Christchurch City was based on the information contained within the database (using the method of Youd & Idriss, 2001). The liquefaction analysis was completed using an automated program embedded within the database.

The main output for the project was the creation of a Liquefaction Hazard Map and Ground Damage Map, both at scales of 1:50,000.

Stability Analysis, Lake Hawea Control Dam Abutment

By Mark Sinclair
Maunsell, Auckland

The Lake Hawea outflow is controlled by a sluice culvert beneath an embankment dam. At the upstream end of the sluice, the embankment is retained by 9 to 12 m high counterfort and cantilever retaining walls. Of concern is the effect on retaining wall stability of a 3 to 4 m thick layer of gravels deposited upslope of the walls by on-going long shore drift, particularly retaining wall stability under seismic loading and this has been reassessed.

The paper details the method of stability analysis, modelling three dimensional effects of the dam abutment and wall geometries, modelling wall reactions, soil and hydrodynamic loads, and determination of seismic displacements. Different thicknesses of deposited surcharge material were modelled, as were different lake levels. Both drained and undrained conditions on the failure surface under earthquake loading were considered. Results are presented for stability, sensitivity, wall capacity and upstream shoulder displacements.

Assessment of Seismic Effects for the State Highway 2: Dowse to Petone Upgrade Project

Merrick Taylor
Beca Carter Hollings and Ferner Ltd, Auckland

The proposed realignment of State Highway 2 (SH2) from Petone overbridge through to the Dowse intersection in the Hutt Valley, Wellington, New Zealand, occurs within a region of high seismicity. Because of its location immediately adjacent to the active Wellington Fault (M 7.4) the site is subject to very large seismic design loadings (1000 year Return Period PGA of 0.65 g, Maximum Credible Earthquake PGA of 1.0 g). Geotechnical assessment of the site included a liquefaction analysis based on the results of a site-specific seismic hazard assessment. This analysis included assessment of the likely magnitude of induced ground subsidence, and of the effects on bridge piles, MSE abutments/ramps, and nearby commercial properties at Dowse. Results of the seismic assessment present significant challenges to bridge and MSE wall designers for this project in achieving compliance with Transit New Zealand design philosophy requirements. This paper discusses methodologies adopted for the liquefaction assessment, and the results and implications for the design of key structures.

NORTHERN AREA STUDENT PRIZE DECEMBER 2003

Two entries were received for the northern area student prize in 2003. The abstracts from both entries have been included in this publication for your information. Congratulations to Hamish White for his presentation entitled 'Integration and Interpretation of seismic and geotechnical data for a block cave mine' which won the Northern Student Prize.

The Society Management Committee has decided to change the format of the student prize in order to encourage further participation and make it more prestigious. Further information will be available about this shortly.

Integration and Interpretation of Seismic and Geotechnical Data for a Block Cave Mine

Hamish White

The need to mine economically by applying low cost underground mass mining methods and by mining larger, deeper, more competent and lower grade ore bodies is becoming increasingly important to the mining industry. Block caving is one of these low cost mass mining methods.

International mining research initiatives have identified that knowledge of caving mechanics under a variety of conditions is paramount to the future success of the underground mass mining industry. Currently, the key areas of caving mechanics research where seismic and geotechnical monitoring are important include:

- Rock mass characterization
- Understanding cave behaviour through back analysis
- Mechanics of caving
- Cave monitoring

Data collected during the course of this thesis comes from the most intensive mine-wide seismic and geotechnical monitoring system in the world, situated at Northparkes block cave mine.

This thesis describes the importance of seismic and geotechnical monitoring with respect to current mining industry research. Case examples of data collected from the monitoring system illustrate the role monitoring can play in understanding caving mechanics. Principally, seismic and geotechnical monitoring can aid in detecting pillar and abutment stresses, location of the cave back and provide quantitative analysis of activity for safety procedures and back analysis.

The integration of the two data sets covered in this thesis is considered a world first. Having seismic and geotechnical data available from the one platform enables comparisons to be made between an actual measure of the rock mass response (geotechnical) and that inferred from source parameters (seismic). Measurements are validated through rigorous documentation of system performance.

The system is modular and can be easily configured for other remote monitoring applications and instrumentation.

A Stroll Through Te Puia

Simon Morris

Te Puia hot springs have traditionally been accredited by Maori with healing properties. Since early Europeans visited them, they have been a tourist attraction on the East Coast for about a century. With the use of the springs as a healing source, Te Puia is also the location of the East Coast District Hospital (Te Whare Hauora o te Ngati Porou). In an effort to minimise costs for the hospital, it decided to assess the natural heat and gas discharge features of the area.

Massive units of sandstone dominate the surrounding geology. The local units at Te Puia are part of an early deformation phase known as the East Coast Allochthon. Te Puia is geographically located on the Deformation Belt of the Hikurangi margin. The margin itself sits offshore, and the eastern proximal sedimentary units to the Raukumara Central Ranges buttress the accreting sediments. Te Puia sits on the western edge of the Accretionary Prism complex.

The landscape surrounding the hospital is unforgiving. Te Puia itself is located on top of a large complex landslide. The effects of the landslide can be seen about the hospital, on car parks and roads. The large coastward slide complex is most probably associated with or in mélange. A previous model suggested this area sits on a crush zone. Coastal erosion destabilises the toe and encourages further movement.

A prominent slope failure mechanism in Te Puia is regolith sliding which causes significant damage to farms and property, particularly around Pukeiti Stream, west of the thermal area. Failure is commonly induced during heavy rainfall. Susceptible areas are planted with trees. The regolith failure is chaotic, with little or no preservation of the internal structure of the material.

The springs themselves, are thought to be formed from the dewatering system of the Accretionary Prism complex in the bedrock. The concentration of thermal activity is located at the western headscarp of the coastward moving large slide mass.

The spring's contents are dominant bicarbonate, chloride, sodium and sulphate. Natural gas seeps are also common in the area. Seasonal fluctuations of around 10% are observed with temperature ranges from 42.5° to 72.2°C. Discharge rates of the springs vary between 5.98 ls^{-1} and 5.09 ls^{-1}. Chloride contents of the springs range from 5824 ppm to 8772 ppm. Bicarbonate ranges from 81 ppm to 309 ppm.

There are approximately 13 springs within the reserve, of which 5 were previously known. Common deposits include travertine terraces and mats, calcareous deposits left by dissolution of bicarbonate in the water. Mt Molly, which dominates the immediate relief of the area, is a large mass of travertine.

Invitation

The Austrian Society for Geomechanics has the pleasure to invite you to the ISRM Regional Symposium EUROCK 2004 in conjunction with the 53rd Geomechanics Colloquy.
The International Society of Rock Mechanics (ISRM) was founded in Salzburg in 1962 as a result of the enlargement of the so-called "Salzburger Kreis", formed around Prof. Leopold Müller. The Geomechanics Colloquy in Salzburg since its initiation in 1951 has always been a perfect meeting place for researchers and practitioners. The success of this concept not only shows in the continuous meetings over more than 50 years, but also in the attendance of regularly over 650 participants.

Aims and Scope

It can be observed in many countries around the world, that geotechnical engineering is often oversimplified. It is quite true, that experience is an important factor in rock engineering projects, but a sound engineering approach always should accompany design and construction. During the conference several topics related to design, construction, monitoring, and maintenance will be addressed.

Symposium Venue

The Symposium will be held at the Salzburg Convention Centre, which is located very close to the center of the city. Salzburg itself is famous for its unique scenery and atmosphere.
For more information on the city visit following web site:
www.salzburg.info

Important Dates

Submission of abstracts	January 15th, 2004
Acceptance of abstracts	February 15th, 2004
Submission of papers	May 15th, 2004
Deadline for registration	September 1st, 2004

Correspondence

Submit abstracts to: eurock2004@tugraz.at

All other correspondence related to the Symposium shall be addressed to:
Austrian Society for Geomechanics
Paracelsusstrasse 2
A-5020 Salzburg, Austria
Tel: ++43 (0)662 87 55 19, Fax: ++43 (0)662 88 67 48
E-mail: salzburg@oegg.at
Web: www.oegg.at

Proposed Sessions

The Symposium will cover following themes

Consistent Methods for the Geomechanical Design of Underground Structures (A)

The principles of the Austrian Guideline for geomechanical design of underground structures will be outlined and first experiences with its application discussed. Contributions with examples of the application of consistent design methods for underground structures are welcome.

Support Methods ahead of the Tunnel Face - Function and Applications (A)

Jet grouting, spiling and pipe umbrellas are widely used practices for the support ahead of the face. In spite of its wide application, design methods are still not developed to an acceptable level. The function of such methods shall be discussed and successful / less successful applications demonstrated by case histories.

Geotechnical Monitoring of Engineering Structures (A)

Short term and long term monitoring, data evaluation and interpretation, alarm levels and criteria. The focus will be on long-term monitoring.

Rehabilitation and Upgrading of Underground Structures (A)

Many tunnels, galleries and caverns have come into age. Natural aging processes, increased traffic volume, and revised safety standards require reassessment of stability, repairs, and reshaping. Methods of assessment, analysis, and construction will be discussed.

Determination of Rock Mass Properties (B)

This topic is an "evergreen", but it appears that there is ample room for improvement. Empirical, experimental, and numerical approaches shall be discussed and reviewed with respect to their applicability.

Rock Excavation (B)

Optimization of cutting and blasting techniques, influence of rock and rock mass parameters on performance, vibration and induced damage are topics of this session.

Numerical Modelling – Continuum versus Discontinuum Models (B)

Presently no satisfying criteria exist which model is appropriate under which circumstances. Case studies and back analyses, as well as theoretical aspects are discussed.

Languages

Conference languages will be German and English. Simultaneous translation is provided in the plenary sessions (A). In the parallel sessions (B) the official language is English, no translation will be provided.

Technical Visits

Technical visits to important rock engineering sites and tunnels will be organized on October 9th.

Accompanying persons program

A program will be organized for accompanying persons.

Organization

Organizing Committee

Wulf SCHUBERT (Chair)
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Chris HABERFIELD
Marek KWASNIEWSKI
Frantisek KLEPSATEL
Jakob LIKAR

Registration Information

Registration before August 15th, 2004

OeGG & ISRM members	€ 200.-
Regular participants	€ 260.-
Students	free

Late registration

OeGG & ISRM members	€ 240.-
Regular participants	€ 300.-
Students	free

Registration fee covers the Symposium participation and the proceedings.

Technical Exhibition

Exhibition facilities are available at the symposium venue. Due to strong interest, interested companies are advised to book early.

Notice

Austrian Tunnel Day

The 4th Austrian Tunnel Day will be held on October 6th also in the Salzburg Convention Centre. The conference is organized by the Austrian ITA national committee and focuses on practical aspects of tunnelling and site reports. The Tunnel Day can be booked in conjunction with the EUROCK 2004 / Geomechanics Colloquy.
A detailed program will be available early in 2004.

CONFERENCE REPORTS

9th Australian New Zealand Conference on Geomechanics

8–11 February 2004, Hilton Hotel, Auckland

Reported by: 'Phil Flash', for *NZ Geomechanics News*

I didn't turn up on time to the 9th Australian New Zealand Conference on Geomechanics, but I sure knew I had arrived. I've never been to the Hilton before, and was immediately impressed by the venue. Funny how provincial southern boys are easily awed of the glitz and glamour of the big city and the harbour setting. I was greeted by familiar friendly faces including some from across that the ditch that I hadn't seen for a while, and I knew it was going to be a good few days.

Unfortunately I was not able to make it to Prof Martin's Keynote on the first morning, but by all accounts it was a superb, wide ranging introduction to the conference. Prof Martin managed to include state of art references and comments on many developing aspects of geotechnology.

I did make it to Laurie Wesley's NZ Geomechanics lecture the next day and was pleasantly surprised by the presentation and that, as a simple engineering geologist, I understood most of it. ET Brown's John Jaeger Memorial Lecture was equally impressive. I enjoyed this journey through Prof Brown's extensive experience in dealing with rock, for all sorts of purposes, including the Hot Dry Rock Geothermal Energy prospects in South Australia.

The paper presentation sessions were most enjoyable. With the two parallel sessions providing enough variety and interest for all, it was often a difficult decision to decide which presentation to go to. The venue worked well and the facilities were excellent. The presentations were of a high standard and in the slope stability session I chaired, it was very difficult to judge which should be considered for an award. Grant Murray, in his inimitable style, entertained with an account of Mine Waste Risk assessment using all of three slides as I recall. In contrast Graham Hancox gave a superbly graphic tour of the effects of the Mw 7.2 Fiordland earthquake of 22 August 2003. Ben Rouvray demonstrated how to monitor freeway batters extensively using the West Charlestown Bypass project in Newcastle as an example and Allan Garrard had a good case-study of a slow-moving landslide from Bellarine Peninsula, Victoria. Jon Sickling presented work on seismic stability of New Zealand hill slopes using Wellington and Auckland examples.

Hot Topic sessions were held as the last session on the Monday and Tuesday, with three topics to choose from each afternoon. Each session had a panel of experts and a learned chair. On Monday afternoon the topics included Piling, Footings on Reactive Soils and Geotechnical Risk, and on the second afternoon Earthquake Geotechnical Engineering, Rock Shear Strength and Numerical Modelling. I couldn't attend all of these for obvious reasons, but I was disappointed that the Geotechnical Risk topic became dominated by a discussion on practitioner liability rather than assessing geotechnical risk.

An important aspect of any conference are the social events and no less so at this conference. The Powhiri and officially opening on the Sunday night was a most fitting, traditional Kiwi start to the conference that impressed us all, while the drinks and snacks provided the opportunity to catch-up with old friends and meet new ones. The balcony venue overlooking the harbour provided an inspirational backdrop. The morning and afternoon teas and lunches were served in the same space as the posters and trade displays and this enabled technical interaction to continue beyond the formal sessions.

The highlight of the social programme had to be the 'mystery' dinner. The well kept secret venue and the Pacific theme was colourful and full of fun. We were met at the steps of the Auckland Museum by Cook Islanders, laes and champagne and then treated to a spectacular display of Cook Island song and dance. This was followed by a tour of the pacific exhibition of the Museum and then into the entrance foyer which was the dinner venue. Many had joined in the fun with Pacific style dress, and the dining area was equally colourful, with lighting and pacific flower centrepieces at each table.

We were entertained by a choir from the cloisters and by the compare for the evening, who poked good natured fun at all Pacific Island cultures, and hosted a quiz on the Pacific Islands. This bought out the competitive nature of many geotechs, including some fierce trans-Tasman rivalry as well as collaboration, akin to the spirit of CER. My only objection was that NZ was not considered to be part of the Pacific, which meant that my answer to the question of the number of Pacific rugby teams that performed a traditional challenge before the game was wrong. The dinner tables placed amongst the large columns of the massive museum foyer were an impressive feature of the dinner venue but contributed to the poor acoustics which was the only down side of the night.

To the eNZ of the Earth – a little South Pacific paradise in the bottom-left (or is it the top?), eastern hemisphere of the globe… but boy, can we educate, entertain and turn on a party.


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STANDARDS, LAW & INDUSTRY NEWS

Managing Ourselves and Others at Work – Promoting Lucrative Personal Skills

Alaa Ahmed-Zeki, Hobart-Tasmania, Australia

Introduction

Geotechnical practitioners have learned that soil mechanics is a science associated with some level of art. People management, on the other hand, can probably be claimed to be an art associated with some level of science. Many would say that practising the latter is just a matter of common sense, and they are probably right, provided that they have the right traits, and get the training they need.

As many would agree, the prerequisites to be a successful technical person are quite different to those required to become a successful manager responsible for managing staff. However, there can be a safe transition from being a purely technical team member to a team leader, so long as we have chosen the right person, and have enhanced their capabilities with the right training concepts.

The idea of writing this discussion article originated from the observation that many geotechnical practitioners, similar to others working in the engineering field, rise to managerial positions with little verification of the crucial personal skills they will need in their challenging new role. Unfortunately, in many firms, appointing a manger or a practice leader is some form of reward. If we are keen on improving our workplace environment and reduce staff turnover, then current and potential team leaders will need to actively work on improving their personal skills. Admittedly, this is not an easy task, as we will see in this article, but can certainly be a very lucrative and a fulfilling one.

Better Communication Skills in the Workplace

A survey was carried out by www.CareerOne.com.au (Ref. 1) requesting a response to the question: 'What would improve your workplace?'. The results of this survey have shown that the top-ranking factor registered by people on the world-wide web (accounting to about 39% of the responses), was Better Communication. The second highest factor selected was to have Flexible Work Hours, chosen by 19% of the respondents. Poor communication between managers and their subordinates, kills morale, creates frustration and ultimately leads to high staff turnover. More details will be discussed in the following sections.

A Challenge for Employers

The international recruitment firm Hudson has conducted a survey, which involved 7500 Australian employers to nominate their top human-resources (HR) priority for this year (Ref. 1). In their 'Hudson's Report', the highest percentage (36% of those surveyed) of employers surveyed identified Staff Development and Retention as their organisation's highest staffing priority for the year 2004.

Despite this relatively high percentage of employers (and this was applauded by the Hudson report), this percentage appears to the writer fairly low. What it means is that two-thirds of the surveyed employers did not tag this issue for highest priority in their workplace. The second highest number of employers (30% of those surveyed) considered performance enhancing and productivity as the most important.

Hiring the right staff, retaining and developing them, requires team leaders that have the right personal and interpersonal skills.

ANZ Dominant Management Style

A study of 166,410 managers in Australia and New Zealand found the dominant style of our leaders to be 'avoidance'. Avoidance behaviour hardly wins trust and respect (Ref. 2).

How often have you chosen indirect communication channels when you had to deliver bad news that may elicit a strong negative or highly charged emotional response (questioned Margot Cairnes in Ref. 3)? How often have we taken the coward's way out and sent an email or a letter rather than pick up the phone or meet with someone face to face? It appears that many leaders are so uncomfortable with conflict and emotion that they will do almost anything to avoid dealing with it.

Those who adopt avoidance as their management style are reactive managers. If we are so preoccupied protecting ourselves and feeling threatened, our ability to properly evaluate people's performance, capabilities and work attitudes will be in much doubt. We will loose the trust and respect of clients if we were not proactive in communicating with them on a regular basis regardless of the intensity of the situation. Typical reactive managers find their comfort in adopting the 'ostrich' and 'panic room' approaches and will find they are constantly responding to calls of urgency for 'fire fighting', due to awkward situations they have created themselves.

How often have reactive managers run away from situations by saying ‘I can’t remember’? How often have they shied away from challenging poor behaviour in their workplace? How often have they given others and themselves excuses for sub-standard communications saying ‘we are just too busy’?

People and Work

Research by I. Mitroff & E. Denton (cited in Ref. 4) has shown that people gain meaning and purpose at work through (in order of importance):

1) The ability to realise their full potential as a person
2) Being associated with a good/ethical organisation
3) Having interesting work
4) Making money
5) Having good colleagues/being of service to humankind
6) Being of service to future generations
7) Being of service to the immediate community

According to the *Theory of Hierarchy of Needs* (Ref. 5), people behave according to their internal needs they attempt to fulfil. The types of Needs can be categorised as follows:

- Pysiological needs (survival; water, food, shelter)
- Safety needs (feel safe, secure and free from threats)
- Belongingness needs (desire to affiliate & be accepted by others)
- Esteem needs (gaining positive self-image, feeling valued & appreciated)
- Self-actualisation needs (opportunity to reach full potential).

Observations show that success depends primarily on the person. Ruth Ostrow, a journalist in the Australian newspaper quoted the following (Ref. 6): ‘Therapists believe we only grow when we push ourselves out of familiar terrain, out of our comfort zone, when we take risks and move boundaries’.

Most smart people love to learn specifically when it comes to Leadership training courses. However, very few are keen to change. To avoid change, some people negate the value of what they have difficulty in seeing and comprehending. As mentioned in Ref. 7, ‘(current) leadership training courses generally do not work because we are teaching people what they like, rather than what they need’.

It is worthwhile to note here that a manager operating in the ‘Safety’ mode will struggle communicating with subordinates operating in the Self-Esteem and Self-Actualisation modes.

Towards Enhanced Management Skills

In simple terms, and as is the case with the selection of any candidate for a vacancy, we choose team leaders based on their:

- Ability (or job readiness, which includes skills, capability, knowledge and experience), and,
- Willingness (or psychological readiness, which consists of confidence, commitment and motivation to complete the task).

However, we need to breakdown these two categories more to ensure they are well understood and properly applied. Based on responses to a survey from 287 project managers in USA, the attributes that a successful project manager requires in the order of their importance are (Ref. 8):

Communication Skills (selected by 84% of the respondents)
a) Listening
b) Persuading

Organisational Skills (75%)
a) Planning
b) Goal-setting
c) Analysing

Team Building skills (72%)
a) Empathy
b) Motivation
c) Team spirit creation

Leadership Skills (68%)
a) Sets an example
b) Energetic
c) Vision (big picture)
d) Delegates
e) Positive

Coping Skills (59%)
a) Flexibility
b) Creativity
c) Patience
d) Persistence

Technological Skills (46%)
a) Experience
b) Qualifications

Jim Collins in his book *Good to Great* (cited in Ref. 9) outlines a form of leadership he calls Level 5. Level 5 leaders he describes as having a paradoxical mix of humility and will. They know where they are going and are committed to getting there. However, they do not impose their will on others but rather create environments in which people can thrive, learn and grow. We rarely hear the names of the Level 5 leaders because they are so busy giving credit away to others.

Cairnes in Ref. 9 was critical about leaders being passionate about their work (which she sees that that can be destructive) and she rather likes to see the 'commitment' attribute instead. This point of view about 'work passion' appears to be affected by the post 9/11 atmosphere, as we notice Cairnes citing leaders like Hitler and Bin Laden, being too passionate about what they did and believed in.

The writer of this article believes that similar to 'Love', there is nothing wrong with being passionate about one's work. If there was a problem in those situations then it is in the people themselves. Every now and then we hear about lovers who have exercised violence against each other.

Team Management Styles

Based on the 'Situational Leadership Theory' (Ref. 5), leadership or team management styles could be:

- Directive or the Telling style
- Supportive or the Selling or Coaching style
- Participative or the Consulting style
- Achievement-oriented or the Delegating style

Choosing the right style depends on the successful judgement of the team leader in assessing their team member's 'readiness'. Without the right skills for the team leader to make the right judgement, there will not be any positive leadership and the whole process falls apart. A re-visit to Section 6 above becomes necessary at this point.

