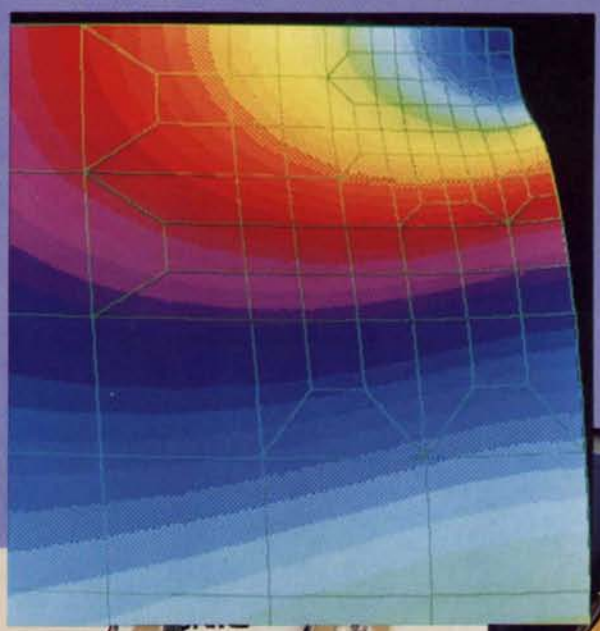
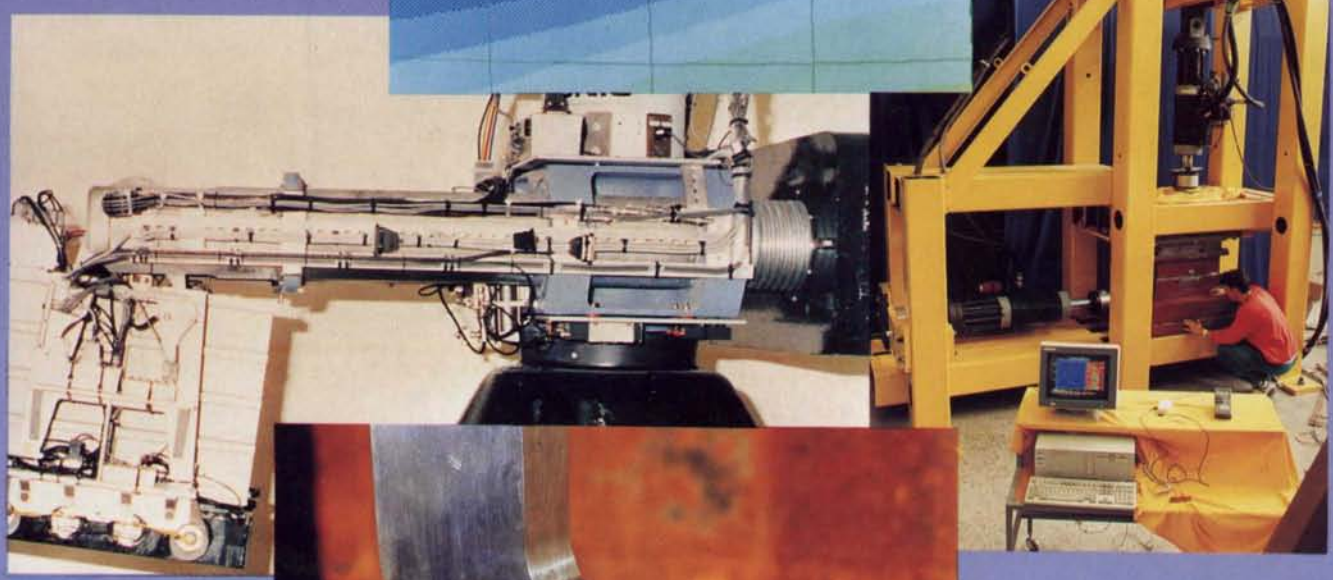
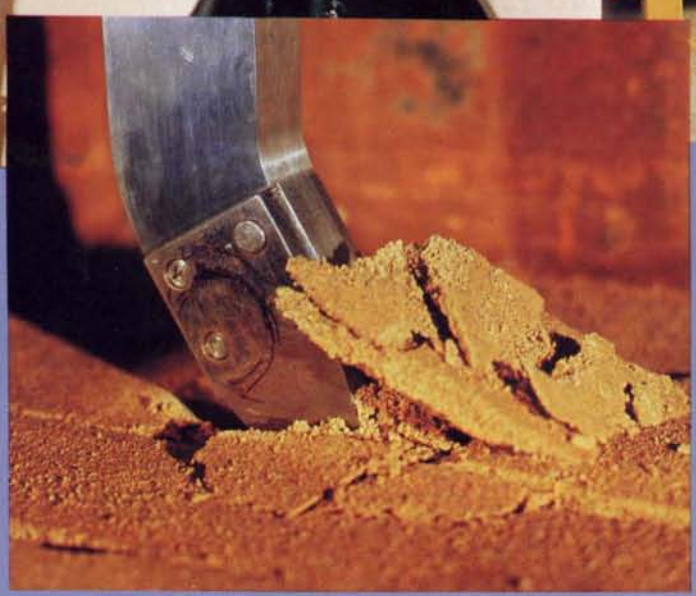
Australian Geomechanics







News Journal of the
Australian Geomechanics
Society

ISSN 0818 - 9110

No. 23, MARCH 1993

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Issue No: 23 **March 1993**

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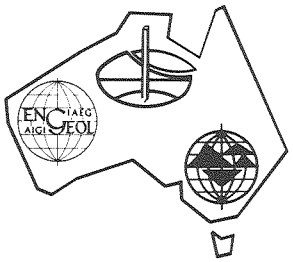

AUSTRALIAN GEOMECHANICS

News Journal of the Australian Geomechanics Society

ISSN 0818 - 9110

No. 23, MARCH 1993

PUBLISHED FOR THE AUSTRALIAN GEOMECHANICS SOCIETY BY
THE INSTITUTION OF ENGINEERS, AUSTRALIA
National Office: 11 National Circuit, Barton ACT 2600
Telephone: (06) 270 6555 Facsimile: (06) 273 1488

SUBSCRIPTION:
$16.00 per year for members (2 editions per year)
$20.00 per year for non-members Single back issues $10.00

Overseas orders must include an additional $10.00 per year to cover airmail postage.

The Institution of Engineers, Australia

The Australian Geomechanics Society is jointly sponsored by:

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EDITOR'S NOTES

The Editorial Panel of Australian Geomechanics seeks contributions for future editions. The following comments are offered to assist would-be contributors.

Technical contributions can include any of the following:-

- Papers, not necessarily of standard or content required for acceptance in, say, Transactions of the I.E. Aust, although high standard contributions are, of course encouraged. State Groups might consider submitting selected addresses.
- Technical notes.
- Comments on papers published in Australian Geomechanics.
- Brief notes on "wrinkles" encountered in the practice of geotechnical engineering which the contributor is prepared to share with the readers.
- Descriptions of geotechnical projects of special interest.
- Failures or "partial successes". Share your experiences with others.
- Contributions for the various regular columns or features.
- Letters to the editorial panel.
- Items of amusement, either of a geotechnical, or general nature, or at the expense of yourself or one of your colleagues!

Australian Geomechanics is now being produced in electronic format using Wordperfect for Windows, and AmiPro for Windows on IBM compatible hardware. Contributions are preferred on 3.5" floppy disk in either of these formats. If this is not possible, ASCII or text files are acceptable, and our computer will try to decipher your other word processing format. Please specify with your submission the format used to generate the file. **All contributions must be accompanied by a hard copy (i.e. ink on paper).** If the submission includes figures or photographs, please submit these in camera-ready form.

Contributors may still present camera-ready material which should be either in A4 size, if prepared on a laser printer or typed, or A3 for lesser quality print. The following guidelines will assist with maintaining some uniformity of style and production (applies in the main to production of A3 documents produced on other than laser printer):-

Text: The material should be submitted in typed form and preferably in the following format:

- Character quality - double density letter quality, golf ball or daisy wheel
- Character size - 12 pts on A3 ; 10 pts on A4
- Column width -110mm on A3; 85mm on A4
- Line spacing - single
- Paragraph spacing - double
- Main headings - numbered 1,2,3..., 10cpi
- Formulae - typed or clearly handwritten
- Lines per page - 55

Diagrams and Tables: These should be sharp black on white and of the correct size for incorporation into the finished document (i.e. 100mm wide for single column or 220mm wide for double column on A3, or 80mm wide for single column and 170mm wide for double column on A4). Original ink drawings should be submitted if possible, and will be returned if required.

Photographs: These should preferably be good contrast black and white gloss prints and of the correct size for incorporation.

Position: Please ensure that all such items are clearly marked to indicate position in paper.

Authors will remain responsible for the integrity of their material and for permission to publish.

Contributors are reminded that the deadlines for submission of material are 1 May for the June edition and 1 Nov for the December edition, unless otherwise advised by the editors. Contributions should be forwarded to the Editorial Panel, Australian Geomechanics, c/- Department of Civil Engineering, Monash University, CLAYTON, VICTORIA 3168. Telephone (03)565 4982 or facsimile (03)565 4944.

The Editorial Panel January, 1993: Chris Haberfield, Julian Seidel, Peter Thornton.
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All publications received by the Society are soon to be transferred to I.E.Aust National Headquarters in Canberra. State Secretaries are to hold a full listing of items held. Enquiries regarding access to this library should be addressed to Peter May.

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Barrett, Fuller & Partners has been established as an independent consulting practice since 1980, with founding partners John Barrett and Peter Fuller providing professional services in geotechnical engineering and ground support. Since then the practice has grown with the addition of partners Don Miller (engineering geology and spatial data analysis), Geoff Searle (Civil Engineering) and Phil Dight (open pit design and reinforcement). The group now comprises over seventy staff throughout Australia and New Zealand and provides professional services in mine design and planning, ground reinforcement, geotechnical engineering (both mining and civil), environmental planning and spatial data information systems.

BFP has established a regional network of NATA registered soil testing laboratories with laboratories in Melbourne, managed by Andrew Roberts, Launceston by Mike Maundrill and Perth with Greg Bilton.

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Barrett, Fuller and Partners prides itself on providing timely technical advice. Further information can be obtained from Don Miller on (03) 883 3335, Trevor Stevenson (09) 321 6833 or Paul O'Grady (02) 299 2141.

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Maunsell has for many years maintained an in house geotechnical engineering group to compliment its civil engineering skills. This group is headed by Brian Chandler in Melbourne and Ben DeWit in Sydney. Our group has extensive wide ranging expertise in geotechnical engineering, site investigations, geotechnical design, analysis and documentation through to construction supervision, monitoring and testing of foundation elements. One such area of expertise is our PDA/CAPWAP pile testing services which is lead by Jon Cannon, Technical Manager. Our full range of geotechnical engineering services have been provided on many of Maunsell's major national and international projects for example the National Tennis Centre in Melbourne, the Kaltim Prima Coal Development in Indonesia and the Mekong River Bridge in Thailand which is currently under construction. As well as providing a full range of services, Maunsell's geotechnical group also engage and coordinate others to assist us in providing site investigation services depending on the location of the project site and the availability of our resources. In such cases Maunsell maintain overall management of the geotechnical investigations and carry out independent review of the work as part of our geotechnical design and documentation services.

For information on our Geotechnical Services including PDA/CAPWAP testing, contact Brian Chandler, Melbourne (03) 828 1234, Fax (03) 826 8636, or Ben DeWit, Sydney (02) 959 3422, Fax (02) 957 6536.

If you would like to see your organisation's profile published here, send the details to the Editorial Panel (after checking that you have paid your Supporting Member's subscription!). We will publish profiles on an 'as received' basis and we are publishing profiles of Supporting Members of the Australian Geomechanics Society. These will be published on an 'as received' basis and we reserve our editorial rights to limit extreme self aggrandisement!

A NOTE FROM THE EDITORS

The responsibility of producing Australian Geomechanics has now passed from the Western Australian Group to the Victorian Group of the AGS. The new editorial panel, on behalf of all AGS members, would like to thank our colleagues from the wild west for their efforts and congratulate them for a job well done.

While we will continue to produce issues of high quality, the change in Editorial panel will undoubtedly bring about changes in style and emphasis. We would like to think that we can put aside our parochialism and present a balanced view of geomechanics as practised in Australia.

Our main goal in producing Australian Geomechanics is to provide a news journal that is relevant, informative, interesting and at times controversial. To do this we need contributions from all members. This not only includes technical papers and state group reports, but any items that would be of interest to the geotechnical community. We would be particularly pleased to receive feedback, such as in the form of letters to the Editor, on articles published or on anything that affects AGS members. We are happy to consider any submissions that are at all remotely related to geomechanics, including photographs, anecdotes, unusual or interesting news items, project descriptions, supporting company profiles, notices of local conferences and seminars and so on. The journal can only be as informative as the submissions we receive from you.

Following on in the tradition of the previous editorial panel, we have decided that each edition of Australian Geomechanics should have a theme. This edition focuses on geomechanics research and research institutions in Australia. By concentrating on this theme we hope to inform all AGS members of the areas of research currently being undertaken, and the special skills, equipment, expertise and post-graduate courses available, at our research institutions. The information provided is but a very brief summary of the facilities available at each institution and we urge readers to contact individual institutions for further, more detailed information. Hopefully, all AGS members, whether in consulting, contracting, Government instrumentalities (that is if any still exist) or research, will find these summaries useful.

In compiling this information, we were astounded by the number of institutions actually involved in geomechanics research and even more so by the range of research topics, equipment and areas of expertise available.

We have endeavoured to include information on all research institutions, and if we have missed anyone, we apologise. If any institution has been missed, we would be happy to include information in the next edition of Australian Geomechanics. Contact the Editors for further information.

This edition opens with a series of three brief articles, written by three eminent Australian academics, none of whom really need an introduction. Their contributions to the AGS and to the practice, science and art of geomechanics in this country are well known and greatly appreciated.

The first article is a Guest Editorial on geomechanics research in Australia by Garry Mostyn. Garry is a Senior Lecturer with the School of Civil Engineering, University of New South Wales. He is also the current Deputy Chairman of the AGS National Committee and is well known for his outspoken views on every topic ranging from affirmative action, through geomechanics to politics. The second article is by Professor Harry Poulos, an Australian geotechnical engineer with an outstanding international reputation. Harry is currently Chairman of the Board of Directors of Coffey Partners International Pty. Ltd., and has a part time appointment within the School of Civil Engineering at The University of Sydney. Harry's outstanding contribution to geomechanics research is well known, and it is for this reason that he was asked to give us his thoughts on the future of geomechanics research in Australia. The final article is by another well known and outspoken Australian academic, Associate Professor Ian Johnston from the Department of Civil Engineering at Monash University. Ian has attempted to summarise the quagmire of information available on funding for co-operative research in Australia. He has done the tedious task of wading through the fine print and the bureaucratic gobbledly-gook, to present us with a concise summary of the funding that is available. It is clear, that there are quite generous funding arrangements available, especially for co-operative research between industry and academia. With untied Government funding for research becoming tighter and tighter, it is essential that industry and academia get together so that our geotechnical knowledge continues to grow.

All three articles are essential reading. We hope that this issue will help to initiate a new level of co-operation between industry and academia, and result in a win-win situation for all involved.

Chris Haberfield, Julian Seidel and Peter Thornton

GUEST EDITORIAL

RESEARCH IN GEOMECHANICS IN AUSTRALIA

Mr Garry Mostyn
Deputy Chairman, AGS, School of Civil Engineering
University of NSW

I have been asked to write a biting incisive editorial about research in geomechanics in Australia. Well as I am an engineer clear analysis (in its broadest sense) and not biting incision are more likely to be my hallmark. Further I am a late entrant into geotechnical research having spent most of my career in consulting. Notwithstanding these limits I offer the following thoughts from the point of view of a practitioner and academic.

'... a common response from ARC peer reviewers is 'If the research will have the stated benefits to industry then industry should fund it".'

There appears to be two major problems facing geotechnical research in Australia, money and students.

Research in Australia is generally funded from either Australian Research Council (ARC) grants or from industry. Generally our research is "applied" and a common response (recounted by disappointed applicants) from ARC peer reviewers is "If the research will have the stated benefits to industry then industry should fund it". From discussions with disappointed applicants this seems to be a common response. This raises a number of issues. Firstly the benefits are generally spread right across society, as would be the case with improved footings over reactive soils or say better slope design. As research is a long term commitment (years at least) those with a problem today are unlikely to have their problem benefit from any research started today. Thus the benefits of research are unowned future benefits for indeterminate members of society. It is hard for anyone to capture and own the results of geotechnical research because, unlike other areas of engineering, these are rarely patentable. There are also implications that "industry" is a monolithic entity which acts with one mind and that applied research is less worthy of ARC grants than pure research. I am aware of one researcher who at one time was involved with four grant applications; one was successful and that was the one,in his own estimation as an expert in the relevant fields, with the least merit but had supportive reviewers.

'It is hard for anyone to capture and own the results of geotechnical research because, unlike other areas of engineering, these are rarely patentable.'

Reviewers have often said that the work proposed has already been completed, this often shows a lack of understanding on their part. Often it takes a doctoral student a year to find out that what is being undertaken is in fact new and radically different from work apparently tackling the same problem. In fact I'm of the opinion that

'in most areas of geomechanics our ignorance far exceeds our knowledge - not many problems have really been solved.'

in most areas of geomechanics our ignorance far exceeds our knowledge - not many problems have really been solved. At the best we have useable answers to some problems. If you are asked to assess an ARC application, help your colleagues, take the trouble to do the job well. If you don't know the proposed researchers inform yourself. If you think it has been done, find out why some else in the field thinks it has not been. Be supportive of good proposals, please don't take this as a request to be supportive of bad proposals.

In my experience about four out of every five geotechnical engineers in Australia have postgraduate qualifications, maybe two out of ten have doctorates. In the past this has been considered typical of what is required to practise in our field. Even though geotechnical engineering is not as novel as twenty years ago, it is still not at the point where a graduate from a civil engineering degree can claim expertise in the area. This will be exacerbated by the pressure to include more people oriented (social, legal and managerial) aspects in our undergraduate programmes; these pressures are well founded as more and more engineering projects are being controlled by these issues and engineers have been poorly equipped to deal with them.

'If you are in industry, look to funding some research on problems that interest you. Fifteen to twenty five thousand dollars a year, tax deductible on attractive terms, is generally enough to get good Australian graduates to undertake postgraduate research.'

Each year in October, even in these times, a few firms ring and ask have we any good graduands from our postgraduate programmes. Generally the answer is "yes but" they are already employed elsewhere or they are not Australian residents. If we are to maintain the level of expertise in young geotechnical professionals then we must find ways to encourage those with some experience to return to university. The scholars we are looking for at MEngSc level are honours graduates, at research level preferably a good honours degree. These people find work in industry easy to obtain and need some inducement to return to study or research. If our profession requires postgraduate qualifications we must offer those inducements.

If you are in industry, look to funding some research on problems that interest you. Fifteen to twenty five thousand dollars a year, tax deductible on attractive terms, is generally enough to get good Australian graduates to undertake postgraduate research. These students will work 2500 hours a year on research and receive many hours of supervision and technical assistance. This cost to benefit could not be matched by any commercial organisation. This is the much discussed "win-win" situation, the firm wins with directed research, the scholar wins with postgraduate training, the university wins with good postgraduate students and society wins with more knowledge.

Three thoughts to finish.

As I write the tertiary entrance requirements for 1993 have been released. At UNSW civil engineering, mining engineering and applied geology have entry requiring students to be in the top 13 to 16% of high school leavers (out of interest environmental and computer engineering, the top 3%). Other universities have a similar story. Thus Australia will have a continuing supply of talented graduates, let's hope that there are jobs in industry for them and that some wish and are able to undertake research.

Late last year I and many others were concerned to find the University of Western Australia and CSIRO proclaiming to the world that "coordinated, multi-disciplinary education and training in Geomechanics" was not available in Australia. Everyone expects commercial organisations to make somewhat outrageous claims (in spite of S52 of the Trades Practices Act), but such a claim does no service to our profession nor the claimants' colleagues. For over twenty years, UNSW has offered postgraduate programmes in geotechnical and mining engineering and engineering geology. We have recently introduced environmental engineering and a combined course enabling a student to obtain both civil and mining engineering degrees. Postgraduate students are able and encouraged to take subjects from the different schools and often research supervision is drawn from more than one school. I expect that other universities in Australia have similar programmes. The simplest enquiry would have revealed the above information.

Some refreshing activity from Standards Australia, public meetings to consider/contribute to draft standards for both piles and residential slabs and footings. These are to be encouraged but now the geotechnical community must contribute. Despite widespread disquiet about the draft site investigation standard only three individuals turned up to voice their views at a public meeting held in Sydney.

SPECIAL REPORTS

THOUGHTS ON THE FUTURE OF GEOMECHANICS RESEARCH IN AUSTRALIA

Professor Harry Poulos
Chairman, Coffey Partners International Pty Ltd

The previous generation of geomechanics researchers in this country operated under conditions which differ significantly from those which apply today. In the past:

(a) geomechanics was then an emerging discipline, with a wide variety of problems awaiting solution.

(b) researchers had substantial freedom to choose a topic which interested them, and to pursue it as they saw fit.

(c) they could work either as part of a team, or as individuals.

(d) geomechanics research was relatively cheap to undertake, provided that the research infrastructure (such as a laboratory or a computer) was available for the researcher's use.

Today's circumstances are vastly different, and tomorrow's will be even more so.

Geomechanics is a maturing, if not entirely mature, discipline, and much of the primary research has been done. We are now in the secondary phase (or in some cases, even the tertiary phase) of research refinement in many of the issues related to traditional soil mechanics, rock mechanics, and foundation engineering.

Some freedom of choice of research topic remains, but researchers are increasingly constrained to seek topics which are "relevant to industry", and which will attract funding from grant-giving bodies. Such finding is now essential, since research is no longer "cheap". We are now very much in a "user-pays" mode of operation, and many of the overheads which used to be absorbed by the researcher's host institution are now costed and charged for. Increasingly, it is difficult to do individual research, as the increasingly complex requirements of computer programming, laboratory testing and field testing, make it almost mandatory to have some research assistance, either in the form of fully-qualified and highly-paid research personnel, or research students, who are also becoming increasingly expensive to support.

What then must the geomechanics researcher of tomorrow do if he or she wishes to pursue serious research and hope to be successful? I would suggest that there are at least four issues which must be addressed:

1. the selection of a suitable research area

2. the possibility of involvement in multi-disciplinary or inter-disciplinary research, rather than being confined to the traditional "furrows" of soil mechanics, rock mechanics, engineering geology, or foundation engineering.

3. acquisition of funding

4. participation within a research team.

The selection of a suitable area of research often poses less of a problem for established research groups than for individuals or groups who do not have a "track record". Many of the more successful groups have taken an evolutionary approach to their research, extending and building upon their past work in order to solve new problems. In such cases, the continuity of the research process produces rapid incremental advances in research output and a burgeoning body of publications. However, in some cases, it may also tend to inhibit the tackling of new and different problems.

The Australian Geomechanics Society has identified three broad areas of research which are considered to be of economic relevance to Australia and which offer potential for significant advances in knowledge to be achieved through research. These are:

(a) problematic soils of Australia and the Pacific Rim
(b) mining geotechnics
(c) environmental geotechnics.

'...what we do <u>not</u> need is a third- or fourth-generation revisiting of tired topics for which the potential for new knowledge, new understanding, and economic benefit is minimal.'

These are broad areas which have global as well as local importance, and which can be pursued for both

short-term and longer-term objectives. While such a listing of research areas does not preclude other topics being considered, what we do not need is a third- or fourth-generation revisiting of tired topics for which the potential for new knowledge, new understanding, and economic benefit is minimal.

All of the above-listed research areas have inter-disciplinary components, and the old divisions between soil mechanics, rock mechanics and engineering geology should be set aside. The success of the Australian and New Zealand Geomechanics Societies is some evidence of such barriers becoming less rigid. We should however be prepared to work outside even these broader boundaries of geomechanics and embrace disciplines such as chemistry, biology, seismology, geography, soil science and agriculture into our research thinking and our research teams. Indeed, in an area such as environmental geotechnics, such a broadening of the research skills base is mandatory.

We must also recognise that at least some of our research in the future will need to be focussed on geological and geotechnical conditions and problems in specific geographic areas. Such research may certainly be more applied than fundamental, but is still very important and can be validly classed as research.

'Few individuals can expect to obtain consistent research support in the future unless they become part of a coherent research team.'

Research funding is available (at east nominally) though Government and private sources. Government funding, such as that through the Australian Research Council, is increasingly competitive and difficult to obtain, as evidenced all too clearly by the mere 19% success rate of new applications for 1993. Industry in Australia has been reluctant to fund research, except for limited projects of immediate relevance, and it is likely to be some time before a more research-oriented culture is developed. Consequently, the leader of a research team will perforce have to spend time and effort in seeking appropriate funding, and less actually doing the research.

"Basic research is when I'm doing what I don't know I'm doing".'

This then leads to the question of research teams. Few individuals can expect to obtain consistent research support in the future unless they become part of a coherent research team. Indeed, because of the funding constraints mentioned above, even established research teams may have increasing difficulty in obtaining funding for their activities. Consequently, it may well be necessary in the future for both individuals and groups to "joint venture" in research projects and combine their resources and skills in order to further their research aims. The Co-operative Research Centre scheme is a mechanism available for such an approach, and also for extracting industry funding for research. Its long-term viability, however, remains to be proven, since research partners are often separated by vast geographical and ideological distances. Nevertheless, joint-venturing, if carefully and rationally planned, should be a means of undertaking larger-scale projects and enabling groups to pool their resources and "think big" (or at least bigger) in terms of developing both laboratory and field testing programmes.

In summary, we must recognise that, in the foreseeable future, geomechanics research will need to address subjects which have at least some measure of short-term relevance to Australia and to the Asia-Pacific area. Increasingly, we must be prepared to amalgamate, joint venture, and form teams which include both traditional geomechanics researchers and those in peripherally-related disciplines. We must be prepared to engage in more coherent and focussed research programmes rather than individual (and often unrelated) research topics. At the same time, we must not completely inhibit the individual researcher who insists on doing his/her own thing, or the person or group doing fundamental research which may not have an immediately foreseeable application. The famous scientist Werner von Braun defined such research as follows:

"The outcome of any serious research can only be to make two questions grow where only one grew before".'

"Basic research is when I'm doing what I don't know I'm doing". One of the challenges we face in geomechanics research is to make provision for such efforts to continue within the more short-term result-oriented environment in which the majority researchers must operate.

Finally, how can we measure our success as researchers? Clearly, one way is to obtain quick answers to immediate questions, and this appears to be the measure by which contemporary research is being judged. However, a more satisfactory measure, and one which will ensure the survival of meaningful research, is provided by the 19th century American economist and social philosopher, Thorsten Veblen, who wrote:

"The outcome of any serious research can only be to make two questions grow where only one grew before".

FUNDING FOR COLLABORATIVE AND COOPERATIVE RESEARCH

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The face of Australian research has changed dramatically in recent years. One of the most powerful factors involved has been the political pressure applied to the higher education system principally as a result of the Dawkins initiatives of the latter part of the 1980s. These were aimed at, amongst other things, enhancing the total research capacity of the system, making more efficient use of the resources available and forming closer links between industry, society and academia. The overall result has been that approximately 24 universities and 50 Colleges of Advanced Education, as well as numerous other smaller institutions, were remoulded into about 35 large universities, all competing for the research dollar.

There have also been major changes made to the way in which research funds are made available. While in years gone by, a large proportion of the total funds were distributed through individual researchers, today it is more likely to be distributed through various formal research centres such as the Special Research Centres, Key Research Centres, Cooperative Research Centres and, in engineering, Centres for Engineering Excellence. These centres are, however, not totally funded by the government but require a significant input from industry and commerce. It follows that to be awarded a centre, a great deal of private fund raising is necessary as well as a demonstrated commitment from the private organisations. In other words there has been a shift in funding away from the public sector.

'...approximately 24 universities and 50 Colleges of Advanced Education, as well as numerous other smaller institutions, were remoulded into about 35 large universities, all competing for the research dollar.'

The universities themselves have become far more corporate in their approach with the formulation of research management plans, the development of research strategies and the identification of research strengths. This has led to a great deal of competition to form groups that may be perceived as research strengths thereby contributing to the overall aims of the university. These groups have often had to be developed from across interdisciplinary boundaries so that resources could be combined to reach the required critical mass to obtain recognition. The boundaries that were crossed were not restricted to just between departments in one institution, but were often between faculties, campuses and even between institutions. This has led to various other forms of research centre, which just like the formal government backed centres, have been heavily encouraged to seek significant private funding.

'...which involves a tax concession of 150% for money spent on research and development.'

Clearly, then, there has been a distinct move towards greater competition for the funds available for research with preference generally given to those projects which are directly related to industry, as well as having a significant financial commitment from industry. It is not unusual to find funding based on a 50:50 (dollar for dollar) split between government and private funding. It follows that cooperation and collaboration are the buzz words for successful research fund applications.

While the above discussion has been about research funding in general, it is also specifically applicable to geomechanics. It follows that if our technology in its various forms is to continue to develop, the above changes must be accepted and research funding vigorously pursued. However, it must be recognised that it is not just the academic who should be chasing the dollars. With the significant changes in emphasis, the practitioner should now take advantage of the many more opportunities that have become available for making use of the universities' facilities (including staff and students) for research and development. In order to help this process, this article aims to summarise some of the general funding sources that are available for this important work and how they operate. There are many other specific sources of funding which are directed towards a particular part of industry (e.g. the various categories of the Energy Research and Development Corporation). These will not be considered.

The first major source of research finance is through the Department of Industry, Technology and Commerce (DITAC) which has Innovation Support Programs administered by their Industry Research and Development Board. These programs have been specifically developed to make Australian industry more competitive by providing funding for projects that involve technical originality and some risk. These programs include the *Tax Concession for Research and Development Scheme* which involves a tax concession of 150% for money spent on research

and development. An example of this would be a company who wishes to develop some particular form of instrumentation might spend $50,000 principally on hiring a research engineer. This engineer might work through a university department thereby strengthening the university's research base and its contacts with industry. The 150% means that the tax concession of about 40 cents in the dollar is allowed on $75,000 (i.e. 1.5 x $50,000) to give a refund of $30,000. This means that $50,000 of research has been carried out at a cost of about $20,000, or about 40 cents in the dollar. This particular scheme requires a minimum expenditure of $50,000 to attract the full 150%, although it is understood that there is a sliding scale going from 100% to 150% between $20,000 and $50,000. For companies that are unable to benefit from this tax concession, there is also the *Discretionary Grants Scheme* which will provide up to half of eligible costs on projects worth at least $50,000. Again there are many ways in which this form of project can be assisted through strong contacts with universities.

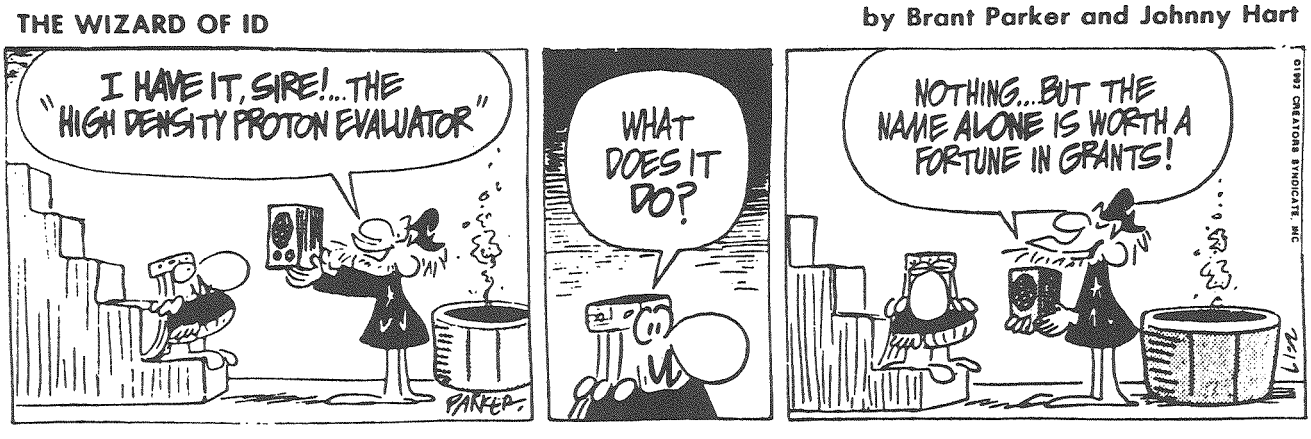
'A qualifying company would receive $40,000 over 2 years towards the graduate researchers salary and the university $10,000 over 2 years towards academic support costs.'

Another scheme is the *National Teaching Company Scheme* wherein a company and a university agree to undertake a particular research project, principally at the company's premises. A qualifying company would receive $40,000 over 2 years towards the graduate researchers salary and the university $10,000 over 2 years towards academic support costs. This again forms a valuable link between universities and industry. In addition, any funds outlaid by the company may be eligible for the 150% tax concession scheme. There is the *National Procurement Development Program* which basically assists companies to develop research which will be of direct use to a government agency. The company would normally work with the agency to make the product of the research commercially viable. Once this has been developed, there is no reason why the product cannot then be sold to a wider market. The government agency can take many forms including local government and statutory authorities. Grants of up to half project costs are available with a minimum of at least $50,000.

The *Advanced Manufacturing Technology Development Program* will provide funds for the development of products, services or systems which will generally benefit Australian industrial competitiveness. Grants of up to half project costs are involved on projects costing more than $500,000 over a maximum of 3 years. Finally, there is the *Generic Technology Grants Scheme* in which up to 90% of costs will be met by DITAC for commercially driven research and development in certain strategic technologies. The list of these technologies changes from time to time. In previous years, there may have been little to interest geotechnical researchers but it is understood that the latest list includes, in addition to biotechnology, communications technology, information technology and manufacturing and materials technology, waste and environmental management technology. This latter topic may be of some considerable geotechnical interest. There are other schemes available through DITAC including financial support for collaborative research between Australia and certain other countries.