Work Delegation

Positive change comes from sharing power (Ref. 10). This leads us to the issue of work delegation. A separate section is allocated here to 'delegation' due to the observed difficulty most team leaders face in adopting it as a fruitful management style. Delegation is not about giving someone a task to perform; it means giving someone a result to achieve. It involves giving the subordinates the authority to decide without consulting the manager. However, the manager cannot delegate accountability. Observations have indicated that the issues that prevent mangers from proper delegation are (Ref. 8):

- Fear of losing control
- Regret at giving up jobs they enjoy
- Belief that they can cope with the job

Good managers succeed in the delegation process when they resist the temptation to intervene in the work of their staff. Many managers confuse that with Quality Assurance procedures, knowingly or otherwise.

Why Have Managers Failed?

The main five common factors that prevented managers from succeeding and moving upwards were found to be (Hal Richards in Ref. 12):

1) Inability or unwillingness to build relationships
2) Failure to meet business objectives
3) Inability to build and lead a team
4) Inability to adapt to new situations, cultures, structures and businesses
5) Inadequate preparation for promotion

Richards described these managers as 'derailed' and stated that the most common derailing behaviours include:

- Procrastination
- Defensiveness
- Perfectionism (especially when it comes to other people's work)
- Rigidity
- Inability to trust others

Great (management) boards have social systems characterised by trust, open debate, mutual respect and individual accountability, while boards that under-perform and oversee corporate collapse are characterised by rigid roles, game playing, political posturing, buck passing, poor communication and lack of transparency (Ref. 13).

What Distinguishes the Most Successful Consultants?

Maister (Ref. 14) answers this question as follows: It is the characteristic variously described as energy, drive, enthusiasm, motivation, morale, determination, dedication and commitment. This is what our clients will look for when comparing us to our competitors. The main factors that stand out that create this characteristic (or otherwise kill it) are the skills and behaviour of the practice leaders. This applies to individuals as much as it applies to companies.

Learning From Experiences and Moving Forward

As an engineering consultancy puts it quite rightly in a vacant position advertisement:

> 'We know it is people that make the real difference and this drives us to attract, retain and develop professionals of the highest calibre'.

As managers and team leaders, it is crucial that we proactively think about what to do on a day-to-day basis to achieve this vision. Managers should be responsible and accountable for the welfare of their staff as much as they feel responsible for their department's financial performance, and they should show perseverance in applying healthy practices in their workplace.

Companies need to select people with the right characteristics/attributes and build on that wealth by training them to improve their skills. The leadership training programs should focus on the individuals' needs rather than on what they like.

The key to success here is in the genuine attempts to learn better communication skills and the ability to change, not by 'faking it' or by pretending to have it. There was a manager of 30 years technical experience, responsible for 40 people, who had the habit of using 'buzz words' during group personal development workshops, words like 'empathy' to indicate possession of this trait. Ultimately, that manager was transferred to the marketing department after a number of staff moved out. If negative surprises originate from your side, then you are a 'derailed' manager.

Many team leaders will say that they know all this jargon about personal and people management skills but they are too busy doing the 'real work'! As a team leader, you are obliged to create a learning environment: Always learn the basics, do the basics, and keep learning. Ask yourself: Do you have measures that tell you whether you are or aren't managing your team successfully?

To succeed in their staff management role, team leaders need not only welcome and properly and timely address feedback from staff they manage, it is in fact their responsibility to actively seek and address staff feedback and properly address it with no undue delay.

So do your homework, learn and change, and you will have a healthy workplace, improve morale and productivity of your team, will control human stress level, improve your life and keep on climbing!

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REVIEWS

Foundation Design Codes and Soil Investigation in View of International Harmonization and Performance Based Design

The Japanese are in the process of developing a foundation limit state design code and held the above symposium in 2002 as a stage of its development. A total of 41 papers and a draft version of the new Japanese foundation design code (Geo-code 21) are presented in the Symposiums proceedings and are published under the following sessions titles;

- Theme and Key Note Lectures.
- Session T-1: Limit State Design Codes.
- Session T-2: Professional Practice.
- Session T-3: Geotechnical Design and Site Investigation.
- Session F-1: Load Resistance/Multiple Resistance Factor Design for Foundation Engineering.
- Session F-2: Slopes and Pile Foundations.

The Symposiums theme speakers included T.L.L. Orr, I.G. Buckle and F.H. Kulhawy who presented papers on the development and use of limit sate codes in Europe and North America, notably Eurocode 7 and the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD).

Topics of papers presented in Session T-1 included, a history of usage of limit state design codes in Denmark, comparison of a design of a flexible cantilever retaining wall using Eurocode 7 and classical methods, and a collection of papers on the design of pile and shallow foundations using various limit state design codes.

In session T-2 several papers were presented on investigations in clays and determination of their strength properties for sites in Korea, Japan and the United Kingdom. Papers were also presented on forensic Geotechnical engineering, a review of ground improvement design codes and the use of performance based design contracts in Geotechnical consulting.

Papers discussing the use of Geotechnical investigation and testing design codes in Europe and Japan were presented in Session T-3.

A series of papers discussing the use of load resistance/ multiple resistance factors in the design of foundations were presented in session F-1. Including references to design practice in Hong Kong, Japan, Australia and the US, notably the K.K. Phoon, F.H. Kulhawy and M.D. Grigoriu coauthored EPRI study *Reliability-Based Design of Foundations for Transmission Line Structures*.

Papers discussing the performance-based design of foundations and analysis of slopes were presented in the final session, F-2. Individual topics included the finite element analysis of slopes and shallow foundations, SPT-based methods of pile bearing capacity analysis, and the performance of piles both under static and seismic conditions.

Generally the papers were of a high standard and varied enough topics that there would be something of interest to most, and especially to those who have a passion for the topic, however few papers contained references to New Zealand.

Reviewed By: Michael Laws.
Sinclair Knight Merz.

Foundation Design Codes and Soil Investigation in View of International Harmonization and Performance Based Design – Proceedings of the International Workshop on Foundation Design Codes and Soil Investigation in View of International Harmonization and Performance Based Design, IWS Kamakura 2002, Tokyo, Japan, 10–12 April 2002

Editors:	Yusuke Honjo, Osamu Kusakabe, Kenji Matsui, Masayuki Kouda and Gyaneswor Pokharel.
Publisher:	A.A. Balkema
Year published:	2002
ISBN:	90 5809 381 6
Web shopping at:	http://www.balkema.ima.nl
Price:	150 euro

A Short Course In Soil And Rock Slope Engineering

This hardbound book, first published in 2001, is a treatise of 432 pages, divided into Part 1, Soil Slopes, (192 pages), and Part II, Rock Slopes (185 pages). It is written in S.I. units, and supported with 3 pages indicating the correct S.I. units to use, Bishop and Morgenstern's Stability Coefficient Charts, (13 pages), and Hoek - Bray's Stability Coefficients (6 pages). It includes 2 pages of data for a worked example and incorporates the research work in references and bibliography of no less than 446 items.

The authors (including Dr. Bruce Menzies, a 1962 graduate from the University of Auckland), have cooperated with many to produce this extensive and thorough course for the lecturer, student and geotechnical engineer. It is now an established reference work.

It is a direct and easy-to-read presentation of the analysis and application of the essential engineering principles for soil and rock slopes. It is applicable to not only British engineering locations, but worldwide, including the particular difficulties faced by NZ geotechnical engineers.

The authors capture the reader's attention with sequence photographs of two extraordinary failures:

- 11 December 1993 Kuala Lumpur, Malaysia, Highland Towers. 90 degree rotation from an earthflow.
- 7 April 2000, Dorset, England, columnar rockfall.

They have thoroughly researched historic and modern geotechnical engineering papers. Worldwide classic engineering slope and rock failures are provided with an in depth presentation of the failure, an analysis and effective remedial solutions. Included is the authors' own university (University of Surrey) study of the economic use of trench subsoil drains to increase the Factor of Safety against by 42% to justify the use of failed land for university buildings.

The authors have written a specific chapter on Stabilizing and Investigating Landslips taking into account subsoil drainage. Machine driven horizontal subsoil drains are becoming popular as a mitigation or remedial option in NZ geotechnical engineering, and an applicable chapter is included.

Included with the purchase is a SLOPEW Student Edition CD and a supporting Tutorial Chapter. An extensive software index is provided. The reader is confidently led through the analyses by the authors. They have spared no effort, with aerial photographs, illustrations and site plans leading to worked examples.

This is a highly recommended short course for both teaching and as a necessary usable working reference for every geotechnical engineer.

Reviewed by: Paul Finlay
Waitakere Consulting Engineers

A Short Course in Soil And Rock Slope Engineering

Editors:	Noel Simons, Bruce Menzies & Marcus Mathews
Publisher:	Thomas Telford
Year published:	2000
ISBN:	0 7227 2871 7
Web shopping at:	http://www.t-telford.co.uk
Price:	£45 Hardback

A Short Course In Geotechnical Site Investigation

I was introduced to the original volume in the Simons and Menzies (and subsequently Matthews) short course series, Foundation Engineering, when working in London in the 1980s. That first volume has been amongst my most widely consulted references since then, and I recently replaced it with the 2nd edition. It was, therefore, with some eagerness that I offered to review the latest addition to the short course series, Geotechnical Site Investigation.

This volume, and in fact the entire three volume series, is based on University of Surrey short courses. To quote from the preface to Geotechnical Site Investigation, 'These courses were designed not only to familiarise students with the practicalities of geotechnical engineering but also to refresh the knowledge of practicing engineering geologists and civil and structural engineers.'

Geotechnical Site Investigation concentrates, quite correctly for a 'short' book, on planning a site investigation. To repeat advice given by Glossop in 1968, 'If you do not know what you should be looking for in a site investigation, you are not likely to find much of value.' This book aims to help bring the reader to the point of being able to design a comprehensive site investigation. It is divided into four chapters: Planning and conceptual design; The desk study and walk-over survey; Geotechnical hazards and risk management; and Parameter determination: classic and modern methods. Each chapter is illustrated with comprehensive and wide ranging case studies, which I found particularly informative. Thorough listings of more detailed (and, relatively up to date) references are provided.

Chapter 1, Planning and conceptual design, provides an overview of UK practice in terms of borehole layout and spacing, and emphasises the value of developing a geological model. That essential element of all geotechnical engineering, knowledge of precedent, is used very effectively with eight case studies reflecting the investigation of a number of different issues using a range of approaches. Each of these examples shows the importance of targeting investigation efforts to particular design issues or geotechnical risks.

The second chapter covers desk studies and walk-over surveys. It is, naturally, related to UK practice and sources of information. As a result, it is the principles rather than the detail that are of more relevance to the New Zealand practitioner. A useful aide memoire to classes of information for geotechnical desk studies is provided, along with guidance on potential sources of information. I found the 12 page section on the use and interpretation of aerial photography particularly thorough (as an introduction) and useful. Similarly, the five pages devoted to walk-over surveys also provide a useful introduction to this important part of our work as geotechnical engineers.

Geotechnical hazards and risk management are addressed in the third chapter. Entire books have been written on each of these aspects, so again one can only expect an introduction here. The first part of the chapter, dealing with hazards, is somewhat patchy in its coverage of the subject, while the 46 pages devoted to risk management are well structured and provide a valuable introduction to this increasingly more rigorously considered aspect of geotechnical engineering. It contains recommendations for making geotechnical investigations more effective, which I found particularly thought provoking. Software supported risk management is described, drawing heavily on the CIRIA RiskCom system. Again, this provides an introduction to a rapidly growing field.

The final chapter covers parameter determination, and I was hoping to find a whole lot of useful charts and correlations which would justify me keeping this book within easy reach on my desk. Unfortunately, this is not the case, and other references will need to be consulted. Key laboratory and field test methods are described and for the most part are as relevant to New Zealand practice as they are to the UK. There is a comprehensive discussion on sample disturbance, which is worth careful reading. The Standard Penetration Test is virtually dismissed, which was disappointing. I was hoping for not just correlations but also a discussion on efficiencies and the many and various correction factors that apply to this test. In contrast, particularly useful introductions are provided to cone penetration testing, pressuremeters and various seismic/geophysical test methods.

Appended to the main text is a copy of the 1957 Soil Mechanics Ltd manual entitled Writing Reports. While this document reflects the time it was published, the essential principles of site investigation report writing are clearly explained. Many of us would, I suspect, benefit from reviewing our own 'house style' of reports against this.

In summary, Geotechnical Site Investigation very much reflects the other part of its title. It is equivalent to a short course, offering an introduction to site investigation techniques and practice. It very much focuses on planning rather than interpretation of investigations, and as a result will occupy a different place on my book case to the companion volume on Foundation Engineering. For an experienced practitioner, it provides a very good read (though I suspect few of us have the time to settle into a book of this nature). It would also provide a valuable introduction to the 'next' level of geotechnical site investigation for younger geotechnical engineers with a few years of experience, particularly if they were about to head off to the UK on their OE. Geotechnical Site Investigation certainly meets its stated aim of bringing the reader to the point of being able to design a comprehensive site investigation, though any such design will always need to be tempered by the realities of the New Zealand marketplace.

Reviewed by: Gavin Alexander
Beca Infrastructure Ltd

A Short Course in Geotechnical Site investigation

Editors:	Noel Simons & Bruce Menzies
Publisher:	Thomas Telford
Year published:	2000
ISBN:	0 7227 2751 6
Web shopping at:	http://www.t-telford.co.uk
Price:	£45 Hardback

Geotechnical Engineering in and out of the Ivory Tower

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Summary: An account is given of the results of various research activities undertaken since the writer's move from geotechnical engineering in the outside world to the "ivory tower" of Auckland University. The motivation for much of this research arose from practical situations encountered while working outside – in the employ of government agencies and an Auckland consulting company. The research described covers retaining forces for steep slopes, back analysis applications, seepage studies, and the behaviour of compacted clay and clay embankments. A large number of students from many parts of the world, mostly postgraduate, but including some undergraduates, have contributed to the research described in this paper.

INTRODUCTION

Geotechnical engineers, especially those who work in the consulting world, know only too well that time and financial constraints impose severe restrictions on the opportunities available to them to do much more than satisfy the immediate expectations of client and employer. Taking time out from the daily demands of the office to look a little deeper into some of the technical problems and issues encountered along the way is not an easy matter. As the title of this lecture implies, the writer has worked "outside" the ivory tower - in the employ of government agencies in both New Zealand and Indonesia, and for a consulting firm specialising in geotechnical engineering; that experience forms the background to this paper. The consulting world is both a stimulating and demanding environment, and I have pleasant memories of my time as part of it. At the same time I found the constraints of time and cost somewhat frustrating, because of the many occasions when I would have liked to step aside for a few days, or maybe longer, to think about and investigate issues relating to particular jobs I was involved with.

The university environment, at least until recently, has been more relaxed, and much less controlled by time deadlines and profit margins. Research has always been one of its functions, and spending time thinking about and debating issues part of its ethos. Since retreating into the "ivory tower" about 17 years ago, I have attempted to make use of the opportunity this provides to investigate some of the technical questions which challenged or interested me during my existence in the outside world, and which I always intended investigating further, but never found the time to do so. The results of some of these investigations are described in this lecture.

SLOPE STABILITY AND BACK ANALYSIS STUDIES

Retaining forces for cuts in steep slopes

A problem that geotechnical engineers come up against from time to time is how to determine the forces needed to support vertical or near vertical cuts in steep slopes. Sometimes these cuts are made simply to provide extra level ground at the rear of a house site, or to make room for extensions to a factory or some other building. The slopes involved are sometimes very steep and clearly without large safety margins against slip movement, even before the cut is made. They may be very large slopes, essentially "infinite" as far as theoretical analysis is concerned. Estimating the forces needed to retain cuts in such slopes is often a difficult undertaking, especially if the slope material is not homogeneous, and groundwater conditions are uncertain and change with time. Slopes in residual soils in particular may consist partly of soil and partly of highly weathered rock, containing considerable coarse material, so that the challenge of measuring or assigning shear strength parameters to the material is quite formidable.

The particular job that made me give some deeper thought to this problem was a proposed new highway in Malaysia, from a place called Kerling (between Kuala Lumpur and Ipoh), to the Fraser Hill holiday resort area. The planned route passed through rugged hill country with steep slopes, on some of which large translational slides had occurred in the not too distant past. Any cuts made would need to be retained with tied back walls if large scale instability was to be avoided, and estimates made of the forces which could be expected to act on the walls. I suppose the orthodox way to approach this situation would be to sample the soils and measure their strength parameters in order to undertake a Coulomb wedge analysis, or use the parameters in some ready made formula for earth pressure. Sampling and testing the soils was not an attractive proposition. Getting drilling rigs into the area was difficult enough, given the usual budget and time constraints, and the rather heterogeneous nature of the residual soils involved made testing and selection of representative parameters difficult.

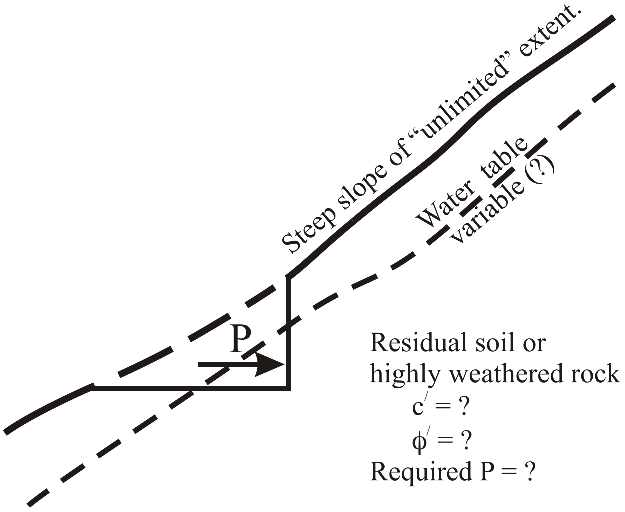


Figure 1. The problem addressed.

Rather than attempt measurement of, or guess at, the soil strength parameters, it seemed that back analysis might prove a more productive approach, so I set out to do this. Figure 1 illustrates the problem. The slope is considered to be of unlimited extent, and the water table depth dependent on seasonal and weather conditions. The starting point of the analysis was the assumption that the slope was of infinite extent, and was in a state of limiting equilibrium. From these assumptions soil strength parameters can be obtained by back analysis; these can then be used in a conventional Coulomb wedge analysis to determine the required force. An assumption has to be made about the depth of the water table and one of an infinite number of possible combinations of c' and ϕ' must be selected.

The analysis produced a rather surprising result, at least at first sight, namely that the resultant force became less as the assumed slope angle was increased. This didn't seem right; along with most geotechnical engineers, I had the idea that the steeper the slope behind a retaining wall the greater the force on the wall. However, I think I persuaded myself that the analysis was essentially correct, and used its results in a report recommending force levels for the design of the retained cuts. Time did not permit a fuller investigation of the method and a thorough check of its validity. After moving to the university, I had a project student look into the method and repeat my analysis, looking at a wider range of cases. His analysis fortunately came up with results essentially the same as my earlier results, and I will describe briefly the way the analysis is done.

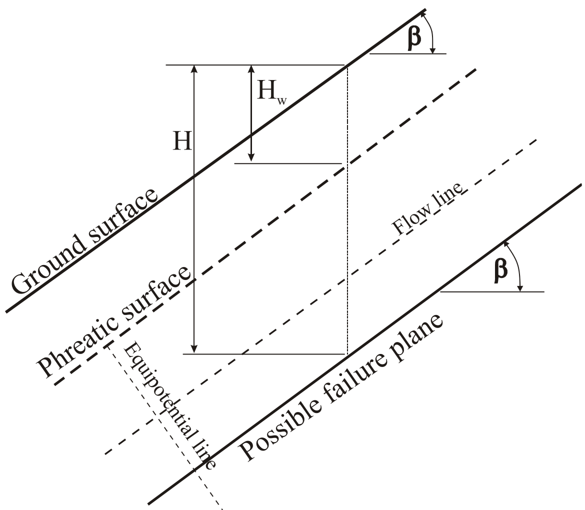


Figure 2. Assumed situation of an infinite slope at limiting equilibrium.

Figure 2 illustrates the basic assumption of an infinite slope, which is assumed to have a safety factor of unity. Possible failure on a plane at depth H is postulated and the equilibrium of the layer of soil above this depth is investigated. The ground water level is at a depth H_w below the surface, and seepage is assumed to be parallel to the surface. Equipotential lines are thus perpendicular to the surface. Static analysis of the equilibrium of the soil mass above this possible translational failure plane at depth H does not produce a unique set of strength parameters, only a range of possible combinations of c' and ϕ'.

The expression for the safety factor is:

$$S.F = \frac{c'}{\gamma H \cos\beta \sin\beta} + \left[1 - \frac{\gamma_w}{\gamma}\left\{1 - \frac{H_w}{H}\right\}\right]\frac{\tan\phi'}{\tan\beta} \quad (1)$$

For the case of limiting equilibrium, (S.F. = 1), this becomes:

$$\frac{c'}{\gamma H \cos\beta \sin\beta} = 1 - \left[1 - \frac{\gamma_w}{\gamma}\left\{1 - \frac{H_w}{H}\right\}\right]\frac{\tan\phi'}{\tan\beta} \quad (2)$$

For the case of a slope in which no water table is present, the expression becomes:

$$\frac{c'}{\gamma H \cos\beta \sin\beta} = 1 - \frac{\tan\phi'}{\tan\beta} \quad (3)$$

And for the case of a slope with a water table at the ground surface the expression becomes:

$$\frac{c'}{\gamma H \cos\beta \sin\beta} = 1 - \left[1 - \frac{\gamma_w}{\gamma}\right]\frac{\tan\phi'}{\tan\beta} \quad (4)$$

where γ and γ_w are the unit weights of the soil and water respectively

These equations are essentially the same as those given by Taylor (1948), in a slightly different form. They show clearly that for a given value of ϕ' the value of c' needed to maintain equilibrium is proportional to the depth H, as pointed out by Taylor (1948). By making an assumption about the water table depth, and adopting the value of say ϕ', we can calculate the value of c' needed to maintain equilibrium. We now have the information needed to proceed with the Coulomb wedge analysis to determine the critical wedge and the maximum force needed to retain the wall. The forces involved in the wedge analysis are illustrated in Figure 3.

For simplicity, the "wall" required to take the force P is assumed to be frictionless, so that P acts horizontally. In practice, retention of the slope may not involve a "wall" at all; ground anchors or soil nailing may be used, involving a relatively thin facing or a segmental facing at the cut face. The anchors or nails can be installed as the cut proceeds. With such retention systems the assumption of a frictionless wall is appropriate, as there can be no tendency for the soil to move relative to the "wall". The solution is obtained by varying the wedge angle α until the maximum value of P is obtained.

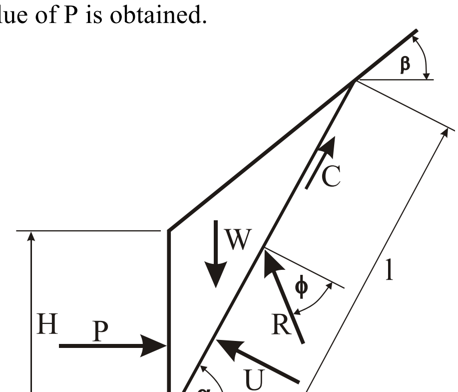


Figure 3. Forces involved in the Coulomb wedge analysis to obtain the retaining force P.

From wedge equilibrium considerations, it can be shown that

$$P = W\tan(\alpha - \phi') + U\frac{\sin\phi'}{\cos(\alpha - \phi')} - C\frac{\cos\phi'}{\cos(\alpha - \phi')} \quad (5)$$

It can also be shown that the values of W, U, and C are given by the following expressions:

$$W = \frac{1}{2}\gamma H^2 \frac{\cos\alpha\cos\beta}{\sin(\alpha-\beta)} \quad (6)$$

$$U = \frac{1}{2}\gamma H^2 \frac{\gamma_w}{\gamma}\frac{\cos^2\beta}{\sin(\alpha-\beta)} \quad (7)$$

$$C = \frac{1}{2}\gamma H^2 \frac{\cos^2\beta\sin\beta}{\sin(\alpha-\beta)}\left[1-\frac{\tan\phi'}{\tan\beta}\right] \quad \text{for the dry slope} \quad (8)$$

.

$$C = \frac{1}{2}\gamma H^2 \frac{\cos^2\beta\sin\beta}{\sin(\alpha-\beta)}\left[1-\left\{1-\frac{\gamma_w}{\gamma}\right\}\frac{\tan\phi'}{\tan\beta}\right] \quad \text{for the phreatic surface at ground level} \quad (9)$$

In deriving the value of U it is assumed that the making of the cut does not affect the seepage condition, ie seepage continues toward the cut with seepage lines still parallel to the ground surface. This is a conservative assumption, as in practice some drawdown of the phreatic surface is likely to occur, at least near the face of the cut. The term $\gamma H^2/2$ occurs in each of these equations (6) to (9), so that it is easier to calculate and present the results in terms of an active coefficient K_a rather than the force P_a.

Using these equations to solve for the force P by varying the wedge angle α produces the "surprising" result that P is maximum when the wedge angle becomes the same as the slope angle ie when $\alpha = \beta$. In other words the critical wedge is no longer a wedge but has become an infinite slab of constant depth parallel to the surface of the slope. Figure 4 shows the result for the simplest case, a dry cohesionless material, with an assumed ϕ angle of 40^o.

As the reader may well be aware, analytical solutions are available for both the peak value of K (= K_a) and the critical angle α (= α_c) for this case of a dry cohesionless material (see for example Jumikis, 1962).

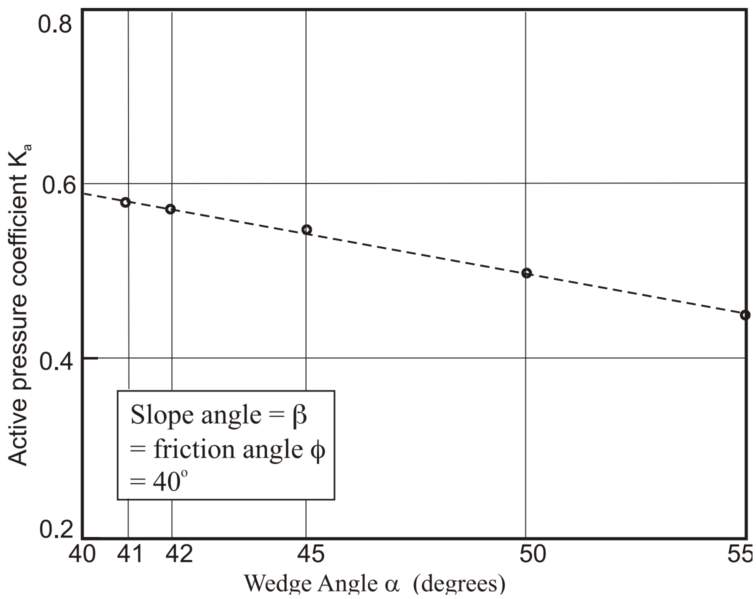


Figure 4. Determination of K_a by trial wedges for a dry cohesionless slope with $\beta = \phi = 40^o$.

For the case of zero wall friction these are:

$$K_a = \frac{\cos^2\phi}{\left[1-\sqrt{\frac{\sin\phi\sin(\phi-\beta)}{\cos\beta}}\right]^2} \quad (10)$$

$$\tan(\alpha_c-\beta) = \tan(\phi-\beta)+\sqrt{\tan(\phi-\beta)[\tan(\phi-\beta)+\cot\phi]} \quad (11)$$

For the limiting case when $\beta = \phi$, these equations become:

$$K_a = \cos^2 \phi \qquad (12)$$

$$\alpha_c = \phi \quad (= \beta) \qquad (13)$$

where α_c is the critical value of the wedge angle α.

Figure 5 illustrates graphically the solution given by equations (10) to (13)

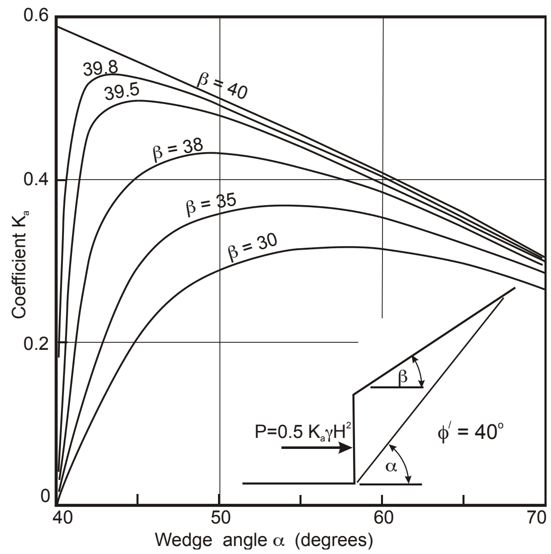


Figure 5. Values of K_a versus wedge angle α for dry cohesionless slopes with $\phi = 40^o$.

It is seen that as β increases, the value of K_a increases as expected, and the position of the peak value of K_a moves from the right to the left of the graph. The graphs are seen to have progressively sharper peaks. In the limiting situation of $\beta = \phi$, the critical wedge angle also becomes equal to β and ϕ, and the peak value of K_a coincides with the left axis where α equals β. In other words, the inclination of the critical wedge decreases as the slope angle increases, and becomes progressively closer to the slope angle. Figure 6 shows the values of K_a versus slope angle for this case of the dry cohesionless slope.

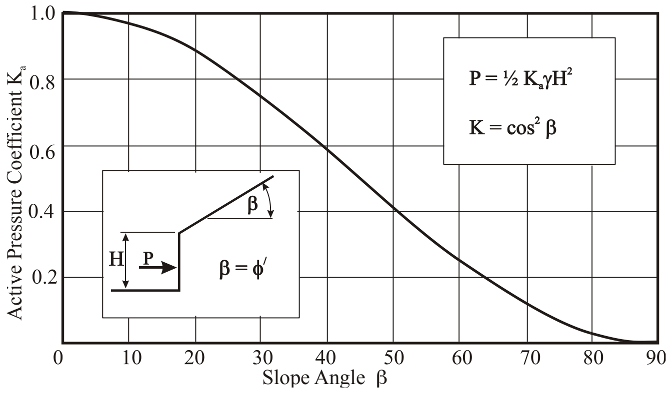


Figure 6. Active pressure coefficient K_a for walls supporting dry cohesionless slopes at limiting equilibrium ($\beta = \phi'$).

Moving on from the simple case of a dry cohesionless material makes the solution a little more cumbersome. Analytical expressions, such as those in equations (10) to (13) are no longer available, but the results of trial wedges can be plotted as in Figure 4 above and the intercept of the line through the points with the vertical axis gives the required value of K_a. In all, four cases have been investigated:

Case (a): Dry cohesionless material

Case (b): Cohesionless material with the phreatic surface at ground level.

Case (c): Material with some cohesion, no seepage.

Case (d): Material with some cohesion, phreatic surface at ground surface.

The analysis of Cases (c) and (d) requires assumption about the relative magnitudes of c' and ϕ'. For simplicity, an arbitrary assumption was made that the value of ϕ' is somewhat less than the slope angle, and related to it by the relationship: tan $\phi' = 0.7$ tanβ. The cohesion component c' then takes on whatever value is needed to maintain stability, in accordance with equations (10) and (11) above. The analysis produces the somewhat surprising result that the K_a values are the same for the Cases (c) and (d).

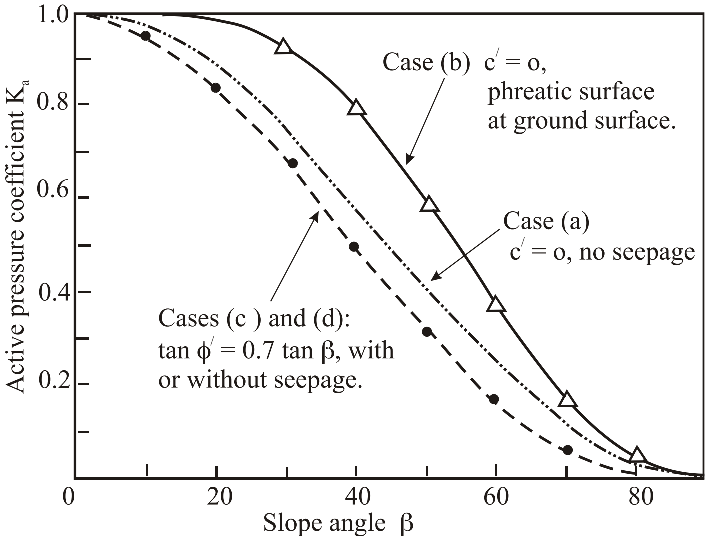


Figure 7. Values of K_a versus slope angle for all cases.

A fuller account of the analysis of these cases is given elsewhere (Wesley, 2001). The results from all four cases are plotted in Figure 7. The figure may appear surprising or illogical at first sight as the value of K_a decreases as the slope angle increases. However, simple logic dictates that the graphs must have the form they have. If the slope is flat and is at limiting equilibrium then clearly the material has the properties of a liquid, and the horizontal stress will equal the vertical stress (ie $K_a = 1$). On the other hand, if the slope is stable at 90^o, then no force is required to retain it. Hence the K_a value must start at unity for a level slope and decrease to zero for a vertical slope. The analysis in no way contradicts the fact that if we are dealing with the same material then the steeper the angle behind the retained wall the greater the force on the wall. The starting assumption is that the slopes are on the point of failure, so that if the slope angles are different then we are clearly dealing with different materials, or different seepage situations.

The most relevant cases are certainly (c) and (d). It is perhaps surprising that (c) and (d) give the same result, since (c) is for a slope without seepage pressures and (d) for a slope with the water table at the ground surface. The explanation lies in the fact that the required value of the cohesion c' is different in the two cases. For a typical case, say a 35^o slope with $\gamma_w/\gamma = 0.6$, and tan $\phi' = 0.7$tanβ, the back analysis of the infinite slope gives the result shown in Figure 8.

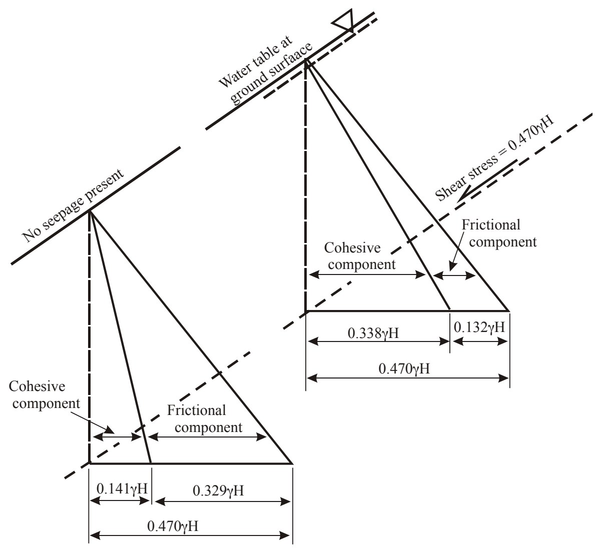


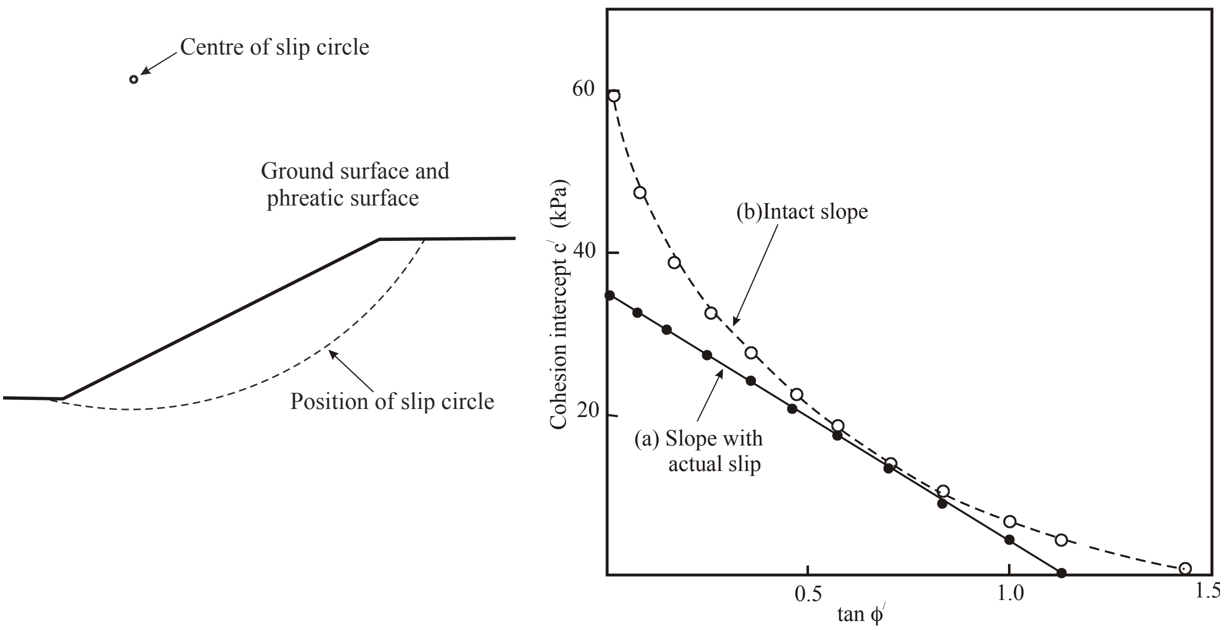
Figure 8. Cohesive and frictional components of shear strength with and without seepage present.

The required shear resistance to maintain stability is 0.470H. With no seepage present the required cohesion intercept $c' = 0.141\gamma H$, and the frictional component is $0.329\gamma H$. However when seepage is present the required cohesion intercept $c' = 0.338\gamma H$ and the frictional component is only $0.132\gamma H$. Thus when the wedge analysis is carried out the relative proportions of cohesive and frictional resistance on the slip plane are different but the net result is the same.

There are a number of assumptions involved in the above analysis, but the basic method is sound and should be a more reliable indicator of required force levels than simply assumption of soil parameters or a K_a value.

Shear strength parameters from back analysis of single slips

Until quite recently I wrongly believed that it is not possible to obtain unique values of c′ and ϕ′ from the back analysis of a single slip, even if full details of the geometry of the slope and pore pressures are known. I became aware that this is not the case through the work of a Japanese professor at Tokoshima University in Japan (Yamagami and Ueta, 1996). Yamagami and Ueta presented a method for determining c′ and ϕ′ from a single slip. With the help of one of my students (Leelaratna, 1999) I looked into this method, and in doing so came across several other methods which are rather more straightforward than the Japanese method. These are described below. The methods are valid only if the slope consists of homogeneous material.



(a) The slope analysed. (b) The results of back analysis.

Figure 9. Back analysis of a slope to obtain values of c′ and ϕ′.

Figure 9 (a) shows a slope in which a slip has occurred at the position shown. The slip surface is assumed to be circular and the ground water table is taken to be at the ground surface. By carrying out conventional slip circle analysis, it is possible to obtain a range of values of c′ and ϕ′ which satisfy the criteria that the safety factor for the slip shown is unity. This has been done using the standard Bishop method. The range of values so obtained is shown graphically as curve (a) in Fig. 9 (b). By plotting c′ versus tan ϕ′ the plot is almost linear; this appears to be the normal situation when the analysis is of a specific slip surface.

From this point onwards there are several methods for deciding which of these possible combinations is the correct one. Perhaps the simplest method is to now ignore the actual slip circle and carry out stability analysis of the slope using as a starting point each of the combinations of parameters shown in Fig. 9 (b). In other words we are now ignoring the slip, and treating the slope as an intact slope. This analysis produces a series of critical slip circles as shown in Fig. 10. Examination of these shows that each circle has a different location, and only one of these circles has a safety factor of unity. All the others have safety factors less than unity. Thus the true field values of c′ and ϕ′ must be those applying to this one circle which is compatible with the field situation. The values so obtained are $\phi' = 30^o$ and $c' = 18$ kPa.

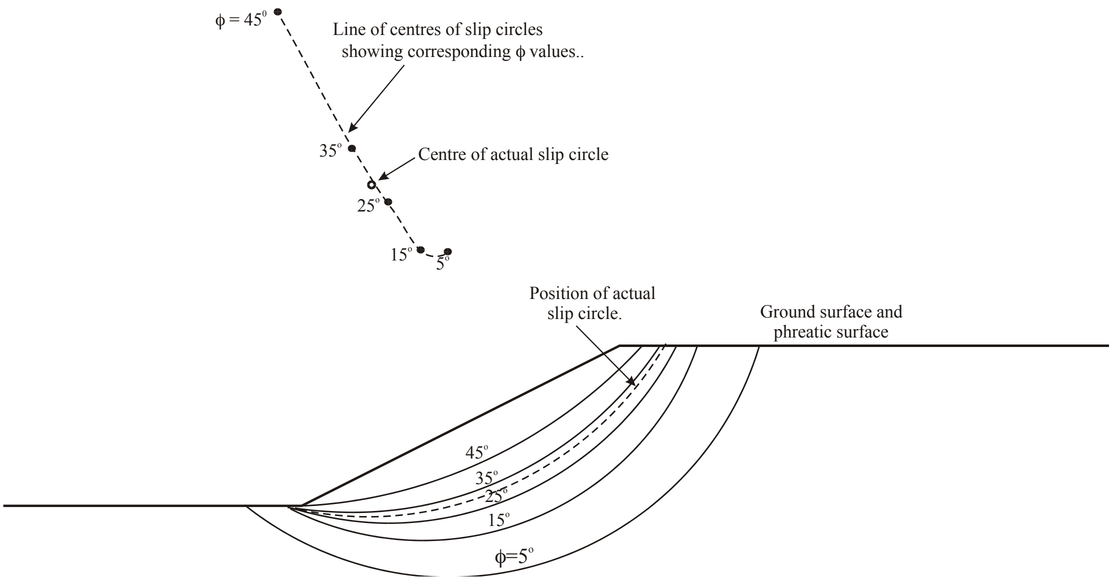


Figure 10. Critical circles obtained using the shear strength parameters obtained from back analysis of the actual slip surface.

A second approach is to ignore the actual slip surface (and the data obtained from it), and to repeat the back analysis treating the slope as intact. This gives a new set of combinations of c′ and φ′ which apply to the intact slope. This range of values is also shown in Fig. 9(b) as curve (b). The point where the two sets of values coincide, ie where the curves touch in Fig. 9(b) defines the values that must apply in the field. There are other possible methods; these are described in Wesley and Leelaratnam (2001).

Back analysis of terraced rice-fields

This is not a high-tech example of back analysis but I will include it as the steep terraced rice-fields of Java and other parts of Southeast Asia have long had a certain fascination for me. They are a spectacular demonstration of the very good properties of the soils on which they are built - unusually high shear strength and a resistance to erosion. They are built on slopes as steep as 40^o and irrigation water permanently flows from one terrace to the next. Individual terraces are up to 3m high. It is hard to imagine local Auckland soils remaining stable in this situation. The particular aspect of soil behaviour which they demonstrate very clearly is the reality of the cohesive component of shear strength (c′), even in a saturated remoulded soil. At least half of the terrace height must consist of remoulded soil. The rice-fields in Java are formed on slopes of halloysite or allophone clays, which have φ′ values generally between about 35^o and 40^o. The terraces can only remain stable if there is a significant and long term value of c′. This point is of some significance in view of arguments sometimes put forward by the "critical state" school that the c′ component of soil strength cannot be relied on.

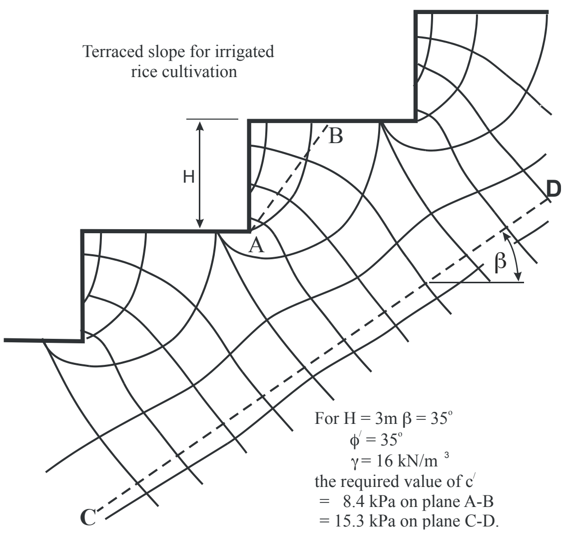


Figure 11. Back analysis of terraced rice-fields to obtain c′ value.

It is possible to get an estimate of the c′ value by analysing possible failure modes. Figure 11 shows an assumed flow net and two possible failure planes. The back analysis gives c′ from 8 kPa to 15 kPa. These field values are at the lower end of the range obtained from triaxial testing.

The above flow net is a simple hand drawn effort. It assumes an infinite slope, so that the seepage pattern is identical at each terrace. I doubt that this is the case in practice; because slopes aren't infinite, and possibly also because the surface layer may be of lower permeability than the underlying material, the flow may not be as parallel to the slope as the above flow net implies. During my time in Indonesia I had intentions to install some piezometers in rice-fields to find out just what the seepage situation actually is. However I did not find time to pursue this interest, which was probably just as well because there were many more pressing and useful matters to spend my time on. Recently I have had a student using the SEEP/W programme (Hongwu Zha, 2002) to look at several seepage situations of interest to me, one of which was terraced rice-fields.