'...Generic Technology Grants Scheme in which up to 90% of costs will be met by DITAC for commercially driven research and development in certain strategic technologies.'

The other main source of funding is through the Department of Employment, Education and Training (DEET). However, as might be expected, whereas DITAC is very much oriented towards industrial applications and development, DEET is more concerned with matters of an educational nature. The principle source of DEET funding is the Australian Research Council (ARC). The *ARC Large Grants Scheme* provides significant funds for research each



year. The applications are competitively based and they close around the beginning of the March preceding the year they are awarded. While the scheme does not require complementary funding from industry, there is no doubt that such additional funding would be of some considerable advantage.

'...current strike rate for these grants seem to be about 1 in 5 or 6, and grants significantly greater than about $200,000 seem very rare.'

It is normal, however, for a successful application to demonstrate a clear link with industrial practice and the benefits the research will bring. The funds available each year tend to vary and, as always, they never seem to be enough. The current strike rate for these grants seem to be about 1 in 5 or 6, and grants significantly greater than about $200,000 seem very rare. The *ARC Small Grants Scheme* complements the Large Grants in that they are usually used for pilot studies prior to the development of a Large Grant application. These grants have similar selection criteria, are usually for the duration of 1 year and have values of up to about $20,000. One of the major problems with the Small Grants is that the funds are only made available at about the same time the applications for the following year's Large Grants are to be submitted. It follows that any pilot study has hardly got off the ground by the time an application for a Large Grant is required. This means that there could be a significant break in continuity unless other sources of funding can be found.

'...DEET will provide a research scholarship for a suitable student of about $18,000 p.a. for up to 3 years provided a company will agree to provide an annual commitment to the project for the duration of the scholarship.'

There are also other forms of research funding directed towards the support of individual rather than specific projects. An important source for support for research students is the *Australian Postgraduate Research Scholarship*, several of which are usually available at all universities. Other more lucrative sources include the *Australian Postdoctoral Fellowships*, *Australian Research Fellowships*, *Queen Elizabeth II Fellowships* and *Australian Senior Research Fellowships*. While in principle all these fellowships are awarded on the basis of applicants' academic records, there can be no doubt that the proposed subject of research must have a major influence on the outcome, if it can be shown that the research is of significance to Australia's wellbeing.

DEET does have 2 important sources of funding that do require direct involvement from industry. One is the *Australian Postgraduate Research Award (Industry)*, for which 100 were available for 1992. Basically, DEET will provide a research scholarship for a suitable student of about $18,000 p.a. for up to 3 years provided a company will agree to provide an annual commitment to the project for the duration of the scholarship. The minimum commitment is $5,000 in cash and a further $5,000 in kind. This seems to be an excellent means of carrying out research directly related to a company's aims for a relatively small outlay. This commitment becomes even smaller when considering that there seems to be scope for tax concessions of various forms, including the 150% concession.

The other is the *Australian Research Fellowship (Industry)*. There are usually about 10 of these available for any one year and for 1993, a pool of $250,000 has been made available. Basically, the fellowships are for academics to work for between 3 to 12 months on at least a half-time basis, mostly at the industrial workface. There is no financial commitment necessary from industry, but should there be any, some tax concessions may be available.

The last major source of DEET funding relating to cooperation is the *Research Infrastructure Cooperative Grants (Mechanism C)* scheme. This scheme supports relatively large scale initiatives made by at least 2 higher education institutions acting cooperatively. One of the obvious cases in this category is the funding of centres to form facilities to uniquely service an identified national need or priority. It is critical that the level of cooperation is genuine and not merely superficial, and therefore, any application should go to some lengths to demonstrate this key ingredient. As with many of the other schemes, a clear advantage to industrial and commercial interests must be shown, preferably with some matching funding from these private sources. Indeed over the last couple of years, of the total funds available (over $12 million p.a.) about half has been allocated for projects involving at least dollar for dollar funds from other sources.

In conclusion, it is clear that there have been some significant changes to the face of Australian research, especially in the way it is perceived, organised and funded. Whilst it would be easy to sit back and bemoan these changes, it is more important that the Australian geomechanics fraternity adjust quickly to ensure that our international standard for research is maintained. There is funding available, but researchers and practitioners must make some considerable effort to agree on how this should be done for everybody's long term benefit.

PRIORITY AREAS IN AUSTRALIAN GEOMECHANICS RESEARCH

by H.G. Poulos[1], I.W. Johnston[2] and G.R. Mostyn[3]

ABSTRACT

This paper summarises the result of a review of priority areas in geomechanics in Australia, carried out by a sub-committee of the Australian Geomechanics Society. Three broad areas are defined:

1. Problematic Soils of Australia and the Pacific Rim
2. Mining Geomechanics
3. Environmental Geomechanics.

For each area, details are given of research objectives, current use of technology in Australia, potential benefits of the research, and the research and development potential. Some of the problems pervading geomechanics research are also outlined.

INTRODUCTION

In 1990, the National Committee of the Australian Geomechanics Society (AGS) appointed a sub-committee to consider the question of priority areas in research in geomechanics. The objectives of this exercise were to provide some guidance both for applicants seeking research funding, and organisations or groups supplying this funding. Almost concurrently, the Institution of Engineers Australia embarked on a revision of the Engineering R & D Outlook Report produced in 1988-9. Consequently, the development of a reasoned list of research priorities by the AGS served a further purpose.

This paper summarises the results of the AGS sub-committee's deliberations. Three broad priority research areas have been defined:

1. problematic soils of Australia and the Pacific Rim
2. mining geomechanics
3. environmental geomechanics.

In each case, details are given of the problem and the research objectives, current use of the relevant technology in Australia, local trends in this technology, potential benefits of the research, and the research and development (R & D) potential.

Finally, some problems facing research in this country are discussed.

2. PROBLEMATIC SOILS OF AUSTRALIA AND THE PACIFIC RIM

2.1 Description and Objectives

There are number of problematic soil and rock types including expansive clays, collapsing soils, dispersive clays, calcareous sediments and soft rocks, in the countries comprising the western Pacific Rim. Many aspects of economic development involve significant geotechnical input and solution of engineering problems posed by these problematic soils, for example, damage to structures and roads caused by swelling and shrinking of expansive clays, erosion in earth dams due to deflocculation of dispersive soil, and low bearing capacity for offshore oil and gas platform foundations sited on calcareous sediments.

There is an urgent need to undertake research into:

(i) the engineering behaviour of these problematic soils
(ii) treatment to improve engineering properties of these soils
(iii) effective methods of geotechnical and foundation design in these soils.

2.2 Current Uses of the Technology

In Australia, problematic soils are widely encountered in:

(i) the construction industry (both domestic and industrial)
(ii) transportation (roads, railway tracks)
(iii) resource development via open-cut mines
(iv) offshore oil and gas

2.3 Local Trends in Research

1. research in calcareous sediments, driven by problems with Bass Strait and NW Shelf platform.
2. research in expansive soils, driven by continuing problems with building foundations
3. research in soft rock technology, driven by the prevalence of these deposits in areas of economic significance.

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1. Chairman, Coffey Partners Internationl Pty Ltd, Sydney
2. Associate Professor in Civil Engineering, Monash University
3. Senior Lecturer in Civil Engineering, University of NSW

2.4 Potential Benefits of Research and Ability to Capture Benefits

Many facets of mining, civil and infrastructure development encountered difficulties with problematic soils. Delays and failures can cause substantial economic losses, estimated to be in excess of A$250 million per annum. Technology and skills can be exported to other Pacific Rim countries with similar geotechnical problems. Potential damage, loss of life and environmental disaster (e.g from flooding caused by failures of dams constructed of dispersive soil) can be reduced substantially by appropriate research.

Australia has extensive research facilities within some of its Universities and the CSIRO Divisions of Soils and Geomechanics, and has a number of internationally respected research workers in the field. Linkages can be formed with the mining and resource industries, and also the construction industry, and through these, international markets for technology and skills can be developed.

2.5 Research and Development Potential

The research fields are fertile, in many instances still in a "primary" phase; current technology is almost 1/3 to 1/2 way up to "S curve". Required technological breakthroughs include:

1. better methods of identification and quantification of problematic soils.

2. suitable methods of mechanical and chemical treatment of these soils.

3. more reliable methods of geotechnical and foundation design incorporating modern geotechnical analysis techniques.

3. MINING GEOMECHANICS

3.1 Description and Objectives

Mining geomechanics involves the application of geotechnical engineering to the mining industry. This requires a wide range of technical expertise aimed at greatly improving the industry's international competitiveness and standing. Geotechnical engineering plays a crucial role in economic operations, safe working conditions and environmentally sound development, and is therefore a key factor in the above. As minerals and energy resources represent over 60% of Australia's total commodity exports, this should have a major influence on the country's economy.

Specific areas requiring R & D include the assessment of in-situ conditions; methods of modelling development; techniques for efficient construction and extraction (loosening, breaking and removal of material), methods of handling, transportation and stockpiling of materials, including waste; stabilization of excavations left after extraction; environmental impact and control of developments.

3.2 Current Uses of the Technology

There are a large number of applications of mining geotechnics in Australia, including coal mining, basic metal mining, gold mining, general resource and energy mining, quarrying, road building and heavy civil construction industries (structures, tunnels, underground space and storage).

3.3 Local Trends in Research

(i) Development of mechanised excavation; driven by need to reduce costs and increase productivity and production rates.

(ii) Stabilization of stockpiles and waste dumps; driven by safety, environmental and cost-saving considerations.

(iii) Stabilization of permanent and semi-permanent mining slopes; driven by safety, efficiency and economic considerations.

These all arise, at present, from problems experienced in existing industrial or mining operations for which better solutions are required for social approval of the continuing activity within Australia.

3.4 Potential Benefits of Research and Ability to Capture Benefits

As noted earlier, a high proportion of Australia's exports are mining oriented. Even minor improvements must have major influences on our economy. We are also very close to many developing countries which require these products. These same countries are also developing their own resources and may require ongoing technological advice, education and training services (in Australia or overseas), equipment and service backup. These comments apply to all forms of operation, and are particularly important with respect to environmental and safety considerations. We are in an ideal position because of proximity and experience with similar conditions. The potential benefits must be enormous, perhaps greater than any other industry.

Basically Australian mining technology is as good as any other country's, but, unlike some other nations (e.g USA), we seem to lack the ability to get this message across as much as we should. It would seem that there is insufficient marketing of these skills, at both national and international level. Another major problem is that while much of the initial development work takes place without too many problems, the important later and final stages often suffer from the lack of support at a local level.

3.5 Research and Development Potential

The potential for R & D in mining geomechanics within Australia is immense, principally because of our proximity to operations both here and in neighbouring countries and the small but very active group of people working in this area. Despite a relatively low national population, the technical output of this group has been recognised throughout the world. In general terms, we must be very close to lift-off on the "S" curve resulting in quite major developments for even relatively modest investment. The technological developments are many and varied. The risk must be very minor when considering the benefits and the investment required to bring the many aspects to market could be as variable as the range of aspects themselves. The product, i.e. the development of mining geomechanics to service our own and neighbouring countries' mining industry, could undoubtedly be produced in Australia.

4. ENVIRONMENTAL GEOMECHANICS

4.1 Description and Objectives

As is well known many environmental problems are associated with disposal of solid and liquid wastes from industrial and mining processes. Many of these problems are centred on the interaction of these wastes with the earth which is the field of environmental geomechanics.

Mine tailings technology can be taken as an example. These generally consist of fine-grained solids suspended in fluid which is often loaded with chemicals used in the mineral extraction processes. The storage and densification of the tailings and migration of the fluid and potential pollutants are areas requiring considerable research. Similar problems are experienced in many industrial operations, often in sensitive urban and near-urban environments.

Some areas that require immediate research are:

- Impact of chemicals on physical properties of clays.
- Contaminant flow and absorption in unsaturated soils.
- Contaminant wall design.
- Quantification of risks.
- Landfill design and behaviour.

It is suggested that suitable long-term objectives would include:

1. physical and hydraulic design of containment walls;
2. basic physico-chemical behaviour of soils, especially clays; and
3. the management, monitoring and assessment of subsurface pollution. The long-term objectives are generally driven by legislative and social concerns and the impact that these have on the economy of any particular operation.

4.2 Current Uses of the Technology

The technology is required in a wide range of primary and secondary industries, including:

1. Petrochemical
2. Manufacturing
3. Coal mining
4. Metalliferous mining
5. Transport
6. Construction.

4.3 Local Trends in Research

Among the research projects being undertaken are the following:

1. Pollution migration modelling be centrifuge and numerical methods.
2. Groundwater studies by field observation.
3. Tailings densification at laboratory and full scale.
4. Remote sensing of pollution.

4.4 Potential Benefits of Research and Ability to Capture Benefits

Virtually all areas of economic activity are now constrained, often to a large degree, by environmental considerations. These lead to our dominant export sector, mining, suffering reduced efficiency compared to overseas competitors. Many projects may well not proceed due to our inability to solve the environmental problems associated with development. There are similar problems with manufacturing and petrochemical industries, where environmental problems may effectively stop us from replacing imports with value-added local manufacture. Indeed the growth within Australia of the industries discussed above is almost certainly closely linked with solution of associated environmental problems.

The problems Australia faces now will be faced by many of our regional neighbours in due course and there is and will be a market for export of technological advice, education, training and equipment.

Overall the benefits are measured best by the fact that if we do not solve these problems then many areas of economic activity will be stifled.

A discussed earlier, research at present is totally market driven and thus the benefits are captured almost completely. The problem of course is that there is no long-term view and a future project will not, in general, fund current research. Research in environmental geomechanics will certainly be captured by industry, as even in a depressed economy there is a ready market in industry for postgraduate engineers with research degrees. In addition many Australian companies and consultants have the desire and ability to apply current and future research results in this area.

Freeing up mining and industrial activity while not compromising our environment will provide such large benefits that these will be captured by either industry or society. It is this sort of research that will enable us to compete internationally. The only limit to capturing benefits will be our society's inability to agree to technical solutions to environmental problems.

4.5 Research and Development Potential

There appears to be substantial potential for the following reasons:

1. Currently relevant research fields are very fertile with most researchers being young academics or professionals.
2. Current technology must be about 15 to 25% of the way along the "S curve", thus providing relatively large returns for each unit of research input.
3. Current technology is about 50% of the way to its realisable potential.
4. This technology does not require any "break throughs" but continual and incremental development.
5. As the work is continual and incremental and realisation of benefits considerable, the risks are almost non-existent.
6. Once each element of research is complete, its application only requires appropriate industrial problems. Australia has many mining and industrial organisations and consultants able to effectively apply or implement the results of research in this field.

5. PROBLEMS FACING AUSTRALIAN GEOTECHNICAL RESEARCH

The principal factor influencing Australia's ability to achieve the desired R & D capacity is lack of support (principally funding) by industry and government. There is also a major problem in attracting and keeping competent research personnel when other countries are offering so many more rewards, financially, in employment conditions in general, in opportunities, and a higher standing of engineers within the community. The potential is quite clearly there but the capacity seems limited by the inability of our political masters to see beyond the short-term gain. We require major and consistent investment for long-term development in the technology.

Other problems which may hinder research progress are:

1. the lack of a culture in inter-disciplinary research; all three major areas of research described herein require input from a group which goes well beyond the traditional geotechnical and geological members of the geomechanics community.

2. the general lack of will on the part of industry to support and commercialise research, and on the part of government to support international venturing comparable with that given by other governments to their nationals.

3. Often the difficulty in carrying out collaborative research among competent groups with common interests, primarily because of geographical distance, and the reluctance of funding bodies to provide significant travel expenses.

4. the low level of recognition of the importance of technical expertise and training as important national assets.

6. CONCLUDING REMARKS

Three broad areas of geotechnical research have been identified as priority research areas: problematic soils of Australia and the Pacific Rim, mining geomechanics, and environmental geomechanics. Each area has substantial "payback" potential to Australian industry, and there are potentially large rewards for relatively modest outlays of research funding.

There are significant problems which tend to inhibit the development of geomechanics research, primarily in the lack of research funding support industry and government. Despite these problems, there are a number of positive factors in Australia, for example:

(i) the presence of a pool of talented and competent professionals and researchers
(ii) research groups with well-established links with major overseas research and industrial groups
(iii) a somewhat unique set of geological, geotechnical and environmental conditions which have required the development of local solutions to local problems, where imported solutions have not been found to be effective.

It is to be hoped that such positive aspects will more than outweigh the negative factors, and that the Australian geomechanics community will pursue with vigour the research areas outlined herein.

GEOPARAPHERNALIA

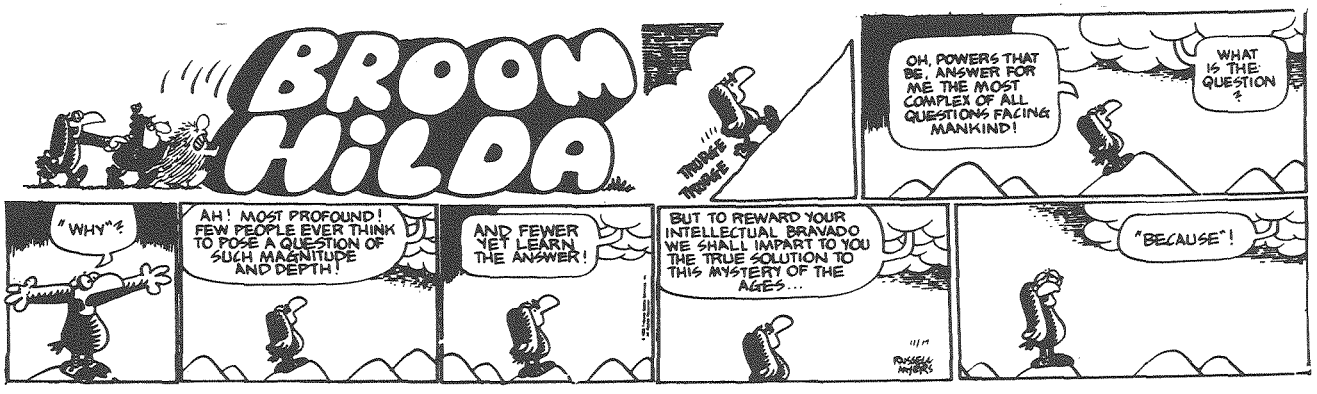
THE CREATION OF THE MERGER

In the beginning was the Plan
And then came the White paper
And the White Paper was without form or text
And the Plan was completely without substance
And darkness fell upon the face of the Academics
And they spoke unto their Head of Department saying
"it is a crock of s..t and it stinketh".
And the Heads of Department went unto their Chairmen and sayeth:
"it is a pail of dung, and none may abide the odour thereof".
And the Chairmen went unto the Deans and sayeth:
"It is a container of excrement, and it is very strong, such that none here abide it".
And the Deans went unto their Professorial Board and sayeth:
"it is a vessel of fertiliser, and none can abide its strength".
And the Professional Board went unto the Council and sayeth:
"It contains that which aids plant growth, and it is very strong".
And the Council went unto the Vice-Chancellor and sayeth:
"This powerful new plan will actively promote the growth and efficiency of the Universities, And this University in particular".
And the Federal Minister looked upon the Plan
And saw it was good
And in time the Plan became the Merger.

SPHERICAL CHICKEN SYNDROME

In spite of the usefulness of such Euclidian curves as equivalent ellipses and convex hulls, in my various studies of carbonblack profiles I was always wary of attempts to simplify the structures in order to give them outlines which made them manageable by available mathematics. I felt that the smoothing out of ruggedness by transforming the profile outline to Euclidian equivalent profiles was a symptom of the **"spherical chicken syndrome"** which sometimes affects scientists. This "disease" diverts them from reality into extensive studies of oversimplified models of real systems. The name of this disease reputedly comes from the historic approach of a physicist asked to study the heat generated by a hut full of chickens. It is said that the aim of this study was to see how much heat was generated and lost by the chickens, and how efficient the cooling-heating system for the chicken house throughout the winter would have to be to keep the chickens happy. Six months after the study began, the physicist was asked if he had solved his problem. "Not yet", he said, "but I am carrying out modelling experiments on a computer to find how much heat is lost from the surface of a spherical chicken". The real feathers, legs and wings of a chicken were too challenging mathematically for the computer, so the physicist replaced the real object with a model that he could handle on a computer. One of the most dangerous temptations for a graduate student studying a particular problem is to change the problem structure so that he can solve it with existing technology, rather than to insist on developing new technology to deal with the reality he is supposed to be studying.

From "A Random Walk Through Fractal Dimensions" Kaye, Brian H. (1989), VCH, Publishers New York.



THEORISTS VS EXPERIMENTALISTS

"Theorists conduct experiments with their brains. Experimenters have to use their hands, too. Theorists are thinkers, experimenters are craftsmen. The theorist needs no accomplice. The experimenter has to muster graduate students, cajole machinists, flatter lab assistants. The theorist operates in a pristine place free of noise, vibration, of dirt. The experimenter develops an intimacy with matter as a sculptor does with clay, battling it, shaping it, and engaging it. The theorist invents his companions, as a naive Romeo imagined his ideal Juliet. The experimenter's lovers sweat, complain, and fart."

From "CHAOS" James Gleik (1987)

RULES FOR RESEARCH

1. Always draw your curves, then plot the reading.
2. In case of doubt, make it sound convincing.
3. Experiments should be reproducible. They should all fail in the same way.
4. Do not believe in miracles. Rely on them.
5. If an experiment works, something has gone wrong.
6. No matter what result is anticipated, there will always be someone eager to

   (a) misinterpret it,
   (b) fake it,
   (c) believe it happened to his own pet theory.

7. In any collection of data, the figure most obviously correct, beyond all need of checking, is the mistake.

   Corollary 1: No one whom you ask for help will see it.

   Corollary 2: Everyone who stops by with unsought advice will see it immediately.

8. Once a job is fouled up, anything done to improve it only makes it worse.
9. Science is truth - don't be misled by facts.

AUSTRALIAN GEOMECHANICS RESEARCH INSTITUTIONS

Too little is known about the geotechnical research being conducted, the equipment and expertise developed and available, and the post-graduate courses given at our research institutions. We thought that it was about time that this information was collated and presented in an easily accessible reference document. We hope that we have achieved this. We also hope that all geomechanicists will use this information to their advantage and promote an even higher level of collaboration than that which already exists. A positive response can only result in a win - win position for all.

In the following pages you will find a brief description of the personnel, contact information, current research activities, possible future research activities, available equipment and postgraduate courses offered at Australian institutions involved in geomechanics research. The Institutions and their relevant Departments, Centres or Schools that we contacted for information are listed in alphabetical order in the table of contents below. While we endeavoured to contact all appropriate bodies, we may have invariably missed some out. We apologise to those we have missed (if any) and we will be happy to publish material from any such institution in the next edition of Australian Geomechanics.

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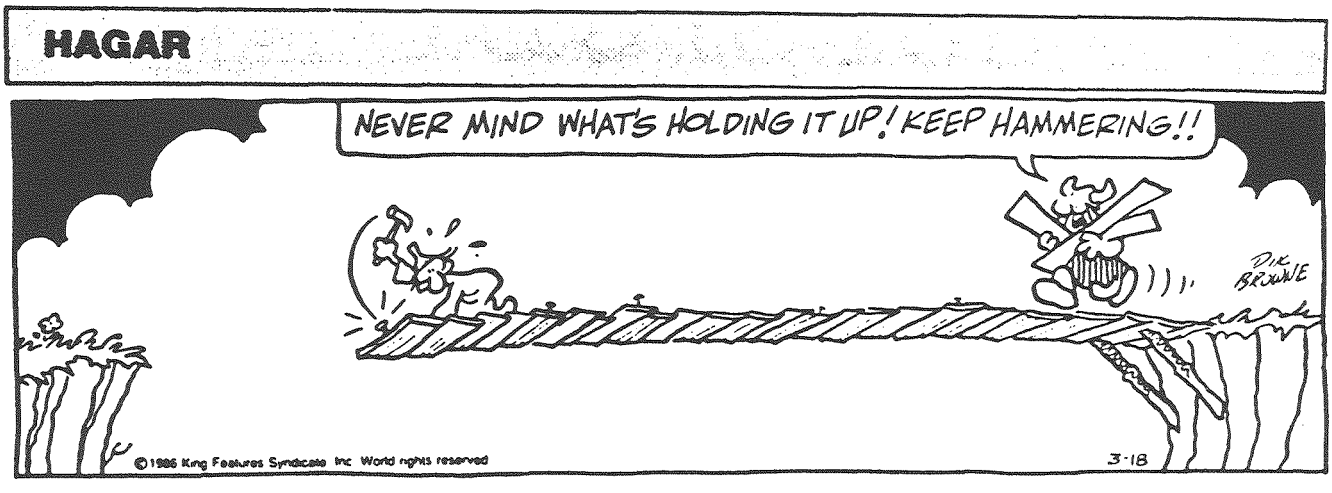
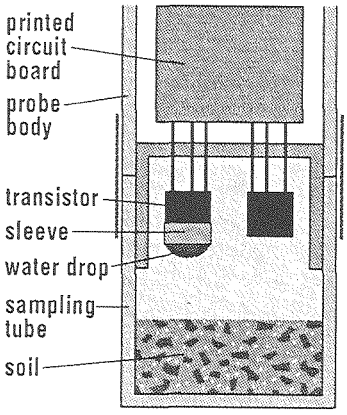


TRANSISTOR PSYCHROMETER

This new instrument for Soil Suction Measurement was released in Dallas Texas at the 7th. International Conference on Expansive Clays

It is the result of a collaborative venture between CSIRO Division of Soils and Soil Mechanics Instrumentation and has many advantages over the older types of suction measuring equipment:

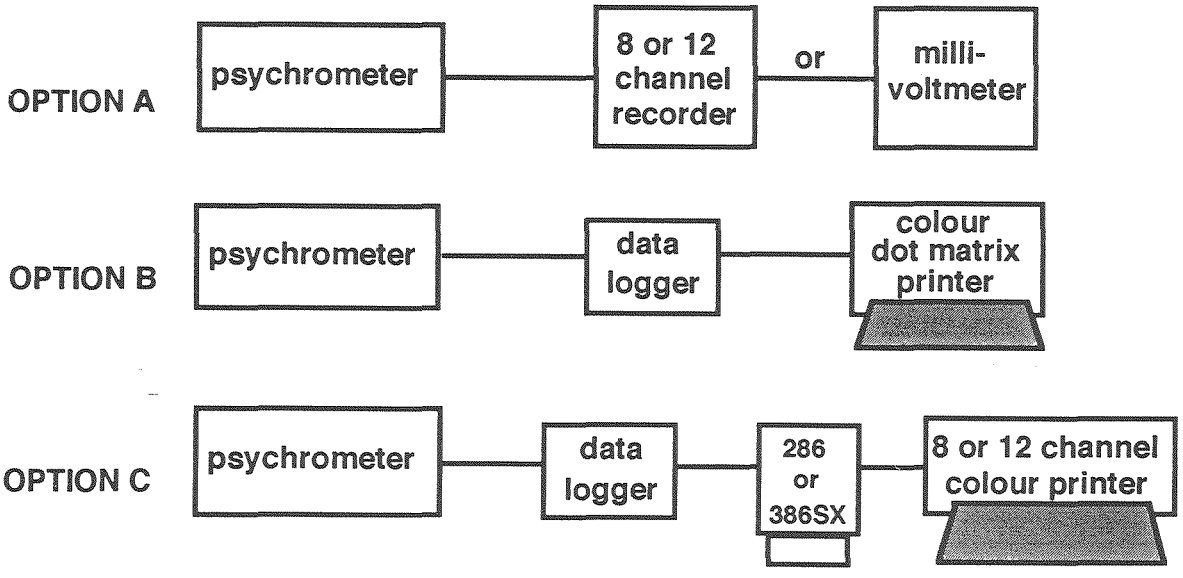
- high output voltage
- quicker response
- stable calibration
- 48 samples/day
- low cost per probe
- range pF 3.0 to > pF 5.5



The psychrometer has been developed to fully utilise the trend in geotechnical laboratories for computer driven testing and recording.

Our data logger has an RS232 port for data extraction or it can send information in graphic or numeric form directly to a colour dot matrix printer.

The options for data recording, storage and manipulation are:



For further information write to P.O. Box 90, Stirling, South Australia 5152. or Telepone (08) 370 9984 Fax (08) 370 8012

SMI Soil Mechanics Instrumentation

Manufacturers of a range of instruments for measuring moisture reactive soil volume change and flow parameters

AUSTRALIAN COAL INDUSTRIES RESEARCH LABORATORIES LIMITED

Address: PO Box 9
Corrimal NSW 2518

Phone: (042) 84 1711
Fax: (042) 83 6001

Contact: Dr Bernard Madden

Permanent Academic Staff:

Bernard Madden; John Shepherd; Peter Hatherly; Russell Frith; Mark Colwell; Peter Willey; Nick Gordon; Alex Stewart; Tomasz Lewandowski; Steven Ditton; Blair McKenzie; Rikesh Patel.

Overview of Research Areas and Consulting:

The Geotechnical Engineering Group of ACIRL conducts applied research for the Australian coal mining industry and provides a consulting service for all organisations influenced by mining.

Extensive research into all aspects of underground mining have been conducted by ACIRL over the past few years. This includes exploration and geotechnical assessment of anticipated conditions, the design and layout of mines for stability and maximisation of recovery, the optimisation of longwall and roof support, the effects of mining on the surface and structures and the behaviour of geologic and support materials by laboratory testing.

Specific Active Research Projects:

Current research projects funded by NERDDP are:

Rock Mass for Surface Mine Applications; integration of Methods for the Prediction of Faults ahead of Mining; The Borehole VSP Method for Detailed Coal Seam Mapping; Determination of Stressfield Conditions from Exploration Drill Core; Improved Recovery of Underground Coal Resources Compatible with Surface Land Use; Improved Methods of Subsidence Engineering; Improving Pillar Extraction Safety; Detection of Incompetent Mine Roof.

Particular Areas of Expertise Related To Consulting:

ACIRL's Geotechnical Engineering Group contains a wide range of experience for all exploration and underground mining consulting. Continued practical application of both research and consulting enables the group to assist in both the planning of future operations as well as the day to day solutions to operational problems.

All rock material properties can be obtained by the extensive testing facilities, these include a stiff servo controlled 2 MN Schenk capable of conducting multi stage triaxial tests.

ACIRL's Geotechnical Engineering Group offer consulting in:

Mine Design; Roof Support; Subsidence; Geophysics; Geotechnical Assessments; Rock Testing; Geotechnical Risk Assessment.

AUSTRALIAN NATIONAL UNIVERSITY

CENTRE FOR AUSTRALIAN REGOLITH STUDIES GEOLOGY DEPARTMENT

Address: GPO Box 4
Canberra ACT 2614

Phone: (06) 249 2056
Fax: (06) 249 5544

Contact: Dr. Tony Eggleton

Permanent Academic Staff:

Contact the Institutions.

Overview of Research Areas:

The Australian regolith: mapping, soil science, mineralogy, geochemistry, age, remotely sensed character, interaction with water.

Specific Active Research Projects:

The nature and age of basalt weathering in eastern Australia - evidence for the rate of weathering and soil formation, reaction processes, and environmental indicators; The Quaternary stratigraphy and mammal fossils of the northern Monaro; The mineralogy, geochemistry and evolution of bauxitic and lateritic pisolites; Regolith geology, geochemistry and radiometrics over two granitic regions in Queensland; The weathering of pyrite; The ultra structure of kaolinite and relation of structure to origin, extraction and processing; Remote sensing of the regolith at Shark Bay, Qld.; Radioactive tracers in saline waters; Formation of silica skins over rock art; Element adsorption on Fe oxyhydroxides during weathering; Dispersion of metals in the regolith and remotely sensed data; The palaeoclimatic signals in fossil wood; Roles of suspended sediment in Canberra's urban lakes; The nature of sediments in Gippsland lakes and their role in phosphorus storage/ release; The release of phosphorous from bottom sediments in the Gippsland lakes; The petrology of the volcanic plugs of the Monaro; Mapping the geology and regolith (including soils) of the Boorowa 1:100,000 sheet.

Future Areas of Research anticipated:

Extensions of the above; Remote sensing the regolith; Dating the regolith.

Particular Areas of Expertise related to Consulting:

Mineral analysis, particularly clay mineral X-ray diffraction; Regolith and environmental geology investigations.

Facilities for Research, Consulting and Testing:

X-ray diffraction laboratory; Electron microscopy (Scanning and Transmission); Atomic absorption elemental analysis.

Postgraduate Courses offered:

Graduate Diploma in Science (10 months); Master of Science in Regolith Studies by course-work and sub thesis (15 months); M. Sc by research (1-2 yrs); Ph.D (3 yrs).

PETROPHYSICS RESEARCH GROUP RESEARCH SCHOOL OF EARTH SCIENCES

Address: GPO Box 4
Canberra ACT 2601

Phone: (06) 249 4076
Fax: (06) 257 0737

Contact: Dr. S.F. Cox

Permanent Academic Staff:

Dr. I. Jackson and Dr. J.D. Fitz Gerald

Overview of Research Areas:

Mainly experimental studies of mechanical properties of geological materials under conditions of high pressure and temperature.

Specific Active Research Projects:

The interaction between fluids and deforming rocks with emphasis on the evolution of porosity and permeability and its implications for mechanical strength; frictional sliding in rock interfaces in the presence of high pressure, reactive pore fluids; The anomalous mechanical properties of materials undergoing structural phase transformations; Elastic and inelastic properties of geological materials with seismological application; The influence of secondary phases including melt on the rheology of olivine aggregates.