Treating the slope as infinite produces a flow net very similar to the hand sketched effort above, but if the slope is modelled a little more realistically with a source (a canal) at the top and receiving stream at the base the pattern is rather different, as shown in Figure 12.

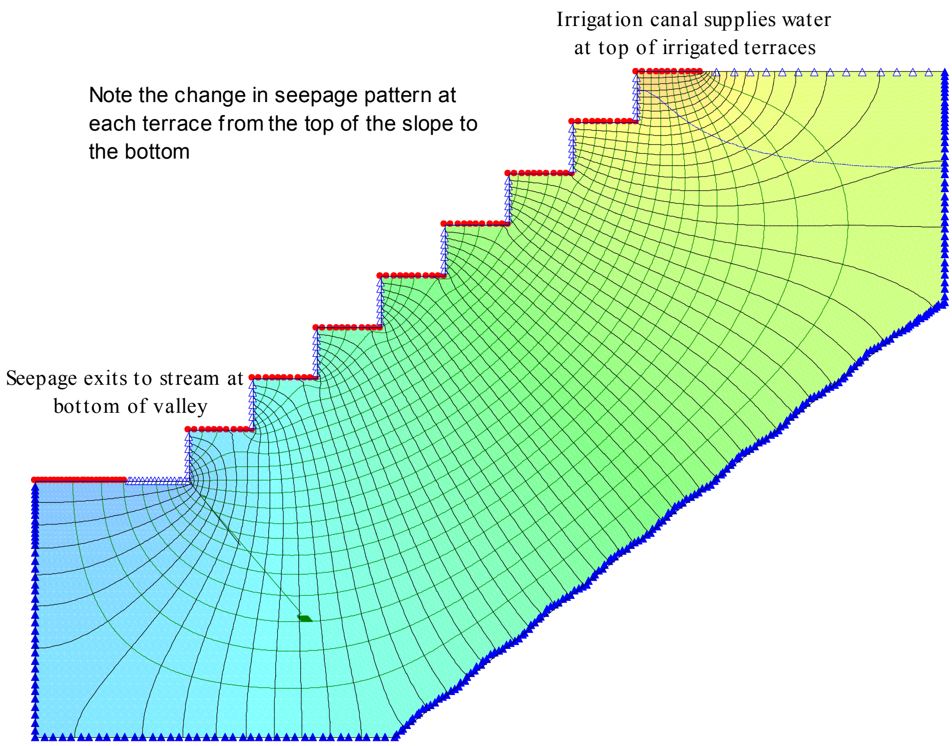


Figure 12. Terraced rice-field flow net generated with SEEP/W.

This is a suitable point at which to move on from back analysis, and side issues like terraced rice-fields, and look into some other seepage studies of more relevance to engineering situations.

SEEPAGE STUDIES

Seepage into sheet piled excavations: 3D and 2D analysis

Between the Waikato River and the Huntly Power Station there is a large facility built almost entirely below ground level known as the cooling water intake structure. It is essentially a large concrete box, about 64m long, 24m wide and 14m deep. Its construction posed a considerable challenge, because the site consisted of deep deposits of pumice sand, of quite high permeability. An original intention to build the structure in an open de-watered excavation had to be abandoned because deep well trials were not successful. It was eventually constructed above ground level without its bottom floor and sunk into the ground like a giant caisson. Deep sheet piles were installed around the perimeter of the structure to prevent sand collapse from around the outside of the structure. Suction pumps were used to extract water and sand from within the caisson, thus inducing the sinking process. An issue in planning the operation was the extent to which the water level within the caisson could be lowered without running the risk of uplift "heave" of the base of the excavation due to excessive hydraulic gradient.

A trial of the procedure intended for the main structure was actually carried out on a smaller structure, known as the "elver (juvenile eels) chamber"; this was to be part of a special migration channel for juvenile eels. Sinking this structure showed that base heave failure was a very real threat. It occurred twice during the trial.

There were a couple of issues that stimulated my interest while involved in the planning of this project. The first was the question of 3D flow nets versus 2D flow nets. Sketching a conventional 2D flow net to predict the point at which the hydraulic gradient will reach the critical value is not difficult (provided you can remember your soil mechanics lectures on flow net sketching and the formula for critical hydraulic gradient), but how to adjust this for the 3D effect of a box structure is a little more problematical. Rather than deal with this uncertainty, it was easier to decide not to significantly lower the water level within the structure at all, and thus avoid altogether the danger of uplift failure. However this did not entirely eliminate my curiosity about the 3D versus 2D situation.

The second issue that interested me was the general properties of the sand at the site. The bulk density of the sand varied from 1330 kg/m^3 to about 1840 kg/m^3 with an average of only 1500 kg/m^3. This is a long way below the value of about 20 to 22 kg/m^3 expected with normal sands. Clearly the pumice content of the sand was very high, and one could not help wondering what the implications of this were for its engineering properties in general. I later had some involvement with pumiceous sands in the Bay of Plenty, and the use of CPT testing to investigate them. Whether the same interpretation could be put on the results of these tests as for more normal sands was an open question. Research into the properties of pumice sands and CPT testing is described elsewhere (Wesley et el, 1999) and will not be covered here.

When I joined the university in 1986, the geotechnical section had a computer programme called GeoFlow. It was a finite element programme of the Fortran "fixed format" variety. Not knowing very much about the joys of fixed format programmes, I very happily inflicted it on a postgraduate student (Ampualam, 1990), with the task of investigating 2D and 3D flow into sheet piled excavations. Figure 13 illustrates the problem addressed.

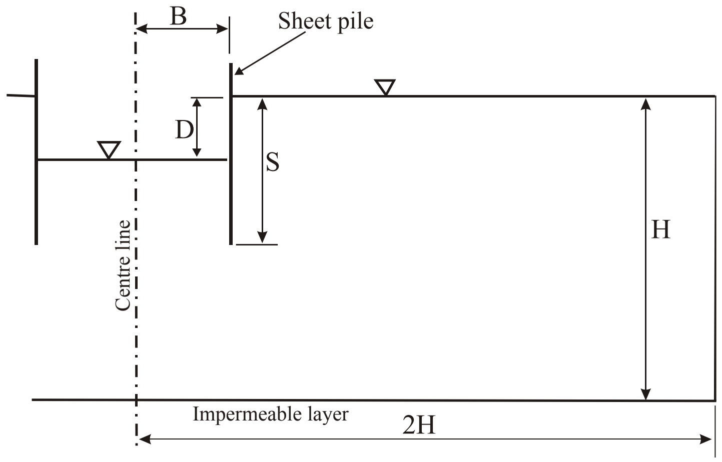


Figure 13. Geometry of sheet piled excavation.

The GeoFlow programme allows 2D and axisymmetric (or radial) flow to be investigated, so the comparison made is between flow into a 2D excavation of infinite length and a circular excavation having a diameter the same as the width of the 2D excavation. The essential difference between the two situations is that in the axisymmetric case the flow is progressively forced into a smaller "channel" as the flow approaches the excavation, with the result that head loss within the excavation will be greater. Thus the exit hydraulic gradient at the base of the excavation would be expected to be higher. Various ratios of B/H, D/S and S/H were investigated. Typical results are shown in Figure 14 for the situation where D/S = S/H = 0.5, and B/H is variable.

It was found that in all cases the exit hydraulic gradient was greater by about 35% to 55% for the axisymmetric than the 2D case. This finding is for a circular excavation, so it does not provide a complete answer with respect to the situation at Huntly, which involved a rectangular structure. There is clearly the possibility that the hydraulic gradient will be greater at the corners of a rectangular structure where the greatest "crowding" of flow occurs. This effect will also be greatest when the structure is relatively shallow compared to its depth. With a deep structure, the upward flow within the structure is restrained to be essentially vertical, in which case the hydraulic gradient cannot vary across the cross section.

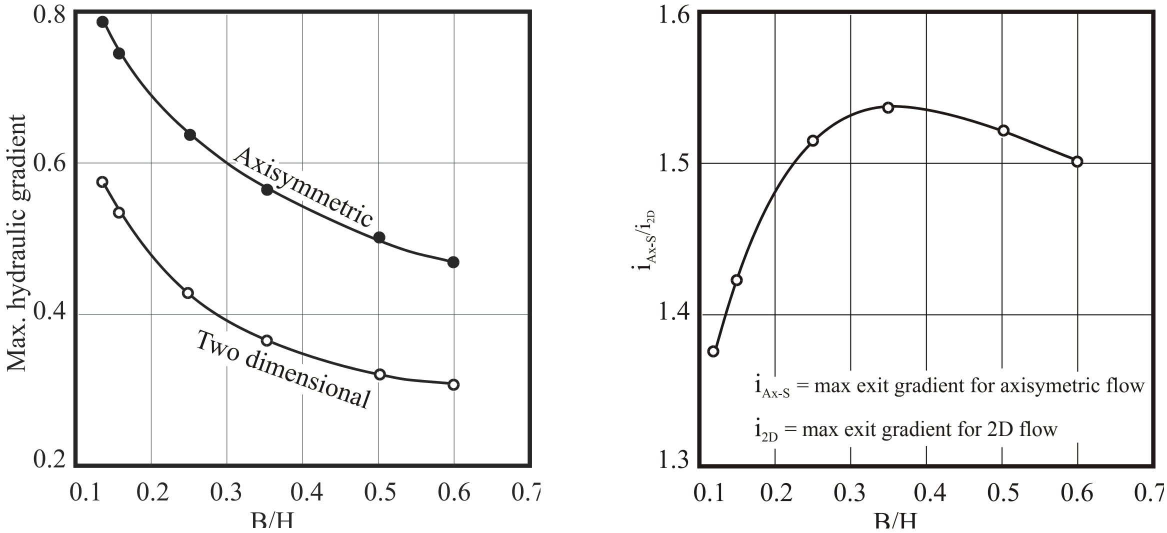


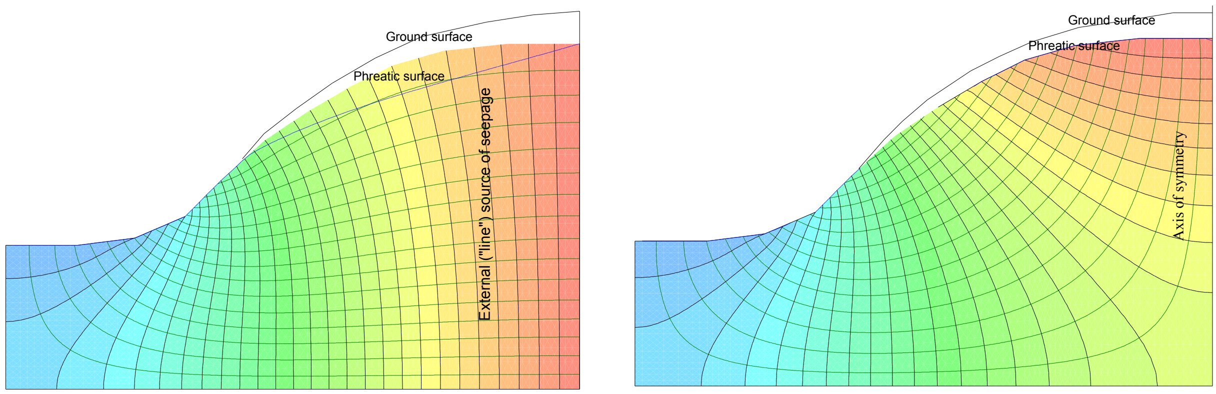
Figure 14. Comparison of exit hydraulic gradient at base of sheet pile excavation for axisymmetric and 2D flow (for D/S = S/H = 0.5).

Flow into open excavations

Analytical solutions for this situation are not available, although some text books use the Dupuit solutions and their adaptations for partially penetrating wells or slots (eg Leonards, 1962). A master's student (Visvanathan Ragunathan, 1994) was looking for a project topic at the time I was interested in this situation; the results of his study were informative and of practical value and are presented fully elsewhere (Wesley et al, 1996).

Influence of seepage assumptions on stability analysis

An assumption frequently made in drawing the seepage pattern in natural slopes is that the source of seepage is external to the slope. This means that seepage enters the slope approximately horizontally and flow nets are commonly drawn with horizontal flow lines and vertical equipotential lines. This is probably reasonable for many natural situations, but may not always be so. With relatively steep "double-sided" slopes the only possible source of seepage is rainfall on the slope itself, and at the upper end of the slope the flow lines may be closer to horizontal than vertical

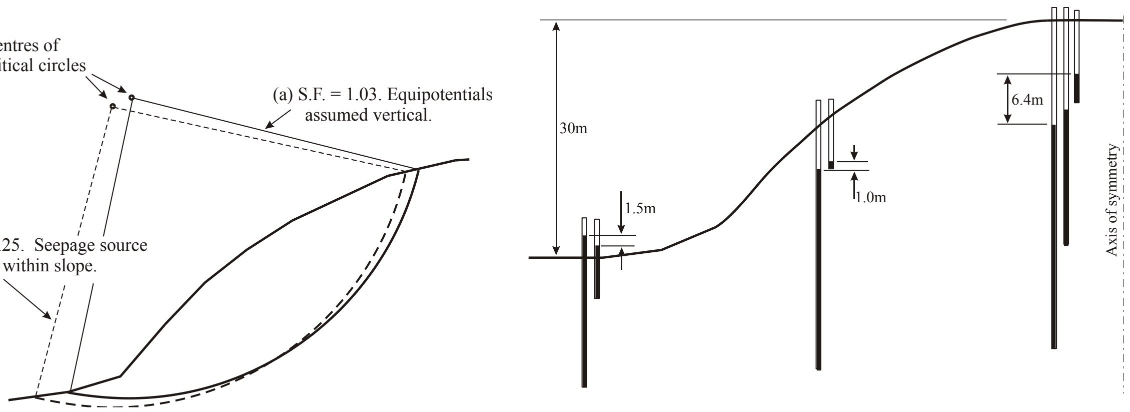


(a) Flow net when seepage source is external to slope.

(b) Flow net for "double sided" slope with seepage source entirely within the slope.

Figure 15. Hill-slope seepage patterns for two assumed sources of seepage.

Along with the terraced rice-field seepage described earlier, Hongwu Zha (2002) undertook some limited investigation of these situations using the computer programme SEEP/W. Figure 15 shows typical flow nets for the two situations, the first (a) is for the seepage source external to the slope, and the second (b) is for rainfall recharge within the slope itself. In this latter case the upper surface has been assumed to be the same as for case (a). The surface is therefore static and undergoing recharge from surface rainfall. It is evident that there is little change in the flow net at the base of the slope but considerable difference at the upper part. The equipotential lines for the slope having surface rainfall recharge are almost horizontal and the flow lines almost vertical. Pore pressures in this zone would therefore be considerably less than those associated with the assumption of vertical equipotentials. The influence of the seepage pattern on the safety factors of the slope have been investigated using SLOPE/W. In the first case the phreatic surface was specified; when this is done the programme assumes the equipotentials are vertical. In the second case a grip of points representing the flow net was used. The results are summarised in Figure 16 (a) below. The safety factor is 1.03 in the first case and 1.25 in the second. The position of the critical circle is not greatly changed. As expected it moves towards the tow of the slope because of the increased pore pressures here and the reduced pressures higher up the slope**.**



(a) Influence of seepage conditions on Safety Factor and position of critical circles.

(b) Standpipe piezometer levels for case of seepage source within the slope.

Figure 16. Influence of assumptions made regarding seepage state on safety factors and piezometer levels.

While on the subject of seepage in natural slopes, and especially that represented in Figure 15 (b), it is perhaps worth noting the relationship of the seepage pattern to piezometer readings, especially in multiple stand pipes (of varying depth) at the same location. There seems to be a tendency to assume that the only explanation for different water levels in such piezometers is a perched water table (when the head decreases with depth) or artesian pressure (when the head rises with depth). This is not necessarily the case. Figure 16 (b) shows the water levels to be expected in piezometers placed at varying depths at three locations in the slope. These are taken directly from Figure 15 (b). In the upper part of the slope the head is much less in the deeper piezometer, while at the base of the slope the head is greater in the shallower piezometer. In the central part of the slope the levels are almost the same, which is to be expected as the equipotentials here are close to vertical. Where there is a difference in levels, it is simply the result of the seepage state in a uniform slope, and not an indication of perched water tables or artesian pressures.

Significance of the ground water table.

A further point worth noting in regard to natural slopes is the significance of the water table. It is easy to assume that the water table is some sort of definitive boundary below which seepage occurs, and above which nothing happens. We lecturers are probably at fault in leaving our students with this impression. It is of course not the case that seepage is only occurring below the water table.

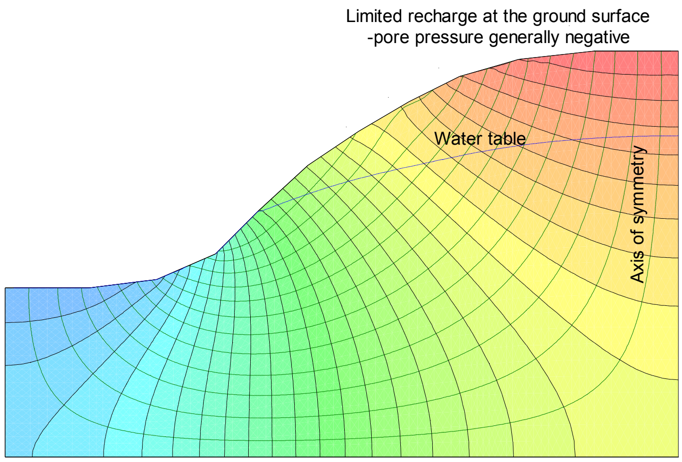
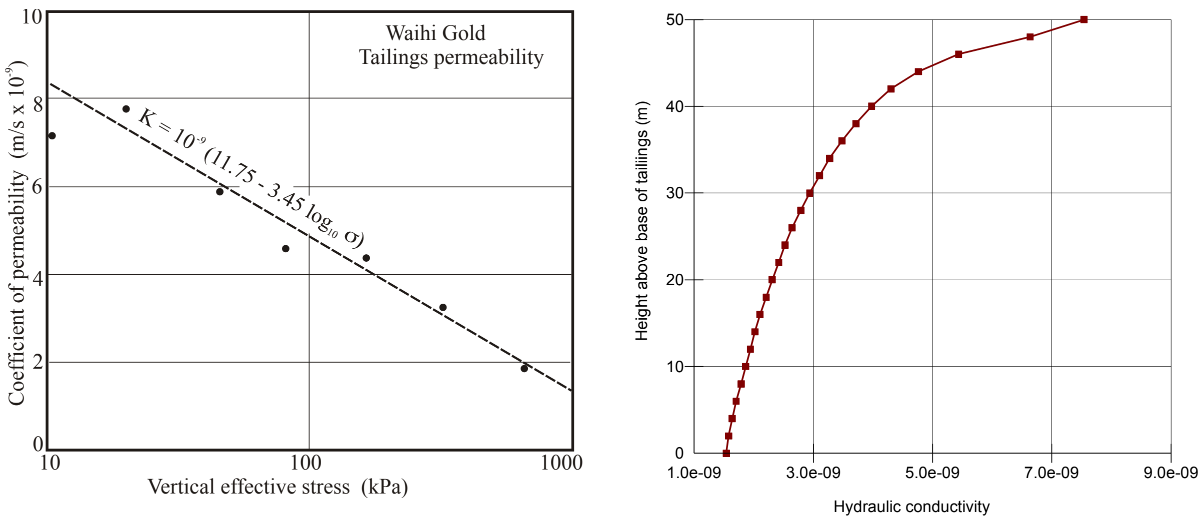


Figure 17. Water table and seepage pattern with "limited" recharge at the surface.

In many clay profiles, the water table is quite deep, but the soil may be fully saturated to within less than a metre of the ground surface. Seepage will still be occurring above the water table, and will be governed by the same laws that govern its behaviour below the water table. The only difference is that the pore pressures will be negative and the actual state of seepage more variable and less amenable to easy definition. Figure 17 illustrates this point; it represents a hillside where intermittent rainfall and evaporation maintain a zone of negative pore pressure in the upper part of the slope. The computer generated flow net has been produced by setting a series of negative pore pressures as the boundary condition at the upper part of the slope surface. The programme rightly plots the water table as the line of zero (atmospheric) pressure.

Seepage through settled mine tailings

Mine tailings, such as those from the Martha mine, consist predominantly of fine plastic clay material. They are generally deposited underwater and slowly consolidate with time. They thus form an artificial normally consolidated deposit. In such a deposit the effective stress will increase with depth, at least once consolidation is underway. This means that the material will be less permeable with depth, because of the lower void ratio. Various drainage conditions apply to tailings dams. In some cases, under-drains are installed before filling commences; this means that drainage during consolidation can occur towards both the upper and lower boundary. On completion, these "lagoons" can be treated in various ways. They may be left as wetlands, in which case the tailings will have a permanent recharge from their upper surface and seepage will occur vertically towards the under-drains, if these exist.

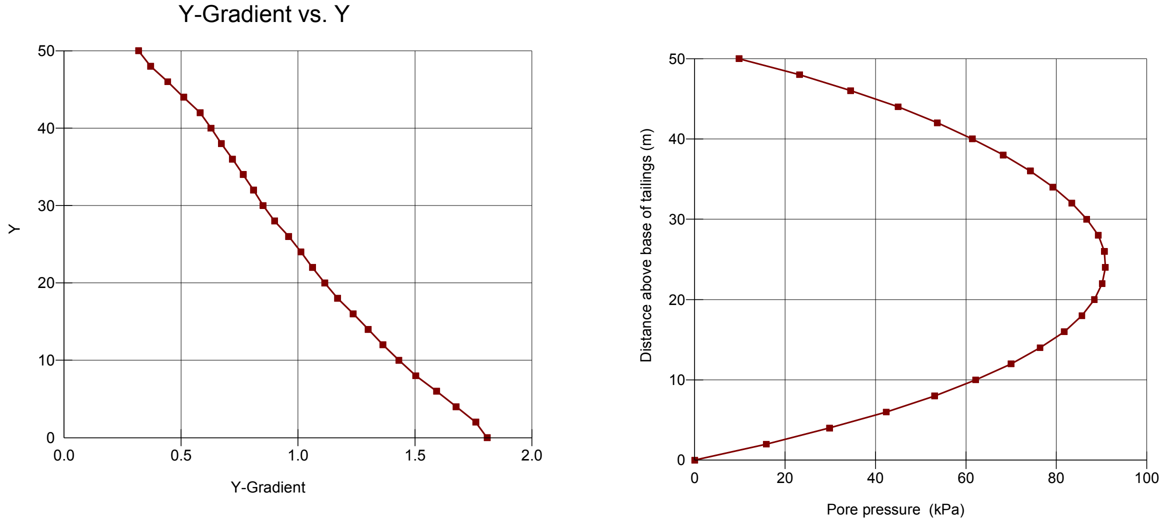


(a) Experimental results. (b) Estimated permeability variation with depth.

Figure 18. Coefficient of permeability in mine tailings at Waihi Gold Martha mine.

The seepage pattern in this situation is therefore not straightforward. The increased resistance to flow in the lower part of the slope means that the vertical hydraulic gradient must increase with depth and some pore pressure will be permanently present in the slope. In other words pore pressure dissipation will not tend towards a zero situation as may naturally be assumed. Figure 18 (a) shows the relationship between permeability and effective stress from experimental tests; the values have actually been calculated from c_v and m_v values obtained from consolidation tests on the tailings. Figure 18 (b) shows what this means in practice within a 50m thickness of tailings. It is seen that the coefficient of permeability (hydraulic conductivity) decreases with depth by a factor of about 5.

In Figure 19 graphs are shown of the hydraulic gradient and pore pressure in the tailings assuming free under-drainage at the base and a depth of water of one metre at the surface. The hydraulic gradient has an average value very close to unity as expected, though it is less than half this at the surface and about 80% greater at the base. The maximum residual value of pore pressure is about 90 kPa, which is somewhat less than I intuitively expected when I started looking into this matter. The total stress at the centre (25m deep) is about 400 kPa, so the influence on the final effective stress is not very great though still quite significant.



(a) Hydraulic gradient (b) Pore pressure

Figure 19. Hydraulic gradient and pore pressure within consolidated mine tailings.

BEHAVIOUR OF COMPACTED CLAY AND CLAY EMBANKMENTS

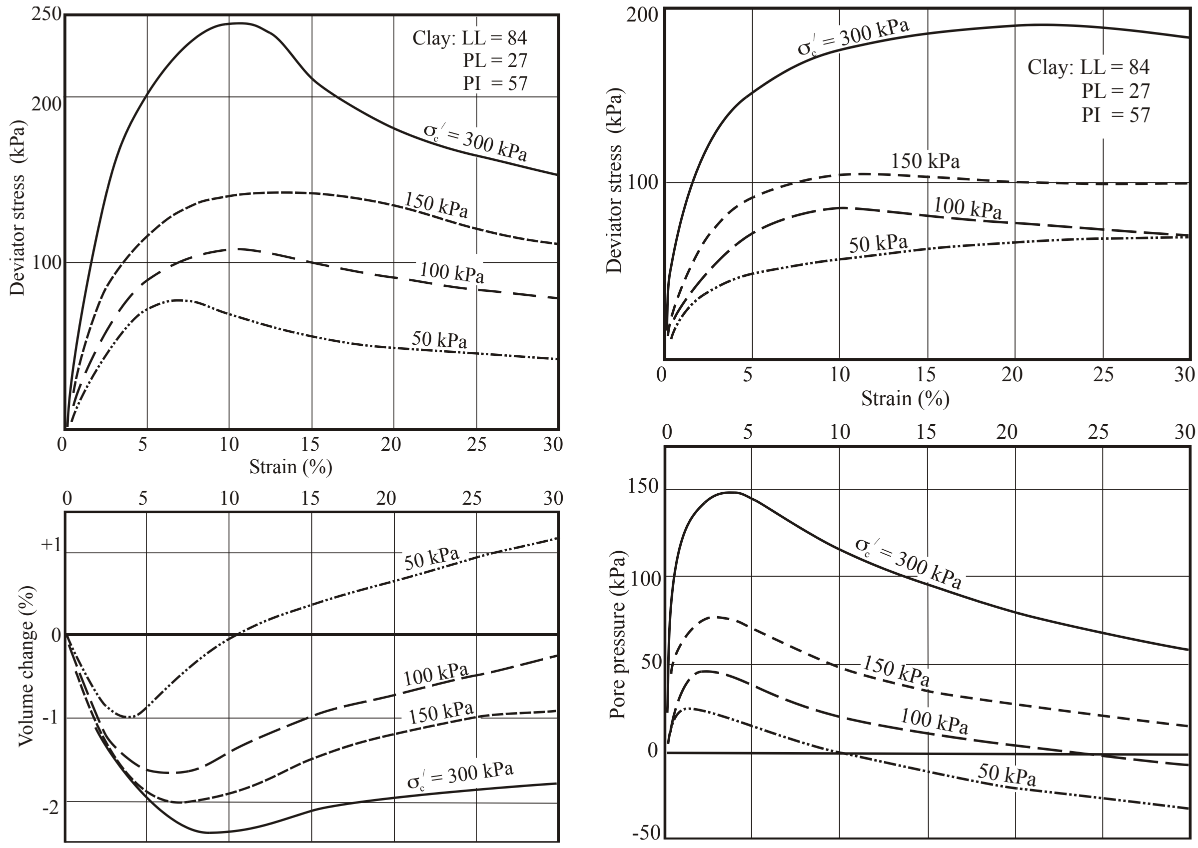
A few years ago I become interested in the behaviour of compacted clay and clay embankments. Prior to then, I had regarded them as rather dull materials compared to undisturbed soils, especially when the latter are highly structured or contain unusual clay minerals. However, some recent interaction with the local geotechnical profession over issues involving compacted clay made me change my mind, at least to some extent. The reasons are explained in the following sections.

Parameters for the Design of Reinforced Earth Walls

A few years ago, a group of local consulting engineers approached the geotechnical group at Auckland University with a question relating to the design of reinforced earth walls, namely what does ϕ'_{cv} signify? The parameter appears in various design codes, in particular British codes for the design of geogrid reinforced earth walls. Local engineers, designing reinforced earth walls using local clays, wanted information about this parameter, in particular its relation to the familiar peak ϕ' value, and what would typical values be for New Zealand clays. The parameter ϕ'_{cv} comes from the critical state concept originating from Cambridge University. It is the value operating when a soil is loaded to such large strains that a steady state (the critical state) is reached. In the critical state it will continue to undergo strains at constant stress and constant volume – the cv stands for constant volume. The term ϕ'_{crit} is also used, meaning the critical state angle. The concept in adopting it for design purposes is that it represents an ultimate value which will not decrease further with deformation, and is therefore a safe design parameter. While able to answer the question of what ϕ'_{cv} meant, my colleagues and I could not say with any certainty what its value was likely to be for typical New Zealand clays.

A master's student, Craig Davidson, looked into this question as part of an M.E. thesis several years ago. By carrying out conventional triaxial tests to large strains Craig aimed to answer the question, at least for the four local clays he did tests on. Both drained and undrained tests were conducted, and taken to a strain of about 30%. The results of his work are described in Davidson (1999) and in Wesley and Davidson (2000), and only a brief summary is included here. Figure 20 shows typical results for one of the clays. Examination of these figures shows that even at 30% strain the critical state has still not been reached. In some tests, especially the undrained tests, the deviator strength does appear to have almost levelled off, but changes in pore pressure are still occurring. Similarly in the drained tests, volume changes are still occurring.

In Figure 21 the results are plotted in the form of conventional stress paths, for both the drained and undrained tests. A failure line has been drawn through the peak values as well as the "end points" ie the values at large strains. These large strain values are as close to the critical state as the tests got. It is seen that the failure line at large strains is not much below the peak line, especially if the cohesion intercept is ignored. Thus if the large strain ϕ' value is assumed to be close to the critical state value, then adopting the peak ϕ' adopted for design and ignoring the c' value should not be very different from using the ϕ'_{cv} value.



(a) Drained tests

(b) Consolidated undrained tests

Figure 20. Triaxial tests on an Auckland plastic clay (Weathered Waitemata series) taken to large strains.

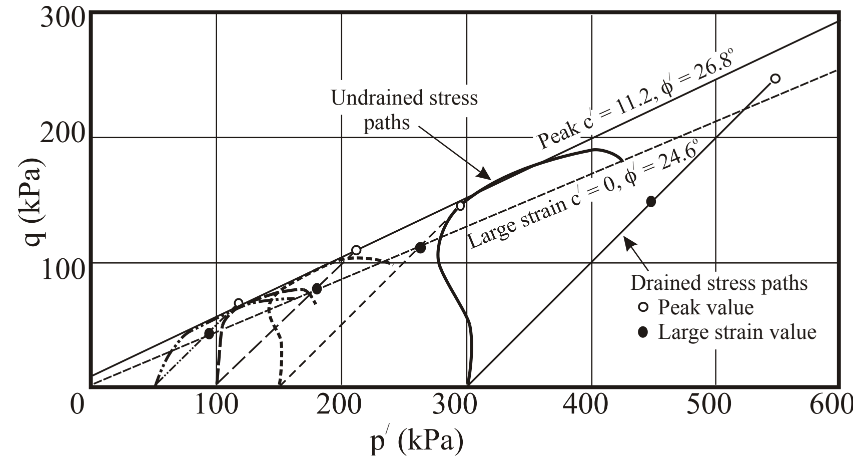


Figure 21. Stress paths from drained and undrained tests.

The conclusion from the tests was therefore very useful, namely that attempting to measure the critical state friction angle is likely to be an unproductive exercise, and that adopting the peak ϕ' value (and ignoring the cohesion intercept) should not be very different from using the critical state ϕ'_{cv} value. Whether the arguments for using the critical state ϕ'_{cv} value for design are at all legitimate is another question, which will not be addressed here.

Total stress and effective stress analysis methods for the design of compacted clay embankments

Investigating this topic may seem like a rather backward step - revisiting a topic long since adequately covered by earlier researchers. There may be some truth in that. However I became interested in this issue following an incident of "under-performance" in a large highway embankment of compacted clay. Involvement in the investigation of causes and appropriate remedial measures made me think seriously about the question of undrained versus effective stress analysis for the design of clay embankments, especially those which do not involve water retention. My natural "bias" on this issue probably dates from lectures by Professor Bishop in the 1960s. Bishop, having been a pioneer in establishing the fundamentals of clay shear strength in terms of effective stress, and being very much interested in earth dams, concentrated on effective stress analysis in his lectures. At the same time, in his "classic" paper with Bjerrum (Bishop and Bjerrum, 1960), he made some pertinent comments on total versus effective stress analysis, pointing out that only in special cases could they be expected to give the same result. Bishop supported the use of total stress analysis for short term stability of undisturbed fully saturated clays.

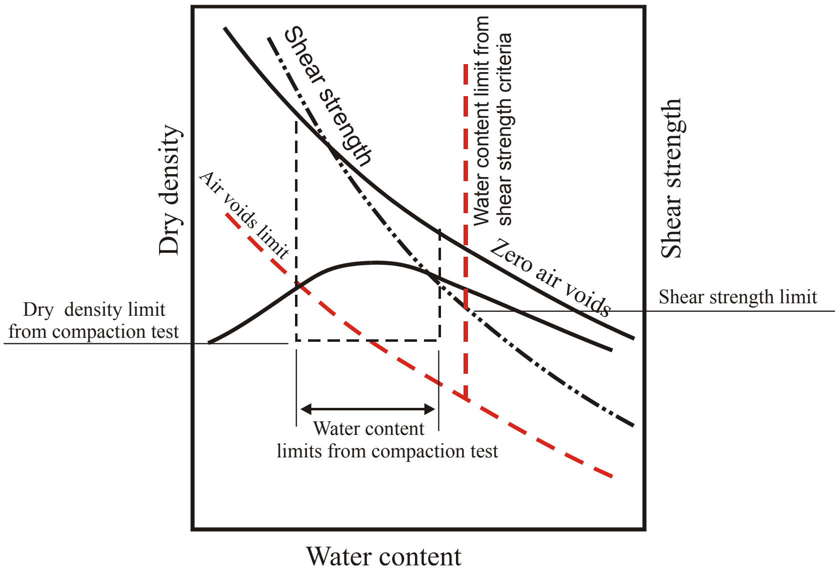


Figure 22. Compaction control using undrained shear strength and air voids.

The embankment in question was for a highway, so that many of the factors that favour (or dictate) effective stress analysis for earth dams were not present. In addition, its construction had been controlled using the familiar New Zealand method of specifying undrained shear strength and air voids rather than the traditional method of water content and dry density. If undrained shear strength is a specified requirement of the compacted clay forming the embankment then it would seem logical to use it as a design parameter. For those unfamiliar with the use of shear strength and air voids to control earthworks the concept is illustrated in Figure 22. Specifying a lower limit (usually around 150kPa) for the shear strength prevents the soil being too wet, and specifying an upper limit to the air voids prevents the soil being too dry. The net result is very much the same as with the traditional method, but the specification remains the same regardless of variations in soil properties.

While it has long been known that effective stress and total stress analysis will generally not give the same safety factor, it is quite difficult to find clear guidance in the literature as to which method is preferable for designing compacted clay embankments, or which is likely to be the more conservative. Lambe and Whitman (1969) in discussing the "End-of-Construction" case, state that "from the standpoint of reliability, there is no basic difference between the two methods. The gaps in our knowledge which make it difficult to estimate pore pressures make it equally difficult to properly evaluate undrained strength. There is one major advantage to the use of the effective stress analysis: the pore pressures assumed during design of a dam can be checked by field measurements and the design can be modified during construction if necessary." Vaughan (1971) implies that either method can be used and discusses in some detail the implications of each method in terms of safety factor and strains in the embankment.

A post graduate student from Zambia, Sulanji Chituta, has been looking at this question, primarily from the point of view of a designer, and seeking to answer the question of what differences in safety factor result from using an effective stress or a total stress method for "end of construction" stability, and which should be regarded as the more appropriate. His work is not yet complete and only some aspects will be described here. A large bulk sample of weathered Waitemata clay was obtained, and a conventional compaction test carried out. Samples were then prepared at different water contents ranging from slightly dry of optimum to considerably wet of optimum. Each of these samples was then subject to the range of tests that would normally be carried out as part of a routine (or conventional) design procedure. These tests covered the following:

1) Undrained shear strength
2) Effective strength parameters
3) Pore pressure response to undrained all round stress application, and the B parameter.

With the results of these tests, design in terms of effective stress and total stress can be carried out for each value of water content. The research is still in progress and only some limited results are described here.

The results of the standard compaction test and the shear strength measurements are shown in Figure 23. Undrained shear strength was measured using both hand vane and unconfined compression tests. It is evident that the vane produces substantially higher values than the unconfined tests.

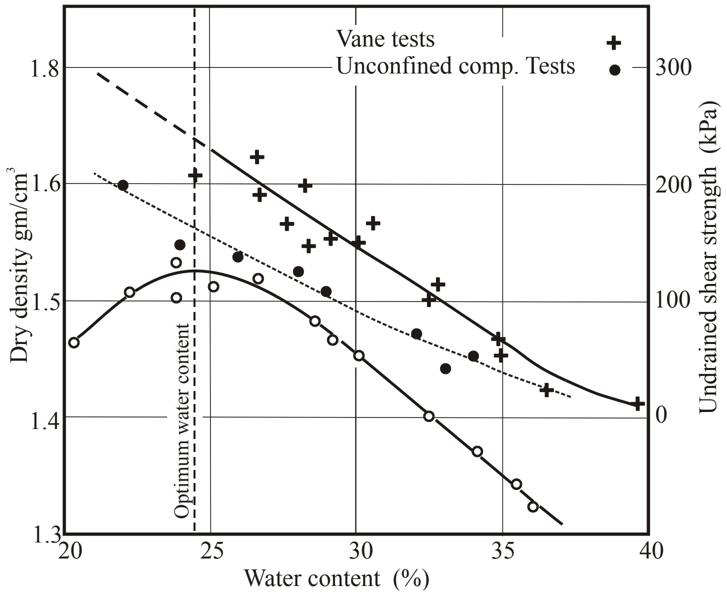


Figure 23. Standard compaction test result and shear strength measurements.

The effective stress parameters c′ and ϕ′ were measured using consolidated undrained tests, the soil being compacted to a density corresponding to the standard compaction curve in Fig. 24. It was found that over the water content range investigated there was only a very small variation in these parameters. All the test results are shown in Figure 26.

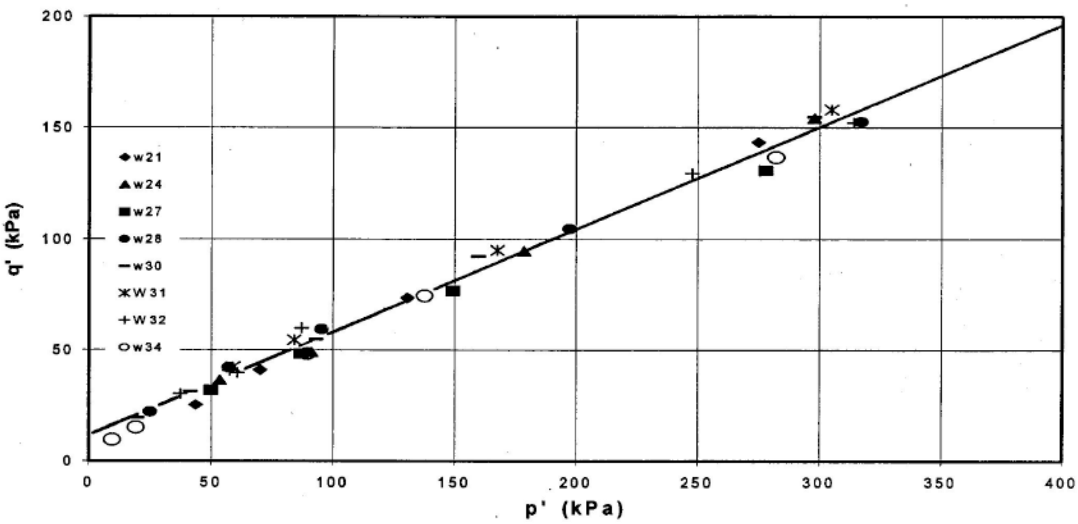


Figure 24. Summary of consolidated undrained triaxial test results (water contents from 21% to 34 %).

The pore pressure response to an all round stress increase (ie the parameter B) was measured by simply setting up samples in a triaxial cell and applying the cell pressure in stages, while measuring the pore pressure response. In these tests, as with any compacted sample, the initial pore pressure is negative. No attempt was made to measure the negative values accurately; only that part of the response curve with positive pore pressures was reliably established. In a field situation the pore pressure response will be somewhat different from that in these tests, as there will be different constraining conditions, the principal stress directions will not be constant, and the response will vary from point to point within the embankment. For simplicity however the B values have been used and applied as though they are also valid for applications of vertical stress equal to the depth of any soil element below the surface of the embankment. This is believed to be a reasonable representation of how designers would use this information in practice.

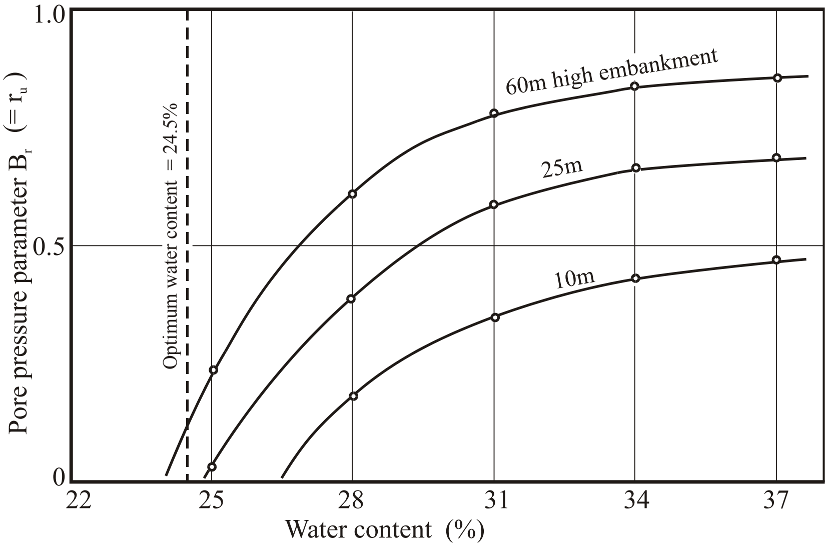


Figure 25. Pore pressure response for embankments of varying heights.

The pore pressure response data is summarised in Figure 25 as graphs of B_r versus compaction water content for embankment heights of 10, 25, and 60m. The parameter B_r is the ratio of pore pressure to vertical stress; it is not the same as the B parameter just described, which is the ratio of change in pore pressure to change in total stress. It thus takes account of both the initial negative pore pressure and the B parameter, and is numerically the same as Bishop's r_u parameter. The figure looks a little odd at first sight, but it must be remembered that the starting point for all tests is a negative pore pressure, so that for any water content the curves only become positive when the embankment height (or confining stress) reaches a certain value. With a water content of 25%, no positive pore pressures will develop in a 10m high embankment; they will just become positive when the embankment approaches 25m.

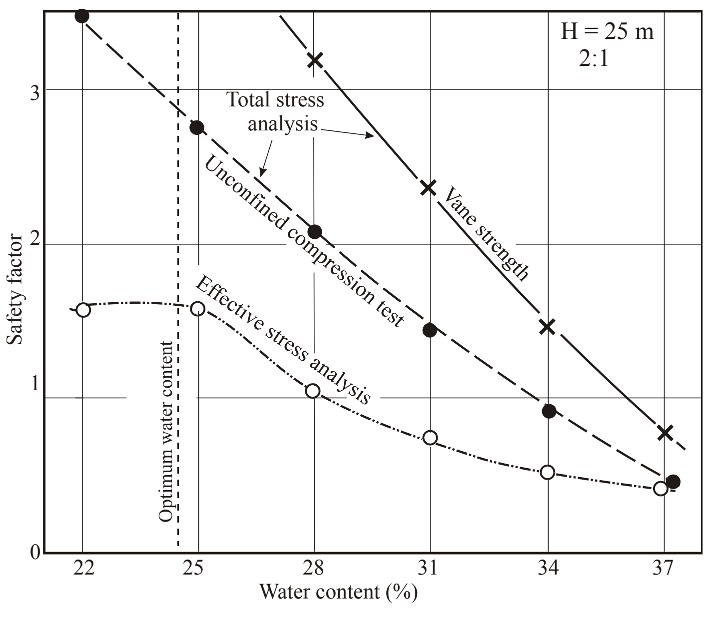


Figure 26. Safety factors for 25m high embankment with a slope of 2:1.

Stability analysis of various slopes by both total stress and effective stress methods has been done using the information in Figures 23, 24, and 25. An example of the results is presented in Figure 26. The large difference in values between the two methods of analysis is immediately apparent. The safety factors from the total stress analysis are almost double those of the effective stress analysis, except at very high water contents. The upper limit of water content likely to apply in practice is about 33%.

To understand the reasons for the difference, reference is made to Figures 27 and 28. Figure 27 shows the shear strength along a typical failure surface in terms of the total and effective stress analysis. The value to maintain stability (the required strength) is also shown. The analysis in terms of effective stress was done using the SLOPE/W programme and the Bishop method; the values of strength shown are those at the base of each slice.