Future Areas of Research Anticipated:

Fault mechanics in the presence of aqueous fluid and fine-grained fault gouge; The inelasticity of fluid-saturated crustal rocks.

Particular Areas of Expertise Related to Consulting:

See above and below.

Facilities for Research, Consulting and Testing:

Experimental rock deformation laboratory capable of compressive testing of rock specimens under controlled conditions of confining pressure (to 300 MPa), pore fluid pressure (to 250 MPa), load to 100 kN and temperature (to 1300°C); Equipment for study of rock anelasticity through measurement of forced torsional oscillation (to 300 MPa, 1200°C at strains $\leq 10^{-6}$); Ultrasonic techniques for measurement of acoustic wave speeds; In house analytical transmission electron microscopy.

Postgraduate Courses Offered:

Ph.D. through research.

AUSTRALIAN ROAD RESEARCH BOARD LTD

Address: P.O. Box 156
Nunawading VIC 3131

Phone: (03) 881 1555
Fax: (03) 887 8104
Telex: (AA) 33113

Contact: Dr. Ian Johnston, Executive Director

Permanent Academic Staff:

130 staff involved in six Programs. Program Managers as follows:

David Bennett, Road Infrastructure; Jim Jarvis, Road Safety and Environment; John McLean, Transport Efficiency; Fred Clark, Engineering Services; Peter Milne, Research Applications; Alastair Lindores, Management Services.

Overview of Research Areas:

Pavement Performance; Surfacings; Quality Management Systems.

Specific Active Research Projects:

Accelerated Loading Facility; Quality Management Systems; Seal Design and Performance; Modified Binders and Delivery Systems; Asphalt Mix Design and Performance; Pavement Performance; National Pavement Condition Indicators; Unsealed Roads; QMS for Local Government; Overlay Design.

Future Areas of Research anticipated:

Recycling; Maintenance Strategies; Cemented Materials; Asset Management.

Particular Areas of Expertise related to Consulting:

Elastic layer modelling of pavements; Back-calculation of material properties; Falling weight deflectometer surveys; Accelerated loading facility program; Laboratory characterisation of asphalt, binders and

unbound materials; Statistical compliance schemes; Weigh-in-motion surveys and traffic classification; Evaluation of the structural condition of pavements; Pavement design, including overlay design; Bitumen durability testing; Characteristics of binders; Crack movement; Skid Resistance.

Facilities for Research, Consulting and Testing:

Accelerated Loading Facility; Universal Testing Machine (MTS); Materials Testing Apparatus (MATTA, UMATTA); Falling Weight Deflectometer; Carrimed; British Portable Skid Resistance Tester; Bitumen Durability Testing (RTFD); Elastometer; Soil Classification Equipment; Dynamic Cone Penetrometer; Golden River Capacitative Weighpad; Back-Calculation Program (EFROMD2).

Postgraduate Courses offered:

Nil, although some research is commissioned with tertiary institutions.

BHP MELBOURNE RESEARCH LABORATORIES

No information received.

CSIRO

AUSTRALIAN PETROLEUM COOPERATIVE RESEARCH CENTRE (APCRC)

Address: CSIRO Division of Geomechanics
Kinnoull Grove
Syndal VIC 3149

Phone: (03) 881 1355
Fax: (03) 803 2052

Contact: Dr. Adrian Williams, General Manager
Dr. David Hobday, Business Development Manager.

Permanent Academic Staff:

Leaders of the six applied research fields are listed below.

Overview of Research Areas:

The APCRC was formed in July, 1992 to provide research and training facilities for Australia's oil and gas industry under the Federal Governments Cooperative Research Centre Program. The APCRC is an unincorporated joint venture between the CSIRO Divisions of Exploration and Geomechanics, the Centre for Petroleum Engineering at the University of New South Wales and the National Centre for Petroleum Geology and Geophysics at the University of Adelaide. The APCRC coordinates the research effort of these groups, and maintains networks with petroleum and resource companies, and other interested parties.

Specific Active Research Projects:

Geological Exploration Methods

Dr. Joe Hamilton [CSIRO Division Exploration Science (02) 887 8630] - Specifically aimed at a better definition of basin evolution and exploration methods by focusing on source rock characterisation, maturation, migration, trap development and reservoir diagenesis.

Reservoir Properties and Characterisation

Dr. Lincoln Patterson [CSIRO Division Geomechanics (03) 881 1249]: Research into methods of achieving the best possible recovery of oil and gas by understanding the effect of shape, behaviour and pattern of pores and rocks on gas and liquid flow in reservoirs.

Improved Oil and Gas Recovery

Prof. Val Pinczewski [UNSW (02) 697 5189]: Research to develop new technologies for draining 'tight' reservoirs, and harnessing new energy sources such as coalbed methane, and to recover these resources more efficiently.

Basin Analysis: North West Shelf and Timor Sea

Dr. Bill Stuart [Univ. of Adelaide (08) 238 3800]: Aimed at developing the appropriate technology and skills to help industry make best use of the small body of drill core, well log and seismic data to assist with the development of these fields.

Coalbed Methane Extraction

Mr. Jim Enever [CSIRO Division of Geomechanics (03) 881 1297]: Particularly targeted at the development of innovative well testing technology, simulation techniques and pilot production facilities in relation to this technology.

Drilling and Wellbore Engineering

Dr. David Hobday [UNSW (02) 697 5297]: Aimed at defining local conditions, particularly the stress patterns and rock behaviour, to incorporate new drilling practices and better predict and manage wellbore performance to ensure efficient and long term development of oil and gas fields.

Particular Areas of Expertise related to Consulting:

See above.

Facilities for Research, Consulting and Testing:

Facilities are available at all four of the key centres. Contact the relevant group leaders for further information.

Postgraduate Courses offered:

The APCRC has a commitment to education and training through creation of postgraduate, postdoctoral

and visiting fellow research positions within the APCRC, and to development and presentation of undergraduate and post-graduate material and short courses to strengthen links with industry. The APCRC offers postgraduate awards for outstanding candidates who wish to further their studies in one of the six applied research programs.

DIVISION OF GEOMECHANICS
QLD CENTRE FOR ADVANCED TECHNOLOGIES

Address: PO Box 883
Kenmore QLD 4069

Phone: (07) 212 4444
Fax: (07) 212 4455

Contact: Dr. Graham Price

Permanent Academic Staff:

Dr. Graham Price (Acting Chief of the Division, Program Manager, Metalliferous Mining); Dr. Cliff Mallett (Assistant Chief, Program Manager, Coal Mining); Dr. Adrian Williams (Assistant Chief, Program Manager, Oil & Gas Engineering).

Overview of Research Areas:

The objective of the Division is to undertake strategic research aimed at enhancing the competitive edge of the Australian mining and hydrocarbon extraction industries. In general such research is directed towards increasing the efficiency, productivity and safety of these resource extraction industries. The research interests of the Division fall into six primary areas.

Metalliferous Mining: This research program aims to develop new geomechanics systems and technologies in order to maximise the economic recovery of minerals and metal ores from underground and open pit mining operations. CSIRO is at the forefront of innovative technology and provides strategic research and technical support to the mining industry. The program concentrates mainly on conventional geomechanics, structural geology and geophysics, the accurate delineation and, orebody boundaries, rock structure, mechanical properties, stress conditions, computer graphics (3D visualisation) and numerical modelling of excavation stability. Research is focussed in three areas:

- The development of integrated mining methods for deep open pits;
- Integrated geological, geophysical; mine design and computer visualisation systems;
- The development of specific products and technologies designed to improve mine productivity and reduce costs.

Coal Mining: Australia's coal export industry is very dependent upon Queensland's shallow surface coal mines. The continuing depletion of these deposits is driving changes in mining techniques. This program focuses on three main areas:

- Deep surface and highwall mining methods;
- Productivity increases in underground operations;
- Surface coal mine rehabilitation

Research is currently directed to the identification, monitoring and prediction of geological and geomechanical factors affecting the performance of mining operations. Numerical modelling methods provide a design and evaluation capability and allow optimisation of excavation stability and productivity, particularly in respect to coal pillar design. Intrinsically safe instrumentation is being developed which can continuously monitor equipment and rock mass parameters and these help reduce delays in the mining cycle. Technologies for machine sensing, control and communication are being developed as part of the industry shift to integrated automated mining machinery. The mining industry now places great emphasis on environmental responsibility and issues of surface mine rehabilitation, subsidence over underground mines and the management of mine gases are being addressed.

Oil and Gas Engineering: Australia's oil and gas production is worth more than $8 billion per annum. This represents more than 70% of our oil needs and 100% of our gas needs, and it provides for oil and gas exports worth more than $4 billion per annum. It is therefore important for Australia that this industry is competitive and develops its scarce oil resources efficiently. This research program aims to contribute to the performance of Australia's upstream oil and gas industry by working with the industry to develop the required understanding of Australian reservoirs and the technologies to enable the efficient recovery of the resources they hold. The research focuses on the following major industry issues:

- Coalbed methane;
- Wellbore stability;
- Reservoir characterisation
- Stimulation of tight reservoirs.

Specific Active Research Projects:

Metalliferous Mining: Constitutive modelling and material instabilities; An integrated mining method for deep open pits; Rock support and reinforcement practice; In-situ cementation of weak and porous rocks and sediments by crystal growth technologies; Real-time image analysis system for improving rock; Fragment size and shape control; Numerical and experimental modelling of rock behaviour; Computer modelling of structural and related controls on ore deposits; Fractal graphics; Commercialisation of SIROLOG technology; Ground probing radar; Interactive generation and compression of three dimensional images using fractal geometry; Integrated geological, geophysical and mine design visualisation systems; Minimisation of ore dilution in metal mines.

Coal Mining: Microseismic application to mining; Mining machine monitoring; Mining machine automation and communication technologies; Hazardous mining - intrinsically safe monitoring and communication; Highwall mining; Dragline stability

monitoring; Goaf stress monitoring; Interpretation and analysis of continuously monitored geotechnical data; Structural interpretation for new underground (longwall) and open-cut developments; Physical properties of coal and coal measure rocks which control strength, fracture and breakage; Geotechnical information systems for coal mining; Airborne (SAR) evaluation of coal mines; Coal mine design and system engineering.

Oil & Gas Engineering: Development of a high pressure triaxial cell; Stimulation of tight reservoirs; Wellbore stability; Hydraulic fracture stimulation; The mechanics of multiphase flow in coal; Characterisation of oil and gas reservoirs; Coalbed demonstration project - MIM; Well testing technology; Stimulation by cavity completion; Diagenesis and matrix stimulation.

Future Areas of Research Anticipated:

Please contact the Division.

Particular Areas of Expertise Related to Consulting:

Geomechanics; Structural Geology; Petroleum Geology; Geotechnics Engineering; In-Situ Minerals Analysis; Mine Communication Systems and Technologies; Geotechnical Instrumentation and Monitoring Systems; Numerical Analysis; Mining Engineering; Petroleum and Reservoir; Geophysics; Mine Design and Visualisation.

Facilities for Research, Consulting and Testing:

Contact the following the more information:

Metalliferous Mining: Rock Mechanics Research Centre, PO Box 437, Nedlands, Western Australia, Phone: (09) 389 8421, Fax: (09) 389 1906.

Coal Mining: Queensland Centre for Advanced Technologies, PO Box 833, Kenmore, Queensland 4069, Phone: (07) 212 4444 Fax. (07) 212 4455.

Oil and Gas Engineering: Melbourne Laboratory, PO Box 54, Mt. Waverley, Victoria, Ph. (03) 881 1355 Fax. (03) 803 2052.

Postgraduate Courses Offered:

None

CURTIN UNIVERSITY OF TECHNOLOGY

SCHOOL OF CIVIL ENGINEERING

No information received

SCHOOL OF APPLIED GEOLOGY

Address: GPO Box U1987
Perth WA 6001

Phone: (09) 351 7968
Fax: (09) 351 3153
Telex: AA92983

Contact: Dr. A. Qadeer Rathur

Overview of Research Areas:

Laterite weathering profiles and resulting geotechnical properties; Geotechnology of the coastal limestone formations including eoliantes and beach rocks.

Specific Active Research Projects:

Geotechnical properties of laterite weathering profile near Boddington, WA; Engineering properties of coastal limestone from Rocky Bar, WA.

Future Areas of Research:

An M.Sc. project just started entitled "An investigation of the geotechnical characteristics of soils and rocks in road excavation for a proposed highway, West Java, Indonesia."; Neotectonics in Earthquake Research in Stable Continental Interiors; Abrasion in Mining and Civil Engineering; Investigation of Hydrogeological Problems in Mining & Civil Engineering.

Facilities for Research:

Major research facilities are in well equipped Hydrogeology-Engineering Geology Laboratory and include: Donath triaxial deformation apparatus; Point load testing apparatus; Field shear box - with low friction pressure maintenance unit; Ruska porometer; Ruska permeameter; Pioneer mole trailer mounted drilling rig; Rock jaw crushed and pulveriser - hydraulic; Rock grinder - ring type; Hach DR 2000 - Spectrophotometer for chemical analysis of waters.

This is supported by Sedimentology Laboratory, Petrology Laboratory, rock preparation workshops, access to XRD, XRF, SEM, remote sensing/satellite technology facilities, geochemistry as well as Geomechanics and Water Laboratories in the School of Engineering.

All these are backed up with well equipped Computer Laboratory within the School of Applied Geology as well as main frame computing facilities of the University.

Post Graduate Courses Offered:

Postgraduate Diploma (Hydrogeology; Engineering Geology); Master of Science (Course Work as well as Research based); Ph.D. (Research).

Other Comments

The Hydrogeology-Engineering Geology Unit of the School of Applied Geology maintains very close links with industry and in particular with geotechnical and groundwater consultants. Many of these consultants contribute to the courses in hydrogeology and engineering geology.

DEPARTMENT OF MINING ENGINEERING AND MINE SURVEYING
WESTERN AUSTRALIAN SCHOOL OF MINES, KALGOORLIE

Address: PO Box 597
Kalgoorlie WA 6430

Phone: (090) 805 150
Fax: (090) 805 151

Contact: Prof. T.S. Golosinski, Head of Department of Mining Engineering and Mine Surveying

Permanent Academic Staff:

Dr. Graham Baird; Dr. David Clibbery; Mr. Paul Dunn; Mr. R. Ganeswaran; Prof. T.S. Golosinski; Mr. Trevor Little; Mr. Tony Snow; Dr. Tad Szwedzicki.

Overview of Research Areas:

Geotechnical instrumentation and monitoring, rock reinforcement (selection and design), numerical modelling, geotechnical mapping using photogrammetry, rock cuttability and drillability, subsidence monitoring and prediction, blasting, expert system applications, seismicity in mines.

Specific Active Research Projects:

Laboratory testing of mechanical properties of hard rock including the influence of testing methods and sample shape on the behaviour of rock specimens; Selection and design of blasting techniques for selective open pit mining using expert system technology; Application of some seismic techniques for underground mines; Open pit and underground drill and blast practices; Prediction and control of subsidence over hard rock mines; Drillability of various rocks of Western Australia using specific energy approach for diamond drilling.

Future Areas of Research anticipated:

Extend current drilling research into drillability of rocks for other types of drilling methods; Survey methods of geotechnical slope monitoring; Application of road header technology to hard rock conditions; Behaviour of mine opening in high stress conditions (laboratory testing); Rock cuttabilty and diggability assessment of different rocks.

Particular Areas of Expertise related to Consulting:

Laboratory testing for mechanical properties of rocks; slope stability; rock fragmentation; rock noise; support and reinforcement of excavations; subsidence over hard rock mines; pillar design; geotechnical instrumentation; application of mathematics to geomechanics; drilling and cutting of rocks; rock diggability and related selection of mining equipment; survey methods and equipment in slope stability control and monitoring.

Facilities for Research, Consulting and Testing:

The Department has a well equipped rock mechanics laboratory in which all rock tests specified by the International Society of Rock Mechanics (ISRM) Suggested Methods for Rock Testing can be undertaken.

In addition to the standard items of equipment the Department has a 450 tonne capacity servo- controlled INSTRON testing facility with 4.5 MN load capacity, 10 MN/mm frame stiffness, 2.33 mm/s loading rate, 2.0 ms response time, and maximum daylight of 650 mm vertical and 530 mm horizontal. The facility is used for non-standard static and dynamic testing and for the research into post- failure behaviour of rock.

With regards to drilling and rock cutting components, existing equipment includes a diamond drilling facility, which has been set up to monitor drilling thrust, drilling moments, penetration rates, and rotational velocity.

Postgraduate Courses offered:

The Department is offering a Master of Engineering Science programme by course work and minor dissertation in Mining Geomechanics in 1993. The programme is designed to be a two year part-time course.

The Department also offers M.Sc. and Ph.D. degrees by research.

JAMES COOK UNIVERSITY OF NORTH QUEENSLAND

DEPARTMENT OF CIVIL AND SYSTEMS ENGINEERING

Address: Dept. of Civil and Systems Engineering
James Cook University of North Queensland
Townsville QLD 4811

Phone: (077) 81 4476
Fax: (077) 75 1184

Contact: Dr. John Eckersley

Permanent Academic Staff:

Dr. John Eckersley

Overview of Research Areas:

Past research has covered a wide range of areas in rock and soil mechanics and pavement performance, including both fundamental and applied aspects. The development of devices for in-situ rock stress measurement has become well known in the mining industry. Current work focuses mainly in mining and civil geotechnical problems of particular significance to northern Australia.

Specific Active Research Projects:

Seismic piezocone penetrometer investigations in soft soils; Drainage and stability of coal stockpiles; Static liquefaction and flowsliding in cohesionless soils; Resistance of short piers to combined uplift and lateral loading; Slope stability in tropical environments.

Future Areas of Research Anticipated:

Current research areas are expected to continue into the future, with additional areas being developed following the expected new staff appointment.

Particular Areas of Expertise Related to Consulting:

Slope stability in open strip coal mining; Stability and drainage of coal stockpiles.

Facilities for Research, Consulting and Testing:

The soils laboratory is equipped for conventional strength and compressibility testing including computer based data logging, and repeated load triaxial testing of pavement materials. Computerised pressure control facilities are being progressively commissioned. Equipment available for rock testing includes a 5000 kN testing frame (rock triaxial testing), a 1000 kN servo-controlled machine (elastic modulus and post-failure testing), and slake durability equipment.

The Department operates a Hogentogler seismic piezocone penetrometer by agreement with its owner, Queensland Department of Transport. This is deployed on the JCU Geology Department's light drilling rig, or on a heavier contract rig. Other equipment for field investigations includes JCU designed devices for in-situ measurement of rock stress (2-d borehole slotter) and deformability (borehole jack), a heavy dynamic cone penetrometer, a Sinco biaxial inclinometer and field data loggers.

A range of mainframe and microcomputer based software is available within the Department.

Subject to teaching and research commitments, facilities are available for consultative testing. In-situ rock stress measurement is currently available through Barrett, Fuller and Partners (Melbourne) using JCU equipment.

Postgraduate Courses Offered:

Ph.D.
M.Eng.Sc. (primarily by research)
M.E. (primarily by coursework or professional practice)
Grad.Dip.E. (primarily coursework)

The Department has pioneered a unique Degree course in Rock Engineering in which coursework was undertaken in 4 residential sessions of 3 to 4 weeks duration each over 2 years. Unfortunately, this program cannot be offered at present due to staffing limitations.

LATROBE UNIVERSITY

GEOLOGY DEPARTMENT

No information received.

MACQUARIE UNIVERSITY

DEPARTMENT OF EARTH SCIENCES

No information received.

MONASH UNIVERSITY

DEPARTMENT OF CIVIL ENGINEERING (CLAYTON CAMPUS)

Address: Wellington Road
Clayton VIC 3168

Phone: (03) 565 4954
Fax: (03) 565 4944

Contact: Assoc. Prof. Ian B. Donald

Permanent Academic Staff:

Assoc. Prof. I.B. Donald; Assoc. Prof. I.W. Johnston; Dr. A.K. Parkin; Dr. C.M. Haberfield.

Overview of Research Areas:

The research carried out by the Geomechanics Group of the Department of Civil Engineering concentrates on the use of high quality laboratory and field tests in conjunction with sound theoretical and numerical studies to investigate a wide range of practical geotechnical problems. This has led to the acquisition or development of an extensive range of standard and non-standard laboratory testing facilities and an impressive range of computer programs. Major areas of investigation have included soil and rock properties, in-situ testing, calibration chamber applications, rockfill testing, rock joint behaviour, slope stability, pile analysis, pavements, retaining walls, on and off-shore foundations and fracture mechanics applied to geomaterials.

Specific Active Research Projects:

The following is a summary of the main areas of currently active research. The chief investigator/s are given in brackets:

Slope stability - computer analyses (Donald); Numerical analyses of earth retaining structures (Donald); Cyclic loading properties of soft soils (Donald); Acceptance criteria for laterites as pavement materials (Donald and Parkin); Shear behaviour of rough rock joints (Johnston and Haberfield); Pressuremeter interpretation for soft rock (Haberfield and Johnston); Fracture toughness properties of soft rock (Haberfield and Johnston); The bearing capacity of foundations in weak rock (Johnston and Haberfield); Use of expansive concretes to improve

pile and rock anchor capacity (Haberfield and Johnston); Numerical modelling of fracture propagation (Johnston and Haberfield); Post-peak behaviour of rock joints (Johnston); Earth pressures in weak rock (Johnston); Engineering properties of coal (Johnston); Cyclic loading properties of rough rock joints (Haberfield and Johnston); Off-shore foundations (Johnston and Haberfield); Laboratory and field performance of pavement materials (Parkin); Calibration chamber for cone penetrometers (Parkin); Rockfill testing and throughflow of rockfill dams (Parkin); Hydraulic fracture in soil materials (Parkin); Repeated load triaxial testing of pavement materials (Parkin);

Future Areas of Research anticipated:

The active areas described above will continue. New areas of research include:

Development of design criteria for rock facades for buildings (Haberfield); Geomembranes (Donald and Parkin); Stream channel stability dispersivity and credibility (Parkin).

The research group is open to any suggestions from industry to possible areas of research and in particular areas involved in environmental geomechanics.

Particular Areas of Expertise:

Standard and advanced laboratory testing of soil and rock; Field pile testing; In-situ testing; Rock joint testing (cyclic and static); Numerical analyses including finite element, FLAC, slope stability (finite element, GWEDGEM and EMU), socketed pile and rock joint performance and retaining walls.

Facilities for Research, Consulting and Testing:

Facilities include fully equipped soil testing and rock testing laboratories, extensive strong floor area of 5000 kN point load capacity and full workshop facility. A wide range of standard and non-standard equipment as described below is available. The Department prides itself on being able to design and manufacture specialist equipment or testing facilities based on a client's needs including advanced instrumentation, software development and specialist data logging equipment.

Laboratory Testing:
The full suite of standard laboratory soil and rock tests ranging from Atterberg limits through reversible direct shear machines to the full range of triaxial tests; A range of loading frames ranging from 50 kN to 5000 kN capacity. Many are servo-controlled and capable of displacement or load controlled testing; A hydraulic servo-controlled, modular actuator system by INSTRON with two 1000 kN and three 250 kN jacks. Both load and displacement control testing is possible; A wide range of hydraulic jacks, load cells and data logging equipment suitable for use in laboratory or in the field; A wide range of specialist instruments such as Poisson's ratio rigs, middle third rigs, Ko rings, automatic volume change devices, etc.; Several high pressure (up to 70 MPa) triaxial cells with full-pore pressure and volume change measurements; A large constant normal stiffness direct shear machine that can accommodate samples up to 50 mm by 200 mm, useful for testing rock joints, pile/rock interfaces, soil/concrete interfaces and soil and rockfill materials; A large, fully computer controlled, cyclic constant normal stiffness direct shear machine that can accommodate samples up to 200 mm by 600 mm - useful for testing large samples of rock joints, pile/rock interfaces soil/concrete interfaces under static and cyclic conditions; A large constant normal stiffness, ring shear device for determining residual properties of soil, rock and rock joints - samples up to 150 mm diameter; A cyclic, constant normal stiffness, simple shear and triaxial machine - sample sizes up to 75 mm diameter; A large cyclic triaxial machine for testing pavements and rockfills - sample sizes of 200 mm diameter by 400 mm high; A large calibration chamber for quasi-static and dynamic testing of in-situ instruments, e.g. cone penetrometers, model piles - samples 1.2 m diameter by 1.8 m high, dry or saturated, stationary sand spreader for formation of dry sand samples; Rockfill testing equipment, including triaxial cell for 370 by 760 mm samples to 1.6 MPa confining pressure and 600 by 600 mm fixed/floating ring oedometer.

Field Testing
Field shear vane equipment; Field tube sampling equipment up to 85 mm diameter; Non-standard specialist field testing applications as specified by the client.

Computing
The Geomechanics Group has a large number of IBM compatible PCs ranging from 286 to 486 machines. It also has unlimited access to computer laboratories containing large numbers of 286, 386 and 486 as well as Macintosh machines. All computers are networked with each other and with a system of approximately 30 VAX mini-computers. Access to super computers is also available. A large suite of programs is available for use on all machines.

Postgraduate Courses offered:

The Department offers postgraduate research degrees at Masters and Ph.D. level. A coursework Graduate Diploma in Geomechanics is also available. Contact the department for further information.

DIVISION OF CIVIL ENGINEERING (CAULFIELD CAMPUS)

Address: PO Box 197
Caulfield East Vic 3145

Phone: (03) 573 2380
Fax: (03) 573 2796

Contact: Keith McKenry

Permanent Academic Staff:

Keith McKenry; Adrian Power.

Overview of Research Areas:

This division was formerly part of Chisholm Institute of Technology in which teaching was the primary role. Current research interests are computer aided data collection and shallow depth geophysical investigations.

Specific Active Research Projects:

None current.

Future Areas of Research Anticipated:

Landfill settlement predictions.

Particular Areas of Expertise Related to Consulting:

'FLAC' analysis; Standard soils tests; Geotechnical site investigations; Optical petrography.

Facilities for Research, Consulting and Testing:

Fully equipped soils laboratory; Static cone penetrometer; Auger drill; Petrological thin section equipment; Seismograph and resistivity equipment.

Postgraduate Courses Offered:

Contact the Department.

VIEPS DEPARTMENT OF EARTH SCIENCES

Address: Clayton Vic 3168

Phone: (03) 565 5762
Fax: (03) 565 5062

Contact: Dr. S.J.D. Cox

Permanent Academic Staff:

Dr. G. Houseman and Dr. M.W. Jessell.

Overview of Research Areas:

See under Specific Active Research Projects.

Specific Active Research Projects:

Brittle rock failure - monitoring formation in compression tests using acoustic emissions, quantitative damage modelling; Remote sensing/geophysical characterisation of fractures - ultrasonic probing of fractures under varying loads, digital image analysis for fracture mapping; Strength characterisation of shales from small samples; Modelling the earth's mantle flow using computational fluid dynamics; Stress analysis (finite elements) - stress distribution in heterogeneous materials, stresses around cracks in a non-linear viscous medium, growth of shear cracks; Large strain rock deformation - deformation mechanisms in hot-worked polycrystals, simulations and in-situ experiments using analog materials, image analysis of microstructures.

Future Areas of Research Anticipated:

Please contact the Department

Particular Areas of Expertise Related to Consulting:

Please contact the Department.

Facilities for Research, Consulting and Testing:

Joint CSIRO/Monash large volume/high pressure (300 MPa) high temperature (200°C) deformation apparatus, including servo control of confining pressure and two fluid pressures. Six channel AET PC controlled Acoustic Emission monitoring and recording apparatus.

Postgraduate Courses Offered:

Research programmes area available leading to M.Sc. and Ph.D. degrees.

VIEPS short course - Mechanics of Rock Deformation (5 days)

UNIVERSITY COLLEGE GIPPSLAND

No information received.

QUEENSLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF CIVIL ENGINEERING

Address: GPO Box 2434
Brisbane Qld 4001

Phone: (07) 864 2540
Fax: (07) 864 1515

Contact: Professor Keith Wallace

Permanent Academic Staff:

Mr. Bevan Boyce; Dr. Frank Bullen; Prof Keith Wallace

Overview of Research Areas:

Unsaturated soils; Soil and rock reinforcement; Pavements; Retaining Walls.

Active Research Projects:

Unsaturated Soils: Lateral swell pressures in expansive soil; Theoretical modelling of swelling subgrades and cracking pavements; Moisture transients in pavements; Effect of vegetation on wetting and swelling.

Soil and Rock Reinforcement: Analysis and design considering relative extensibility of reinforcement.

Pavements: Low cost road performance in Australia and Malaysia; Use of marginal materials.

Retaining Walls: Crib analysis and design.

Future Areas of Research Anticipated:

Full scale testing at the new Carseldine Field station. Facilities to be developed include soil and pore water pressure instrumentations, 200 tonne jack, data logger and inclinometers.

Particular Areas of Expertise Related to Consulting:

Soil and site improvement; Slope stability; Foundations, pavements and earthworks.

Facilities for Research, Consulting and Testing:

QUT's geomechanics laboratory is NATA registered for a number of tests. Specialist areas include: triaxial and direct shear - soil and rock; soil density/compaction; testing of rocks to ISRM standards.

Soil Mechanics: Computer controlled triaxial equipment for automatic stress path testing for the shear strength of soils; 60mm shear boxes for the direct assessment of soils; Soil dewpoint psychrometer for the measurement of suction in expansive soils; Oedometer load frames and hydraulic Rowe cells for assessing the compressibility of clay soils; Standard load frame for CBR assessment of road pavement subgrade materials.

Rock Mechanics: Point load index, triaxial shear strength cells and shear box for the direct shear along joint surfaces.

Software: Extensive software in areas of soil stability, seepage, consolidation and pile analysis.

Postgraduate courses offered:

Ph.D., M.Eng., M.Eng.Sc., Grad.Dip.

Other Comments:

QUT has established a research centre to focus attention nationally on civil engineering research. Known as the Physical Infrastructure Centre, this body works closely with industry and government to strengthen, upgrade and refurbish the State's physical infrastructure. The Centre is involved with improved design, analysis, management, maintenance and rehabilitation techniques. Nine principal researchers, three external associated researchers and 12 internal associate researchers contribute to the Physical Infrastructure Centre.

SCHOOL OF GEOLOGY

Address: GPO Box 2434
Brisbane QLD 4001

Tel: (07) 864 2324
Fax: (07) 864 1535

Contact: Cathy Fielding, Administration Officer or Graham Shorten, Lecturer in Engineering Geology.

Permanent Academic Staff:

Associate Professor David Gust (Head of School); Associate Professor Lloyd Hamilton; Mr William Ridley; Mr Joe Williams; Mr Graham Shorten; Mr David O'Connell; Dr Al Grenfell; Dr Malcolm Cox; Mr Simon Lang.

Overview Of Research Areas:

The School of Geology is concentrating its geomechanics-related research into coastal and nearshore environments. Activities range from foundation studies in estuarine deposits to coastal erosion studies of resort beaches, and from landslides in tropical residual soils to offshore mine tailings disposal and pipeline siting. The School is involved in earthquake hazard microzoning projects in coastal cities in the region and in groundwater geochemistry and pollution studies of coastal and island aquifers.

Specific Active Research Projects:

Engineering properties of tropical organo-calcareous silts; Coastal erosion at the Fijian Hotel, Suva Harbour; Earthquake hazard microzoning studies of the major southwest Pacific regional centres; Coastal processes study and engineering- environmental mapping of the Natadola Beach development area, Fiji; Naturally occurring acid groundwater in unconfined coastal aquifers; Trace element distributions in shallow marine and fluvial sediments; Occurrence and geochemistry of groundwater on small islands; Water quality monitoring in the Brisbane River; Stable isotope studies in coastal surface water and groundwater.

Future Areas of Research:

Relation between offshore geology and commercial fisheries; Microzoning study of Brisbane; Structural geology and petroleum potential, Tonga.

Particular Areas Of Expertise Related To Consulting:

Engineering in nearshore environments; Geochemistry of groundwater.

Facilities For Research, Consulting and Testing:

Wet geochemical laboratory with clean room; Modern facilities for petrographic preparation and examination; Warman Cyclosizer for sediment studies; Equipment for engineering geology and nearshore environment studies; Experimental petrology apparatus; Geophysical instruments.

Apparatus for soil testing is available within the School of Civil Engineering and XRD, SEM and EDS electron microprobe facilities at QUT are also readily accessible for student research. Cooperative arrangements with other institutions in the area provide access to electron

microprobe, XRF, fluid inclusion, and stable and radiogenic mass spectrometry.

Postgraduate Courses:

B.App.Sc. (Honours), M.App.Sc. and Ph.D. by coursework and research.

RMIT UNIVERSITY

DEPARTMENT OF CIVIL AND GEOLOGICAL ENGINEERING

Address: Swanston Street
Melbourne VIC 3000

Phone: (03) 660 3235
Fax: (03) 639 0138

Contact: Associate Professor W. Peck

Permanent Academic Staff:

The staff of the RMIT Department of Civil and Geological Engineering includes four academic and three technical officers working in the field of geological engineering/geomechanics. Contact the Department for details.

Overview of Research Areas:

Geological Engineering / Geomechanics (Assoc. Prof. Warren Peck)

Flow of groundwater through jointed and/or porous rocks and soils - supported by groundwater modelling packages for two and three dimensional flow; Land contamination, salinisation and flow of pollutants through the ground; Slope stability - supported by fully equipped soil mechanics laboratory including shear strength testing with pore pressure measurement, rock mechanics laboratory with MTS computer-controlled universal strength testing facility, and trailer - mounted GEMCO soil sampling /rock coring drill rig; Engineering geophysics - resistivity and seismic refraction capabilities to support engineering site investigations using easily portable equipment suitable for sites with vehicular access difficulties; Construction materials - thin sectioning binocular microscopic and petrographic microscopic examination of aggregate and ballast samples supported by field survey capabilities for existing quarries and potential new quarry sites.