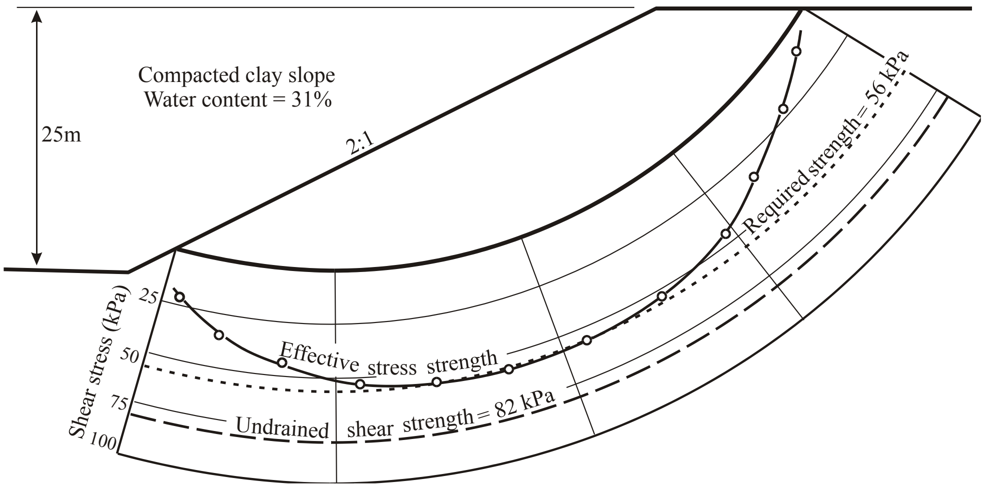


Figure 27. Stress state along a failure surface for water content = 31 %.

The undrained strength is constant all along the failure surface, and taken as the value from the unconfined compression tests. The effective strength along the surface rises from a very small value at each end to a maximum value at the centre, just greater than the value needed to maintain stability. This highlights the reason for the low value of safety factor using the effective strength method - the strength values reflect the effective stress along the failure plane, obtained from the total stress and pore pressure.

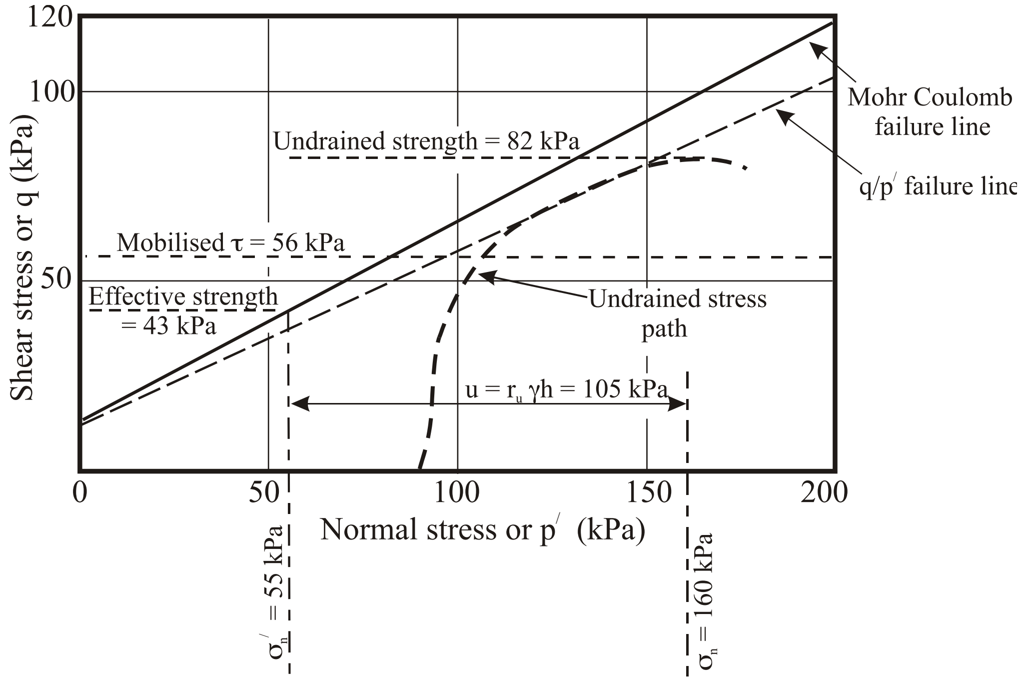


Figure 28. Shear strength of a soil element in terms of undrained and effective stress analysis.

Figure 28 illustrates the situation with respect to a typical element along the failure surface. The total stress is 160 kPa. The pore pressure using the B_r value form Fig. 25 is about 105 kPa, and the effective stress is 55 kPa. This corresponds to a shear strength of only 43 kPa. The undrained shear strength is 82 kPa, and the effective stress path corresponding to this value is shown. Hence in the unconfined compression test from which the undrained strength is obtained the effective stress must have been about 90 kPa, ie there was a negative pore pressure in the compacted soil of 90 kPa.

Thus the essential reason for the difference in safety factors is the difference in pore pressure (and thus effective stress state) in the two methods of analysis. This arises from two factors:

a) In the effective stress analysis, the pore pressure is obtained from the assumed B_r value. Only positive values of B_r are considered. The fact that the compacted soil may initially be subject to large negative pore pressure and that B_r could be negative is ignored. In the total stress analysis, the pore pressure and effective stress are not considered; the effective stress is largely governed by the negative pore pressure in the compacted soil prior to testing.
b) The stress path which the soil will follow when stressed is not taken into account. In the effective stress analysis the strength is taken directly from the Mohr-Coulomb envelope at the effective stress currently acting on the failure surface. In the undrained analysis, the pore pressure changes during testing so that failure occurs at a different effective stress state.

It is worth noting that these effects become less marked as the stress level increases. Figure 29 shows the situation with a 60m slope at 4:1. In this case, at low water contents, the effective stress analysis produces safety factors lying midway between the two values from the total stress analysis, although at higher water contents the effective stress value is again lower than the total stress values.

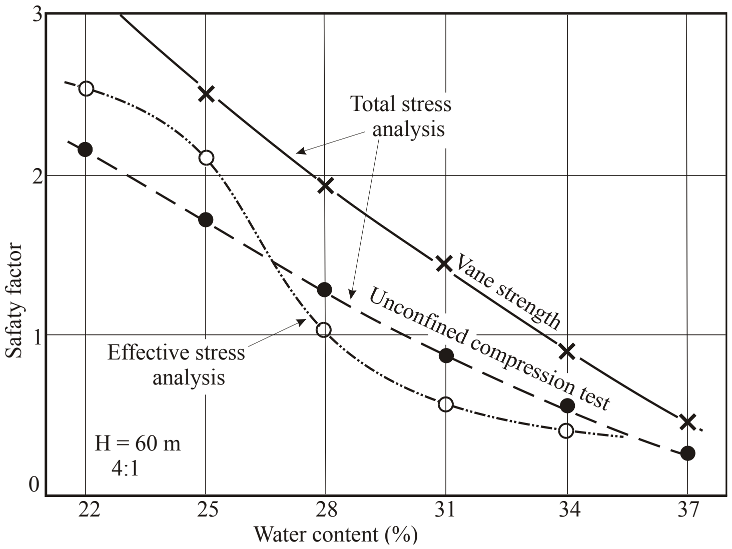


Figure 29. Safety factors for 60m high embankment with slope of 4:1.

The question of which is the more appropriate method cannot be given a simple answer. In theory, it appears that the total stress method should give a reliable result, especially if the undrained shear strength is actually measured when the embankment is constructed. However, there is clearly uncertainty regarding the undrained shear strength – two quite different values are obtained using a compression test and a vane test. Other methods will produce further variations. The effective stress analysis certainly appears conservative in most cases, although this doesn't necessarily mean that it is correct. It involves assumptions about the strength that are not directly related to the actual (ie measured) shear strength of the compacted soil. Compacted clay, will initially always involve a negative pore water pressure, but it is most improbable that designers will take this into account in the design process.

It must be remembered that it is only the short term (or "end of construction") safety factors that are being compared here. These values may increase or decrease with time as pore pressures change and bring about changes in strength. Changes in pore pressure are more easily measured than changes in undrained shear strength, and for this reason it would appear appropriate to analyse both short term and long term stability using effective stress analysis. As a matter of principle, changes in strength and consequent changes in safety factor with time should be assessed using the same formulation of shear strength, and the same method of stability analysis. Using total stress analysis for short term stability and effective stress analysis for long term stability, as is not infrequently done, does not give a reliable indication of the change in stability with time.

GENERAL EVALUATION OF SOIL PROPERTIES

To close I will make some general comments about the evaluation of soils as engineering materials. It seems to me that our profession is always in danger of developing an unhealthy addiction to numbers alone, especially those produced by sophisticated analytical and numerical methods, and from time to time we need to remind ourselves of some very basic aspects of geotechnical engineering, especially with regard to soil evaluation.

About 8 years of my professional life was spent in the geotechnical section of the Indonesian Public Works Department. This had responsibility for site investigation work from one end of the country to the other, so that the range of soil and geological conditions encountered was very diverse. Evaluating the properties and likely behaviour of an unknown soil at any particular site was always a challenge, and I wondered at the time, and again in more recent years, as to what are the most useful "indicators" or "pointers" readily available to engineers as to the likely behaviour of a particular soil. My list would be something like the following, at least with respect to clays and silts:

(a) Geological information. For example, in Indonesia, with any new job involving an unknown site, the first question I would try to get an answer to was whether the site was in a volcanic or non-volcanic zone. Java had reasonably good geological maps, so the question could be answered by reference to them, even if not totally reliably. The question was very important because of the stark contrast between the properties of the volcanic and non-volcanic areas. The same situation is also true to a considerable extent in New Zealand.

(b) Observation of field behaviour. While not always feasible, it is rare that there is no opportunity to observe, or fossick out information on actual field behaviour. This can be done by observing slope behaviour, exposures in cuttings, or the performance of existing structures, be they roads, houses, or major buildings.

(c) Undrained shear strength and sensitivity. Both these properties can be assessed reasonably accurately by direct manipulation of the soil, provided of course it can be sampled. Sensitivity is an under-rated property in my view, as it tells us a good deal about a soil. Highly sensitive soils owe most of their undisturbed strength to structure, in the form of bonds of some sort between particles. They can be expected to display distinct "yield" stresses – reflecting the stress level at which the inter-particle bonds start to break down.

(d) Atterberg Limits and natural water content. I am a great believer in the usefulness of Atterberg Limits, together with natural water content. The two pieces of information of greatest value that these give are, firstly, the Liquidity Index of the soil, and secondly, the position it occupies on the Plasticity Chart.

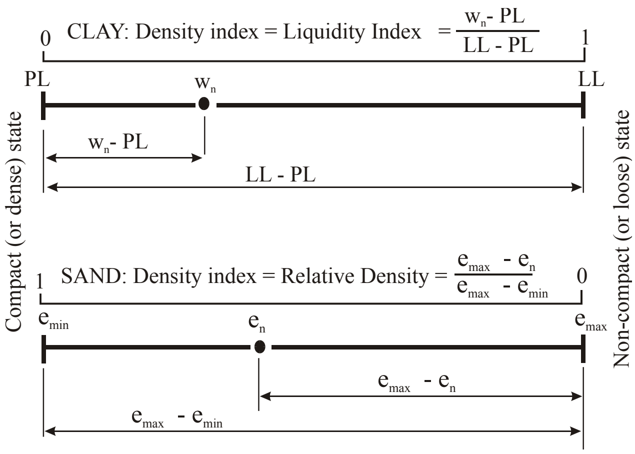


Figure 30. Measures of compactness in fine grained and course grained soils.

Figure 30 illustrates the two measures of "compactness" used in soil mechanics, namely the Liquidity Index for clays and the relative density for sands. They are each a measure of the position the soil occupies in relation to reference "density states", namely Atterberg Limits in the case of clays, and maximum and minimum densities in the case of sands. A liquidity index of zero indicates a "dense" clay, likely to be of moderate to high strength with very low sensitivity. It is very unlikely to show a marked "yield" stress. On the other hand, a clay with a liquidity index approaching or exceeding unity is likely to be highly sensitive with a very clear "yield" stress. The liquidity index is particularly useful if earth works are contemplated, as it is an indicator of likely handling difficulties and the degree of drying required. There is of course likely to be a close connection between liquidity index and sensitivity of the soil.

The second piece of very useful information is the position the soil occupies on the Plasticity Chart, a fact which is easily lost sight of. Soil mechanics literature contains many correlations of soil properties with either plastic or liquid limit. These correlations are inherently unsound, because neither parameter on its own indicates very much about the soil. Consider the Plasticity Chart shown in Figure 31 and the position of three soils A, B, and C.

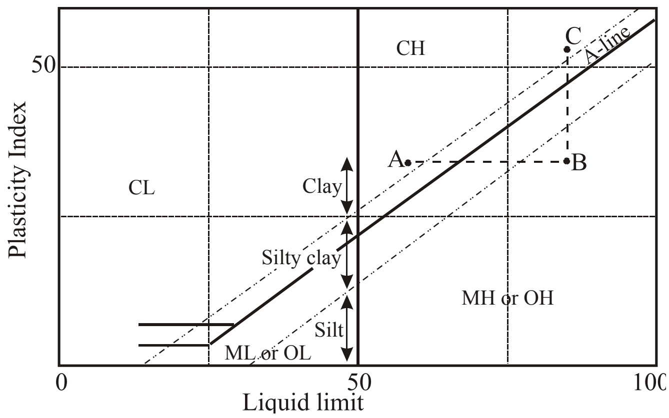


Figure 31. The Plasticity Chart.

Soils A and B have the same PI but will have very different properties. Similarly, soils B and C have the same LL but will have radically different properties. The two soils most likely to have similar properties are soils A and C, and the Plasticity Chart rightly classifies them into the same category, namely high compressibility or high plasticity clays. A and C have neither the same LL not PI. If correlations are restricted to groups of soils that occupy zones a consistent distance above or below the A-line then correlations with PL of LL may well be satisfactory, but only on this limited basis.

It is the distance a soil occupies above or below the A-line that is the most useful indicator of likely properties. (see Wesley,1988). This is no more than confirming Casagrande's original intention when he developed the Plasticity Chart. In the writer's view, it would be useful to divide the chart into a further zone by setting up lines parallel to the A-line creating a silty clay zone as indicated in Figure 31. Soils lying well above the A-line are likely to be difficult soils, especially those with liquid limits above 50. They are characterized by low shear strength, high compressibility, and susceptibility to shrink and swell problems.

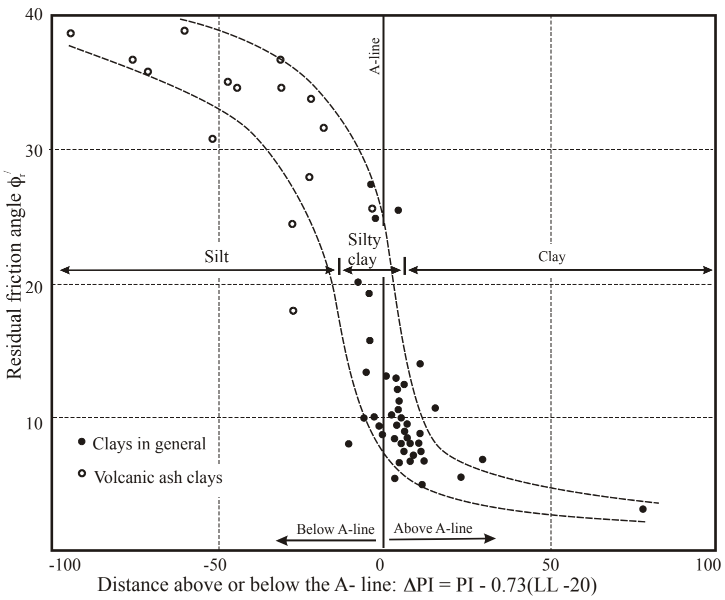


Figure 32. Residual friction angle (ϕ'_r) versus distance above the A-line.

An example of the usefulness of distance above or below the A-line for indicating soil behaviour is the correlation between residual friction angle (ϕ'_r) and Atterberg Limits. A number of researchers (eg Lupini et al 1981) have pointed out that correlations between ϕ'_r and PL or LL (or clay fraction) are possible within specific soil groups, especially sedimentary soils containing common clay minerals, but these have no general validity. Clays containing halloysite or allophone do not conform to these correlations. However, if the distance above or below the A-line is used, rather then PL or LL, then a correlation of more general validity is obtained. After meaning to investigate this correlation for some time, I eventually got around to doing it recently. Figure 32 is the result.

Although the correlation is rather crude it does show a consistent trend for all soils. Those lying well below the A-line generally have very high ϕ'_r values and those lying well above it have very low values. The chart is however restricted to soils with LL above 50. Those with LL below 50 do not show sufficiently stable behaviour in shear displacement tests for any correlations to be valid (shear behaviour varies between turbulent and sliding). A more complete account of the background to Figure 34 has been written up as a technical note to be published in Geotechnique (Wesley, 2003).

ACKNOWLEDGEMENT

I wish to sincerely thank the New Zealand Geotechnical Society for the honour of presenting this New Zealand Geomechanics Society Lecture.

I am very grateful for the contribution made to the research described in this paper by colleagues both in the workplace and within the university, and to the many students, both from within New Zealand and from around the world, who have carried out much of the work.

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SPECIAL INTERESTS

Numerical Modelling in Geotechnics, Part VIII

Sergei Terzaghi, Sinclair Knight Merz

In this column I want to go back and re-examine the use of Poisson's ratio in geotechnical modelling. This topic arises because of recent work I have been involved with where Poisson's ratio has been poorly used.

Of course, this topic only arises through the use of linear elastic or linear-perfectly plastic models. For more advanced models, Poisson's ratio is very much a minor parameter, as most of the soil deformation is accounted for through plastic deformation in which Poisson's ratio has no meaning. However, the majority of modelling still seems to be performed through use of these simple models.

In order to re-cap, in a linear elastic model, which obeys Hooke's law, strain is directly proportional to the applied stress, and the strain is fully recovered on the removal of that stress. If the stress is applied to, say, a bar along the axis, then as the bar shortens it expands laterally in proportion to the Poisson's Ratio. Mathematically then, in the general case:

$\varepsilon_1 = \sigma_1/E - \nu\sigma_2/E - \nu\sigma_3/E$

$\varepsilon_2 = \sigma_2/E - \nu\sigma_1/E - \nu\sigma_3/E$

$\varepsilon_3 = \sigma_3/E - \nu\sigma_1/E - \nu\sigma_2/E$

$\varepsilon_V = \varepsilon_1 + \varepsilon_2 + \varepsilon_3$

Where:

E = Young's Modulus of deformation

ε_I = Strain in i_{th} direction

σ_I = (Change in) Stress in i_{th} direction

ε_V = Volumetric strain

If the stresses in the 2nd and 3rd direction are zero, it is easy to see that the strains in those directions are non-zero and opposite to the strain in the 1st direction. It is also evident that Poisson's ratio is a significant parameter. All the other various moduli (Bulk modulus, shear modulus etc) can be written in terms of these two parameters. All of this is elementary mechanics, so how does this apply to soils.

Ignoring plastic behaviour for the moment, the first point is that soils are a 2 or 3 phase material – solid, liquid and gas – each phase with very different characteristic properties. The apparent stiffness of the bulk material depends on the behaviour of the individual components and the interaction between them. Hence for a saturated soil, the apparent stiffness changes significantly between a rapid loading (faster than the fluid can drain), and a slow loading (no pore pressure build-up). Under rapid loading there is assumed to be no volume change, and by definition, Poisson's ratio must be 0.5. However, as fluids have no shear resistance, the shear modulus of the soil must remain the same under both drained and undrained loading regimes. This provides a way of linking the drained and undrained behaviour of the elastic continuum. By manipulating the equations[1], one can find that the undrained Young's Modulus can be equal to 1.5 times greater than the drained Young's Modulus, though would typically be considered to be around 1.2 times stiffer. Note that because there is no volumetric change during the initial loading, any deformations or strains induced can only be by shear. Somehow, the apparent stiffness and Poisson's ratio must change during the process of consolidation. This is rarely modelled or taken into account.

I have introduced the topic by considering a situation with strains free to occur. In most geotechnical engineering situations the strains are constrained and an equivalent stress is induced in the material. This leads to the common assumption that there is a direct link between Poisson's ratio and Ko (Ko = $\nu/1-\nu$). Use of this relationship leads to the conclusion that Poisson's ratio for soil is limited between 0.2 and 0.35 for the drained case. This is in direct contradiction of observed behaviour, as most real values of Poisson's ratio vary from 0.05 through to about 0.3.

Of course, real soils are also non-linear, which means that the stiffness parameters are changing all the time even if the elastic assumption is retained. One such model to simulate this behaviour is the Duncan-Chang hyperbolic model. In this model, the primary stiffness parameters are the Young's modulus and the Bulk Modulus, both input as a set of parameters that describe behaviour with respect to a reference stress state. The equivalent Poisson's ratio is then calculated at each step as a function of the instantaneous value of each modulus. In this calculation the Poisson's ratio can vary for a material type from as high as 0.4 to as low as 0.2.

Modern material theory suggests that even in the normal geotechnical engineering stress ranges there is some combination of elastic and plastic behaviour at virtually all strain levels (true elastic-only behaviour is unrealistic beyond 0.005% strain). The true soil skeleton Poisson's ratio can only be determined at very low strains, and may well be different for different types of loading. At higher strains, the apparent behaviour is governed by a mix of elastic and plastic deformation. The plastic behaviour will be very different to the elastic because shearing may induce volumetric strains in contrast to pure elastic shearing. The apparent Poisson's ratio will therefore be different to that of the soil skeleton, and will usually be higher.

However, fudging an apparent Poisson's ratio in order to accommodate an inappropriate analytical model is no substitute for modelling the genuine plastic behaviour. Having said that, it can work for a small strain, high factor of safety problem.

This sort of change of behaviour reinforces that for a problem utilizing an elastic model, one needs to be aware of these sensitivities. For example, a loading problem such an embankment will want a higher Poisson's ratio than an unloading problem for the same soil.

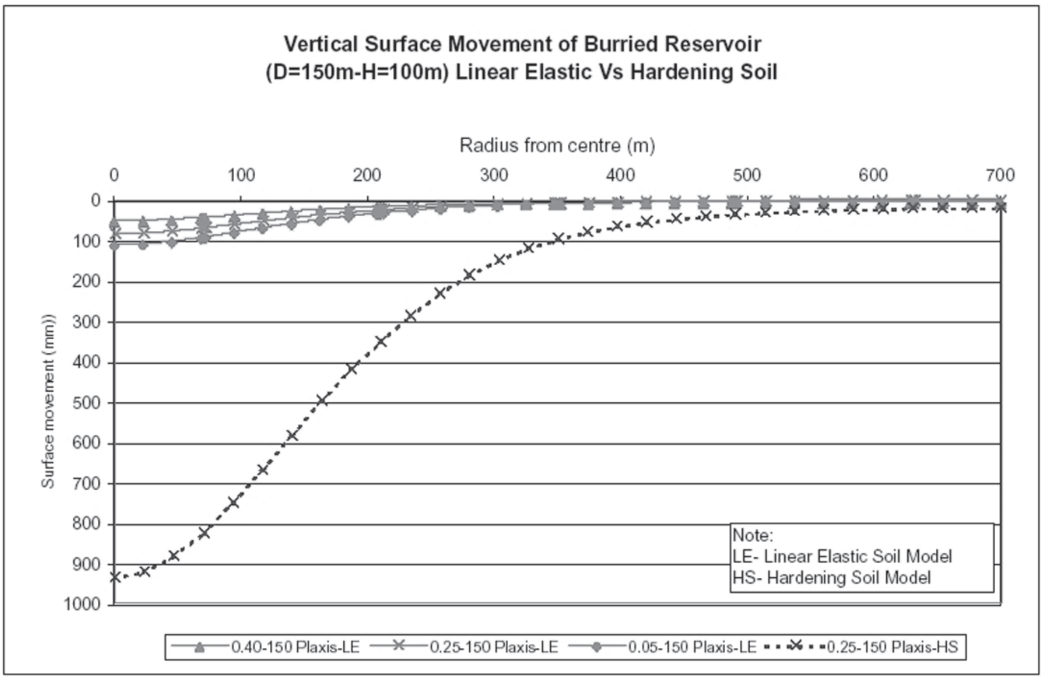
Let us see how these issues actually impact results. I present two different problems below. The first problem is essentially an axi-symmetric unloading problem resulting from de-pressurising a zone at depth. Three linear elastic models with different Poisson's ratios and a more advanced non-linear elasto-plastic model are compared on Figure 1. As much as possible all other parameters remain the same. Only one elasto-plastic model is considered here, as regardless of what was input for Poisson's ratio, the results were similar (that is to say for the advanced models, Poisson's ratio is a minor parameter). The difference between the linear elastic models, and the more realistic advanced model are startling to say the least. There is also a notable difference between the linear elastic models.

The second example is an embankment on soft soil. This is the same embankment as for Columns 1 and 2. Figures 2, 3, and 4 show what happens in a linear elastic analysis with Poisson's ratio at 0.495, 0.25, 0.05. Poisson's ratio at 0.495 is needed for numerical reasons but all other parameters remain the same. Whilst for this problem there is not a lot of difference between the 0.05, and 0.25, there is enough to illustrate the care that is needed.

These examples should be enough to illustrate why one should not use a simple linear elastic or elasto-plastic model for anything other than de-bugging a mesh, a very simple routine problem, or for a problem that is purely strength related (for example a slope stability problem). There is an argument against sophisticated modelling that there is rarely enough accurate factual information to even justify estimating a stiffness property, let alone any other parameters. Whilst I will agree that the information is often limited, most advanced models rely on a behaviour (like the slope of the line on the semi-log e-p consolidation plot) and a single reference point to define the characteristics. There is usually enough information for that.

I support the argument that the linear elastic model (or simple elasto-plastic model) is so poor at representing soil behaviour, that if one is running a model, it is better to capture the behaviour rather than the exact number, and for that, one needs to use the advanced models.

1 Refer to any standard textbook on Soil Mechanics. Soil Mechanics by W Lambe and R.V Whitman is useful for this sort of work.



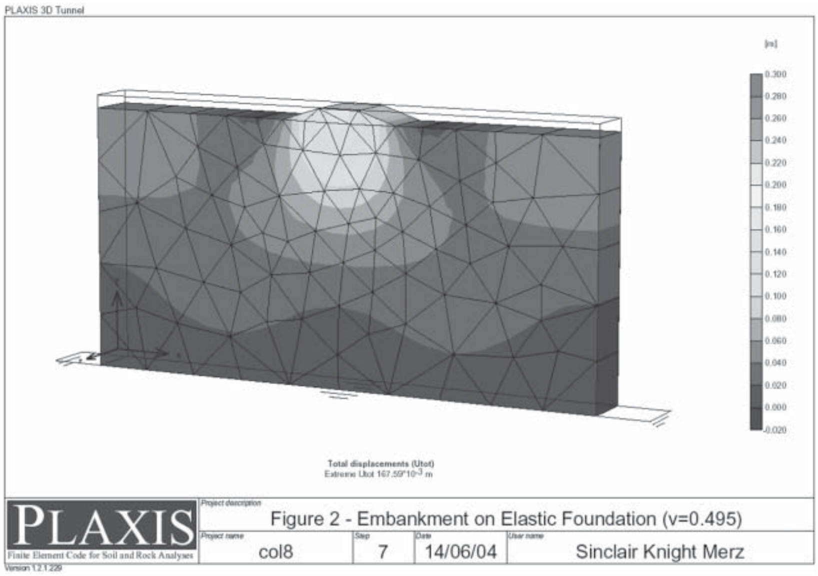


Figure 2 - Embankment on Elastic Foundation (v=0.495)

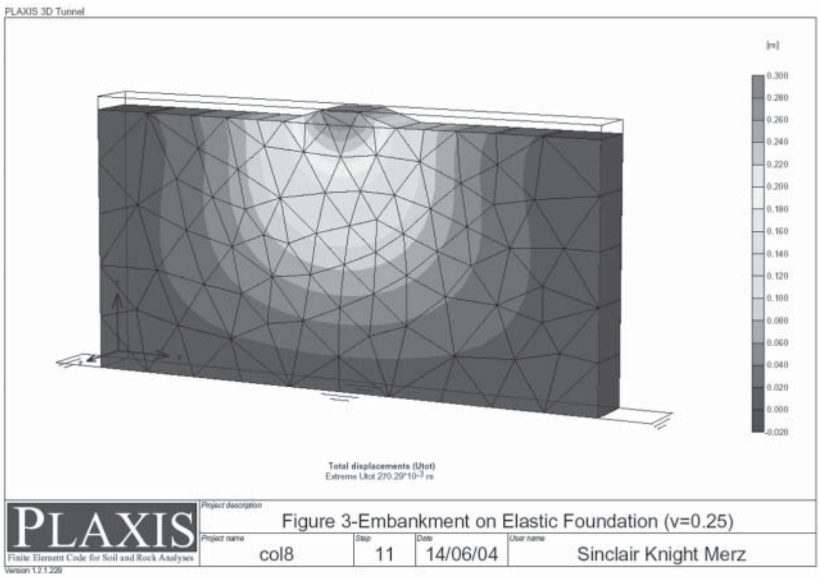


Figure 3-Embankment on Elastic Foundation (v=0.25)

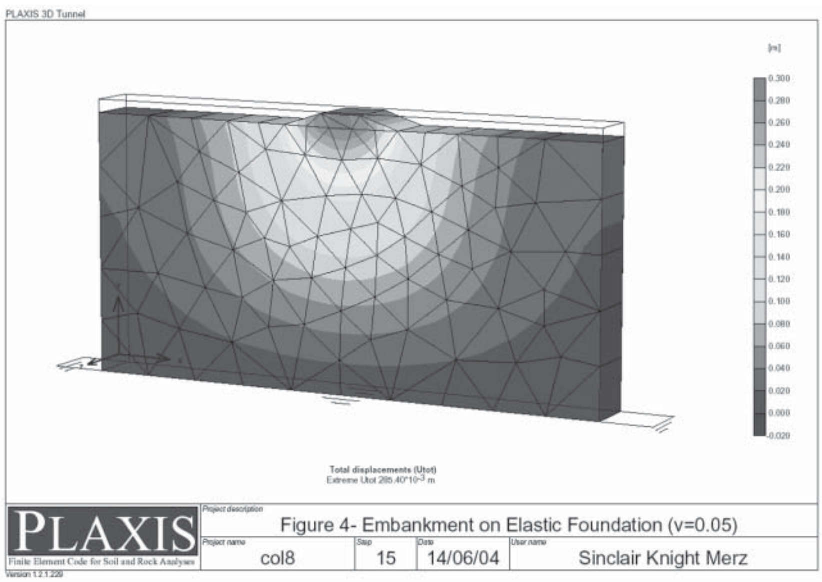


Figure 4- Embankment on Elastic Foundation (v=0.05)

LAURIE'S BRAIN TEASER

The answer to 'Geotechnical Brain Teaser' in the December 2003 Issue.

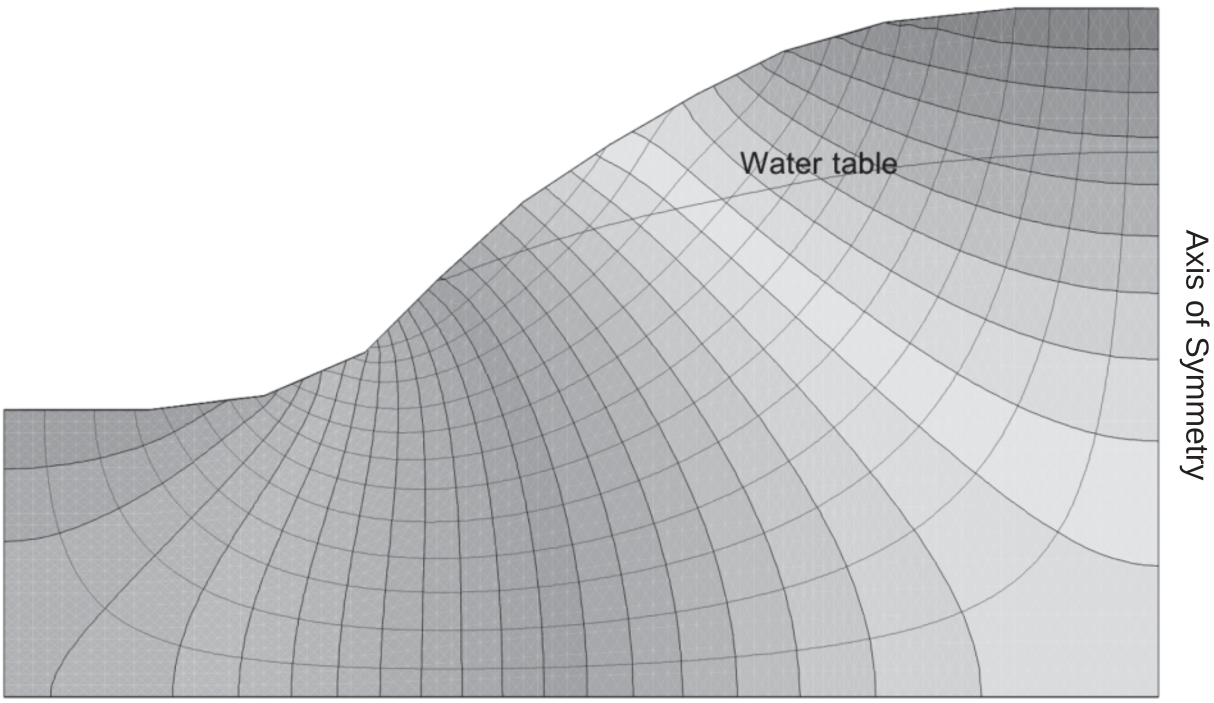


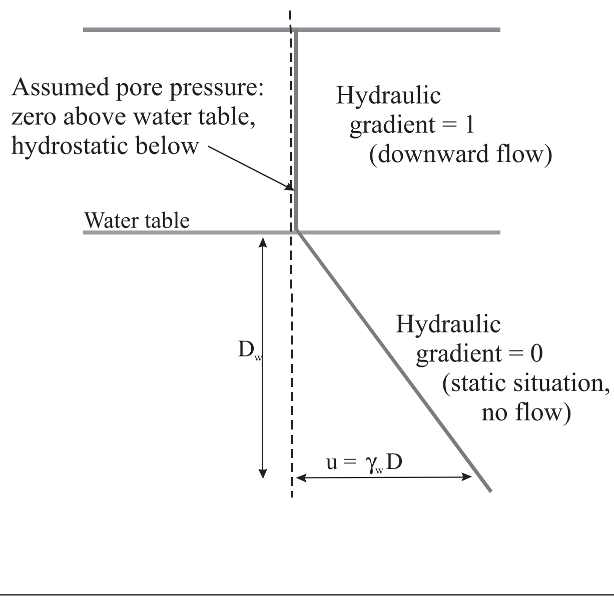
Figure 1: Seepage in a natural slope with re-charge from the slope itself.

There is nothing wrong with this flow net, apart from the fact that it is an idealisation. The purpose of the flow net is to emphasise that in a clay the water table does not constitute a boundary below which seepage is occurring and above which no seepage is occurring. In a clay there will generally be a zone near the surface where the soil is not fully saturated; this is probably not more than about a metre thick. Below this partly saturated zone, there is a continuous seepage zone, in part of which the pore pressure will be positive and part of which it will be negative. The same laws govern seepage above and below the water table, and no discontinuity occurs at the water table.

The flow net in the above diagram was generated using SEEP/W by assigning negative pressures to the surface nodes of the grid over the upper part of the slope and atmospheric pressure (i.e. zero) to the surface nodes lower down the slope. The negative values were simply scaled off an assumed phreatic surface. The computer automatically plots the phreatic surface as part of its output.

Figure 2 below illustrates an impossible pore pressure state (in a clay), but one which we geotechnical engineers tend to assume is the case – i.e. a hydrostatic state below the water table and zero pore pressure above it. Examination of the implications of this in terms of hydraulic gradient and flow shows that such a situation is not possible, except on a very short term transient basis.

Figure 2: An impossible pore pressure state



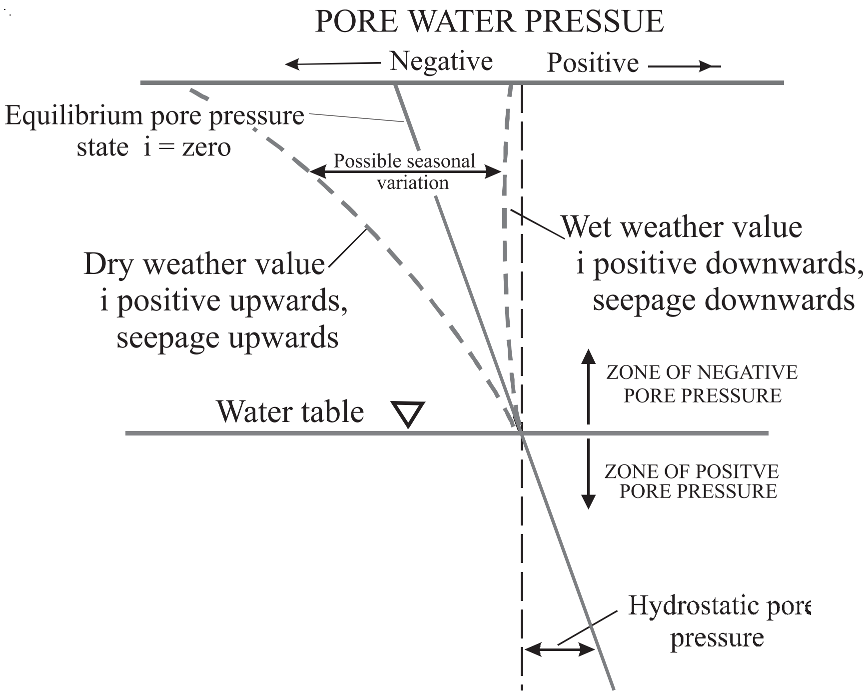


Figure 3: Pore pressure state above and below the water table.

Figure 3 is an attempt to illustrate the true state of pore pressure in a clay above and below the water table. The situation will of course not be steady state. Near the surface the pore pressure will fluctuate a great deal depending on weather conditions. During actual rainfall on the surface the pore pressure at the surface will be zero, while during hot dry spells it will be highly negative.

Along with the fluctuating pore pressure state, the water table itself will also rise and fall depending on the current weather conditions. While the above diagram is for a situation where the water table is level, or more or less level, the same concepts would apply to a sloping water table.

There are a couple of important practical implications which follow from the situation in Figure 3:

(a) The settlement of surface foundations built on clay layers where the water table is some distance below the surface will clearly depend on the pore pressure state above the water table at the time the foundation is built and the 'equilibrium' value after the foundation and the building it supports are completed. The difference in these values contributes to the change in effective stress that will be experienced by the soil below the foundation. This is usually ignored when settlement estimates are made. If the foundation is built at the end of a long dry period, there may be a significant rise in pore pressure after the building is completed, and a corresponding decrease in effective stress. In extreme cases this may mean that the foundation rises rather than settles. This is the 'expansive' soil situation familiar to those in hot climates, especially Australia and South Africa.

(b) If the water table is lowered it will influence the whole pore pressure state, not just the state below the water table. If there are compressible layers above the water table then compression will be induced in these layers, as well as in any compressible layers below the water table.

In conclusion, the water table or phreatic surface is therefore best thought of as the line of zero pore pressure, not as a boundary limiting the zone where seepage is taking place.

THE BOB WALLACE COLUMN

A few articles ago I discussed recent trends in the format of large contracts and queried whether these really were providing clients with value for money. The conclusion that could have been drawn from my observations was that whilst they provided the successful contractors with an opportunity to make more money for less effort they also reduced the 'Engineer's' role to little more than an irritant with no formal responsibility.

Regardless of my opinion, which I am occasionally reminded is not always correct, these contracts appear to be working. Employers are keen to engage in them and, not surprisingly, contractors are more than happy to bid for them. Recognising of course that bidding does not necessarily mean offering the best price. In modern forms of contract the best bid is the one that is dressed up to look like the best value. These contracts are here to stay.

So let's hand it to them, for years Contractor's struggled with competitive forms of tender that were adversarial from tender to final measure and they were lucky if they ever cleared more than 5% profit on turnover. It was hard work and they worked long hours at cut-throat rates to keep those margins and sustain a business. It is no surprise that the large contractors have led the charge towards new forms of contract. They have found a way of making more money, as they say in the vernacular, full credit.

Working long hours. Cut throat rates. Does this sound familiar? I don't know any consulting geotechnical engineers that are not working longer and longer hours. The demands for qualified experienced staff are increasing and whilst that is putting some welcome pressure on salaries the down side is that any increase in general pay rates has to be reflected in recoverable fees. Logic would dictate that we should be witnessing an increase in the time charge rates, but this is not the case. There is increasing pressure to reduce rates in order to be more 'competitive'.

This means that in order to cover the cost of salaries and reduce charge out rates to remain competitive, consultants will have to find innovative ways to maintain profit margins and sustain their businesses. Traditionally that involves putting the squeeze on variable overheads. That means less training, no new software or hardware and you can forget about bonuses or company sponsored social events. Of course, the other way you can afford to pay high salaries and bill low charge out rates is to persuade your staff to work longer hours than they book to the job. As an employer, I'm sure there's nothing better than getting someone to work for you in their own time, when you don't have to pay them.

The latter tactic, whilst not endorsed by anyone, is probably the favoured option for most medium to large consulting engineering companies. These businesses are struggling with ever increasing demands for auditable adherence to H&S, Environmental and Quality processes that add to their operating costs. The commercial pressures on conscientious businesses are more severe than for those that pay lip service to these demands. Then there is the overriding spectre of PI insurance. The level of cover, the premiums and the impacts of recent changes in the insurance industry are just beginning to influence our business. I don't want to be side-tracked on this issue but can anyone consider working for a client that expects $7.5M PI cover for a $1500 fee? Clearly, some one is prepared to take on that commission, or the clients wouldn't be asking.

Perhaps its time Engineers should start thinking about innovative engagement agreements that provide similar benefits for them that Turnkey, Design & Build or Alliance contracts have offered contractors. Instead of harping on about competition, poor wages and employment conditions, over-work, tight deadlines and never ending stress, consultants should take a positive step towards halting this downward spiral. And guess what? Bob Wallace has the answer.

Admittedly, the answer is not entirely original. In the time-honoured fashion of multi-national oil companies, the solution is as simple as jumping on the bandwagon of collusion, price fixing and cronyism. With that in mind I propose that as of 1 September 2004, all consulting geotechnical engineers implement the following pricing strategy.

Description	Charge Rate $/hr	Years Experience[1]	IPENZ Job Points	**Salary $**
Principal	350	>15	>55	**>190**
Executive	275	>15	45 – 55	**>150**
Senior Engineer	250	>12	35 – 45	**>110**
Experienced Engineer	200	>8	25 – 35	**>90**
Qualified Engineer	150	>4	15 – 25	**>70**
Graduate	125	–	<15	**>50**

Note: 1 This is an indication of the minimum number of years experience expected to be required in order to credibly hold a position with the associated level of expertise and knowledge indicated by the IPENZ equivalent job value.

Of course, for large companies offering multi-disciplinary services this proposed increase will probably affect other Engineers. When they see the impact on salaries, employment conditions and profit margins I am sure it will not be a major problem to get their agreement.

In order for this scheme to work, no consultant can offer discounted rates or enter into a contract on a lump sum fee basis. As of July 1 all consultants will be required to turn down work when they already have four weeks of fully committed fee income. No one is required, or expected to work overtime, but you are expected to bill the hours you work, up to a maximum of 40 per week.

The benefits to the industry will be manifold. In a very short time we will see increasing undergraduate numbers; only the very best will get into the courses and only the elite will qualify. The status of our profession will be elevated and the public perception of the value we add to society will be increased. Our salaries will become commensurate with lawyers, doctors, accountants and real estate agents and Bob Wallace will retire, happy in the knowledge that he has changed the face of NZ Professional Engineering.