Specific Active Research Projects:

Contact the department for details.

Particular Areas of Expertise related to Consulting:

See research areas.

Facilities for Research, Consulting and Testing:

See research areas.

Postgraduate Courses offered:

Contact the Department.

SEISMOLOGY RESEARCH CENTRE

Address: P.O. Box 71
Bundoora Vic 3083

Phone: (03) 468 2468
Fax: (03) 467 6184

Contact: Gary Gibson

Permanent Academic Staff:

Gary Gibson and Vaughan Wesson

Overview of Research Areas:

Seismology, especially measurement and analysis of earthquake seismograms, and evaluation of earthquake hazard.

Specific Active Research Projects:

Operation of a network of 80 seismographs in Victoria and New South Wales. These are used to located about 500 earthquakes in this area each year, most being either too small or too deep to be felt.

Development of seismological instrumentation and analysis software. This includes triggered digital seismographs and accelerographs, and telemetered systems providing earthquake alarms.

Development of methods for determining the location and size of earthquakes, evaluation of site and topographic effects, and measurement of the vibration response of structures. This includes non-linear inversion and spectral analysis of seismograms.

Future Areas of Research Anticipated:

Mainly developments in the current areas, but possibly into other areas involving the measurement and analysis of vibrations in the seismic frequency range.

Particular Areas of Expertise Related to Consulting:

Earthquake seismograph and accelerograph instrumentation and analysis software; Evaluation of earthquake hazard for major engineering projects, especially dams.

Facilities for Research, Consulting and Testing:

The SRC operates a permanent seismograph network consisting of 80 instruments. Other portable instruments are available for short-term projects.

The Centre has an extensive computer network with access to a range of computer types and operating systems.

Electronic development, manufacture, test and calibration equipment. This includes CAD systems, high speed logic analysers, spectrum analysers and surface mount manufacturing equipment.

Postgraduate Courses Offered:

Facilities for full-time postgraduate research will be available from 1993.

SWINBURNE UNIVERSITY OF TECHNOLOGY

SCHOOL OF CIVIL ENGINEERING AND BUILDING

Address: PO Box 218
Hawthorn Vic 3122

Phone: (03) 819 8083
Fax: (03) 819 6443

Contact: Kerry McManus

Permanent Academic Staff:

Kerry MacManus; Norm Arnott; Anthony Goh

Overview of Research Areas:

Design, performance and repair of lightly loaded structures on expansive clay soils; Pavement management and stabilisation; Numerical study of the behaviour of retaining wall systems; Expert system applications in geomechanics; Behaviour of pavement materials under dynamic loading; Applications of geotextiles.

Specific Active Research Projects:

Stabilisation of building movement on expansive clays by moisture management; Moisture barriers in pavements; Slab on ground soft spot theory; Knowledge-based approach to pavement rehabilitation and cost effective pavement rehabilitation techniques; Stability of braced excavation systems; Behaviour of concrete cantilever retaining walls; Knowledge-based approach to pavement design; Soil loads on buried plastic pipes; Geotextiles in repair of sealed pavements.

Future Areas of Research Anticipated:

A knowledge-based system for retaining wall design; A knowledge-based system for interpretation of pile stress-wave measurements; A knowledge-based system for moisture stabilisation in expansive clay soils; Systems to stabilise movement in expansive clay soils; Structure-foundation-soil interaction for light structures in expansive clay soils; Numerical studies of the stability of cantilevered and propped retaining walls; Numerical studies of reinforced soil systems.

Particular Areas of Expertise Related to Consulting:

Design and repair of lightly loaded structures on expansive clay soils; Pavement rehabilitation; Numerical analysis of retaining wall and piling systems; Pavement stabilisation; Development of expert systems for civil engineering applications.

Facilities for Research, Consulting and Testing:

A comprehensive range of soil and rock testing equipment is available, including dynamics triaxial testing equipment. Computer facilities include access to CRAY YMP EL supercomputer and IBM 3090 mainframe systems and IBM compatible 486 machines.

Postgraduate Courses Offered:

Master of Technology (Construction) by coursework, Master of Engineering (by research), Ph.D.

UNIVERSITY COLLEGE OF CENTRAL QUEENSLAND

DEPARTMENT OF CIVIL ENGINEERING

No information received.

UNIVERSITY OF SOUTHERN QUEENSLAND

SCHOOL OF ENGINEERING

Address: P.O. Darling Heights
Toowoomba QLD 4350

Phone: (076) 312 505
Fax: (076) 312 426

Contact: Dr. Harry Harris and Dr. Ali Assadi

Overview of Research Areas:

Application of Soil Mechanics to agricultural soils; True triaxial apparatus with rigid boundaries.

Specific Active Research Projects:

Loading by agricultural machinery on soils; Shear bar for soil testing allowing constant volume and constant normal load tests to be carried out; Development of an Elastoplastic Finite Element Program and Finite Element Subroutine Library.

Future Areas of Research Anticipated:

Continued work with soil stress transducer and shear bar; Soil response to stress on a semi-field scale; Finite Element formulation of the upper bound and the lower bound of classical plasticity.

Particular Areas of Expertise Related to Consulting:

The Soils Mechanics Laboratory has facilities to carry out the following tests as per AS1289 - Methods of Testing Soils for Engineering Purposes.

Soil Classification Tests:
Liquid limit, plastic limit, plasticity index, linear shrinkage, soil particle density, particle size distribution and sand equivalent; Determination of Organic Matter; Content; Soil Compaction and Density Tests; Standard and modified dry density/moisture content relation, density in place, minimum and maximum dry density of cohesionless material.

Soil Strength and Consolidation Tests:
CBR Test, unconfined compressive strength, triaxial test, consolidation tests, laboratory vane shear test, direct shear box test.

The following tests as per the Materials Testing Manual of the Queensland Department of Main Roads.

Miniature Abrasion Loss; Relative Compaction of Soil (Nuclear Density/Moisture Gauge); In-situ California Bearing Ratio (Dynamic Cone Penetrometer); Artificial Weathering Resistance; Sand Equivalent Test; Permeability.

Post Graduate Courses Offered:

The School of Engineering offers and MEng by research as well as a PhD in selected areas.

THE UNIVERSITY OF ADELAIDE

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Address: GPO Box 498
Adelaide SA 5001

Phone: (08) 228 5874
Fax: (08) 224 0943
Telex:

Contact: Dr. W.S. Kaggwa

Permanent Academic Staff:

Dr. W. S. Kaggwa; Mr. M. B. Jaksa.

Overview of Research Areas:

Dr. Kaggwa: Offshore geomechanics; cyclic behaviour of calcareous sand; laboratory and field testing of soils; stress state of quasi-saturated expansive clay; screw plate testing; earthquake loading and its effect on soils.

Mr. Jaska: Spatial variability of soils; statistical and probabilistic analysis and design in geotechnical engineering; residential foundation design; in situ testing of soils.

Specific Active Research Projects:

The influence of spatial variability on the geotechnical properties of a stiff, overconsolidated expansive clay; Cyclic behaviour of remoulded Adelaide clay; Properties of remoulded and undisturbed expansive clay, normalised with respect to consolidation stresses; Modelling and interpretation of in situ testing of soils, with particular reference to the interpretation of screw plate test results; Laboratory and field tests on calcareous sands and collapsing soils; Determination of a rock mass strength criterion for engineering design.

Future Areas of Research anticipated:

Computer applications of geotechnical engineering; Retaining wall design.

Particular Areas of Expertise related to Consulting:

Cyclic behaviour of calcareous sand; Full-scale testing of buried pipes; Retaining wall design; Piles in expansive soils.

Facilities for Research, Consulting and Testing:

Bishop and Wesley triaxial cells - computer controlled 14 MPa, 100mm diameter triaxial cell; Cone penetrometer test with computer data acquisition system; screw plate test; dilatometer.

Postgraduate Courses offered:

The Department offers postgraduate research degrees at Masters and Ph.D. levels.

UNIVERSITY OF CANBERRA

SCHOOL OF APPLIED SCIENCE
CENTRE FOR AUSTRALIAN REGOLITH STUDIES

Address: PO Box 1
Belconnen ACT 2616

Phone: (06) 201 2525
Fax: (06) 201 5030

Contact: Dr. Graham Taylor

Refer to Australian National University, Geology Department, Centre for Australian Regolith Studies for details.

THE UNIVERSITY OF MELBOURNE

DEPARTMENT OF CIVIL AND AGRICULTURAL ENGINEERING

Address: Parkville, Vic 3052

Phone: (03) 344 6784
Fax: (03) 344 4616

Contact: Dr. P.J. Moore

Permanent Academic Staff:

Assoc. Prof. W.E. Bamford, Dr. P.J. Hoadley, Assoc. Prof. P.J. Moore and Mr. J.R. Styles

Overview of Research Areas:

Much of the research undertaken in the geotechnical engineering area has been in direct or indirect response to industry needs. This work has included projects on rapid drawdown effects on earth dams, cracking in earth dams; pile settlement; up-lift capacity of piles; earth pressures on retaining walls; behaviour of foundations subjected to vibration; compaction control; characterisation of pavement materials; behaviour of natural gas pipelines; drilled caissons - drillability and effects of drilling fluid on stability; cuttability and drillability of rocks, monitoring and prediction of tunnel boring machine performance; slake durability and swell properties of mine roadway materials.

Specific Active Research Projects:

Assessment of mountings for measurement of free field vibrations; Vibrations caused by pile-driving; Vibrations caused by blasting operations; Evaluation of irrigation channel seepage losses; Response of footings to repeated horizontal loading; Rock cutting by diamond saws; Stability of well-bores in hot water saturated horizontal shales.

Future Areas of Research Anticipated:

Factors affecting decay of vibrations away from a source; Erosion susceptibility of bare soils and effects of vegetation; Behaviour of slopes under seismic loading; Effects of vibrations from earthquakes of blasting upon the stability of underground structures; Dry grouting of highly weathered granite rocks.

Particular Areas of Expertise Related to Consulting:

Characterisation of rock properties for surface mining; rock cuttability; development of rock property profiles for a hydro-power scheme; foundation investigation and evaluation for high rise buildings; problems in earth dam construction and control; analysis of piled foundations; provision of temporary support for excavations; analysis of damage to domestic buildings; appearance as expert witnesses.

Facilities for Research, Consulting and Testing:

In addition to equipment used in routine soil testing, the department possesses equipment for repeated load triaxial testing, high pressure triaxial testing and dispersion testing. Routine test equipment can be modified to accommodate non-standard loading paths. Facilities are also available for dynamic loading of model foundations. For testing of rock, equipment is available for the determination of strength, dynamic and static elastic properties, drillability, cuttability and abrasiveness. Access to a variety of computers, including a Cyber 990, several VAX's, IBM PC AT's, Macintosh computers, and a network of over 60 Sun and SPARC workstations, is available. Software availability includes the packages - ANSYS, PAFEC and LUSAS - non-linear general purpose FE programs with specific facilities for modelling static and dynamic soil behaviour.

Postgraduate Courses Offered:

Research programmes are available leading to M.Eng.Sc. and Ph.D. degrees. M.Eng.Sc. Coursework programme is available with the following geotechnical base subjects.

Analysis and Design of Retaining Systems; Analysis and Design of Shallow Foundations; Deep Foundations; Earth and Rock fill Dams; Site Investigation; Rock Engineering; Special Studies on Geotechnical Engineering.

Contact the Department for further details.

DEPARTMENT OF EARTH SCIENCES

No information received.

UNIVERSITY OF NEW SOUTH WALES

UNIVERSITY COLLEGE, AUSTRALIAN DEFENCE FORCE ACADEMY

Address: Canberra ACT 2600

Phone: (06) 268 8335
Fax: (06) 268 8337

Contact: Dr. Sik-Cheung Robert Lo

Permanent Academic Staff:

Prof. I K Lee; Dr. S-C R Lo; Dr. K-S V Li.

Overview of Research Areas:

Constitutive Modelling with particular emphasis on: cemented granular soil, strain path testing, behaviour at large strain (strain softening and asymptotic behaviour), particulate analysis (using Distinct Element Method) for a granular medium, rotation of principal stress axes; Probabilistic Methods; Reinforced Soil System; Foundation Engineering with particular emphasis on: raft-pile system, soil-structure interaction, probabilistic methods in formulating limit state codes; Pavement Engineering.

Specific Active Research Projects:

Evolution of stress induced anisotropy of a granular medium by particulate analysis; Application of probabilistic methods in limit state design of foundations; Finite Element study of reinforced embankment on soft clay; Stiffness of asphaltic concrete and base course materials subject to high frequency

repetitive loading; Structure-raft and structure-raft-pile interaction.

Future Areas of Research anticipated:

Behaviour of cemented unsaturated granular soil under repetitive loading; Behaviour of granular soil under generalised principal stress rotation.

Particular Areas of Expertise related to Consulting:

Determination of Soil Parameters; Special instrumentation; Slope Stability; Reliability Analysis (probabilistic methods); Foundation Engineering, in particular, foundation structure interaction; Reinforced Soil; Pavement Engineering; Soft Soil Engineering.

Facilities for Research, Consulting and Testing:

Triaxial cell with complete internal instrumentation; Cubical True Triaxial Cell with complete internal instrumentation; Fully programmable MTS triaxial cyclic loading system that can control synchronised cycling of both axial and radial stresses at a maximum frequency of 10 Hz; Instron uniaxial cycling loading system, maximum capacity 10 tonne; GDS general purpose digital, pressure/volume controllers; A portable stress path/strain path control system for triaxial or cubical triaxial testing; Direct Simple Shear Cell; Large scale split box (over 1m sq) for testing the anchorage strength and embedded tensile strength of soil reinforcement; Portable Instron jacks; Hollow Torsional Cell (maximum sample size 200 mm dia x 450 mm height); Fully equipped drill rig; CPT truck; Normal soil testing facilities.

Postgraduate courses offered:

Applied Soil Mechanics; Soil Mechanics (to be re-named Advanced Soil Mechanics); Foundation Engineering; Advanced Foundation Engineering; Site Investigation; Soil Dynamics; Pavement Engineering.

All the above courses are single session subjects with 41 contact hours per subject.

CENTRE FOR GROUNDWATER MANAGEMENT AND HYDROGEOLOGY

No information received.

DEPARTMENT OF GEOTECHNICAL ENGINEERING

Address: PO. Box 1
Kensington NSW 2033

Phone: (02) 697 5035
Fax: (02) 697 5034

Contact: Professor R. Fell

Permanent Academic Staff:

Prof. R. Fell, Mr. G.R. Mostyn, Dr. V. Murti, Dr. B. Shackel; Mr. G.E. Swarbrick, Dr. S. Valliapan, Dr. W.O. Yandell.

Overview of Research Areas:

The Department of Geotechnical Engineering has been active in a wide range of research areas. These include studies of soils, rocks and pavement materials. Much of this work has been sponsored by government authorities and by industry. Through such contacts the department maintains strong links with the profession.

Specific Active Research Projects:

Slope stability and landslides, embankments on soft clays, mine tailings, embankment dams, rippability of rock, infiltration through cover over landfills (R. Fell); Slope stability, rock excavation, rock mass properties, reliability analysis, reactive soils (G.R. Mostyn); Dynamic Finite Element Modelling, stress distribution under arbitrarily shaped foundations, method of fragments in seepage problems (V. Murti); Anisotropic soils, repeated loading of unsaturated soils, accelerated trafficking tests of pavements, segmental pavements, pavement design and analysis (B. Shackel); Unsaturated flow and contaminant transport in porous media, large strain consolidation theory, desiccation and cracking of soils (G.E. Swarbrick); Stress analysis of soil and rock, composite analysis of pile foundations, fracture and damage mechanics, finite element method, flow through fractured media, contaminant transport (S. Valliapan); Pavement design and evaluation, pavement maintenance management tyre-road friction, development of mechano-lattice analysis (W.O. Yandell).

Particular Areas of Expertise related to Consulting:

Members of staff are available for consulting. Their particular areas of expertise are described above under Specific Active Research Projects. Contact the Department for further details.

Facilities for Research, Consulting and Testing:

A wide range of facilities are available for research and consulting. Contact the Department for details.

Postgraduate Courses offered:

The Department offers postgraduate degrees at Masters and Ph.D. levels. Masters degrees can be attempted part-time or full-time, by coursework or research and combination of coursework and research. Ph.D. is a research degree. Contact the Department for further details.

SCHOOL OF MINES

Address: P.O. Box 1
Kensington NSW 2033

Phone: (02) 697 4515
Fax: (02) 663 4019

Contact: Professor F.F. Roxborough

Permanent academic staff:

A.K. Bhattacharyya; Professor G. Hocking; G. McNally; Professor F.F. Roxborough; G.C. Sen; E.G. Thomas; V.S. Vutukuri; J.O. Watson.

Overview of Research Areas:

Mining Geomechanics and Engineering Geology
Coal mine strata control, pillar stability, surface subsidence due to longwall mining and partial extraction systems; Stability of slopes in open pit mining; Engineering geology of surficial deposits; Groundwater modelling; Mine backfill technology; Rock properties; Computer modelling of ground movements in mining; Computer modelling of physical and chemical processes in rocks and soils; Two and three dimensional assessment of mine stability by FEM and BEM; Numerical analysis of crack propagation in rock.

Excavation Engineering
Mechanics of rock cutting; Rock excavation using mechanical arrays of picks and free rolling cutters; Impact breakage of rock; High pressure waterjet assisted cutting of rock; Assessment of rock cuttability; Overburden rippabililty and diggability; Rock blasting; Crater optimisation; Ground vibration and airblast; Effectiveness of stemming; Blast initiation; Rock and rock mass properties in relation to blasting.

Specific Active Research Areas:

The overview presented above is an outline of recent and current geotechnical research activity in the School of Mines. Accordingly the following description of specific current projects is far from exhaustive and is restricted to projects which have a major emphasis such as provided by substantial external funding.

Coal mining strata control risk assessment and prediction Underground coal mining in Australia has a serious problem with massive uncontrolled collapses of strata and sometimes catastrophic failures of pillars. A major research investigation is underway with substantial industry funding involving data collection from all mines in NSW, with the objective of establishing safer working designs, procedures and practices. The project has international dimensions in that Professor MDG Salamon (Colorado School of Mines and formerly Director General for the South Africa Member of Mines) is a key participant in the research.

Dynamics of windblast in coal mines
The sudden collapse of goaf strata in coal mines can lead to violent rushes of air through adjacent workings sometimes causing serious damage and injury. Industry funded research is being undertaken into hazard mitigation by means such as early warning systems and refuges.

Surface subsidence
Measurements are being made of surface displacements and interstrata movements arising from longwall operations in underground coal mining. The impact of subsidence on hydrogeology is one aspect of particular interest.

Advances in numerical modelling methods
Research is being undertaken into improving the computational efficiency of 3 dimensional Boundary Element software using Hermitian Cubic and Singular Elements.

Strata control and rock properties
A collaborative study with industry is investigating the relevance of laboratory determined pre- and post-failure properties of coal and selected coal measures rocks to field observation of strata behaviour.

Mine backfill
Feasibility studies on the support potential and selective application of mine waste for backfilling in underground coal mining.

Impact breakage of rock
Analytical and experimental studies are aimed at improving energy transmission to the rock mass from impact devices. This involves the development of a method to significantly modify the pattern of stress waves.

Rock breakage by high pressure water jets
Laboratory studies have demonstrated the potential for targeted pairs of high pressure water jets to produce massive cratering in a hard rock surface. The failure mechanisms involved and the system design criteria for cratering are being investigated.

Ground vibration from blasting
Field studies are being undertaken at an open cut mine and a quarry of the ground vibrations caused by blasting. Particular interest is focussed on the effects of blast design and rock mass properties.

Presplitting in blast design
Field experiments and corresponding laboratory and analytical work are being carried out into the application of shaped charges for rock presplitting.

Particular areas of expertise related to consulting:

Strata control in coal mines; Mine subsidence prediction and amelioration; Mine slope stability; Mathematical modelling of ground behaviour in mining; Backfill technology; Blasting technology; Machine mining and tunnelling; Rock cuttability assessment.

Facilities for research, consulting and testing:

Fully equipped rock mechanics and engineering geology laboratories including a 500kN Schenck Trebel servo controlled testing machine, a 3600 kN Avery compression machine, and two 500kN universal machines. There is a wide range of other laboratory and field equipment including two Mindrill E500 drilling machines capable of coring to a depth of 150m and with

overcoring capability. Excavation engineering has a laboratory with 3 fully instrumented rock cutting rigs, a 1/8 scale instrumented longwall shearer system and a range of blast monitoring equipment. There are special facilities for rock sample preparation.

Postgraduate Courses Offered:

In addition to research programs leading to Doctors and Masters degrees in both Mining Engineering and Engineering Geology, the School of Mines offers the following postgraduate coursework degrees specifically or substantially in geomechanics.

M.App.Sc.*	Mining Geomechanics (external study)
M.App.Sc.	Mining and Mineral Engineering (full-time)
M.App.Sc.	Engineering Geology (full-time/part time)
M.Min.Mgmt.*	Mining Management (modular short course format)

These courses can also be followed to Graduate Diploma level. The Key Centre for Mines, which is a DEET funded Key Centre for Teaching and Research, has a mission to provide continuing professional education for those employed in the mining industry. Accordingly, the courses marked (*) are operated by the Key Centre for Mines and are specifically arranged for those employed in remote areas.

Other Comments:

During 1992 the total funding from external sources for research in geotechnical engineering in the School of Mines was $1.02 million.

WS AND LB ROBINSON UNIVERSITY COLLEGE

No information received.

THE UNIVERSITY OF NEWCASTLE

GEOTECHNICAL RESEARCH GROUP AT NEWCASTLE

Address: Department of Civil Engineering & Surveying
The University of Newcastle
NSW 2308

Phone: (049) 21 6059
Fax: (049) 21 6991

Contact: Dr. Scott W. Sloan

Permanent Academic Staff:

Dr. S.W. Sloan; Dr. D.W. Smith; Dr. H.S. Yu

Overview of Research Areas:

Environmental Geotechnics; Interpretation of In-situ Soil Testing; Numerical Methods and their Application to Geotechnical Engineering.

Specific Active Research Projects:

Environmental Geotechnics:
Analysis of pollution migration in soils, specifically laboratory testing and numerical modelling of fluoride migration through clays; Analysis of transient heat flow through silt and rock.

Interpretation of In-Situ Soil Testing:
Interpretation of the Dilatometer test in soils; Theoretical and field studies of the cone penetrometer test in clays; Laboratory calibration of the self-boring pressuremeter in sand.

Numerical Methods and their Applications to Geotechnical Engineering:
Stability analysis using finite elements and linear programming; Accurate algorithms for displacement finite element analysis; Field testing and numerical modelling of reactive soil behaviour; Cavity expansion model in ground engineering.

Future Areas of Research Anticipated:

Contact the Department.

Particular Areas of Expertise Related to Consulting:

Environmental Geotechnics; Geotechnical Investigation Using In-Situ Soil Testing; Geotechnical Stability Analysis; Finite Element Analysis for Geotechnical Applications.

Facilities for Research, Consulting and Testing:

Triaxial testing; Consolidation testing; Direct shear testing; The School of Engineering Workstation Laboratory; A large calibration chamber (being built); Column testing of soil behaviour.

Postgraduate Courses Offered:

Available programs for postgraduate studies include Ph.D. by research and M.Eng.Sc. by research.

THE UNIVERSITY OF QUEENSLAND

DEPARTMENT OF CIVIL ENGINEERING

Address: The University of Queensland
St. Lucia QLD 4067

Phone: (07) 365 3642 or 365 4162
Fax: (07) 365 4599

Contact: Dr David Williams or Dr K.Y. Wong

Permanent Academic Staff:

Dr David Williams; Dr K Y Wong.

Overview of Research Areas:

Geomechanics of coal mine waste disposal and rehabilitation; Foundations; Earthquake Engineering; Expansive soils and lateritic soils; Dynamic pile testing and dynamic analysis generally.

Specific Active Research Projects:

Co-disposal of coal mine tailings and coarse reject by combined pumping; Application of stochastic analyses to slope stability problems; Analysis of large strain consolidation of soil slurries; Moisture movement within overburden coal mine spoil piles; Effects of foundation-structure interaction on performance of electrical transmission line towers; Upgrading estimated risk of earthquake-induced liquefaction in eastern Australia, following 1989 Newcastle event; Stress wave analysis applied to dynamic testing of piles; Finite element analysis of dynamic loading; Behaviour of lateritic soils relevant to their use as a pavement construction material; Computer simulation of deep excavations.

Future Areas of Research Anticipated:

Mass stability of mined landscapes; Stability of bulk cargoes under wave and ship vibration loading; Application of dynamic testing to non-driven piles.

Particular Areas of Expertise Related to Consulting:

Mine waste disposal and rehabilitation; Mass stability of mine waste dumps; Pile dynamics and earthquake engineering; Embankments on soft foundations; Expansive clay behaviour.

Facilities for Research, Consulting and Testing:

Fully equipped soil testing laboratory, with automated data acquisition.

Specialised testing equipment includes: Hydraulic stress path cells, allowing for internal monitoring of load, strain and pore pressure; A 150mm diameter, 10 MPa stress triaxial cell; Various Rowe consolidometers up to 250mm in diameter; A 300mm diameter permeability cell, with capability to apply different vertical stresses and hydraulic gradients; A ring shear residual strength apparatus. A range of field testing equipment is available, including a nuclear moisture/density depth gauge and various shear vanes.

Extensive laboratory modelling capabilities including a variety of soil/mine tailings slurry sedimentation cylinders and tanks, some allowing pore pressure measurement and density measurement using a gamma ray source; soil/mine tailings slurry beaching flumes; and a seepage model tank.

Range of personal computers with an extensive range of geotechnical software available.

Postgraduate Courses Offered:

The Department of Civil Engineering offers Masters and Doctoral level degrees. In addition, the Geomechanics Group generally offers a continuing education short course or workshop each year.

DEPARTMENT OF GEOLOGY AND MINERALOGY

No information received.

DEPARTMENT OF MINING AND METALLURGICAL ENGINEERING

Address: The University of Queensland
St. Lucia QLD 4067

Phone: (07) 365 3738
Fax: (07) 365 3888
Telex: UNIVQLD AA 40315

Contact: Prof. David Rowlands

Permanent Academic Staff:

Information not supplied.

Overview of Research Areas:

Geomechanical research in the Department is generally of an applied nature and ranges from fragmentation and vibrations associated with blasting to water jet drilling and strata displacements caused by underground coal mining.

Specific Active Research Projects:

The Julius Kruttschnitt Mineral Research Centre within the Department is working in the general area of rock blasting, with particular reference to fragmentation and instrumentation.

Water jet drilling project funded by NERDDC via a sub contract from Capricorn Coal Management.

Future Areas of Research anticipated:

Please contact the Department.

Particular Areas of Expertise related to Consulting:

Please contact the Department.

Facilities for Research, Consulting and Testing:

(Inter alia)

A dual friction belt rig has been developed to test physical models of excavations in stratified deposits. The rig provides quantified information regarding strata

displacements and the re-distribution of forces caused by mining operations.

Postgraduate Courses offered:

Research and Post Graduate courses at Masters and PhD level are offered, and a course-work Master of Engineering Science in Geomechanics commences in 1993.

UNIVERSITY OF SOUTH AUSTRALIA

STRUCTURAL MATERIALS AND ASSEMBLIES GROUP
SCHOOL OF CIVIL ENGINEERING

Address: The Levels
South Australia 5095

Phone: (08) 302 3330
Fax: (08) 302 3386

Contact: Mr Mark Symons

Academic and Research Staff:

Assoc Professor M.G. Symons; Mr. K.G. Mills; Mr. D.A. Cameron; Mr. G.L. Ferber; Mr. L.J. Hudson; Mr. M.P. Rajakaruna

Overview of Research Areas:

Current research effort is directed towards two main areas, namely pavement analysis and design, and expansive soils. The emphasis on pavements has been increased with the recent addition of two AIDAB supported students.

Generally the research programs are well supported by industry.

Specific Active Research Projects:

Analysis and modelling of the performance of structures on expansive soils; Pavement design and development of the falling weight deflectometer; Resilient soil modulus/soil suction relationship for pavement design; Sub-standard gravels for pavements; Efficiency of cement stabilised pavement materials; The theoretical behaviour of clay soils in the presence of vegetation; Numerical modelling of the response of buried flexible pipes to traffic loading.

Future Areas of Research:

It is expected that the interest in soil/structure interaction problems will continue, whether the structure be a pavement, pipe, retaining wall or building and the soil type may range from sands to expansive clays. Research with practical applications will receive priority.

Particular Areas of Expertise Related to Consulting:

Pavements:
Properties of road construction materials; Investigation of pavement distress; Construction techniques; Dynamic pavement analysis.

Soils and Structures:
Tests for soil reactivity and suction; Conventional soil testing; Investigation of damaged structures; Investigation of foundations for large structures; Farm dam construction; Performance monitoring; Testing of buried pipes under traffic loading.

Facilities For Research Consulting and Testing:

Structural Laboratory:
Strong floor equipped with a range of servo- controlled jacks; Soil box to simulate trench conditions for cyclic or static load testing of flexible buried pipes.

Soils Laboratory:
Constant temperature room, housing, soil suction equipment, wet and dry bulb thermistors, 15 bar ceramic suction plate; pH, sodium, calcium and conductivity probes; Three cyclic triaxial cells.

Field Equipment:
Neutron-gamma moisture density depth probe.

Computing
DEC work station with NASTRAN, finite element suite.

Postgraduate Courses Offered:

Doctor of Philosophy; Master of Engineering in Civil Engineering; Master of Engineering in Municipal Engineering; Graduate Certificate in Geotechnical Engineering; Graduate Diploma in Engineering; Graduate Diploma in Municipal Engineering.

MINING ENGINEERING RESEARCH GROUP, DEPARTMENT OF MINING ENGINEERING, GARTRELL SCHOOL OF MINING, METALLURGY AND APPLIED GEOLOGY

Address: The Levels
Pooraka SA 5095

Phone: (08) 302 3222
Fax: (08) 302 3378
Telex: ITECA AA 82565

Contact: Mr. Anthony Meyers, Research Officer

Permanent Academic Staff:

Professor S.D. Priest; Mr. E.K. Hart; Dr. K.R. Notley; Mr. J.E. Stewart; Dr. D.J. Walker; Mr. A.G. Meyers; Dr. C.N. Winsor.

Overview of Research Areas:

Professor S.D. Priest: Rock face stability; Computer and probabilistic methods in geomechanics; Influence of fractures on rock properties; Rock reinforcement.

Dr. K.R. Notley: Mine ventilation; Computer applications in underground mine design.

Mr. J.E. Stewart: Pit optimisation; Mineral economics and risk analysis; Education and training.

Mr. E.K. Hart: Mining history; Innovations in mining methods; Mining equipment; Mine design.

Mr. A.G. Meyers: Influence of fractures on rock properties; Methodology for obtaining input parameters for numerical models.

Dr. C.N. Winsor: Structural geology and mineralisation; Kanmantoo Group; Bore hole log analysis Timor Sea.

Specific Active Research Projects:

Development of a rational approach for predicting the deformability and strength of rock materials containing complex discontinuity networks; Development of rational methods for obtaining reliable geomechanical input data for a range of computer models for the analysis and design of rock slopes; The design and implementation of a range of Occupational Health and Safety courses relevant to the mining and associated industries in South Australia; Optimisation of fan energy in multiple fan ventilation systems; Computer modelling and optimisation of haul-back mining and concurrent augering of the high-wall; Design of open pit iron ore mines; The application of rock support interaction analysis for underground support design; The application of numerical methods for modelling the behaviour of discontinuous rock in mine design.

Future Areas of Research anticipated:

The design and monitoring of fibre reinforced plastic (FRP) rock bolt support systems for mines, including associated software development; Development of an integrated self monitoring FRP bolt.

Particular Areas of Expertise related to Consulting:

Site Investigation; Discontinuity Analysis; Rock Testing; Instrumentation; Rock Excavation Design; Underground Mining Methods; Explosives; Mine Design; Industrial Engineering; Mine Management; Rock Mechanics; Mine Ventilation; Hydraulic Hoisting; Occupational Health; Rock Testing practice and equipment; Ore Reserves; Grade Control; Mine Fill Methods and Materials; Miner Rehabilitation; Production and Resource Scheduling; Joint, Fracture and Vein Analysis; Structural Analysis; Seismic Interpretation.

Facilities for Research, Consulting and Testing:

The Department has the capacity to design and fabricate laboratory test equipment to enable a large range of tests to be performed. In addition, in situ testing can be performed at Kanmantoo open pit mine.

Specimen Preparation Equipment: Mindrill diamond coring drill; Jaw and rotary rock crushing facilities; Core trimmer and end facing equipment; Thin section cutting and preparation equipment.

Load Frames: ELE digital electronic 2MN digital compression testing machine; Instron A1477 1001A servo controlled load frame.

ELE Triaxial Cell Apparatus: 42mm and 150mm diameter Hoek cell; ELE constant pressure unit EL70-100; Micro-processor based confining pressure control system for monitoring specimen volumetric change.

Index Test Apparatus: Point load test apparatus; Brazil test apparatus; Schmidt rebound hammer; Slake durability apparatus; Drag drillability "Goodrich" test apparatus.

Sonic Velocity Test Apparatus: PUNDIT: portable ultrasonic non-destructive digital indicating unit; Terrametrics sonic velocity equipment.

Data Monitoring and Recording Facilities: Video and high speed cine cameras; Yogokawa XY plotter; Bruel and Kjaer Type 1526 strain bridge and amplifier; Computer based data acquisition equipment with DataTaker A/D converter.

Transducers: Strain: strain gauges; Displacement: LVDTs, dial gauges; Load: load cells; Temperature: thermocouples; Pressure: pressure transducers, Bourdon tube gauges.

Additional Equipment: ELE portable shear box EL77-100; Quantachrome stereopycnometer; Rock-bolt pull-out test apparatus; Chyo micro-PT3-1200D balance; Baroid specimen drying oven; Dynavac vacuum pump and desiccator; Amatek portable pressure transducer calibration device.

Ventilation Equipment: 2 micro manometers MDC 0-1000mm WG; Magnehelic gauge 0-60 Pa; Eberline smart portable radiation survey meter; Mettler AT250 microbalance; Ludlum 4310 alpha radiation sample counter; Vane anemometer; SKC air sampling pump model 224 PC7; Sartorius konimeter SM16706; 0.5m diameter wind tunnel with radial flow fan; Inclined manometer test set; Bruel and Kjaer sound level meter model 2209.

Other Comments

The Department of Mining Engineering at the University of South Australia is keenly aware of the importance of providing industry driven research to the mineral industry. Over the last few years, the number of major research and consulting projects with which the department, in conjunction with industry, has been

involved has been steadily growing. The increasing emphasis by the Department on providing quality research to industry has highlighted the need that these research activities be focussed and formalised. This requirement has been addressed by the formation of the Mining Engineering Research Group which primarily aims to conduct and disseminate applied research in Mining Engineering and to provide a focus for mining industry research.

THE UNIVERSITY OF SYDNEY

CENTRE FOR GEOTECHNICAL RESEARCH (Civil and Mining)

Address: Centre for Geotechnical Research
School of Civil and Mining Engineering
The University of Sydney
Sydney NSW 2006

Phone: (02) 692 3923
Fax: (02) 692 3343

Contacts: Professor John Carter

Permanent Academic Staff:

Professor John Carter; Professor John Booker; Professor Harry Poulos; Assoc. Prof. John Small; Dr. David Airy

Overview of Research Areas:

Foundation engineering, behaviour of piled foundations, rock mechanics, numerical and analytical methods in analysis, soil structure interaction, behaviour of cemented soils, environmental geomechanics, pollution migration, behaviour of soils at elevated temperatures, offshore geotechnics.

Specific Active Research Projects:

Effects of density and cementation on cemented soils; Response of cemented materials to fatigue loading under triaxial conditions; Effects of chemicals on hydraulic conductivity of clays; Strength and compressibility of shales from Sydney area; Effect of temperature on the properties of clayey soil; Development of large ring shear apparatus to investigate skin friction on piles in sands; Investigation of factors affecting ultimate loads on piles in cohesive soils; Slope reinforcement with piles; Piles in calcareous sediments; In-situ enhancement of existing foundations; Piled raft foundation design; Behaviour of foundations on expansive soils; Settlement of clays following earthquakes; Behaviour of rafts on layered soils; Analysis of excavation; Surface subsidence caused by pumping of groundwater; Behaviour of earth and rockfill dams; Thermo-mechanical behaviour of soil and rock; Mechanics of fractured materials; Pollution migration in soils; Excavations in urban environment; Behaviour of jointed rock masses.

Future Areas of Research anticipated:

Remediation strategies for polluted ground; Response of piles subjected to seismic loading; Performance of pile-reinforced pavements; Influence of construction activities on existing pile foundations; The behaviour of piled rafts; Geotextile reinforced dams; Subsidence due to drawdown of the water table; Embankments on soft soils; Efficient analysis of settlement and creep; behaviour of large granular bodies; Boundary element analysis of pollution migration.

Particular Areas of Expertise related to Consulting:

Stress path triaxial testing; Pile foundations; Earthquake engineering; Foundation settlement; Embankments on soft clays; Finite element analysis of earth and rockfill dams; Seepage; Flow; Design of raft foundation; Consolidation problems; Retaining structures; Finite element analysis; Settlement and creep behaviour; Pollution migration in soils; Boundary element methods.

Facilities for Research, Consulting and Testing:

Triaxial testing:
3 stress path cells up to 100 mm dia x 20 MPa.
Rock tests up to 64 MPa (Axial loads up to 500 kN).
Cyclic Axial loading at frequencies up to 50 Hz.

Shear tests:
Shear boxes (up to 300 x 300 mm) for core (up to 80 mm ϕ) and conventional samples with optional Constant Normal Stiffness loading. A large (1 m diameter) ring shear apparatus.

Oedometer testing:
Rowe type oedometer (76 mm ϕ for consolidation and permeability testing.

Chemical testing:
Gas chromatograph / Ion selective electrodes for measurement of chemical species.

Model testing:
Several confinement vessels suitable for a range of models tests up to size of large pot.

Screw plate testing:
Excellent technical support enables specialised testing equipment to be made as required.

Software for analysis of a wide range of geotechnical problems including Finite Element Analysis of seepage, consolidation stress and strain induced by tunnelling, embankments and foundations; Pile behaviour and pile group behaviour; Slope stability analysis.

Postgraduate Courses Offered:

The School of Civil and Mining Engineering offers Master's Courses covering a wide range of geotechnical disciplines. These studied in the Masters program can be full-time or part-time and lead to the award of the

Master of Engineering Studies (MES) degree or a Postgraduate Diploma.

Masters or Doctoral degrees obtained by research are also offered. Short courses and Seminars are also offered periodically.

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

No information received.

UNIVERSITY OF TASMANIA

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING

No information received.

GEOLOGY DEPARTMENT

No information received.

UNIVERSITY OF TECHNOLOGY, SYDNEY

SCHOOL OF CIVIL ENGINEERING

No information received.

DEPARTMENT OF APPLIED GEOLOGY

Address: PO Box 123
Broadway NSW 2007

Phone: (02) 330 1757
Fax: (02) 330 1755

Contact: Prof. Evan C. Leitch

Permanent Academic Staff:

Assoc. Prof. B.J. Franklin; Assoc. Prof. B. Marshall; Dr. E. Frankel; Dr. G. Skilbeck; Dr. S. Sanga-meshwar; Mrs. J. Nicholson.

Overview of Research Areas:

Research is undertaken in aspects of both applied geology and fundamental geology.

Specific Active Research Projects:

Regional geology, tectonics, structural geology, the geology and geochemistry of ore deposits, igneous and sedimentary petrology, sedimentology, petroleum geology, coal geology, engineering and environmental geology and geotechnics.

Future Areas of Research anticipated:

Continuation of research in above areas.

Particular Areas of Expertise related to Consulting:

Regional geology, structural and mineagraphic studies of ore deposits, petroleum and coal geology, aspects of engineering and environmental geology and geotechnics.

Facilities for Research, Consulting and Testing:

Basic geological research facilities. SEM and modern semi quantitative XRD facilities, raman laser microprobe, fluid inclusion laboratory. Geotechnical equipment in part in association with the School of Civil Engineering.

Postgraduate Courses offered:

Master of Applied Science by Thesis.
Doctor of Philosophy.

Other Comments:

Geomechanics and related fields are not a major research strength within the Department, but cross-discipline studies in which these fields are allied with structural geology, engineering and environmental geology, and the geology of ore deposits are pursued.

THE UNIVERSITY OF WESTERN AUSTRALIA

AUSTRALIAN CENTRE FOR GEOMECHANICS

Address: The University of Western Australia
Nedlands WA 6009

Phone: (09) 380 3380
Fax: (09) 380 1130

Contact: Mr. R.J. Jewell

Permanent Academic Staff:

The Centre is a cooperative venture between the five groups listed below.

Contacts for each group are:

Prof. M.F. Randolph (UWA Geomechanics Group)
Prof. C. McA. Powell (UWA Geology Department)
Prof. T.S. Golosinski (Curtin University of Technology - WA School of Mines)
Dr. G.P. Price (CSIRO Division of Geomechanics)
Dr. C.F. Swindells (Department of Minerals and Energy of WA)

Other Comments:

The Australian Centre for Geomechanics was formally established in June 1992 in order to promote research excellence and postgraduate education in Geomechanics, with particular emphasis in its application to the mineral and energy extraction sections of Australia's resources industries.

The Centre draws together the expertise within the five groups forming the Centre and facilitates a multi-disciplinary approach to research and education in Geomechanics. With the guidance of strong industry representation of the Board of Management, and close collaboration with senior representatives of the mining industry, research activities and courses offered will be tailored directly to the needs of the industry.

For more details of research areas, postgraduate courses, etc. see information listed under the separate research groups.

GEOMECHANICS GROUP
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Address: The University of Western Australia
Nedlands WA 6009

Phone: (09) 380 3094
Fax: (09) 380 1044

Contact: Professor M.F. Randolph

Permanent Academic Staff:

Dr. M. Fahey; Mr. R.J. Jewell; Dr. A.B. Cooke; Dr. A.V. Dyskin; Dr. K.J.L. Stone; Dr. H. Joer; Dr. D.P. Stewart

Overview of Research Areas:

The research interests of the Group fall into six primary areas. Many projects combine the expertise in several of these areas.

Computational Rock Mechanics - Arcady Dyskin

The study aims at developing mathematical and computer models for rock engineering design and for prediction of hazardous events such as rock bursts. The study, based on fundamental theoretical and experimental investigation of mechanical behaviour of cracked rock and rock mass with openings, will comprise two major areas:

(a) modelling of deformation and fracture of rock with cracks;
(b) stress-strain calculation and measurements in rock mass with the multi-scale interaction of excavations and geological features.

Environmental Geomechanics - Brian Cooke

The general aim of current research is to examine transport processes governing the movement of contaminants through clay barriers and the vadose zone. Particular focus is on the effect of organic contaminants and the permeability of clay barriers under field stress conditions, the effects of partial saturation on molecular diffusion rates, and the flow of non-aqueous phase liquids in the capillary fringe.

Foundation and Offshore Engineering - Mark Randolph

Extensive research into piled foundations, both on land and offshore, has led to new methods for estimating the capacity of piles and the foundation stiffness under working loads. New models have been developed for dynamic processes such as pile driving, and cyclic loading situations relevant to offshore conditions. Work is currently focusing on other types of offshore foundations, including gravity and jack-up bases, drag anchors and pipelines.

In-situ Properties of Soil - Martin Fahey

Research into determining engineering properties of soils in-situ is being carried out using both self-boring and high-pressure pressuremeters, piezocone, and seismic cone, complemented by laboratory tests. Current work is focused on settlement predictions for footings on sand, the effects of cementation of calcareous soil deformations, consolidation of soft clays and slurried tailings and subsequent surface desiccation due to evaporation.

Mining Geomechanics - Richard Jewell

The stability of both reinforced and unreinforced open pit mine slopes is currently under review. Physical modelling associated with field studies will be undertaken in collaboration with structural geologists in order to provide design information and to verify existing numerical design codes. On the basis of a program of centrifuge testing, new models are being developed for determining the long term consolidation characteristics of and evaluating rehabilitation strategies for mine tailings.

Soil-Structure Interaction - Kevin Stone

The loads attracted to buried structures are dependent on the relative stiffness between the structure and the surrounding soil. Present research is focused on the phenomenon of soil arching and its effect in determining the load transferred to buried structures, such as culverts and systems of flexible capped piles. The research has applications in the study of localised deformation and the formation and propagation of shear bands and is directly applicable to the study and prediction of surface and sub-surface subsidence resulting from the extraction of minerals at depth.

Specific Active Research Projects:

Environmental Geomechanics: Modelling groundwater pollution from mining, mineral processing and waste disposal sites; Chemical properties of amended bauxite residue; Bulk flow in secondary thickeners; Mechanisms of pollution transport through soil; Performance of liner systems for tailings ponds; Consolidation behaviour of slurried tailings; Flow in partially saturated soil; Interaction of non-aqueous fluids with groundwater.

Foundation and Offshore Engineering: Theoretical and experimental studies of pile driving; Plugging of pipe piles under dynamic and static loading; Shallow foundations in calcareous soil; Driven and grouted piles

in calcareous soil; Axial capacity of piles in sand; Piled raft foundations; Numerical simulation of offshore foundation response to a coupled structural and hydro-dynamic loading; Performance of drag anchors in calcareous soil; Pipe-line stability in submarine sediments.

In-situ Properties of Soil: Behaviour of cemented and uncemented calcareous soil; Seismic and pressuremeter measurements for settlement; Analysis of foundations in sand; Non-linear stress-strain response of soil; Measurement of consolidation characteristics of cohesive soil using cavity expansion methods; Response of calcareous soils in simple shear.

Mining Geomechanics: Numerical and centrifuge modelling of coal mine roof strata mechanics and subsidence; Physical and mathematical modelling of rock slope stability; Long term stability of cable-bolted slopes.

Rock Mechanics: Experimental study of three-dimensional brittle crack growth under uniaxial compression; Numerical modelling of interaction of many defects in bounded body; Modelling of multi-scale behaviour of rock mass during underground mining.

Soil-Structure Interaction: Embankment loading adjacent to piled bridge abutments; Modelling discontinuous boundary displacements through soil; An investigation of arching effects on buried structures.

Particular Areas of Expertise related to Consulting:

Calcareous sediments; Laboratory testing of soil; Centrifuge modelling; Offshore foundations; Environmental geomechanics; Pile foundations; Fracture of rocks; Tailings management; In-situ testing (pressuremeter, piezo and seismic cone).

Facilities for Research, Consulting and Testing:

Centrifuge Modelling: The Geotechnical Centrifuge is the only such facility in Australia, and has been operational since 1989. The centrifuge has a 1.8 m radius platform, and a maximum payload of 200 kg at 200 g. The working platform allows modelling of prototype dimensions of 80 x 130 m in plan by up to 100 m deep. The instrumentation and other monitoring techniques are at the leading edge of centrifuge technology, with a two-channel optical slip-ring for data transmission, a pair of miniature video cameras that allow detailed visual monitoring of the experiment and subsequent image processing to reveal strain patterns, cyclic loading actuators that operate at up to 20 Hz, cone and T-bar penetrometers for in-flight site investigation and a four-channel fluid slip-ring for transport experiments. Flight computers provide accurate process control during the experiments.

Field Testing: A range of in situ testing equipment is in current use, including self-boring pressuremeter, screw-plate, shear-vane, piezocone (including measurement of radial stress) and a seismic cone. This equipment can be operated in conjunction with a light drilling rig or with a 20 tonne cone truck. In addition, the Group has developed its own dynamic pile testing equipment and is involved from time to time with other forms of field instrumentation.

Geomechanics Laboratory: The laboratory facilities are modern and fully computer-controlled. High quality oedometer, direct shear, simple shear and triaxial testing equipment is available. Precision cyclic loading is carried out in a 100-tonne Instron load-frame, capable of cyclic loading ranges from - 1 kPa up to several MPa. Bender elements are being used to obtain seismic measurements of low strain shear modulus for comparison with field data.

Computing: The Geomechanics Group has its own computing facilities, with a range of PC-compatible (including ten 486) and Macintosh microcomputers. There are two Sun workstations, and access to a super minicomputer housed within the Department.

Postgraduate Courses offered:

The Geomechanics Group offers postgraduate degrees at Masters and PhD level.

Master of Engineering is a one-year full time or up to three-year part time degree, by coursework (2/3) and minor dissertation (1/3). The course is aimed at graduates with a good Honours degree in engineering.

Master of Engineering Science is a research-oriented Masters degree, with minor coursework requirements, which may be completed in one year full-time, but may extend for up to two years.

PhD is primarily by research with a minimum requirement of two years full-time study, but generally extending to three or three and a half years.

DEPARTMENT OF GEOLOGY

Address: University of Western Australia
Nedlands WA 6009

Phone: (09) 380 2666
Fax: (09) 380 1037

Contact: Prof. C. McA Powell

Permanent Academic Staff:

Dr. M. Dentith, Dr. L. Harris, Dr. B. Logan, Prof. C. McA Powell, Dr. J. Ridley and Dr. J. Vearncombe.

Overview of Research Areas:

Dr. M. Dentith: Seismic interpretation; computer modelling of extensional tectonic systems; analogue modelling.

Dr. L. Harris: Structural geology; analogue modelling of geological structures; tectonics of Proterozoic Mobile Bels; structural controls on mineralisation.

Dr. B. Logan: Deformation responses of carbonates.

Prof. C. McA Powell: Tectonics and structural geology; structure of the Hamersley Province.

Dr. J. Ridley: Numerical modelling of fluid flow in deforming rocks; structural controls on mineralisation in the Yilgarn Craton.

Dr. J. Vearncombe: The complimentary processes of deformation and mineralisation.

Specific Active Research Projects:

As described under Overview of Research Areas.

Future Areas of Research Anticipated:

A laboratory to carry out the analogue modelling of geological structures is expected to be completed by early 1993. This facility has the following aims:

(i) develop conceptual models to be applied in regional geological analysis to aid in the interpretation of fault and shear zone patterns to help resolve structural problems relating to both mineral and petroleum exploration, and

(ii) to use these models to localise dilatant zones within complexly deformed terrains leading to the selection of favourable structural sites for gold and base-metal mineralisation.

The following projects, funded by Western Mining Corporation, are expected to commence in 1993:

(i) shear zone formation and interpretation of regional structure (especially structures hosting mineralisation) of the Murchison Province of the Yilgarn Block, Western Australia and general localisation of dilatant sites in Archaean granite-greenstone terrains, and

(ii) fault and shear zone reactivation in sedimentary basins with application to the structural analysis of the Bangemall, Carnarvon and Canning basins, with emphasis placed on controls of base-metal mineralisation and petroleum occurrences.

Particular Areas of Expertise Related to Consulting:

Analogue modelling of geological structures (with applications to regional structural studies in both the petroleum and minerals sectors); Structural and regional tectonic analysis; Numerical modelling of fluid flow and thermodynamics of orogenic degrees.

Facilities for Research, Consulting and Testing:

The following specialised facilities are available at the University of Western Australia for geological and geomechanics related research and consulting:

Complete petrographic facilities (including XRF and XRD); a palaeomagnetic laboratory; an analogue modelling laboratory to carry out scaled models of geological structures *(to be completed early 1993)*; electron microprobe facilities (in the Electron Microscopy Centre); computer facilities: Apple, IBM, Sun and links to UWA mainframe computers, software for structural analysis, palaeo-stress tensor analysis and computer modelling (extension tectonics, thermodynamics and fluid flow); SHRIMP II Ion Microprobe (UWA is joint owner of this geochronology facility housed at Curtin University); fleet of well-equipped, 4-WD vehicles for fieldwork; a well-stocked library.

Postgraduate Courses Offered:

Research programmes are available leading to MSc and PhD degrees.

Full- and part-time MSc courses in ore deposit geology and evaluation, aimed at industry-based geoscientists. For further information, contact Dr. J. Vearncombe, Key Centre for Strategic Mineral Deposits, Department of Geology, University of Western Australia, Nedlands 6009. Phone: (09) 380 2637, Fax: (09) 380 1037.

UNIVERSITY OF WOLLONGONG

DEPARTMENT OF CIVIL AND MINING ENGINEERING

Address: Locked Bag 8844
South Coast Mail Centre NSW 2521

Phone: (042) 21 3037
Fax: (042) 21 3238

Contact: Robin Chowdhury

Permanent Academic Staff:

Raghu Singh, Robin Chowdhury, Richard Arenicz, Buddhima Indraratna, Ian Porter, Ernest Baafi, Naj Aziz, Yasmin Ashaari.

Overview of Research Areas:

Staff members have diverse interests in soil mechanics, rock mechanics and mining and inter-disciplinary studies are also being encouraged. In fact, most of the staff are members and associates of the Water Engineering and Geomechanics Research Program formed in 1989 as part of the Research Management Strategy of the University of Wollongong with Dr. Robin Chowdhury as Coordinator.

Fundamental Research interests include the following: The stability of natural slopes, excavations and embankments including analysis for earthquakes; Progressive failure in soils; Development of new approaches for analysis of stability; Risk and reliability studies - probabilistic approaches; Failure modes of tropical and residual soils; Failure mechanisms of soft rock; Fundamental and modelling aspects of ground control; Hydro geological modelling with particular reference to underground mines; Constitutive modelling of stabilised soils.

Applied Research interests include: Dam engineering with particular reference to design of core, filters and rockfill shells; Reinforced earth studies; Use of 'waste' materials; Dust control and ventilation in mines; Geostatics and its application to mining; Support systems for mines with particular reference to rock mechanics aspects; Water in mines; Environmental geotechnics and aspects of rehabilitation; Use of band drains in cohesive soils.

Specific Active Research Projects:

There are numerous active research projects (mostly PhD) in many of the above areas which include:

Design, development and evaluation of longwall dust extraction systems; Design of rock bolting systems as a roadway support; Estimation of infiltration into underground excavations; Geotechnical and engineering control of slope stability; Stability of roadway intersections; Effect of base course properties on performance of flexible equipment; Application of reinforced earth in coastal protection structures; Application of rock mass characterisation to slope stability problems; River bank erosion and instability processes; Design and analysis of reinforced earth hydraulic structures; Industrial screening and classification of particulate materials; Waste materials in engineering applications the biofly brick process; Geomechanics of landslides in Illawarra; Underground metal mine crown pillar stability analysis; Geotechnical earthquake reliability analysis; Geological modelling coal deposit Muara Tiga Besa, Sth Sumatera, Indonesia.

Future Areas of Research Anticipated:

With such a large spread of projects, further diversification is not anticipated in the next few years. There will be consolidation and strengthening of the research effort in some of the above research areas depending on availability of resources.

Particular Areas of Expertise Related to Consulting:

Consulting activities have been carried out for both civil engineering and mining engineering applications. Contact the Department for further information.

Facilities for Research, Consulting and Testing:

Basic testing equipment including Dartec and Instron systems; basic soil laboratory testing facilities and some field testing such as pressuremeter and cone penetrometer; Computer-controlled triaxial equipment; Excellent computer facilities including personal computers; Facility to work through the consulting arm of the University, the Illawara Technology Corporation.

Postgraduate Courses Offered:

Research programmes are available leading to Master and Ph.D. degrees.

Students can study for Master of Engineering (Honours) in Civil Engineering and also in Mining Engineering. A range of subjects belonging to soil mechanics, rock mechanics and geotechnology are offered.

Other Comments:

Staff have attracted considerable external funding for research. In the period 1989 - 1991, the Water Engineering and Geomechanics Research Program attracted about one million dollars of external funding. In addition, the dust control project has attracted $100,000.

Staff have published widely in journals as well as in conference proceedings.

The Department has hosted International Conferences on "Ground Control in Mining" (7-10 July, 1992) and on "Environmental Management, Geo-Water and Engineering Aspects" (8-11 February, 1993).

The Water Engineering and Geomechanics Research Program has also organised a number of successful short courses and several short courses are planned before and after the International Conference on Environmental Management.

GEOLOGY DEPARTMENT

No information received.

VICTORIA UNIVERSITY OF TECHNOLOGY (FOOTSCRAY CAMPUS)

DEPARTMENT OF CIVIL AND BUILDING ENGINEERING

Address: PO Box 14428
Mail Centre
Melbourne VIC 3000

Phone: (03) 688 4778
Fax: (03) 688 4096

Contact: Don Jordan

Permanent Academic Staff:

Don Jordan, Harry Friend.

Overview of Research Areas:

Behaviour of soft clays; Recycling of road pavements; Recycling of waste materials to geotechnical uses; Behaviour of geotextiles; Behaviour of house foundations on expansive clays; Embankments on soft soils; Urban environmental issues.

Active Research Projects:

Use of crushed, recycled concrete in road bases; Puncture resistance of geotextiles.

Facilities for Research and Testing:

Data-logged 50kN triaxial testing apparatus; 3 data-logged consolidation oedometers; 2 data-logged reversing shear boxes (up to 60mm square specimens); Drop-cone, CBR plunger and wide-strip tensile test apparatus for geotextiles; Facilities for most tests in AS 1289; Trailer-mounted, rotary auger drill rig with SPT and sampling equipment.

GEONEWS

BIG DRY AIDS FOUNDATION CONSTRUCTION ON THAI-LAO BORDER

Work on foundations for the Mekong River Bridge is proceeding well ahead of schedule as a result of one of the driest wet seasons on record. The bridge, funded by the Australian International Development Assistance Bureau, designed by Maunsell SK Joint Venture and being constructed by John Holland Australia is the first road link spanning the Mekong River which forms the border between Thailand and Laos.

Seasonal variations in river level are normally 9 to 12 metres making wet season construction in the river impractical and it was anticipated that the 68, 1.5 metre diameter rock socketed piles forming the foundations for the six river piers would require two dry seasons to complete. However, with a high water level only 7 metres above the dry season levels all piles and most of the pier construction has now been completed. Unfortunately the news wasn't all that good. A construction pontoon for erection of the superstructure assembled on the river bank awaiting the highwaters never floated and had to be pushed into the river using two 150 tonne jacks.

'Seasonal variations in river level are normally 9 to 12 metres making wet season con-struction in the river impractical...'

Despite being half a world away, rock properties in the river bed were remarkably similar to our own Melbourne Mudstone, and rock socketed pile design principles developed by Williams, Johnston and Donald could be used with confidence. As foundation stiffness was an important factor in the design, axial pile stiffnesses were verified using PDA dynamic pile testing and a 12 tonne drop hammer. Lateral pile loads and pile fixity into the rock were also significant design issues owing to the high level of a ship impact loading during the wet season. Ship impact loading governed rock socket design at most piers, so to verify pile stiffness under lateral loading a pair of instrumented piles were jacked apart. It is pleasing to see that rock socketed piles requiring a high level of quality control to ensure efficient design were successfully installed in a somewhat remote part of the world.

DRILL HOLES METRO TUNNEL

Attempts to drain groundwater from a site in northern France ran into trouble in July when a piling rig pierced one of the running tunnels for the city of Lille's metro system causing an estimated $4M damage.

'Twenty three people were injured, seven seriously, when a passing metro train crashed into the auger.'

A continuous flight auger drilling rig owned by French foundation contractor Soletanche punched a 500mm hole in the tunnel roof and passed through into the tunnel base, hitting a 20,000 V electric cable. Twenty three people were injured, seven seriously, when a passing metro train crashed into the auger.

Main contractor Caroni and Soletanche were having problems with flooding from groundwater on part of a massive development, undertaken by EuraLille, the city's development corporation.

Soletanche said that its operator was drilling a 10m well in a position set out by the main contractor. He is reported to have stopped his machine after drilling through what he thought was a succession of soft, hard and then soft ground. The metro runs 5m under the site.

After the accident Caroni's foreman admitted that he had made a mistake said a Soletanche spokesman. Caroni was unavailable for comment. EuraLille has now banned drilling while the metro is in operation

Reproduced from Construction Today, July/August 1992.

REVISED CONCRETE SLAB DESIGN CHARTS

Coffey Partners International has been commissioned by the Cement and Concrete Association of Australia to produce a revised set of design charts for industrial pavements and slabs. The existing charts are based on the theory of subgrade reaction, and have led to some difficulties in the design of slabs for distributed loadings (such as in warehouse storages). The revised charts are being based on the theory of elasticity. It is anticipated that they will be available in early 1993.

VIBRATION GUIDE

Ground-borne vibrations arising from Piling[*] is an attempt to collect together existing knowledge on the subject - something that has not previously been done.

The main emphasis in CIRIA technical note 142 is on the effect of vibration transmitted through the ground on structures. An important caveat is that the consolidation effect of vibration on loose sand is not dealt with.

There is no British Standard dealing specifically with vibration although it is considered in an Appendix to a British Standard on noise. To compensate, the technical note looks at existing standards abroad such as the German DIN 4150, and ISO 2631 on the effect of vibration on the human body.

Other significant components of the report include a collation of past case histories, some vibratin theory and an empirical database of vibration effect on buildings, as well as guidance on how studies should be carried out.

CIRIA hopes that the report will provide useful guidance, though not ready-made answers to this complex subject. It is felt that by gathering relevant information together in this way, engineers will perhaps be able to assess whether there is a potential problem and how to tackle it. Available at a cost of 40 Pounds from CIRIA Publications Department, 6 Storey's Gate, London SW1P3AU. Fax 071-222 1708.

Reproduced from Ground Engineering, November, 1992.

SYDNEY OPERA HOUSE CAR PARK

Coffey Partners International received the 1992 Merit Award from the Association of Consulting Engineers Australia in recognition of its work on the Sydney Opera House car park for Enacon Parking Ltd. This project involved digging out a 12-storey underground car park beneath the Royal Botanic Gardens. A key challenge in the design of the structure was the geotechnical work, particularly considering the proximity of such a large underground excavation to an area of major environmental, heritage and historical significance.

'...digging out a 12-storey underground car park beneath the Royal Botanic Gardens.'

CPI was responsible for all geotechnical work including temporary and permanent support for the main cavern and the access tunnels, and the project has established a number of world firsts during its construction. It is the first circular underground car parking station, it features rock cover significantly less than ever before it is believed to have the widest span and least cover of any underground structure anywhere, and it is the first use of a car D10N dozer with an impact ripper on any underground site.

QUALITY AT A PRICE

From time to time we encounter examples of the application of 'quality assurance' standards that fill us with misgivings. Typically these examples take the form of striving after a degree of accuracy which, in the context of site investigation, is not only inappropriate but can be fallacious.

A story which came our way tells of a site investigation in Scotland being run under a QA audit. The contractor was informed that measurements of depths and core lengths would not be accepted until he had calibrated all the steel measuring tapes used by the drilling crews.

'The contractor was informed that measurements of depths and core lengths would not be accepted until he had calibrated all the steel measuring tapes used by the drilling crews.'

On asking how this should be done he was instructed to send one tape to the National Physical Laboratory to be laser calibrated. This tape would then be the standard to which all the other tapes would be compared.

The smallest graduation of the tape was 1 cm and the cost of this exercise was about $700.

An authentic comedy always contains an element of tragedy, and this story is no exception. Towards the end of the contract the master tape was borrowed by someone who did not appreciate its significance. It was returned in two pieces.

JCP Dalton Cambridge Insitu

Letter published in Ground Engineering, November 1992

ROCK RECORD

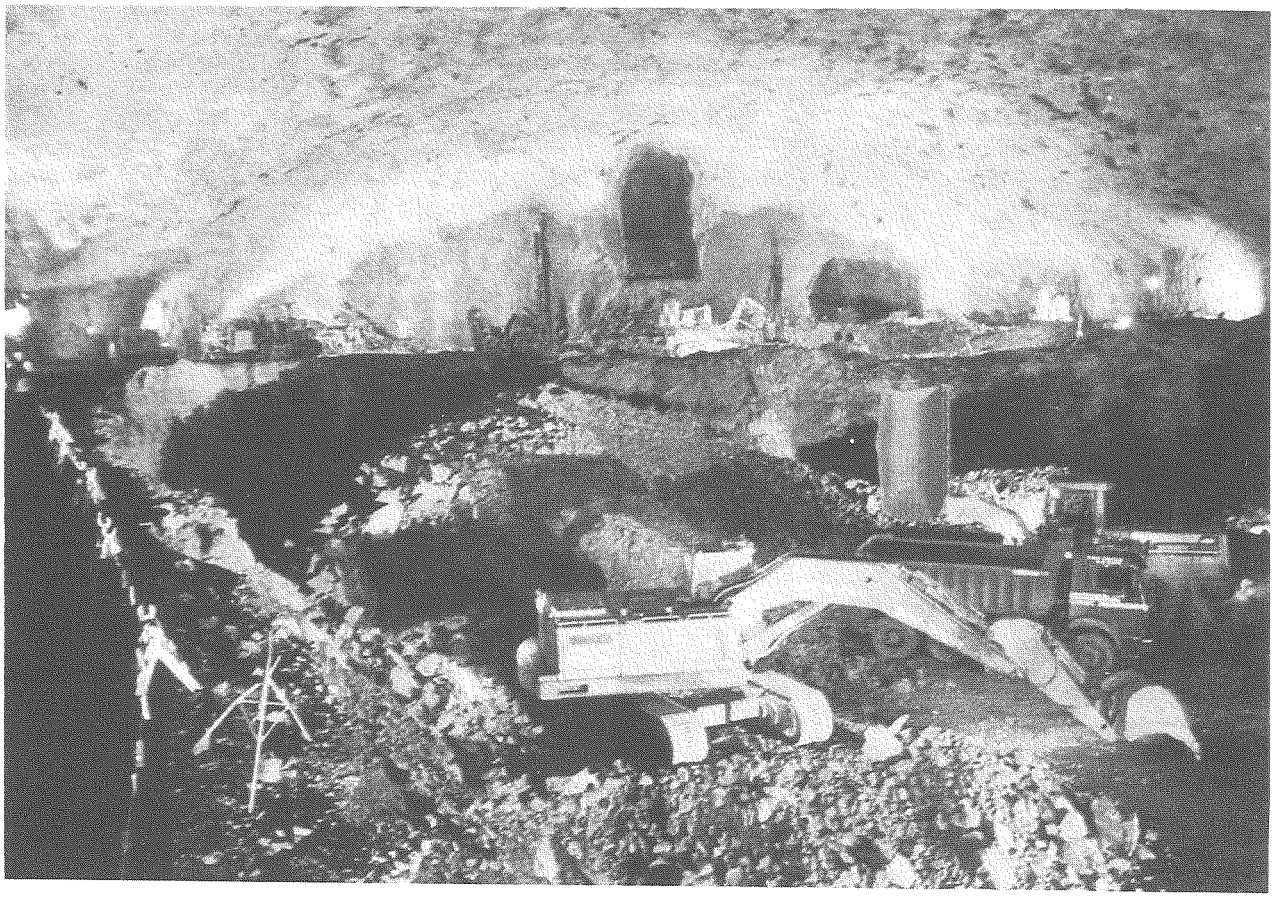
Successful excavation of the world's largest man-made unsupported rock cavern in Norway is a major engineering triumph for the country's depressed rock mechanics industry. The 61m span which exceeds Finland's previous record of 38m is now being fitted out.

The 90m long, 25m high cavern is at Gjøvik in east Norway, 25km south of Lillehammer and 120km north of Oslo. It will be used as a 5100 capacity ice hockey arena for the 1994 Lillehammer Winter Olympics.