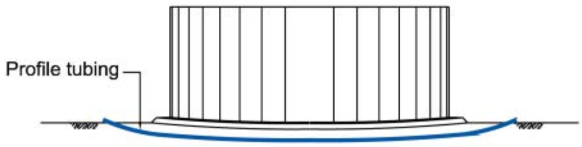
New Services

Window Sampler

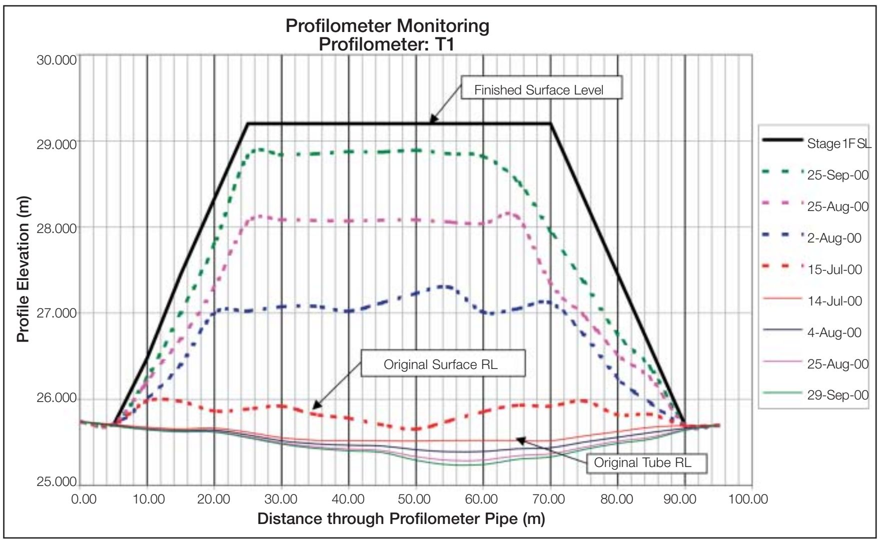
- Geotechnical investigations
- Environmental investigations
- Soil sampling
- Piezometer installation
- Coring to 10 m
- Cost effective
- Continuous core sample of 1 m or 2 m
- Excellent at identifying discrete bedding or layering
- Recovers sensitive soils i.e. liquifying sands
- Useful where access is difficult or there is a space constraint i.e. basements, gardens

Hydrostatic Profilometer

- Settlement monitoring
  - Pavement embankments
  - Oil tanks
- Unobtrusive to construction traffic
- Low-cost installation
- Monitoring length of 130 m
- Monitoring height range of 4 m
- Output
  - Settlement profile versus fill surface level
  - Settlement versus time at a discrete point



Installation below an oil tank



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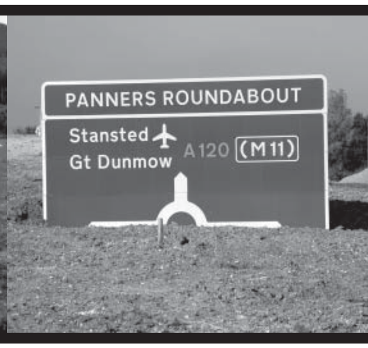
NZ Geotechnical Society 2004 Photo Competition

The year 2004 theme is:
"Anything Geotechnical"

Show us the things that geotechnical engineers, engineering geologists, and technicans in the profession get up to!! Photos of those fantastic projects you work on.



WIN $200

A perfect chance to win some drinks money for the office.

The winning photo will be printed in the December 2004 issue of the *NZ Geomechanics News* and put onto the Society Web Page.

Send your entry to:

- The Geomechanics News Editor, Private Bag 1930, Dunedin by 30 October 2004
- *OR* email to: p.glassey@gns.cri.nz (send as jpgs)
- Clearly mark your entry with your name and provide a caption for your photo

Conditions of Entry:

1. Only amateur photographers may enter.
2. Photos must be taken by the entrant.
3. No computer generated pictures.
4. Any photographs received may be published in subsequent Society publications.
5. Winning entries will be final and no correspondence will be entered into.
6. NZ Geotechnical Society members only may enter.

COMPANY PROFILES

Sinclair Knight Merz

Sinclair Knight Merz (SKM) is an international multi-disciplinary consulting organisation that operates across a broad range of market sectors with offices throughout Australasia, Asia, Europe and South America.

The firm operates business units across five broad markets defined as Environment, Resources, Heavy Industry, Buildings/Property and Infrastructure. Sinclair Knight Merz offers technical consultancy, engineering design, specialist expertise, planning, project and construction management services in all sectors of these markets.

For any SKM project which is built in or on the ground, from a small residential subdivision to a major infrastructure or power project, a thorough understanding of the soils, geology and land formations is vital to effective design and construction. Geotechnical engineering and engineering geology deal with the interface between development projects and the ground. The SKM Geotechnical Group has been formed to integrate the skills of specialist engineers, geologists and earth scientists to provide geotechnical services to Sinclair Knight Merz clients.

SKM Geotechnical Philosophy

For all but the most routine small development, we see the provision of geotechnical services not as a discrete one-off ground investigation immediately before design, but as an ongoing activity through all stages of the project. Integrating geotechnical expertise into the project team from day one can give savings of time and money and more importantly, manage uncertainty and risk associated with the ground. It is vital that the factual information collected in any ground investigation is properly interpreted and used effectively throughout the design and construction process.

SKM Geotechnical Resources

The largest group of SKM's geotechnical resources are based in the Auckland office. There are also geotechnical staff in Wellington, Melbourne, Sydney, Perth and Singapore and the total resources now number approximately 35 staff. Representing just over 1% of the total professional staff in the company this is a business sector with significant growth potential for SKM and opportunities exist around the group for geotechnical staff willing to travel.

SKM Geotechnical Projects

In recent years significant geotechnical projects for the NZ operation has included:

- North Shore Sewer Network Upgrade
- Meghnaghat Power Station, Bangladesh
- Central Motorway Junction, Auckland
- Mt Beauty Hydro-Electric Scheme, Victoria, Australia
- Darajat Geothermal Power Plant and Steamfield, Amoseas, Indonesia
- Encore JV, Deep Soil Mixing Slope Stabilisation Projects

These represent a selection of the wide variety of projects that have provided a broad range technical and professional challenges for the NZ Geotechnical Group. Long may it continue.

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Geotek Services Ltd

Geotek Services Limited, formed in 1994, is a small specialist geotechnical consultancy, with a main office based in Howick, and a satellite office in Papakura.

Operating predominantly in land development, their major areas of expertise are:

- Geotechnical reporting in support of Resource or Building Consents, including subsurface investigations, slope stability analyses for existing and/or proposed contours, settlement analyses or assessment, retaining wall design, on-site stormwater and effluent disposal.
- Subdivisional earthworks compaction monitoring and control, in association with an IANZ Registered Laboratory.
- Investigation and classification of expansive soils in our in-house laboratory. In this regard, Geotek co-authored Acceptable Solutions for residential building development in Manukau City for dealing with expansive soils.
- The senior staff have a particular interest in, and experience of, ground improvement techniques such as soil nailing and/or stone columns.
- The company introduced dynamic probing to New Zealand in 1996. Their Pennine Dynamic probe can provide a continuous indication of soil strength with depth, thereby more readily detecting thin weak layers, which may otherwise be missed by conventional drilling techniques. Probing has been achieved to depths of up to 26 metres in "rotten rock". It is therefore well suited for detection of both slip planes and pile bearing strata. The probe is available for hire, complete with operating Field Engineer, for further details, please contact us as below, or see our advertisement in this issue.

Above: Pennine Dynamic Probe in use on a steep 4 slope at the North Shore, Auckland

Contact details:

enquiries@geotek.co.nz

Howick Office:
PO Box 39015, Howick, Auckland.
Phone (09) 5359814
Fax 09 5357243

Papakura Office:
PO Box 272-1217, Papakura
Phone (09) 2967241
Fax 09 2967243

MEMBER PROFILE

Glen Guy

Occupation

Engineering Geologist,
Tonkin & Taylor Ltd, Hamilton

How Did it Start?

I first got interested in earth sciences and engineering through a presentation given in my last year of college (see they do actually work) where visions of excavators, cranes and large holes in the ground inspired me to go to University. Either that or the fact I didn't have to get a real job for another four years or so. With a love of the outdoors, through sport, mountain biking and camping, geology seemed like the ideal subject to undertake. Unfortunately unlike 10 years previous there wasn't a wealth of geology jobs waiting for graduates. I distinctly remember a lecturer (who shall remain nameless) addressing a 3rd year class and telling us that we should 'pursue other career paths and keep geology as a hobby'. With that sort of advice who needs career councillors.

The Journey So Far…

After graduating with my BSc in 1993 and taking a year off for a quick ski trip to the US and to earn some money I was fortunate to be offered the opportunity to work with the earth Sciences team at Kingston Morrison (now SKM) based in their Auckland office. I spent nearly five years with KML, initially working in the petrology lab and undertaking geotechnical and geothermal fieldwork and eventually given the responsibility as site geologist at a major geothermal drilling operation. During this time I was fortunate enough to work along side some of the geothermal industry leaders such as Jim Lawless and Dr Phil White. The highlight of the four and a half years I spent there was spending the better part of 1996 and 1997 in and out of Indonesia working on the Wayang Windu geothermal exploration project as an exploration geologist. During my time there I also managed to start my postgraduate study at Auckland University.

After a down turn in work as a result of the Asian economic crisis I left KML in late 1998 and headed for Perth, Western Australia (more excavators and big holes in the ground). I hooked up with a Perth based geotechnical consultancy and proceeded to spend the next two years working on projects for both the mining industry and the roading authority. Work typically involved green fields (or should I say red dirt) exploration for industrial development, aggregate searches for roading and tailings dam assessment, design and remediation.

Towards the end of 2000 my son was born and we decided it was time to head back home. I was lucky to be offered a job as an engineering geologist with Tonkin and Taylor in the Waikato office, where I still am. I work as part of a close knit team of eleven engineers and scientist providing integrated civil and environmental solutions for a variety of clients. Projects can range from earth dams for sludge storage to landslip investigation and mitigation to subdivision investigation. Although being the only geotechnical engineer/engineering geologist in the Waikato office it's never a lonely effort as I have a wealth of knowledge only a phone call away. I have also managed to finish my postgraduate degree (finally!) thanks to the support of T&T.

A Typical Week

There's no such thing as a typical week in this job. The day usually starts around 7:30 and may involve anything from battling paperwork, client meetings, inspections and supervision of projects, site assessments, organising fieldwork, or design work. These are typically on projects around the Waikato region but I have been known to venture as far north as Ahipara (Northland) and even spent a few days in Christchurch.

Highs and Lows

I enjoy the interaction with clients, contractors and staff on projects, finally seeing something you've put time and effort into designing finally being constructed (and working!) and being involved in Earthquake Commission natural disaster work The overseas work, especially larger projects, have all been challenging and lifetime experiences. And a definite high is being able to introduce my son to the wonders of geology (there's not many 3½ year olds that know what greywacke is).

Low points would have to be dealing with ignorant contractors and slow payers.

My Ambitions?

- Start and finish my thesis (this would probably involve something work related through T&T).
- Educate the uninformed on the benefits of thorough site investigations.
- Spend time with my kids.
- Finally get around to running that half marathon.

Advice

To anyone starting out in the industry, have a passion for what you do and don't be afraid to ask questions and learn from those around you.

EVENTS DIARY

Links are available from the NZ Geotechnical Society website – www.nzgeotechsoc.org.nz

2004

JUNE 28–JULY 2, 2004, Rio de Janeiro, Brazil

IX International Symposium on Landslides – ISL' 2004

Conference Themes:

– Advances in Geomorphological Mapping and development of geological and geotechnical models in landslide hazard assessment
– Advances in Rock and Mine Slopes design
– Advances in Field Instrumentation and Laboratory investigations
– Pre-failure mechanics of landslides in soil and rock, including creep, softening, progressive failure and sliding in contractive soil.
– Post failure mechanics of landslides, particularly earth and debris flow
– Advances in stabilization methods and risk reduction measures such as catch fences and debris dams
– Mechanisms of slow active landslides
– Also includes short courses and international field school.

Web: http://www.abms.com.br/

JULY 7–10 2004 Grand Mecure Hotel, Gold Coast, Queensland Australia

6th Young Geotechnical Professionals Conference.

Conference aims:

– to promote the professional development of delegates through sharing experience and ideas, and by presenting a paper to senior professionals and peers.
– to provide a forum at which delegates could benefit from the insight of acknowledged authorities within the profession.
– to expand and strengthen the lines of communication between young professionals within the field of geomechanics.
– to promote an enhanced perspective of the varied roles, responsibilities and opportunities encompassed by the geotechnical profession;

Additional aims for the 6th YGPC are:

– to encourage further interaction between Australia and New Zealand professionals;
– to encourage exchange of knowledge between consultants and construction contractors associated with the geotechnical industry;
– to showcase the range of geotechnical projects currently underway in South East Queensland, highlighting the challenges facing geotechnical professionals;
– to encourage recent graduates to attend.

Web: http://www.6thygpc.com

AUGUST 2004, Santiago, Chile

MASSMIN 2004

Conference themes:

– Mine Design Fundamentals
– Mine Planning
– Mine Operation
– Applied Geomechanics in mining
– Mass Mining Methods – Case Stories
– Research and Technological Innovation
– Transition from Open Pit to Underground Mining

Contact person:

Chairman: Dr. Antonio Karzulovic
Email: akarzulovic@akl.cl

SEPTEMBER 9–10, 2004 Paris, France

International Symposium on Ground Movement

Conference Themes:

Ground Mass improvement techniques:
– Dynamic Compaction
– Vibroflotation
– Deep compaction
– Consolidation and preloading of fine grained and organic soils
– Vertical drains
– vacuum loading
– Electro-consolidation
– Injection of granular and fine grained soils
– Stone columns
– Jet grouting
– Lime/cement treated soil columns
– Ground Freezing
– Standards
– Education.

For information: bourgain@mail.enpc.fr

SEPTEMBER 13–17, 2004, Thessaloniki, Greece
International conference on Eco-Engineering:
The use of vegetation to improve slope stability
Conference Themes:
– Vegetation and eco-engineering
– Interactions of vegetation and structures
– Soil reinforcement by roots
– Hydrology and land use
– Soil erosion
– Geotechnical methods and applications
– Slope degradation and forest dynamics
– Applications of land restoration
– Modelling of slope stability
– Decision support systems
– Riverbank and coastline protection measures
– Plant growth versus engineering stability
– Benefits and liabilities in slope protection and erosion control
Web: http://lrbb3.pierroton.inra.fr
Web: http://www.ecoslopes.com

SEPTEMBER 20–22, 2004, Porto, Portugal
2nd International Conference on Geotechnical Site Characterization
– Sponsored by ISSMGE and endorsed by the ASCE Geo-Institute and the ISRM, and will be scientifically led by the members of Technical Committees of the ISSMGE TC16 – for *In Situ* Testing – and TC10 – for Geophysical Methods.
Web: http://www.fe.up.pt/ISC-2

SEPTEMBER 28–30, 2004 Perth, Australia
2004 Ground Support
Conference Themes
– Rock Mass Characterisation for ground support
– Analysis of rock-ground support interactions
– Ground support for seismic conditions
– Quality assurance and quality control
– Performance assessment and monitoring
– Corrosion
– Risk Assessment
– Case studies
Web: http://www.acg.uwa.edu.au

OCTOBER 18–20 2004, Nanjing, China
4th International Conference on Dam Engineering
For more information contact:
The Conference Director
Ci Premier Pte Ltd
150 Orchard Road #07-14
Orchard Plaza
Singapore 238841
Tel: 065 6733 2922 Fax: 065 6235 3530
Email: CIPREMIERE@SINGNET.COM.SG
Web: www.cipremier.com

OCTOBER 21–23 2004, Nanjing, China
International Conference on Soil Nailing and Slope Stability
For more information contact:
The Conference Director
Ci Premier Pte Ltd
150 Orchard Road #07-14
Orchard Plaza
Singapore 238841
Tel: 065 6733 2922
Fax: 065 6235 3530
Email: CIPREMIERE@SINGNET.COM.SG
Web: www.cipremier.com

OCTOBER 19–21 2004, Stellenbosch, South Africa
GEOFILTERS 2004
Conference Themes:
– New developments and products
– Case histories: proven performance
– Instances of failure
– Durability and long term behaviour
– Erosion control
– Laboratory testing
Web: www.wits.ac.za/geofilters2004

OCTOBER 21–23, 2004 SIVAS, TURKEY
ROCKMEC'2004 – VIITH Regional Rock Mechanics Symposium
Symposium subjects
– Original researches and new developments
– Theoretical and analytical studies
– Numerical methods
– Rock mechanics applications and tests
– Geotechnics and in-situ measurements
– Underground mining
– Slopes and open pit mining
– Quarrying
– Drilling-blasting and ground vibration
– Earthquake mechanism
– Mine shafts
– Underground excavations
– Subways and tunnels
– Foundation of dam and power stations
– Oil and natural gas repositories
– Radioactive waste storage
– Military storage facilities
– Geothermal energy applications
– Oil-exploration drilling
– Ground reinforcement studies
www.kayamek2004.cumhuriyet.edu.tr

DECEMBER 14–17, 2004 New Delhi, INDIA
'Tunnelling Asia'2004 – Need for Accelerated Underground Construction – Issues & Challenges'

2005

JANUARY 24–28, 2005 Moscow, Russia
10th ACUUS Conference
Underground Space: Economy and Environment and ISRM Regional Symposium Rock Mechanics for Underground Environment
Conference Themes:
– Concepts of Underground space
– Sustainable development
– Real estate and property issues
– Visualisation in underground space
– Geoecology of underground space
– Risk assessment and management of underground construction
– Numerical solutions
– Underground construction in polar regions
– Construction and support of very wide excavations
– TBM operation in congested urban areas
– Development of rock mechanics in underground construction
Web: http://www.acuus-isrm05.ru

MAY 23–25, 2005 Stockholm, Sweden
International conference on Deep Mixing Best Practice and Recent Advances
Conference Themes:
– Infrastructure
– Offshore/near shore
– Environment
– Earthquakes and vibrations
– and eco-engineering
For information: www.deepmixing05.se

JUNE 15–17, 2005 Amsterdam, Holland
IS-Amsterdam 2005 – Underground Construction in Soft Ground TC 28 of the ISSMGE
Conference Themes
– Tunnelling in soft ground
– Monitoring of underground constructions
– Numerical analysis
– Deep excavations
– Mitigating measures
Web: http://www.tc28-amsterdam.org

SEPTEMBER 12–16, 2005 Osaka, Japan
16th International Conference of ISSMGE
Themes of the Plenary Sessions
1. Soil Mechanics in General
2. Infrastructure and Mobility
3. Environmental Issues of Geotechnical Engineering
4. Enhancing Natural Disaster Reduction Systems
5. Engineering Practice and Education
Web: www.icsmge2005.org

SEPTEMBER 19–21, 2005 Western Australia, Australia
'Frontiers in Offshore Geotechnics' (ISFOG)
– Deep water systems (anchors, suction caissons)
– Shallow water systems (piles, footings, jack-ups)
– Pipelines
– Soil characterization
– Offshore site investigation
– Geophysics
– Geohazards
– Renewable energy facilities
Web: www.isfog.com
Key Dates:
Abstract Submission Deadline 1 July 2004
Manuscript Submission Deadline 15 December 2004
Camera-ready copy due 1 April 2005

2007

JULY 2007 Lisbon, Portugal
11th ISRM Congress
Conference Themes
– Rock engineering and environmental issues
– The path from characterisation to modelling
– Surface and shallow underground structures
– Earthquake engineering and rock dynamics
– Petroleum engineering and hydrocarbon storage.
Plus several workshops are planned.
Web: http://www.isrm2007.org

NEW ZEALAND GEOTECHNICAL SOCIETY INC.

Management Committee Address List 2003

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* Elected members of committee
\+ Appointed position
• Co-opted position

NEW ZEALAND GEOTECHNICAL SOCIETY INC.

Objectives

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.
Students 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.

A $30 per year service centre will apply to all non IPENZ members.

Basic membership subscriptions (inclusive of GST)

which include the magazine *NZ Geomechanics News*, are:

Members	$67.50
Students	$28.10

Affiliation fees for International Societies – Members must affiliate to one of the International Societies

are in addition to the basic membership fee:

International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE)		$24.00
International Society for Rock Mechanics (ISRM)		$33.00
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 Inc.
P O Box 12 241
WELLINGTON

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

NEW ZEALAND GEOTECHNICAL SOCIETY INC.
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: __________ Email: __________
Date of Birth __________
Academic Qualifications ____________________
Professional Memberships __________ Year Elected __________
Present Employer ____________________
Occupation ____________________
Experience in Geomechanics ____________________

Student Members:
Tertiary Institution ____________________
Supervisor __________ Supervisor's 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 & the Environment	(IAEG)	Yes/No
	(with Bulletin)	Yes/No

DECLARATION:

If admitted to membership, I agree to abide by the rules of the New Zealand Geotechnical Society Inc.
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 ____________________

NEW ZEALAND GEOTECHNICAL SOCIETY INC. PUBLICATIONS

Publication Name	List Price Members	List Price Non-Members
New Zealand Geomechanics Society Conferences:		
Proceedings of Technical Groups, Vol 22, Issue 1G *Geotechnical Issues in Land Development* Hamilton 1996	$20	$35
Proceedings of the New Zealand Geotechnical Society Symposium – *Roading Geotechnics 98* Auckland 1998	$40	$70
Proceedings of the New Zealand Geotechnical Society Symposium – *Engineering and Development in Hazardous Terrain* Christchurch 2001	$50	$70
Proceedings of the New Zealand Geotechnical Society Symposium – *Geotechnics on the Volcanic Edge* Tauranga 2003	$50	$70
Australia – New Zealand Conferences on Geomechanics:		
Proceedings of the 9th Australia – NZ Conference on Geomechanics Christchurch, February	$120	$150
Proceedings of the 6th Australia – NZ Conference on Geomechanics Christchurch, February 1992	$50	$100
Proceedings of the 3rd Australia – NZ Conference on Geomechanics Wellington, May 1980	$10	$30
Other Publications:		
NZ Geomechanics News Collection 1970–2003 Volumes 1–66 (CD)	$25	$40
Proceedings of the 2nd Australia – NZ Young Geotechnical Professionals Conference, Auckland, December 1995	$25	$40
Proceedings of the 5th Australia – NZ Young Geotechnical Professionals Conference, Rotorua, March 2002 (spiral bound reprint)	$75	$85
Shear Vane Guidelines	$15	$20
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 Issues of *NZ Geomechanics News* (depending on availability)	50c	50c

Prices do not include GST or postage & handling

Orders to:
Debbie Fellows
Management Secretary
PO Box 12–241, Wellington, Auckland
Email: dfellows@xtra.co.nz

ADVERTISING

NZ Geomechanics News is published twice a year and distributed to the Society's 500 members throughout New Zealand and overseas.

The 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 (mm)
Black & White		
Full Page Internal	$225	185 wide x 265 high
Half Page Internal	$175	90 wide x 265 high 185 wide x 130 high
Quarter Page Internal	$150	90 wide x 130 high
Colour		
Back Cover	$600	210 wide x 297 high
Inside Cover (Front or Back)	$500	210 wide x 297 high
Full Page Internal	$400	210 wide x 297 high
A3 Centrefold	$750	420 wide x 297 high
Inserts		
Insert to be posted with magazine – $200/flyer		
Maximum size single A4 page		
Special price given on request for other types and sizes		
Note		
1. All rates exclude GST		
2. Space is subject to availability		
3. A 3mm bleed is required on all ads that bleed off the page. Bleed must be set up on all files that are supplied.		
4. Advertiser to provide all flyers		

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

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