'Successful excavation of the world's largest man-made unsupported rock cavern in Norway...'

The drill and blast cavern is housed within Precambrian gneiss of the modest Hovdetoppen mountains in the west side of Lake Mjøsa. The depth of cover above the crown varies from only 25m to 50m.

An underground cavern was selected for a number of reasons including the low environmental impact, but an overriding factor was pressure from the Norwegian rock mechanics industry which was looking for a prestige project to demonstrate its capabilities.



The Ice-Hockey Stadium at Gjovik *Photograph Courtesy of International Construction, Dec. 1992*

'The 61m span which exceeds Finland's previous record of 38m is now being fitted out.'

Gjøvik itself has a specific advantage, already boasting an underground swimming pool with a 25m unsupported span completed in 1975. By incorporating the swimming pool and using it as part of the heat exchange mechanism for the ice manufacture, considerable construction savings could be made. Additionally the swimming pool project provided specific construction and design experience.

The NOK 130M ($21M) project is nevertheless more expensive than a conventional stadium. Most of the funding ha come from the Olympic Committees and the community of Gjøvik. The project also qualifies for a civil defence grant as the Norwegian government contributes to projects that can be used for shelter during a war. And because the project is advancing technology, support has come from the Norwegian engineering societies.

The contractor for the turnkey project is VS Group, a joint venture of Norway's two largest contractors Selmer Anlegg and Veidekke.

'...an overriding factor was pressure from the Norwegian rock mechanics industry which was looking for a prestige project to demonstrate its capabilities.'

At the outset the Olympic committee was unsure of the proposals and the contract included the potentially crippling clause whereby if insufficient progress had been made by a specific date the cavern would be abandoned and a conventional stadium provided, within the original time scale and at no extra cost.

Geological and rock mechanic expertise and cavern design was provided by consultants Noteby, Fortifikasjon, the Norwegian Geotechnical Institute (NGI) and Sintef. Initial evaluation was based upon logging exposures in the swimming pool cavern and other nearby tunnels. This information was then supplemented by four diamond cored boreholes from which cross-hole seismic tomography was subsequently undertaken.

RQD values from core logging indicated the rock to be only of fair quality, however the nature of the jointing - sporadic and of low persistence, rough and without clay infilling - offered favourable conditions for a large rock span.

Furthermore in-situ stress measurements indicated horizontal stresses to be considerably higher than the vertical, providing significant natural interlock of the rock mass.

During the early design stage NGI used its self developed and now well established rock mass classifications Q-system to determine rock quality and support requirements. This is an empirical system which takes into account block sizes, friction on joints and active stresses to give a rock mass or Q value indicating the type and amount of support required.

'The analysis indicated that the arch had good overall stability, even when unsupported, principally because of the high horizontal stresses.'

However, the unprecedented span size and the high safety requirement put the cavern outside the existing database. The NGI therefore used numerical analysis, an NGI amended version of UDEC distinct element analysis, to compute the redistribution of stresses during excavation. Three different models were analysed simulating simplified and more realistic joint patterns.

The analysis indicated that the arch had good overall stability, even when unsupported, principally because of the high horizontal stresses.

Final recommendations for reinforcement comprised fibre reinforced shotcrete throughout with systematic rock bolting in poor quality zones. Bolt lengths, spacing and fibrecrete requirements were based on an integrated application of the Q-System and UDEC-BB (BB after NGI's Barton and Bandis).

Total deformations of 5mm to 9mm were computed by the numerical analysis; actual deformation ranged from 4mm to 8mm.

Construction of a 100m long access tunnel started in April 1991 allowing excavation of the main cavern by June. The cavern crown was taken out by drill and blast in four stages starting with a top heading/pilot tunnel followed by abutment tunnels, side slopes and then a final slash to complete the record breaking span. Excavation of the bench in two stages completed the cavern at the beginning of this year, four months ahead of schedule.

Holes were drilled and charged using AMV, Atlas Copco and Tamrock jumbos. Blasting was by specialist subcontractor Magne Sveen using Dyno explosives with up to five blasts being achieved within a 15 hour double shift.

'Total deformations of 5mm to 9mm were computed by the numerical analysis; actual deformation ranged from 4mm to 8mm.'

Mucking was carried out with Komatsu wheeled loaders and Scatia trucks. Most of the spoil has been used locally to stabilise the shoreline of Lake Mjøsa. In one frantic 15 hour period, 636 lorry loads of spoil were cleared from the cavern, one every 90 seconds.

At the time of *Ground Engineering's* visit in May, VS-Group was securing a drainage system and waterproof lining to the cavern crown and sides. Considerable concrete work and electrical installations, primarily for the heat exchange system still remains before the contract handover on 1 August 1993.

Paul Wheeler

Reproduced from Ground Engineering, May 1992

PEOPLE NEWS

Professor David Stapledon, widely regarded as Australia's leading Engineering Geologist has joined Golder Associates in Adelaide. David has more than 40 years experience in a wide range of civil and mining projects, including dams, excavations and earthworks and underground construction. He started his career with the Snowy Mountains Hydro-electric Authority. His academic career started in 1977 after a period with the South Australian Department of Mines and Energy and Coffey and Partners Pty Ltd. While teaching he continued consulting and is in great demand as a Review Consultant in Australia and overseas and as an expert witness on contractual disputes. David will continue half-time as Professor of Applied Geology at the University of South Australia.

Alan Moon, formerly Principal Engineering Geologist with Coffey Partners International, has also joined Golder Associates in Adelaide. Alan has more than 20 years experience in engineering site investigations for civil and mining projects in Australia, New Zealand and Papua New Guinea. He has specialised expertise in soil and rock slope stability.

Although both David and Alan will be based in Adelaide they will continue to work throughout Australia and overseas.

COFFEY CLEARS SYDNEY AROMA

A world class team of Australian air quality experts have been selected to carry out an air quality modelling study for the Sydney, Lower Hunter and Illawarra regions. The team won the contract against fierce international competition including three leading US consultancies specialising in air quality studies.

Coffey Partners International Pty Ltd (Coffey), will lead the team made up of the Environmental Protection Authority of Victoria (EPAV), Macquarie University's Macquarie Park Research Ltd, CSIRO Division of Atmospheric Research and the CSIRO Division of Coal and Energy Technology. All organisations represented in the team are Australian owned.

Sydney, Lower Hunter and Illawarra experience significant pollution episodes, especially when weather conditions do not favour rapid dispersion. Pollutants include volatile organic compounds, ozone, oxides of nitrogen, sulphur dioxide and suspended particles. The study will develop an inventory of the pollution emissions which contribute to air pollution. It will include ways in which emissions are mixed and carried by the wind and then be modelled to identify wind conditions likely to cause high pollution levels. The chemical processes leading to the development of ozone which is the main constituent of photochemical smog will also be modelled. The study will help safeguard public health, select cost effective pollution prevention and control strategies and indicate the effect of urban and industrial expansion with accompanying increases in motor transport.

The work is a major step forward in the Government's $10 million Metropolitan Air Quality Study (MAQS). The study will draw heavily on the use of advanced supercomputer technology to carry out the modelling of the wind conditions and the development of photochemical smog. Professor Greg McRae, an expatriate Australian who is Professor of Chemical Engineering at Massachusetts Institute of Technology will participate in the study as an external consultant. Professor McRae was the leader of the recent highly successful Warren Centre Supercomputer Project which applied supercomputer technology to a wide range of practical problems including air quality modelling of Melbourne. Mr. Ross Best of Coffey Partners International an Mr. Martin Cope of the Environmental Protection Authority of Victoria made significant contributions to the Warren Centre air quality modelling study which was led by Mr. Eric Clayton of Australian Supercomputer Technology.

OLYMPIC 2000 SITE

Coffey Partners International has provided geotechnical services for all construction activities for the Olympic Games in the year 2000. The major facilities now under construction at a total cost of some $300 million at the Olympic 2000 Site are the Aquatic Centre and the Athletic Stadium. The former involved four major pools and the latter caters for track and field events beneath its large cable supported roof structure.

OIL PLATFORM PROJECT

Coffey Partners International recently carried out a major geotechnical investigation for Esso Australia on their $80 million oil platform project in Port Kembla Harbour. The project would involve a major expansion of the multi-purpose berth and the casting basin used for construction of concrete immersed tube sections for the Sydney Harbour Tunnel. These facilities would be used for construction of massive, 28 storey high, offshore oil platforms destined for Esso-BHP's Bass Strait oil fields, the first to be built in the Southern Hemisphere using concrete. The platforms built in the reconstructed casting basin, would then be floated out to the multi-purpose berth, top deck facilities added, prior to the sea tow down to Bass Strait.

RADIO WAVE GEOPHYSICAL DEVICE

Coffey Partners International is developing and commercialising a unique radio wave geophysical device for the geotechnical, groundwater, mining and environmental fields. It is being used by CPI in practical situations for detecting underground caverns such as mining voids, buried tanks and shallow hydrocarbon contamination in soils. Early results in mapping hydrocarbon contaminant plumes are encouraged and, when proven, will provide a facility not otherwise available anywhere else in the world.

BURLEIGH WATERS LAKE AND CANAL RESIDENTIAL DEVELOPMENT

Coffey Partners International is carrying out geotechnical studies on the Gold Coast to formulate a cost-effective foundation treatment and development strategy for the Burleigh Water lake and canal residential development. The main problem is a corridor of soft alluvial clay deposits up to 12 m thick. These difficult conditions have necessitated solutions which include piled foundations, vertical drains with staged preloading and lime column stabilisation techniques. CPI is also working in soft soil conditions for the development of the $2.5 million Town Centre Project at Robina on the Gold Coast and on the $300 million Brisbane to Gold Coast Railway Project at lake Coombabah where stone columns with wick drains and staged preloading techniques are being employed.

GEOTECHNIQUE SYMPOSIUM IN PRINT

THE OBSERVATIONAL METHOD IN GEOTECHNICAL ENGINEERING

Call For Papers

The advantages and limitations of the observational method of construction were described by Professor R.B Peck in his 1969 Rankine Lecture. Field measurements form an integral part of the design and construction process, allowing the design to be modified in response to observations. The method permits maximum economy with safety, providing the process can be modified quickly and effectively during construction. It is a recognised method in the Draft Eurocode 7 and can provide a way of developing our designs beyond existing codified approaches to incorporate recent developments in soil testing, numerical modelling and instrumentation.

This Symposium In-Print will be based on the Transport Research laboratory Seminar held in December 1992 on the Observational Method.

Additional papers of up to 5,000 words are invited, preferably within the following subject areas:

- General Principles
- Embankments
- Excavations
- Ground Treatment
- Tunnelling
- Contractual Arrangements
- Case Histories

Please send a synopsis of approximately 500 words for assessment to the Organising Committee. The papers should highlight:

(i) The best estimate and contingency designs
(ii) The monitoring system and site procedures to enact the contingency plan.

Synopses should be sent by 1st May 1993 to:

Moira Hatheley
Papers and Meetings Department
Institution of Civil Engineers
Great George Street
London SW1P 3AA

Authors will be advised whether their synopses have been accepted by 1st June 1993. Submission of the completed paper for refereeing and assessment will be held by 1st December 1993.

SHAMSHER PRAKASH RESEARCH AWARD 1992

Call for nominations

Shamsher Prakash Foundation announces the 1992 "**S.P. RESEARCH AWARD**" for young (40 years and younger) scientists and research workers from all over the world. Applications/nominations are solicited so as to reach the Honorary Secretary on or before June 30, 1993.

The applicant should be a specialist in Geotechnical Engineering and/or Geotechnical Earthquake Engineering. It is particularly necessary that candidates have significant **independent contributions** and show promise of excellence.

The amount of the award is US $1001 (Indian Rs 30,000 app.) payable in the local currency of the awardee. The application/nomination may be made on a plain paper and the following information must be included:

1. Name of the candidate
2. Complete postal address and telephone/fax number
3. Date of birth
4. Chronology of education
5. Chronology of jobs held
6. Area of specialization
7. Complete list of refereed publications in journals (Please enclose at least 5 significant publications).
8. Statement of processes developed and patents if any.
9. A statement of 500 words of the significant contributions in the past five years and potential of future contributions (on a separate sheet).
10. Any other relevant information.

All applications and nominations will be reviewed by a Judging Committee of International Experts and the award will be announced by September 30, 1993. Suitable arrangements will be made for making the award at an appropriate ceremony in the country of residence of the awardee.

Please send six complete sets each of (1) application/nomination, (2) supporting documents, and (3) publications, to the Foundation.

For any further information, contact:

(Sally Prakash)
Hon. Secretary
"Shamsher Prakash Foundation"
Anand Kutir
1111 Duane Avenue
Rolla, MO 65401 USA

CHINA - HONG KONG - AUSTRALIA LANDSLIDE SEMINARS AND STUDY TOUR

From 11th September to 4th October, 1992, a group of seven Chinese landslide and slope stability experts toured Tasmania, Victoria and New South Wales, visiting sites of interest and presenting papers at two seminars, together with six Australian counterparts. The tour was organised by Chen Zu Yu, of the I.W.H.R. Beijing, Robin Fell and Gary Mostyn of Univ. of NSW and Ian Donald of Monash University. At the time of the visit Dr. Chen was working as a Senior Research Fellow at Monash University.

The visitors were:

Prof. Zhang Youtian (Deputy Chief Engineer, IWHR, Beijing); Dr. Chen Zu Yu (Senior Engineer, IWHR); Mr. Guo Zhijie (Senior Engineer, IWHR); Mr. Bing Fengshan (Vic Director, Dept. of Science and Technology, Ministry of Energy, Beijing); Prof. Fan Zhongyuan (Vice Director, Exploration Technique, Inst. of Changjian); Prof. Li Tianfu (Senior Engineer, North West Hydropower, Design and Exploration Inst.); A/Prof. Chen Shihui (National Natural Science Foundation of China).

The Australian group consisted of the three organisers plus Patrick MacGregor (SMEC), John Braybrooke (D.J. Douglas & Partners, Sydney) and Jim Williams (RTA, NSW). Alan Moon (Coffey Partners International, Brisbane) attended the Victorian section of the tour.

After a weekend of sightseeing in Melbourne with plenty of street theatre and other excitements from the Melbourne International Festival of the Arts, the Chinese group flew to Tasmania for a three day tour, mainly of faced rockfill dams, arranged by the HEC, Tasmania.

On their return to Melbourne a full day seminar was held at Monash University, with papers ranging from the totally theoretical to the highly practical.

China-Australia Landslide Field Symposium at Kangy Angy Cut, the largest road cutting in NSW which has had stability problems since construction in the 1970s. Aussies are John Braybrooke from Douglas Partners (front row), Garry Mostyn from UNSW, Pat MacGregor from SMEC (middle row), Ian Donald from Monash University, Robin Fell from UNSW, Jim Williams from RTA (back row).

Detailed briefings were given of the next three day's tours, with comprehensive notes provided. Sites visited included the Latrobe Valley open cuts (SEC Vic., Geo-Eng Australia), the Upper Yarra Region (Melbourne Water, Golder Associates) and the Lilydale/Montrose area (Coffey Partners). Ms Jun Huai, a Monash postgraduate student in Geomechanics, accompanied the group as interpreter.

On Sunday 2th September, the activity moved to Sydney, commencing with a visit to the University of NSW, Water Research Laboratories at Manly Vale. Monday was given over to a full-day seminar at the University of NSW with completely different presentations and local practitioners were invited to attend, as had also been the case in Melbourne. Tuesday to Friday were spent busing around the New South Wales countryside with Patrick MacGregor, Robin Fell, John Braybrook, Gary Mostyn and Jim Williams as the chief guides, ably assisted by local site engineers and geologists. Stopovers were at Newcastle, Mittagong and Wollongong with a wide range of rock and soil cutting and embankment and natural slope instabilities inspected and discussed.

The interpreter for this leg of the tour was Univ. of NSW postgrad student, Mr. Y.F. Yu.

The final Saturday was spent on tourism in Sydney, one highlight of which was a breezy stroll to the top of the Sydney Harbour Bridge arch, for the more intrepid members of both groups. On Sunday, 4th October, the visitors left for a similar, but shorter, technical interchange in Hong Kong on their way back to China. The Australian contingent began formulating plans for the return visit in July, 1993 to major landslide sites in China, including a trip to the gargantuan Three Gorges Hydroelectric Scheme on the Yangtze River. Both groups look forward keenly to renewing acquaintances.

The organisers wish to record their thanks for and appreciation of the efforts of the many organisations and individuals who contributed their time, expertise and facilities to ensure the great success of this significant exercise in international collaboration - they are too numerous to name individually, but without them this complex but rapidly organised venture would have been impossible.

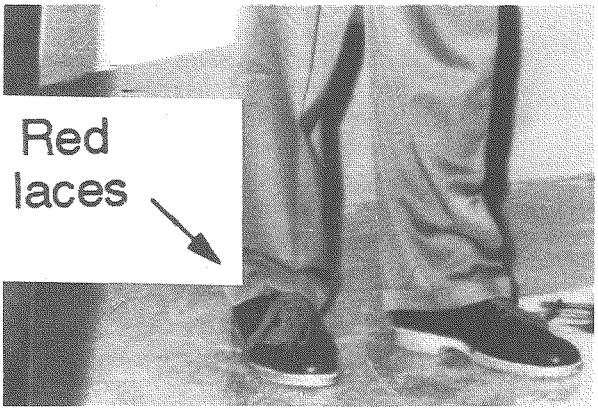
The editors approached several individuals and companies for items of general interest to be included under GEONEWS. Some of these responded and their submissions have been included. If you have any items of interest that you think are suitable for GEONEWS then please forward them to us. As is obvious from this edition several news items were received from the one company.

ROGUE'S GALLERY

Do you have an unusual, old, humorous or controversial photograph of an Australian Geomechanicist? If so, then send it to the Editorial panel so that you can share it with all AGS members. For this edition we have collected a number of photographs of some of out well known geomechanics personalities. Can you identify them? For those who are having trouble turn to Gravel Rash.

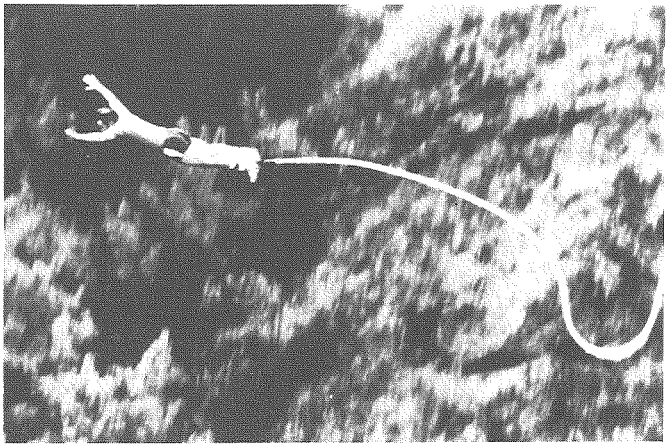
Rogue No. 1
Charlie Chaplin and Ms Curtis

Rogue No. 2
Greek God Adonis

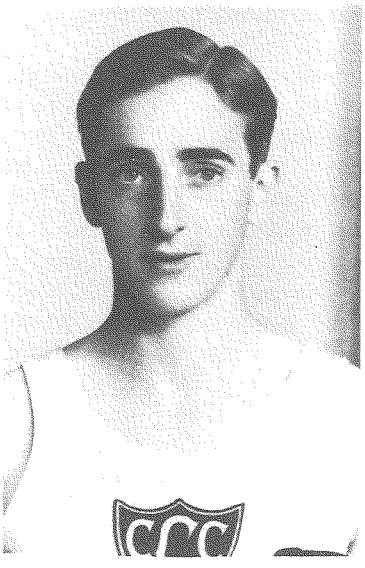


Rogue No. 3
No, it's not Ronald McDonald!!

Rogue No. 4
HEEEELLLLPPP!!!!!!



Rogue No. 5
Indianna Jones?????



Rogue No. 6
All American Male

Rogue No. 7
Bathing Beauties

NATIONAL COMMITTEE MATTERS

CHAIRMAN'S CORNER

by Max Ervin

The AGS has served the geomechanics profession since 1970, but its roots go back to 1953 when a National Committee on Soil Mechanics and Foundation Engineering was formed. The learned society activities of our Society are predominantly the responsibility of local or state groups. It is with these activities of our Society that members will be most familiar, and through which they are able to perceive a tangible benefit from the membership. These activities are largely independent of the National Committee, and of the subscription to the Society that members pay. I therefore thought that through this column, which is to become a regular feature of Australian Geomechanics, it would be appropriate to advise of some of the deliberations and activities being undertaken at a National level and to provide some insight as to why a subscription is paid.

In 1993 the subscription for members of either the IE Aust or Aus IMM will be $40.00, and for non-members it will be $80.00. This difference is levied to provide the Institution of Engineers with some recompense for the State Groups learned society activities, which at present are generally funded from Division budgets, independent of the Society. The $40.00 is levied to provide for membership of one of the International Societies, for production and distribution of "Australian Geomechanics", to assist with Vice Presidential Travel to attend the annual Board meetings of the International Societies and to provide some revenue to the Institution to compensate for the cost of running our relatively large National Committee meetings.

'...it would be appropriate to advise of some of the deliberations and activities being undertaken at a National level and to provide some insight as to why a subscription is paid.'

As such, it has not been the Society's intention or past practice to run the National Committee and its responsibilities entirely within the revenue generated by subscriptions, but to use these subscriptions as a top-up to the contribution which could reasonably be expected from the Institution for running one of the

National Committees of the Civil College. The provision has always existed for some contribution to this operating shortfall by the AusIMM, as a joint sponsor of the Society. However, except for last year it is my understanding this provision has not been invoked. As a result of receiving an invoice last year The AusIMM reviewed its position, and an agreement has now been reached that the maximum contribution AusIMM will need to make in any one year is $5000. The Civil College of the Institution has indicated it also proposes to place a $5000 ceiling on its contribution to AGS. I have resisted this, and argued that our budgeted contribution from the Institution should equal that of other National Committees ($8500 in 1993). This matter has not yet been satisfactorily resolved.

'...increased pressure from the Institution for the National Committee to be responsible for the overall financing of the Society, yet without ability to adequately control receipts or expenditure...'

The introduction by the Institution of a number of other Societies has created some confusion as to our status, and in particular whether we should continue to be considered as a National Committee of the Civil College. Associated with this confusion has been the introduction of the $15.00 subvention on IE Aust

subscription to anyone interested in the Society, as distinct from being a member. The implications of this subvention on our overall operating budget is under review and the current situation may be altered for the AGS in 1993. This review will be part of a wider review of the function and operation of the Society which is being undertaken by a subcommittee of the National Committee.

The review has been prompted by increased pressure from the Institution for the National Committee to be responsible for the overall financing of the Society, yet without ability to adequately control receipts or expenditure (within the present method of operation), and faced with uncertainty as to the level of contribution from the Institution. The outcome of our deliberations will be discussed in a later issue of Australian Geomechanics.

Elsewhere in this issue is published the Society "mission statement" and proposed activities to be undertaken either as specific initiatives or as part of an on-going programme. I would be pleased to receive comments from members with respect to this Action Plan, and in particular on any issues considered appropriate to be addressed by the National Committee.

AUSTRALIAN GEOMECHANICS SOCIETY FIVE YEAR PLAN 1993 - 1998

AIMS AND OBJECTIVES

The aims and objectives of the Society during the period 1993 - 1998 will be as follows:

1. To work with its sponsoring bodies, the Institution of Engineers, Australia and the Australasian Institute of Mining and Metallurgy, to create greater public awareness of the Geomechanics profession and its contribution to society.

2. To maintain and improve standards and to promote professional conduct in the practice of Geomechanics.

3. To promote

   (i) the evaluation and consolidation of existing knowledge and its relevance to practical geomechanics;
   (ii) the assessment of the reliability of various analytical and design procedures; and
   (iii) research and investigation into geotechnical problems which are particularly relevant to Australian conditions.

4. To increase membership of the Society and, in particular, to encourage wider participation in the Society by persons involved in the Mining, Construction, Engineering Geology and geo-environmental sectors.

5. To increase the numbers of organisations involved in the Society as Supporting Members.

6. To promote Australian Geomechanics by hosting appropriate local and international seminars and conferences.

SUGGESTED ACTION PLAN

Many of the proposed actions address more than one of the aims of the Society.

1. Each of the Society's Groups should hold regular meetings with invited speakers addressing topics of interest to geomechanics. At least some of these meetings should be targeted at non geotechnical personnel; thus other engineers, architects, planners, etc should be invited to attend.

   Continuing

2. Where appropriate the content of the above meetings should be more widely disseminated by publication in general civil engineering and other broader based publications. Technical meetings should be recorded, where possible, for wider distribution and speakers encouraged to submit short technical notes or papers to Australian Geomechanics.

   Continuing

3. The Codes of Ethics of the IE Aust and AusIMM should be published at least once every two years in Australian Geomechanics, together with the notes on professional conduct prepared by Dr. P. Mitchell in 1988. These notes should be updated as considered appropriate. Guest editorials in Australian Geomechanics on ethics and liability issues should be encouraged.

   Continuing

4. The Society should, as a national body, hold a National Conference every four years, and the organisation for this conference should be rotated between State and NZ groups, as appropriate. This conference should endeavour to be a regional conference of each of the three international

bodies, with the conference programme being structured to ensure a suitable mix of the three disciplines represented by these bodies. The Regional Vice Presidents of ISSMFE, IAEG and ISRM should work actively with the conference organisers to help achieve this, and to ensure there is no conflict of themes between national and international conferences.

Continuing

5. The Regional VP of the IAEG should continue dialogue with the Engineering Geology Specialty Groups of the Geological Society of Australia and see if any headway can be made in ensuring a unified voice for engineering geologists.

Continuing

6. The Society should, as a National Body, hold a Young Geotechnical Engineers Conference, to bring together young geotechnical engineers and engineering geologists so that they may become more aware of the work of others in their field. The conference should be timed to be held midway between the ANZ Regional Conference, with the organisation and the conference to be rotated between State and NZ groups.

4 yearly

7. On at least a four yearly basis, organise a National Speciality Conference on a topic of either local or national interest. It is expected the responsibility for the organisation of such conferences will be with State Groups, rotating as required. The timing of these conferences will be subject to agreement by the National Committee, but will probably be about midway between the ANZ Regional Conferences.

4 yearly

8. Supporting membership should be promoted by a general mailing of the publicity flier and an accompanying invitation to join. The chairman to follow up selected targets or delegate such targets to committee members.

1993

9. The National Committee and each State Group should formally report on specific issues relevant to aim 3(iii). This may best be achieved by each group reporting every 2 years on progress with respect to these aims and objectives; the National Committee should then consolidate this into a short position paper to be published in Australian Geomechanics.

1993

10. Government and private organisations should be encouraged to contribute, support or undertake research in geomechanics. Local participation should be encouraged.

Continuing

11. Depending on its size each Group should endeavour to organise, say every 2 to 3 years, a workshop/seminar on an issue of local geotechnical interest.

Continuing

12. Each group should encourage the active participation of young professionals in its activities. Thus young members should be encouraged to address technical meetings and to nominate for group committees. Technical meetings aimed specifically at student groups should be held at least every two years, and preferably annually.

Continuing

13. Every committee and sub-committee should report annually to its parent committees regarding its past and future performance. The membership of all committees should also be reviewed annually.

Annually

14. Pursuant to Aim 4, State groups should endeavour to hold joint meetings with other groups, either within or outside the Institution of Engineers, and thus foster greater awareness and wider participation in the Society activities.

Annually

15. Pursuant to Aim 3(i), prepare a position paper with respect to Assessment of Landslip Risk.

1992-1994

16. Pursuant to Aim 3(i), prepare a position paper with respect to Site Investigations for Residential and Light Industrial Development.

1992-1994

17. Pursuant to Aim 3(i), prepare a position paper with respect to Geotechnical Inspection Requirements for Bored Piles and Footings.

1992-1994

NATIONAL COMMITTEE CORRESPONDENT

The latest AGS National Committee meeting was held in Sydney on Friday, 16th October, 1992. As has been the case for the last few meetings, several committee members got together the night before to discuss some of the burning issues on an informal basis. Again, the evening proved to be worthwhile.

The formal meeting started the following morning at 10.00 a.m. with a full agenda. The first item off the rank was the confirmation of the Minutes of the previous meeting. There was concern over wording in an item to do with a review of AGS operations. A lengthy discussion followed. As a first-timer I was surprised to find out that the National Committee has as many perceived problems, if not more, with the Institution of Engineers over finances, than we have at a local group level. As a result, a sub-committee was established to review AGS operations. The sub-committee is to report back at the next National Committee meeting in April. This is an important issue that will directly affect you. If you have any feelings on the matter please inform your local National Committee Representative, or even better still write to the Editor of Australian Geomechanics.

'As a first-timer I was surprised to find out that the National Committee has as many perceived problems, if not more, with the Institution of Engineers over finances, than we have at a local group level.'

The Chairman, Max Ervin, brought up the issue of what should be the length of term of office for the chairman. It was decided that a term of two years was preferred, but the current statute allowing terms of three years was left in place. Despite this, the committee voted to extend Max's term to a third year (1993). The Deputy position was retained by Garry Mostyn for another year.

The issue of State Group representatives and what defined a State Group, now that a Kalgoorlie Group as well as a Newcastle Group, are underway, was discussed. The main discussion centred around the method by which the State Group representatives on National Committee should be elected. The statutes of the Society are clear in that this should be by a mail ballot, although in recent years the National Committee representatives have been elected by State Group Committees. The committee decided that all financial AGS members had a right to nominate for National Committee and hence a call for nominations was to be sent to all AGS members by their local State Group. If more than the required number of nominations was received for each representative, then a postal ballot was to be held. Term of office is for one year only.

The issue of membership fees for 1993 was next on the Agenda. After a brief discussion it was decided to raise the fees slightly, principally because of significant increases in International Society membership costs. It was also decided to keep the current policy of allowing each AGS member free membership of one international society. However, if you require the IAEG Bulletin or membership of another society then you will have to pay the additional costs. As you have paid your fees for 1993, this is not news to you.

Some members of the committee had been approached by Engineering Education Australia (EEA), an arm of IE Aust, to review courses presented through EEA. The question arose whether the courses were reviewed on behalf of the AGS or by an individual. The committee decided that review of courses was a private undertaking and not an AGS responsibility. However, the AGS National Committee would keep a close watch on the situation.

Professor Harry Poulos's term as the Australasian Vice President of ISSMFE is about to end, and there is a need to call for nominations for the next term of office. Further information can be obtained from Max Ervin. Nominations are required by the National Committee meeting on 2nd April, 1993 and should be forwarded through your local State Group.

Standards Australia was next on the Agenda. The majority of the discussion concentrated on the Draft Piling Code. The Committee agreed to encourage Standards Australia to re-open debate on the Draft code. Discussion then followed on the level of communication between the AGS representatives on the code committees, the National Committee of the AGS and AGS members. As a result, it was decided that AGS representatives on code committees would be asked to provide more comprehensive reports to the National Committee than in the past. Summaries of these reports were to be included in Australian Geomechanics. Anyone with concerns about a code should contact the AGS representative on the code committee directly.

The Deputy Chairman, Garry Mostyn presented a draft proposal for the inaugural ANZ Young Geotechnical Professional's Conference. The proposal was accepted and the first conference will be held in February, 1994 at the University of New South Wales. Further details can be found on page of this edition.

Chris Haberfield

INSPECTION OF BORED PILES

Following problems experienced by some AGS members in NSW, each Group has been asked to report on the inspection of bored pile shafts within its local area. Action to date has been as follows:

Brisbane

- Sub-committee formed.
- Not aware of specific problems.
- Questionnaire to be sent to members.

Sydney

- Sub-committee formed.
- Generally no problems, provided engineers descending piles have attended a Work Cover Safety Course (cost $200); all necessary equipment is available on site; and the requirements of the Occupational Health and Safety Act 1983 are followed.
- Despite this one member has had problems and a major contractor has refused to allow access to piles on at least one site.
- Casing must extend to the toe of the pile, even in rock, leaving little of the socket visible for inspection;

Melbourne

- Sub-committee formed.
- Not aware of specific problems.
- Victorian Department of Occupational Health and safety has regulations and a 'Mine Manager' is required.
- Regulations are being obtained from Occupational Health and Safety and from the Association of Drilled Shaft Contractors 'Down-Hole Entry Task Force' in the USA.

Hobart

- No problems.
- Piles have been descended and checked on Sheraton Hobart Hotel sounding weight with a sampling tube to pick up clay used in 600 and 750 dia. piles with success.

Adelaide

- A sub-committee has reported that 75-90% of piles are not inspected at all by a geotechnical engineer.
- The majority of piles are small diameter and could not be descended.
- The majority of piles rely on shaft adhesion so base cleanliness is not critical.

Perth

- No problems
- Equipment approved by Department of Occupational Health, Safety and Welfare used for descent.

The National Committee of the AGS has decided that it is appropriate to prepare a note on acceptable practise, together with regulations governing the method of working in each State

Tony Phillips (Ph: (02) 261 1633 or Fax: (02) 261 2181) is acting as Coordinator. Any individuals who have information to contribute should contact their local group, or Tony Phillips direct. It is hoped that this practise note will be completed within the next 6 months.

NEXT ISSUE - PILING

The next edition of Australian Geomechanics will be centred around "piling". If you have anything to contribute on this theme, then please do so. We would be pleased to receive any papers, technical notes, letters, ideas, photos, anecdotes, new innovations or anything else relating to piling. We would especially like to hear from those in the piling game; so all you consultants and piling contractors out there, here is your chance to blow the rest of us out of the ground with what you have to offer.

Editorial Panel

AWARDS

E.H. DAVIS LECTURER 1993

The Australian Geomechanics Society has selected Mr. Philip Pells as its 1993 E.H. Davis Lecturer. This was in recognition of his contribution to the advancement of both the theory and practice of Geomechanics in Australia since his arrival here in 1975.

His major contributions have been in three main areas:

1. Rock-socketed pile behaviour and design
2. Design of earth dams
3. Application of rock mechanics to the design of underground openings.

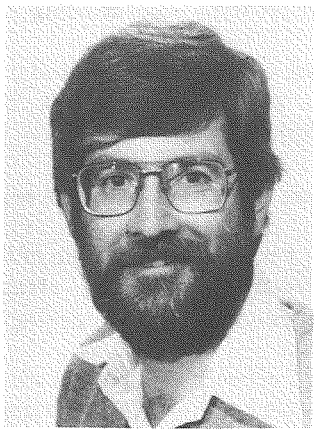
His work in the first area involved theoretical analysis, and laboratory and field testing, and has substantially improved the practice of foundation design in rocks. His 1978 jointly-authored paper has become one of the most widely-used design documents by designers associated with major foundations in New South Wales and other Australian States.

His work on earth dam design has clarified the role of construction pore pressures and high stress induced by compaction on the response and stability of a dam during and after construction. His use of three-dimensional finite elements in dam analysis was one of the pioneering applications of the technique.

He has undertaken both theoretical and design work in relation to underground openings. This has involved theoretical investigation of the relationship between in-situ horizontal stresses and shape of opening, and the derivation of virgin stress fields and in-situ moduli from inverse use of displacement measurements. The most recent application of his work was in the design of the underground parking station for the Sydney Opera House.

Apart from these major areas of research and application, Philip Pells has made contributions to knowledge in the measurement of engineering properties of rock and soil, slope stability, subsidence engineering and computer applications. His achievements and contributions to both the theory and practice of geomechanics in Australia make him a worthy selection as the 1993 E.H. Davis Memorial Lecturer.

SHAMSHER PRAKASH (SP) RESEARCH AWARD 1991



Dr. K.R. Rowe, Professor of Civil Engineering, University of Western Ontario, London (Canada) has been selected for the 1991 SP Research Award in Geotechnical Engineering. This award consists of a cheque for US $1,001.00 and a citation.

Dr. Rowe had his technical education at University of Sydney (Australia). He has made significant contributions in geo-environmental engineering and geo-synthetics. He is one of the pioneers in the integration of engineering designs and hydrology in the design of waste disposal facilities.

DAVID COFFEY SCHOLARSHIP

The David Coffey Scholarship at the University of Sydney was established by Mr David Coffey to provide a scholarship for postgraduate research in geomechanics. The inaugural scholarship was awarded in 1992 to Patrick Kelleher.

His research will involve expanding piles, a concept which involves driving a pile into the ground and then expanding it radially. Tests will be made with model piles driven into artificially cemented calcareous sand. Skin friction increases due to the expansion will be measured.

BOOK REVIEWS

ENGINEERING GEOLOGY OF MELBOURNE

The geology of the Melbourne area is complex, and information and data on the geology and geotechnical properties of the various units which make up the sequence has been scattered and fragmentary.

In some cases, a reasonable amount of work has been published, and the understanding of geotechnical properties has reached quite sophisticated levels (the notable example being the Silurian Melbourne Mudstone). In other cases, units are known only from limited test results contained in unpublished investigation reports.

A feature of the existing information has been the (general) separation of geological information from geotechnical.

'...the list of authors reads like a "Who's Who" of Melbourne's geotechnical fraternity.'

Work on this book was initiated by the Victorian Group in 1989, with the aim of extracting, collating and integrating the available geotechnical data and the relevant geological information. The Victorian Group formed an editorial committee comprising both geologists and engineers to guide the progress of the project. (In the end, a significant proportion of the Group committee were also co-opted to write papers, or to assist with proof-reading and related jobs).

The book comprises 43 invited papers, and the list of authors reads like a "Who's Who" of Melbourne's geotechnical fraternity.

The book is grouped into five separate sections.

Section 1 provides an outline of the geological setting of Melbourne, including stratigraphy, structure, geomorphology and hydrogeology.

Section 2 contains six papers summarising geological hazards and engineering problems which occur in the area: compressible soils, reactive soils, slope stability, ground stress and seismicity, groundwater corrosivity and land contamination.

The individual geological units are covered separately in the next section (Section 3), starting with the Ordovician rocks, (oldest) and working upwards through the sequence to the Recent alluvials. In most cases, a paper on the geology of a unit is paired with a paper on engineering properties. This section contains some excellent summaries which draw together previous publications. Other papers contain significant new information, and will repay careful study.

Section 4 covers the supply and characteristics of traditional geotechnical construction materials in the area (viz : sand, crushed rock, clay and shale, and building stone).

Finally, Section 5 contains a series of papers on geotechnical matters which relate to broader areas than individual geological units. These include papers on house foundations, soil and rock anchors, basements and roads and subgrades. Of particular note is a paper covering MMBW and MURLA tunnelling experience.

This book will be used in a number of ways by the profession.

1. As an aid to the general understanding of the engineering geology of Melbourne.

2. To assist in the planning of future ground investigations and engineering works.

3. To provide an indication of the range of engineering properties of any unit, either for use in preliminary design, or as a check on the "reasonableness" of test data.

4. To assist in the interpretation of investigation results by facilitating identification of the various units, and thereby better correlation and reporting of results.

5. As a source of references to more detailed work in particular subjects and,

6. As a teaching resource for academics and students.

It is expected that this publication will become a key reference in years to come for a readership consisting of geotechnical practitioners, academics, students, contractors, architects, planners, building surveyors and other professionals who need to understand the conditions within the ground. It is hoped that more general readers will also find it of value.

Ref. "Engineering Geology of Melbourne". W.A. Peck, J.L. Neilson, R.J. Olds & K.D. Seddon, Eds. A.A. Balkema, 1992. Available from D.A. Books and Journals Pty. Ltd., Melbourne, Telephone (03) 872 4555. ISBN 90 54 100834.

IN-SITU TESTING FOR GEOTECHNICAL INVESTIGATIONS

Editor M.C. Ervin
Published Balkema

In 1983 the Sydney Group of the Australian Geomechanics Society presented an Extension Course on In-situ Testing for Geotechnical Investigations. This book was prepared as the course notes by leading local engineers and geologists with the intention of presenting the state of practice for in-situ testing in geotechnical engineering in Australia. The reviewer believes this aim was achieved.

The book comprises nine chapters: 1. Why in-situ testing? 2. The Standard Penetration Test. 3. Quasi-static penetration testing. 4. The pressuremeter in geotechnical investigations. 5. Vane shear strength testing. 6. Plate loading tests on soil and rock. 7. Recent developments in the application of geophysics to geotechnical investigation. 8. In-situ permeability testing in soil and rock. 9. Instrumentation in soil. The authors have provided a succinct coverage of each of the commonly used methods of insitu testing, generally covering both the test itself and, more importantly, the interpretation and use of the results. Although the book is now a little dated much of what it contains serves as an excellent introduction to insitu testing as the information therein is not collected in such an accessible form anywhere else. The reviewer believes that this book has been and continues to be one of Balkema's best sellers and deserves this status.

SOIL SLOPE INSTABILITY AND STABILISATION

Editors: B.F. Walker and R. Fell
Published Balkema, 440 pp, 1987

Late in 1987 the Sydney Group of the Australian Geomechanics Society presented an Extension Course on Soil Slope Stability and Stabilisation. This book was produced as the course notes.

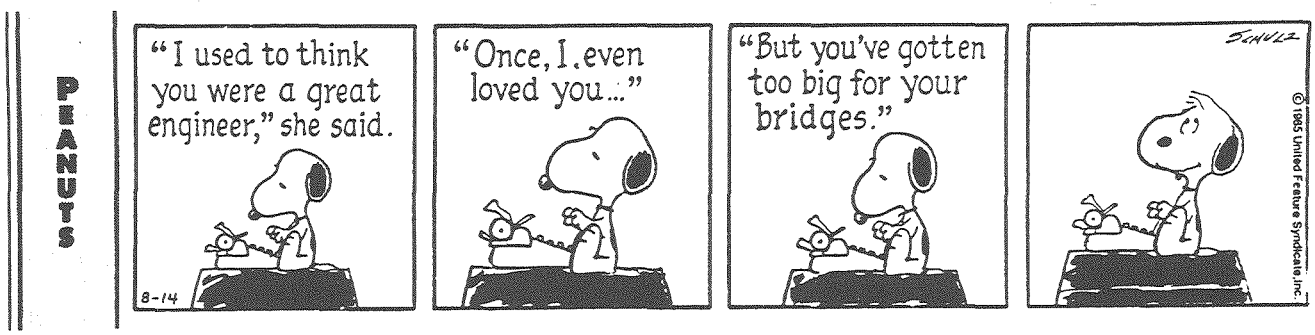
The book is divided into two parts: firstly, slope analysis principles and, secondly, case histories.

The six chapters covering the principles were prepared by invited authors consisting of engineers and geologists with extensive experience in slope engineering. The intention was to cover virtually the entire range of investigation, analysis, design and construction of slopes; thus the chapters are entitled:

1. Landslide classification, geomorphology, and site investigations. 2. Determination of drained shear strength for slope stability analysis. 3. Methods of stability analysis. 4. Groundwater prediction and control, and negative pore water pressure effects. 5. Slope stabilisation techniques and their application. 6. Slope instability in soft ground. These chapters cover 278 pages of the book and cover in a systematic way many of the matters that professional engineers and geologists have had to come to grips with in dealing with both artificial and natural slopes. Considerable effort was made by the authors and editors to ensure that the chapters represented both the published and practical state of play. With a little updating the reviewer still finds these chapters more than suitable for postgraduate teaching.

The second part of the book contains seventeen short (and not so short) papers on aspects of slope stability in the Sydney region. These provide a very good introduction to the practice of slope engineering in NSW and a guide to the history of many of our problems. Generally the papers are of a high standard and engineers in NSW should be familiar with those that pertain to the area of their practice. The reviewer would particularly recommend "Cliff line collapse associated with mining activities" to anyone involved in this type of work.

The book has a fairly complete index which assists its efficient use. In summary the reviewer recommends this book as a very useful contribution to slope engineering with a particularly Australian flavour.



I.E. AUST. SERVICES

LIBRARY FACILITIES

All publications received by the Society are placed in the:

Information Resource Centre
Institution of Engineers, Australia
Engineering House
11 National Circuit
BARTON ACT 2600

Ph: (06) 270 6536
Fax: (06) 273 4200

Books are available for loan to Society members and photocopies of papers or extracts may be obtained on request. Photocopies of articles are available at the rate of $6.00 per item (an invoice is sent with each item).

All Australian Geomechanics Society publications will be indexed for inclusion into Engine:Australian Engineering Database. Engine is publicly available on CSIRO Australis and the Engineering and Applied Science CD Rom. It is also available on EngLink where it is known as En-Form.

INFORMATION SERVICES

The Information Resources Centre (IRC) of the Institution provides a number of services to members.

These include:

Reference and referral service;
Loans of books, videos, audio cassettes, films;
Photocopies of conference and transaction papers, Journal articles, etc;
Computer searches;
IEAust Jobscan;
Engine: Australian Engineering Database; and
EngLink

If you wish to find out more about any of these services please contact IRC staff on:

Ph: (06) 270 6536 or 270 6535
Fax: (06) 273 4200

PECK VIDEOS

The Goemchanics society has purchased two videos by Professor Ralph B. Peck. The videos are titled:

1. Leaders of Geotech Eng Series - Engineering Judgement (40 minutes)

2. Learning from the Ground (70 minutes)

They are for use by all AGS members. The videos are in VHS Pal format and can be borrowed from the Insitution of Engineers Australia Resource Centre (library) in Canberra. Tel: (06) 270 6555 or Fax: (06) 273 1488.

STANDARDS AUSTRALIA

Currently the AGS has representatives on ten SA Committees. These are

CE 9	Testing of Soils for Engineering Purposes	Doug Goad	(03) 819 4044
CE12	Aggregates	Patrick McGregor	(02) 955 1222
CE15	Site Investigations	Tony Phillips	(02) 261 1633
CE18	Piling	Jim Miller	(02) 879 6463
CE20	Geotextiles	Manfred Hausmann	(02) 330 1990
BD25	Footings and Foundations	Peter Stone	(02) 929 0520
CE26	Precast Reinforced Concrete Box Culverts	Peter Mitchell	(08) 212 5733
CE27	Earthworks	Charles Fitzhardinge	(08) 364 2777
CE28	Testing, Pumping and Water Wells	Bob Newman	(08) 226 2510
CE32	Reinforced Soils and retaining Structures	Patric Wong	(02) 888 7444

As a result of the last AGS National Committee meeting it was decided that our representatives on code committees would be asked to provide more comprehensive reports to the National Committee than in the past. Summaries of these reports were to be included in Australian Geomechanics. Summaries of the reports received to date are included below. Anyone with concerns about a code should contact the AGS representative on the code committee directly.

STANDARDS COMMITEE CE12

Aggregates

No action to date.

STANDARDS COMMITTEE CE15

Site Investigation Code

The new Site Investigation Code was finally passed by the CE15 Committee in July and has been with Standards Australia since then.

It was approved for publication on 21 September 1992 and is now (12/11/92) with the printers. One or two months is normally required for publication, so it should be available by December 1992.

COMMITTEE CE/32

Reinforced Soils and Retaining Structures

The first meeting was held on 1st December 1992 and was attended by Messrs Colin Blair (Chairman), Ruben Naccarelli (Secretary), Andrew Shirley and I. Haustorfer. The present constitution of the Committee was analysed and the members considered that it was necessary to approach users and practitioners to achieve a balanced Committee. The members went on to give an overview on the Draft Australian Standard DR 91273 and the Summary of Comments (Doc BD/000-92-1) on DR 91273. The Committee proposed the following:

The Standard be divided under the following framework:

1. General Principals
2. Near Vertical Walls and Abutments)
3. Reinforcement of Natural Ground
4. Reinforcement of Fill

- The draft Standard should be regarded as guidelines for design rather than a document to be called up in legislation.
- The CEN-EUROCODE No. 7 be used as a check list and any important information should be extracted from it.

The next meeting was proposed for March, 1993.

DR92097: Piling - Design and Installation

The draft piling code which will replace AS 2159 is currently out for public comment. The new code has been completely rewritten and modernised. The most significant differences from the old code are the limit state format with sections on strength, serviceability and durability limit states and the fact that the contents are less prescriptive. Both these significant features are consistent with other structural design codes recently introduced by Standards Australia.

The new code features an increase in the amount of detail concerning design requirements for both geotechnical and structural design, the application of load combinations and durability requirements but far less prescriptive rules on pile construction.

The issuing of the draft has resulted in a large number of comments from geotechnical engineers and contractors. As a result, the period for comment has been extended until 26 March 1993 and workshops are scheduled to discuss the code with the engineering community in Melbourne on 24 February, Sydney on 25 February and Brisbane on 26 February.

Some of the items of concern to members are the type of limit state format which has been adopted, the changed terminology, the rules on testing, the contents of the non-mandatory appendices and possible duplication with other codes of structural design rules.

The Australian Geomechanics Society has formed a committee to look at the limit state format used and to determine the most appropriate format which could then be adopted for other geotechnical codes.

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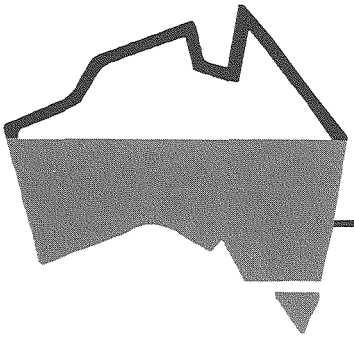
... we also design, customize, manufacture, install, service, and provide technical support for it.

For further information,
contact Alby James or Gavin Langerak at GEOSYSTEMS.



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GRAVEL RASH

The following historical information from the Journal of the Institution of Engineers Australia dated July-August 1948 gives an insight into the beginning of the AGS: "The Institution has established a National Committee on Soil Mechanics with sub-committees in each state and has accredited Australian representatives to the Conference" (Second International Conference on Soil Mechanics & Foundation Engineering). For those who are interested in trivia about how costs have increased the cost of the 6 volume proceedings was approximately A£9 and contained more than 350 papers. The subscription to the Institution Journal was 4 Guineas per annum, post free.

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Some members have questioned the use of a foreign publisher for the Engineering Geology of Melbourne. A. A. Balkema of the Netherlands was prepared to take the risk on the publication at virtually no cost to the Society or the Institution. I am sure the Society would be pleased to hear from any Australian publishers who are prepared to take the risk of publishing books with a limited potential market. A copy of the book will be available at the Institution of Engineers Library in Canberra.

****

Several Australian Standards have generated considerable discussion recently. We have heard comments including:

- Should the Piling Code be in the Limit State format?
- Will the Standards Australia committee considering a code on retaining structures be influenced by the apparent impasse in Great Britain on their retaining walls codes. The British have not been able to publish a replacement to the 1951 edition of the Civil Engineering Code of Practice on Earth Retaining Structures which was reprinted in 1975.
- A reported difference of opinion developed between engineering and seismological members of a committee considering the earthquake zoning of the "Top End" of the Northern Territory. A magnitude 5.2 earthquake which occurred about 90km off the NT coast in October 1992 has probably muddied the waters in more ways than one. Is the risk of an earthquake is higher if one has not occurred in the area recently?

****

The following quotation is taken from the first edition of Geotechnique in 1948 in a paper by H.Q. Golder on earth pressure:-

"There are two approaches to a natural problem. They are the approach of the pure scientist and that of the engineer. The pure scientist is interested only in truth. For him there is only one answer - the right one - no matter how long it takes to get it. For the engineer, on the other hand, there are many possible answers, all of which are compromises between truth and time, for the engineer must have an answer now, his answer must be sufficient for a given purpose, even if not true. For this reason an engineer must make assumptions - assumptions which in some cases he knows to be not strictly correct - but which will enable him to arrive at an answer which is sufficiently true for the immediate purpose."

****

In response to a proposal for a joint Australian New Zealand Conference, the following reply was received by trans-Tasman facsimile:-
Good to hear from you again.
NZGS support the principal.
NZGS would be happy for AGS to run the first conference in 1994 on the east coast of the West Island, Sydney, Melbourne or Brisbane are all easily and cheaply accessible.

The proposal prepared by AGS is well thought out and we have no substantial amendments to suggest. However, there is a small but important oversight in the "AIM" of the conference. The second last line refers only to AGS whereas it should of course, refer to Australasian Geomechanics Societies.

The reply reminds one of the Tasmanian TV weather presenter describing the local weather followed by the forecasts for "that large island to the north".

****

Personal correspondence recently received from a colleague in Canada. ..."As for plans to have a geotechnical research centre - you are a bit slow to make too grandiose plans (they have the Australian Geotechnical Research Centre at UWA which I thought rather amusing, although you could call it the World Centre for Geotechnical Research to try and compete)".

****

News in from Bangkok. A Geotechnical investigation carried out in 1984 for a development on the notorious Bangkok soft clays has only just proceeeded to the design stage. One must wonder if geological changes have occurred to the site.

****

Rogue's Gallery Answers: 1. Mrs. Ian Donald and husband; 2. Max Ervin; 3. Mark Randolph; 4. Garry Mostyn; 5. Harry Poulos and students; 6. Ian Donald; 7. Ian Donald and colleague.

TECHNICAL PAPERS

AUGER PENETROMETER DEVELOPMENT FOR THE COMPACTION CONTROL OF SAND

by Abbas Mohajerani

SUMMARY

The Auger Penetrometer (AP) is a continuous flight auger which penetrates the soil by applying a constant static vertical load during rotary advancement. Auger resistance index (AI), is measured as the number of turns of the auger required for 100 mm depth of penetration. This paper describes an AP with a hinged handle and presents the results of experiments made to study the relation between AI and density of sand(rd), and, possible effects of operator technique and particle size on this relation. It is concluded that: (i) linear relations with strong correlations exist between log(AI) and rd of sands tested, (ii) the AP is capable of producing reproducible results for compaction control of sands, and (iii) different calibration line should be established for sands with considerably different particle size distribution.

1. INTRODUCTION

The use of direct or indirect density measurements for compaction control of sand fills is commonly adopted all over the world. Numerous methods have been developed for this purpose, including the sand replacement, rubber balloon and nuclear density meter methods. These methods disturb the soil surface and require additional laboratory testing or recalibration, but are generally considered to give reasonable to fairly accurate results.

The Auger Penetrometer (AP) was developed by Mohajerani (1982, 1985) at the University of Western Australia as an alternative approach for the determination of density of sand fills. It consists of a 22 mm diameter continuous-flight auger which cuts into the soil by applying a constant static vertical load (total weight of auger, shaft and handle = 43 Newtons) during rotary advancement. Auger resistance index (AI) is defined as the number of revolutions required for a depth of 100 mm of penetration,

$$\text{i.e} \qquad AI = 100\ NT/L \qquad (1)$$

where NT is the number of turns of the auger and L (mm) is the measured depth of penetration (about 100 - 150 mm).

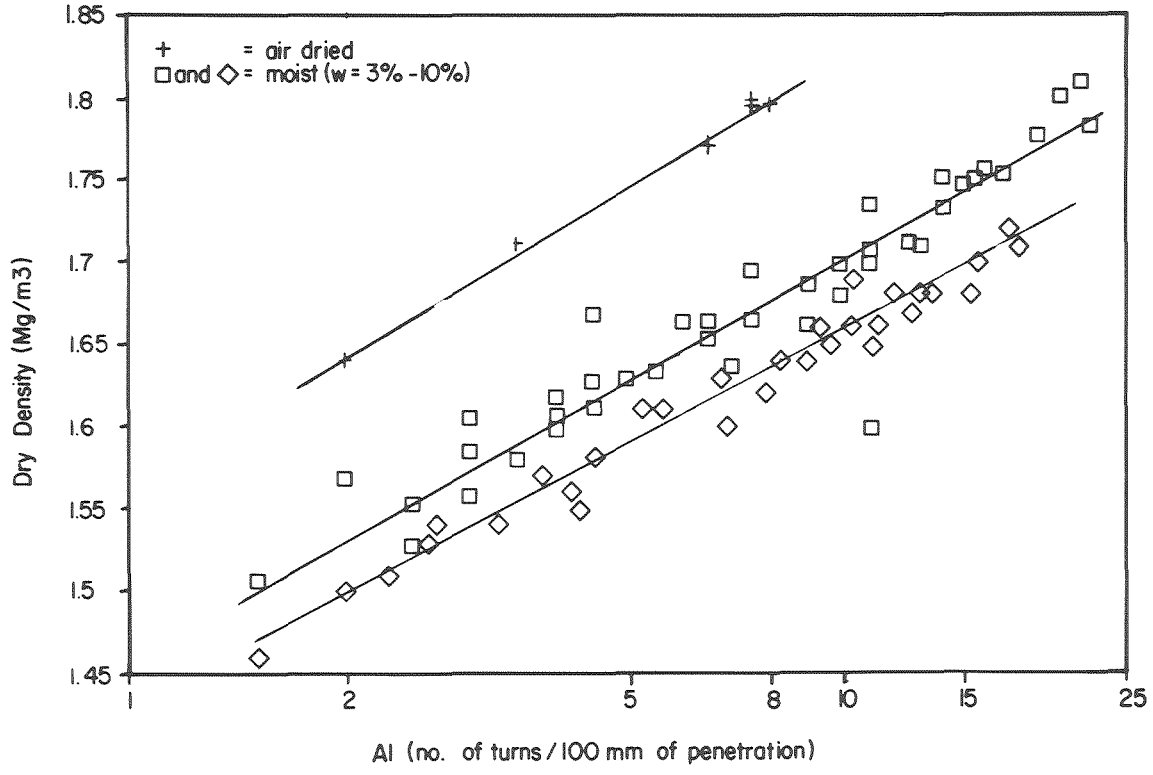

Figure 1: Correlation between dry density and log (AI)

Strong linear correlations have been found between logarithm of AI and dry density of compacted sands (Mohajerani 1982, 1985; Erceg 1982), (Fig.1). Erceg carried out parallel testing with the AP, sand replacement method and dynamic Perth Sand Penetrometer (Glick and Clegg 1965) on a compacted sand fill and found that the results from the AP method compared very favourably with the results obtained using the sand replacement method (Fig. 2). Chivers (1982) used the AP to measure the dry density of a subgrade sand and found a strong linear relationship between the modulus of subgrade reaction and the logarithm of AI (Mohajerani 1985/2).

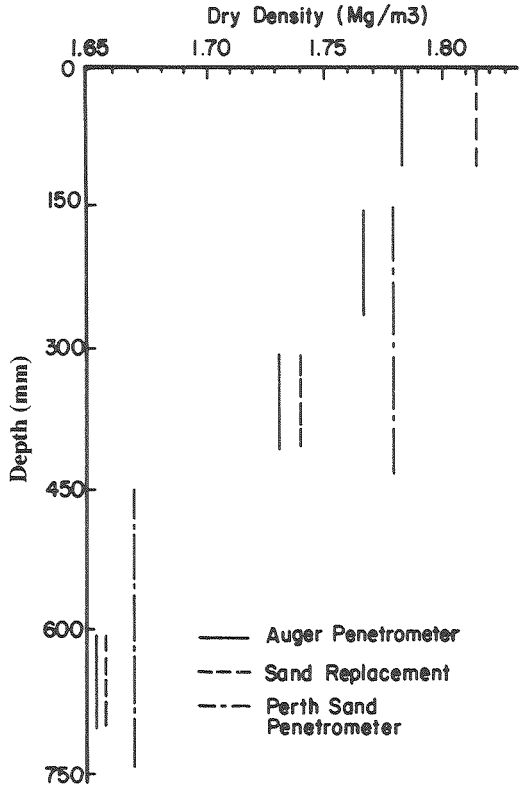

Figure 2: Comparison of the auger penetrometer, sand replacement and Perth sand penetrometer field results (Erceg 1982)

The APs used in the previous studies were equipped with fixed handle, making the penetration results dependent on the individual operators. This could explain the variation shown in Fig. 1, between the results of the two previous independent studies. It has been suggested (Mohajerani, 1985) that a more appropriate handle should be used with the AP to make it independent of operator technique.

In this study the AP was equipped with a very light (perspex) hinged handle to leave the shaft and auger free from operator influence (Fig. 3). Tests were then made to study the effect of operator technique on AI. Also, possible effects of soil particle size and auger condition on AI were investigated.

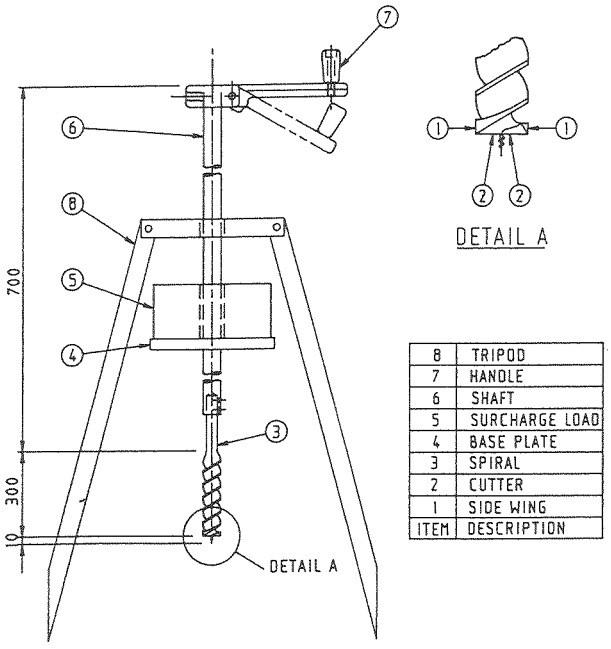

Figure 3: Auger Penetrometer (not to scale)

2. EXPERIMENTAL METHOD

Preparation for testing involved mixing a batch of sand of weighing approximately 15 kg with water to various predetermined moisture contents. Sand samples with moisture contents ranging from 1% to 12% were used to study the influence of changing moisture content on AI-density relationship. After mixing the sand thoroughly, a test specimen was prepared in a C.B.R. mould (height = 177 mm, diameter = 152 mm). It was possible to vary the density by changing the number of layers in the mould and by varying the number of blows of light or heavy standard compaction hammer per layer. The specimen was placed under the auger penetrometer and the auger lowered until the tip reached the sand surface. The shaft was released to settle under its own weight. When the auger had come to rest an initial-settlement reading was taken. The auger was then rotated slowly (at different rates of approximately 0.5 to 1.5 revolution per second) in a clockwise direction and the number of revolutions were counted until 140 mm penetration from the auger tip (127.5 mm from the cutting edge) was reached. It should be noted that, there is relatively very little disturbance around the penetrometer, with apparently no influence of the mould-edge on the penetration resistance. This is because, AP is a quasi-static method and as it penetrates, it transfers the soil through the flights.

Experiments were made by four operators: A,B,C and D, using sand A (Fig.4), and their results were compared. Operators B, C and D had not used the AP before. They were instructed to place the auger tip on the sand surface and release it slowly and when the auger has come to rest to rotate the auger slowly in

a clockwise direction and to count the number of revolutions it takes to penetrate 140 mm.

Operators A,B,C and D turned the auger at different rates (rotary velocities) of approximately 1, 1.5, 1 and 0.5 revolutions per second, respectively.

In order to examine the influence of auger condition on AI three augers were used; an auger in good condition, a rusty auger and a damaged auger. The rusty auger was prepared by etching off the lacquered surface. The auger was then left out in the weather for some months. After testing, the auger tip was then damaged by continual dropping of the auger onto a concrete floor, and the cutting edge and flight were damaged by repeated blows with a hammer.

Augers used in this study were steel augers (suitable for hardwood) with a diameter of 22.225 mm, lead of helix 50.8 mm and length of helix 300 mm (Fig. 3).

In order to study the influence of soil particle size on AI, three fine to coarse-grained, subrounded to subangular, quartzite sands were used. The grading curves are shown in Fig. 4).

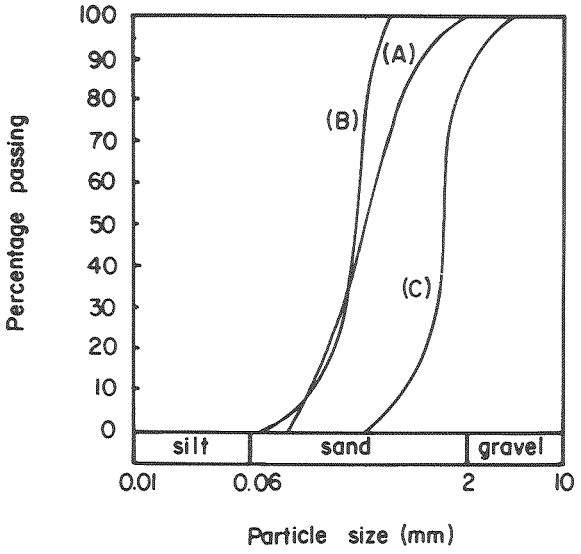

Figure 4: Grading curves of experimental sands

3. TEST RESULTS

3.1 Effect of operator

In any test method, reproducibility of the test when performed by one operator and the effect of different operator techniques on the repeatability of results are important factors.

Experiments were made to find if the AP was capable of producing reproducible results. Figs 5 shows dry density - AI and dry density - log AI relations for tests performed by the four operators, using sand A, when the moisture content of the samples ranged between 3 and 12 per cent, and the following regression equations were established:

$$\rho_d = 1.370 + 0.200 \log(AI)$$

$$(R^2 = 0.909, S_{yx} = 0.020, N = 79) \quad (2)$$

Also, the following regression equations were established from the test results obtained by a single operator (A):

$$\rho_d = 1.362 + 0.213 \log(AI)$$

$$(R^2 = 0.936, S_{yx} = 0.020, N = 44) \quad (3)$$

where ρ_d = dry density (Mg/m3)
AI = number of turn per 100 mm of penetration
R^2 = coefficient of determination
S_{yx} = standard error of estimate, and
N = number of cases.

Strong correlations between ρ_d and log AI for a single operator as well as for four operators, and also, relatively small changes in R2 and Syx values from eqn (2) for four operators to eqn (3) for one operator, indicate that the Auger Penetrometer is capable of producing reproducing reproducible results.

3.2 Effect of particle size

The penetrating resistance of sand to the auger is expected to be related to the particle size. To study this effect on ρ_d - AI relationship three sands, fine to coarse-grained (Fig.4), were used.

The results of tests (Fig. 5) show that particle size does influence the rd-AI relation. In order to study the extent of this influence, for the three sands tested, the following regression equations were established:

for combined results obtained using sand A and sand B (fine to medium-grained),

$$\rho_d = 1.381 + 0.199 \log(AI)$$

$$(R^2 = 0.874, S_{yx} = 0.023, N = 86), \quad (4)$$

and for results obtained using sand C (coarse-grained),

$$\rho_d = 1.501 + 0.290 \log(AI)$$

$$(R^2 = 0.907, S_{yx} = 0.012, N = 17), \quad (5)$$

Relatively very small changes in R^2 (0.035) and S_{yx} (0.003) values from eqn (2) for sand A and eqn (4) for sands A and B indicate that the influence of small changes of particle size on ρ_d - log(AI) relation is apparently negligible.

The results (Fig. 6 and Eqn (5)) also show that there exists a different relation, with a strong correlation, for sand C (coarse sand). This indicates that different calibration line should be established and used for sands with considerably different particle size

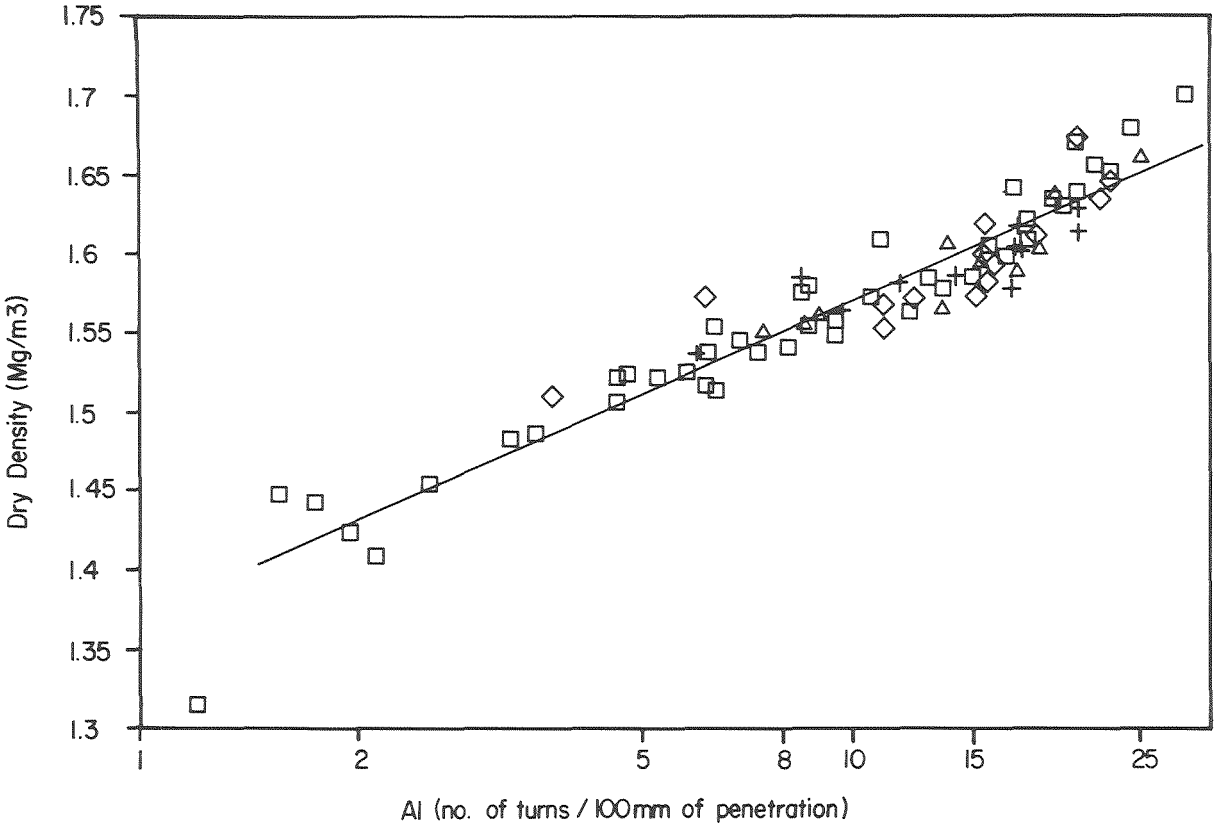

Figure 5: Effect of operator and moisture content (w) on log (AI) - ρ_d relationship (different symbols correspond to different operators)

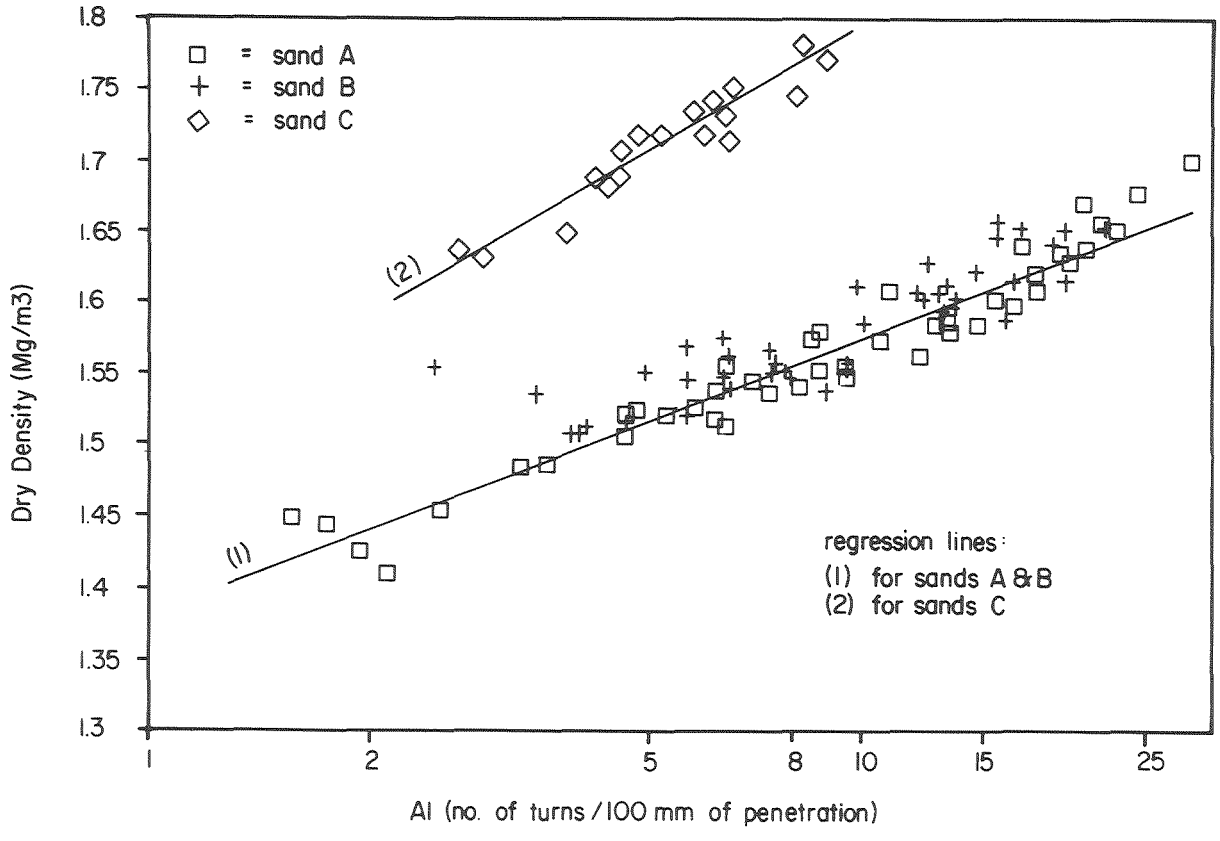

Figure 6: Effect of particle size on AI (w = 3% - 12%), Operator A

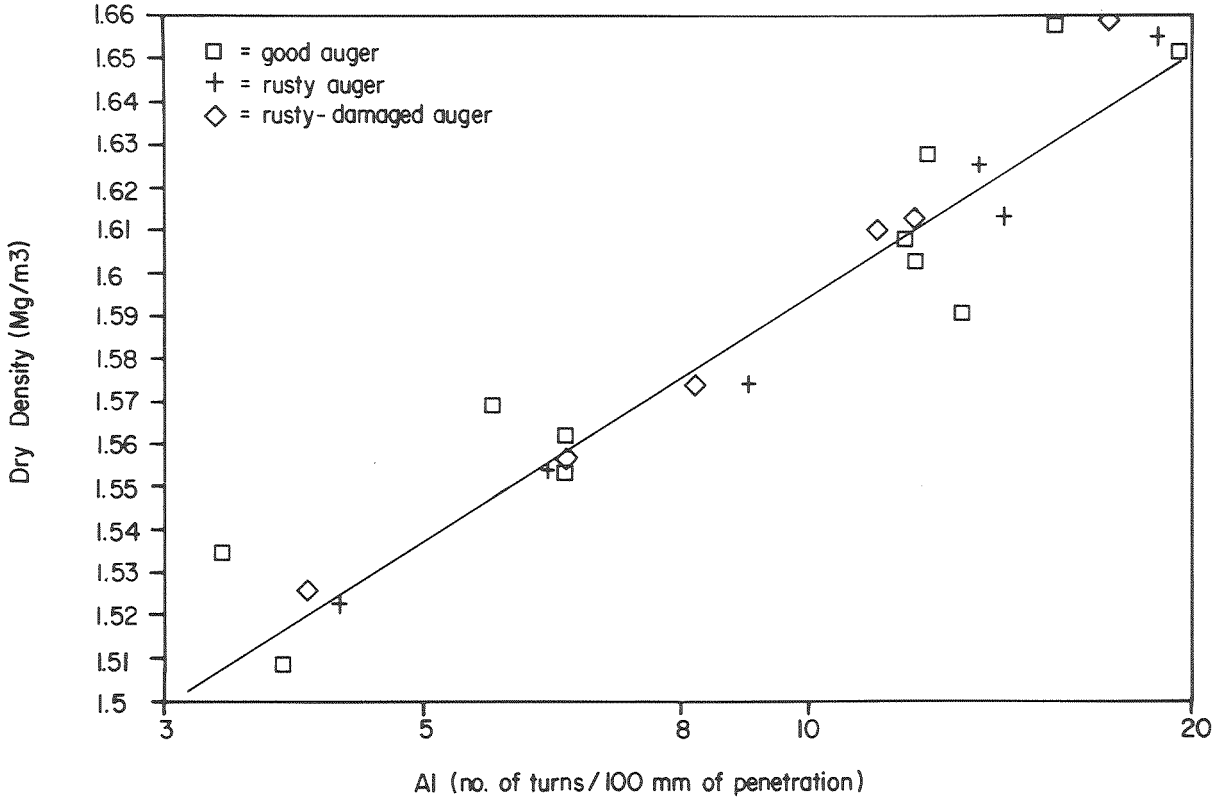

Figure 7: Effect of auger condition on AI (w = 9% - 10%)

3.3 Effect of auger condition

The surface condition of an auger might vary with continued use in the field. To examine whether the auger condition would influence the ρ_d - AI relationship, an auger in good condition, a rusty-auger and a damaged-auger were tested using sand B. The results are shown graphically on Fig.7 and the following regression equation was obtained:

$$\rho_d = 1.409 + 0.188 \log(AI)$$

$$(R^2 = 0.920, S_{yx} = 0.013, N = 23). \qquad (6)$$

Fig. 7 and Eqn (6) indicate that there is apparently no or very small effect of auger surface condition on AI.

3.4 Effect of moisture content

It has been found (Mohajerani 1985) that the ρ_d - AI relationships vary for air-dried (approximately for w < 2 %) and moist conditions (Fig. 1). Under moist conditions, penetration cuts the soil, and a continuous line of chips travels through the auger flight and rises to the surface, and no significant jamming or interference takes place during the cutting process. Under dry conditions, however, penetration takes place without the formation of any cuttings, and the soil particles move against each other, the soil fills all the available room in the throat and flights of the auger, and is then transferred to the surface.

Fig. 8 shows that the effect of changing moisture content for moist conditions of sands tested is relatively small. To investigate the influence of changing moisture content, for moist conditions, the variable w was added to Eqn (2) and Eqn (3). The improvement in R^2 values and the changes in S_{xy} values were less than 0.033 and 0.005 respectively. This confirms the previous results that the effect of changing moisture content on ρ_d - AI relationship may be considered negligible, for the range of moisture contents tested.

3.5 Initial settlement of the auger

As already mentioned, AI is the number of revolution required for a depth of 100 mm of penetration. The depth of penetration could be considered including or excluding the initial settlement of the auger under the applied vertical load. Using either method does not vary ρ_d-AI relation considerably, particularly for medium to very dense conditions (Fig. 9). However, it is easier to measure the penetration depth from the commencement of turning the auger, after the initial settlement.

4. CONCLUSION

An Auger Penetrometer equipped with a hinged handle was used to investigate the relation between AI (number of turns per 100 mm of length of penetration) and ρ_d (dry density) of sand and also to study the possible effects of operator technique,

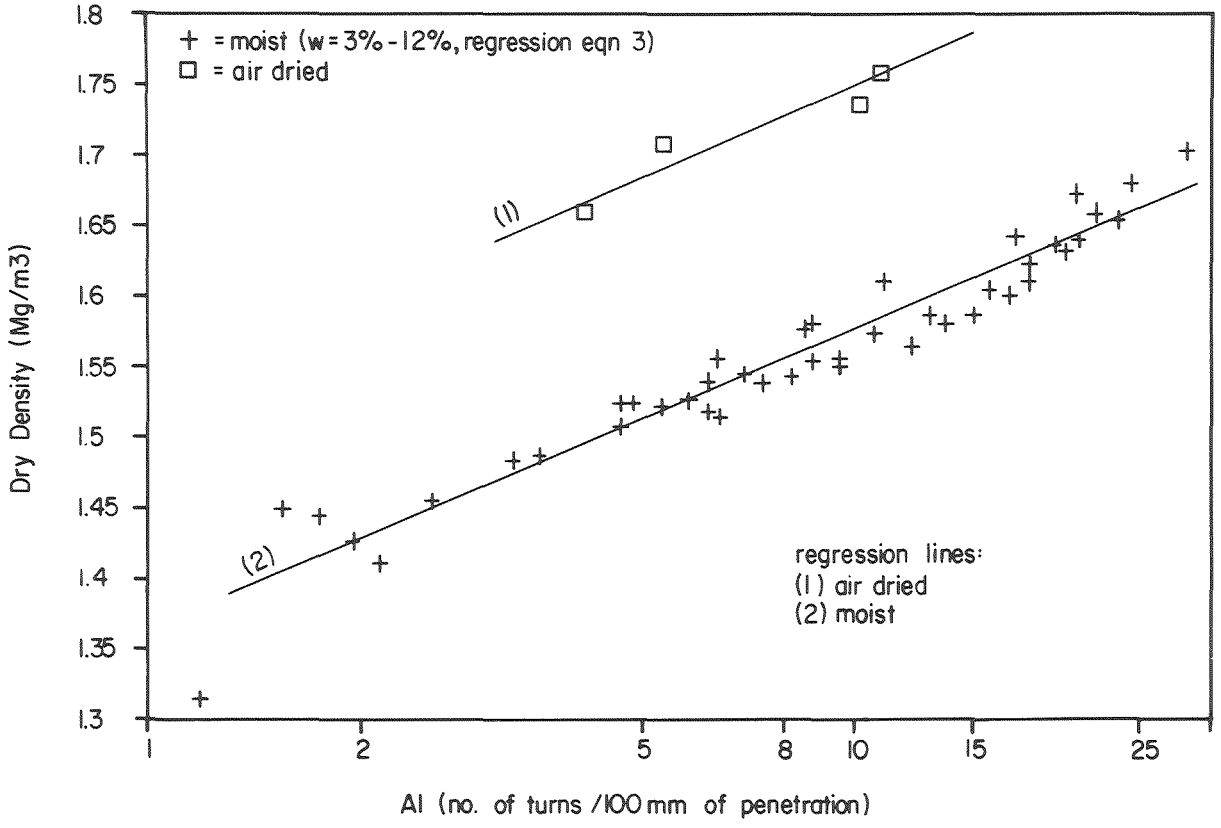

Figure 8: Effect of moisture content, sand A, operator A

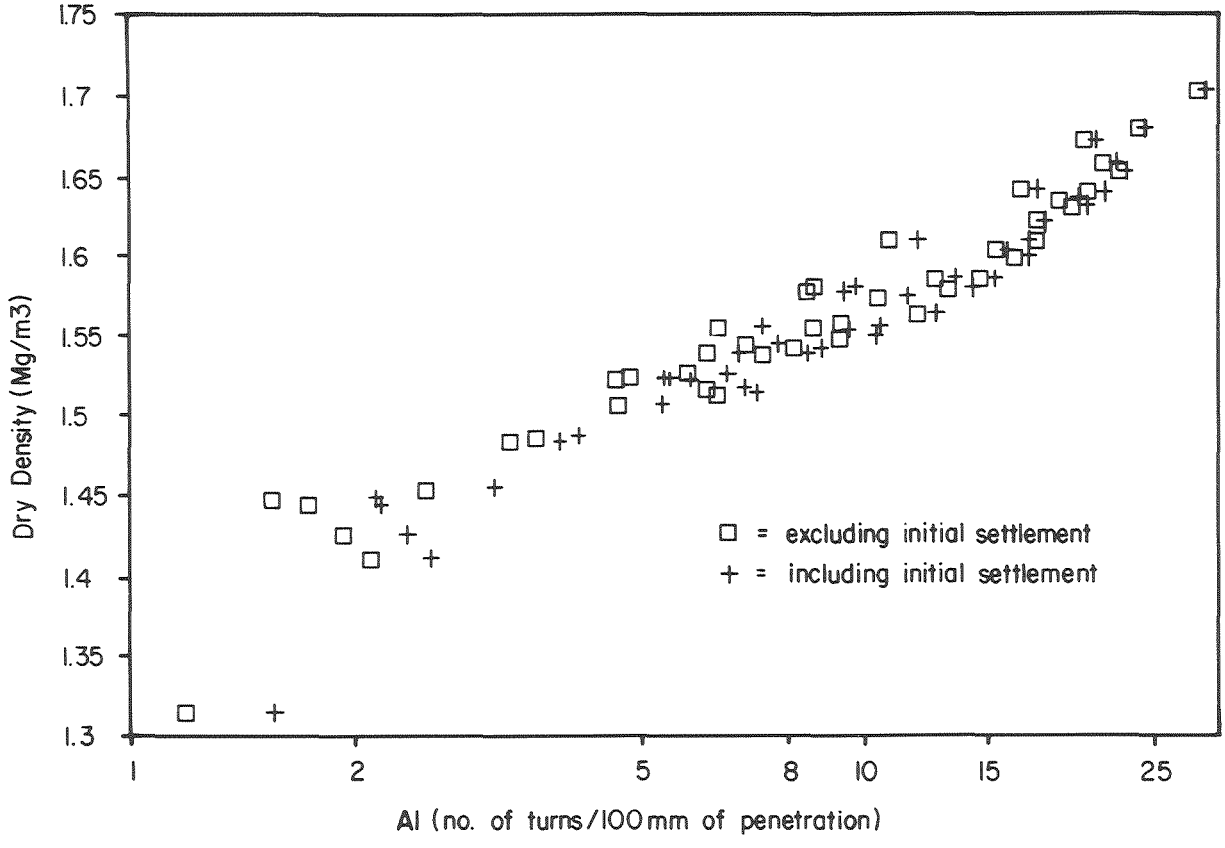

Figure 9: Effect of auger initial settlement

particle size, auger surface condition and soil moisture content on the relation.

Results show that:

1. there are strong linear correlations ($R^2 > 0.9$, $S_{yx} < 0.025$) between ρ_d and log(AI) for the 3 sands tested;

2. the Auger Penetration test is capable of producing reproducible results in sands of the same particle characteristics (viz., particle size distribution, angularity, and type), if it is used with a light hinged handle;

3. the influence of small changes of particle size on AI is apparently negligible,

4. there are different relations for sands with considerably different grain characteristics;

5. there is apparently very small effect of auger surface condition on AI, for sands tested;

6. ρ_d - AI relation vary for air-dried and moist conditions;

7. the effect of changing moisture content, for the range of moisture contents (3 - 12 %) tested, on ρ_d - AI relation is relatively small and may be considered negligible; and (8) including or excluding the initial settlement of the auger under the applied vertical load, in medium to very dense soil condition, does not vary the relation significantly. However, it is easier to measure the penetration depth from the commencement of turning the auger, after the initial settlement.

Auger Penetrometer testing can be carried out by personnel on the job to reduce the number of other more time consuming and expensive density testing control.

It offers the possibility of determining rapidly the density variation over very large areas. It is independent of laboratory testing and easy to calibrate for different sands.

5. ACKNOWLEDGMENT

The author gratefully acknowledges the efforts of the Engineers, especially Ms J. Collins, who as undergraduate students at the University of Central Queensland participated in the experimentation.

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A NOTE ON THE ORIGIN OF WET SEAMS IN EMBANKMENT DAMS

by P.M. James

1. INTRODUCTION

Concentrated seepage horizons, or wet seams, occur in the impervious zones of many embankment dams, as adequately summarised by Sherard (1). Their presence has traditionally been taken as a manifestation of hydraulic fracture, even when this mechanism is difficult to justify. An alternative origin is suggested below, briefly focussing on the adverse role of calcitic soils and the manner in which they can produce porous horizons in otherwise well compacted fill.

2. ANOMALIES OF THE HYDRAULIC FRACTURE EXPLANATION

Some of the significant attributes of wet seams outlined by Sherard include:- the seams develop on first filling, at elevations only marginally below impounding level; trenching in failed embankments has revealed wet seams extending over considerable horizontal distances, sometimes at more than one level; in combination with dispersive soils and inadequate filter protection, their presence can lead to catastrophic failure.

Sherard favours hydraulic fracture as their cause, even in quasi homogeneous embankments, but states that this is because hydraulic fracture appears as the only logical explanation. Uneven foundation profiles are also cited as a cause, although wet seams have been known to occur in dams with smooth foundation profiles. Moreover, at Teton Dam (2), wet seams were traced horizontally well beyond the limits which could be attributed to the influence of profile changes in the foundation.

Hydraulic fracture also runs into difficulties explaining how piezometers installed in wet seams typically record reservoir fluctuations with a minimum of delay, showing the seams to be highly permeable and to remain so even when the head is reduced towards zero. By contrast, extensive hydraulic fracture testing at the Alvita Dam (3) demonstrated that hydraulic fracture occurs only at high pressures, in accordance with theory, and that the fractures seal themselves when the head is marginally reduced below that causing the fracture.

3. AN ALTERNATIVE MECHANISM FOR WET SEAMS

In the early '70's, the writer was involved in a supervisory capacity, with a research project into the failure of small earth dams for the Queensland Water Resources Commission, (4). Field inspections indicated that initial failure of some embankments occurred at the level of poorly compacted horizons in the fill. Such porous horizons are, of course, to be expected in farm dams which are often placed dry of optimum and are typically given only nominal machine compaction. On well supervised projects, such horizons are more difficult to explain. Casagrande, when investigating the failure of the Wister Dam (Oklahoma) in 1969 discounted the possibility of poor compaction as a cause and, to judge from the literature since, this avenue does not appear to have been actively pursued.

However, when embankment soils are calcitic in nature, there is a mechanism available to produce porous horizons.

Calcite has the ability to absorb water into its structure and the effect of this can be seen in routine laboratory compaction tests, where the density/water content curve of a calcitic soil becomes displaced to the right of that for an identical soil without any calcite. The optimum moisture content for the calcite rich soil therefore appears as higher, but the additional water is not available to assist in the compaction process, since it is absorbed by the calcite. What then happens in practice, is that control testing for an embankment relies on patterns, using an average range of optimums for the borrow material. However, if zones of the borrow area are rich in calcite, say greater than 10 - 15%, this additional calcite will absorb some of the water artificially added to the fill, or will otherwise draw water out from the remainder of the fill. Thus, the fill will go in dry of optimum, and particle strength at the base of a layer can then be sufficient to resist breakdown under compaction, thereby developing a porous horizon at the base of such a layer. This horizon can extend over a wide area, although control testing records that the material has been put in at the required optimal conditions. It is of interest to note that the selection of borrow at Teton Dam was designed to exclude caliche rich zones, but when wet seams in the embankment were later tested, they showed up to 16% calcite in the wet seam, in comparison to around 9% in the ambient fill.

Wet seams with a calcite origin raise a problem with regard to the long term solution of the calcite. No filter design is adequate to prevent removal of calcite in solution and a situation of progressive deterioration could well exist. It would be worthwhile evaluating the present situation in any existing earth dam built of such soils. For new dams which are obliged to utilise calcitic soils, compaction as wet as can be tolerated appears to be the most practical solution.

5. ACKNOWLEDGEMENT

The incentive for this note arose from involvement with McIntyre Assocs. Consulting Engineers, on the Chinaman Creek Dam in north west Queensland. The opinions expressed herein are those of the author.

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STATE GROUP PRESENTATIONS

As part of the five year plan we are to encourage state groups to publish papers from some of their technical presentations in this journal. We hope that groups will take this opportunity, and forward to us papers for inclusion under this heading.

MOBILE MINER MM130 DEVELOPMENT

by Rick Willoughby

Presentation to Victorian Group of the AGS
Wednesday 10th June, 1992

PROJECT STATUS

Pasminco will be conducting extensive field trials of the Mobile Miner MM130 at Broken Hill throughout most of 1992. The underground trials are taking place in country rock on the five level of the southern operations where the machine is producing a development drive having a width of 6.5m and a height of 4.1m.

It should be noted that the drive has a low priority in the mine plan and its excavation is a by-product of developing the machine and its support systems. Pasminco has contracted Robbins to conduct the field trials thereby adding to a history of formal agreements between the two Companies all aimed at the long term objective of developing a hard rock mining process offering significant cost advantages over existing technology.

FROM	TO	DESCRIPTION	TO	FROM	DESCRIPTION
0.0	5.5	Muscovite-rich Pelite; coarse muscovite flakes are ubiquitous. Lesser fine garnet and a few 3-5mm feldspar augens. Thin band of sphalerite and galena at 3.9 m.	24.9	28.2	Interbanded Psammite and Psammopelite. Very fine garnet throughout.
5.5	8.1	Retrogressed Pelite with abundant fine sericite and fine garnet.	28.2	32.4	Slighlty retrogressed Psammopelite, highly fractured. Sericite on fracture faces and replacing biotite.
8.1	12.1	Psammopelite containing sillimanite knots and lesser fine garnet.	32.4	36.3	Psammopelite with some alteration of biotite to sericite. Lesser fine garnet.
12.1	15.6	Pelite with ubiquitous 3mm feldspar augens. Abundant sillimanite and lesser fine garnet.	36.3	36.9	Broken and retrogressed Psammopelite.
15.6	18.3	Psammite.	36.9	37.4	Blue quartz Lode with minor fine sphalerite. Sericite after biotite.
21.0	22.1	Pelite with ubiquitous 2mm feldspar augens. Abundant sillimanite and fine garnet.	37.4	52.4	Psammopelite containing fine garnet. Sericite after biotite and lesser partially altered 5mm feldspar augens.

Figure 1: Log of first 50 m of drive

HISTORY OF MM130

The MM 130 had its first tentative swings at the rock face on the 30th April marking the most significant milestone in the development of the machine which evolved from Pasminco's design specification delivered to Robbins in December 1986.

The prior involvement by Pasminco in monitoring the operation of the first Mobile Miner, MM120, at Mt. Isa was invaluable in formulating the design requirements. Specifically the specification concentrated on inherent reliability with a required fatigue life of 25,000 hours and a tight operating envelope to be achieved through automation.

By August 1987 Robbins had done sufficient work on modifying the MM120 configuration to believe that it was possible to build a machine consistent with the design requirements. However it was a full year before Pasminco could appropriate the funds to proceed with the project.

Robbins were given approval to undertake the design in August 1988 but early work on the proposed configuration revealed limitations that could not be resolved. This caused an intensive review with three groups in Seattle and the original patent holder, Dave Sugden, in Australia working on alternative configurations.

Sugden's radical departure from the MM120 configuration was first presented to Pasminco in December 1988 and its merits were immediately apparent.

The new configuration offered much better force management as well as more easily automated restroking and guidance controls. Design work proceeded through 1989 and Pasminco was sufficiently confident of the results to approve manufacture in May of that year.

Perry Engineering of Adelaide were contracted to build the machine and after more than two years of challenging work produced the MM130. The machine tipped the scales at 280 Tonnes prior to its shipment to Broken Hill in February 1992.

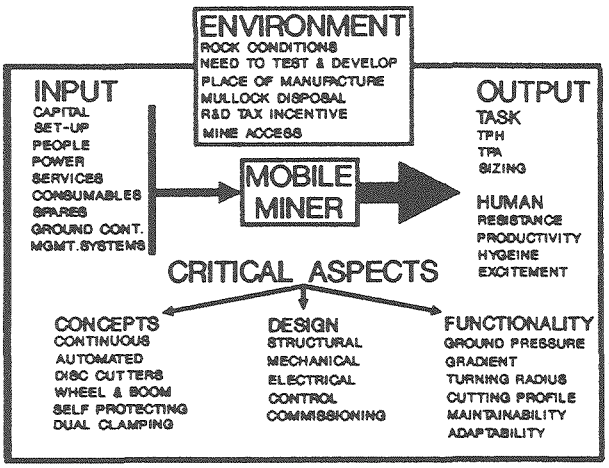

Figure 2: Engineering concept

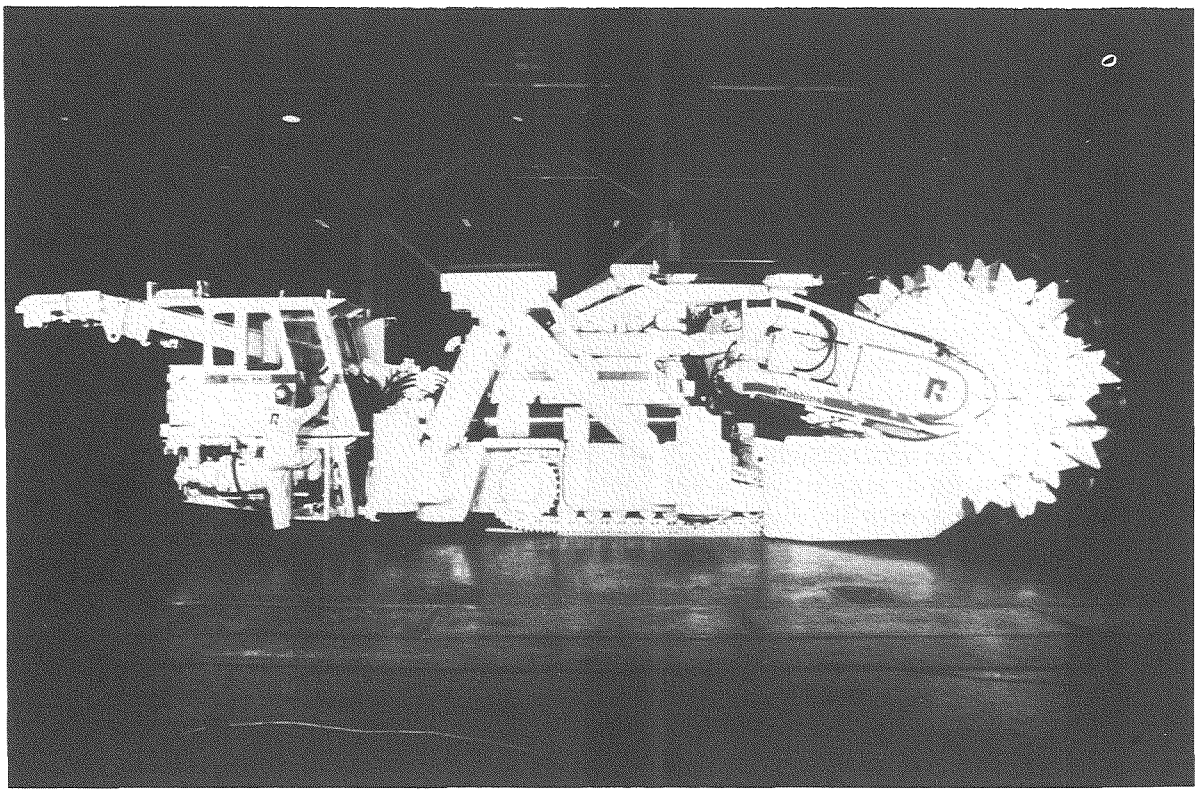

Figure 3: Mobile Miner MM120

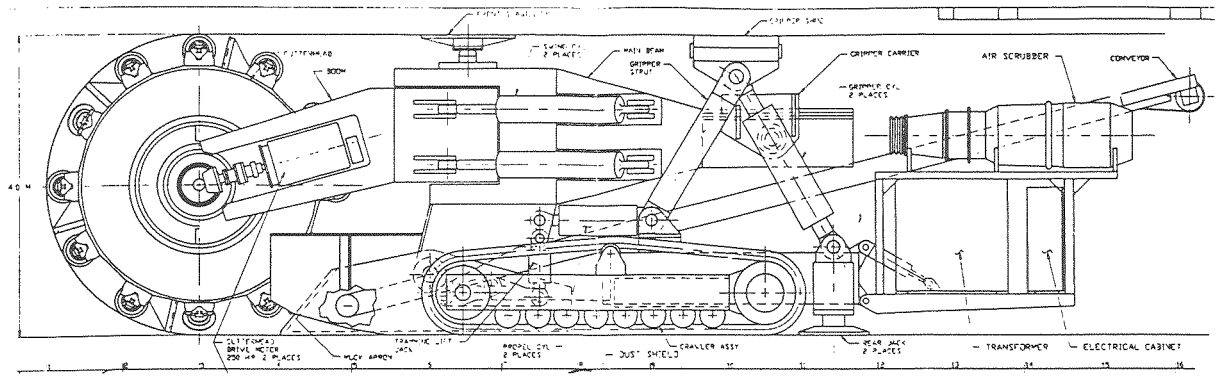

Figure 4: Proposed MM130

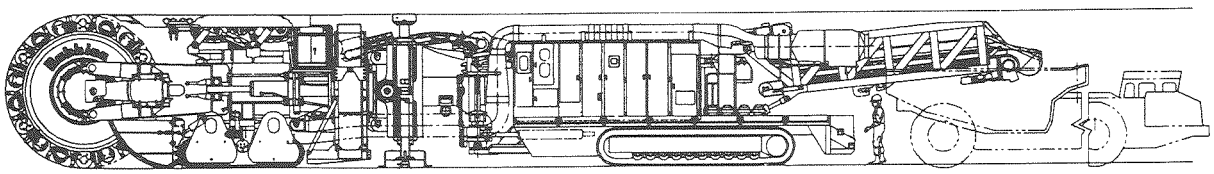

Figure 5: MM130 as designed

Figure 6: MM130 on transport

Surface trials proceeded through March and April to verify the machine's turning and climbing ability before going underground in mid April. The history of the MM130 demonstrates the research and development process. The machine as built is vastly different from the machine initially envisaged and early indications are that its performance is well above the original expectations.

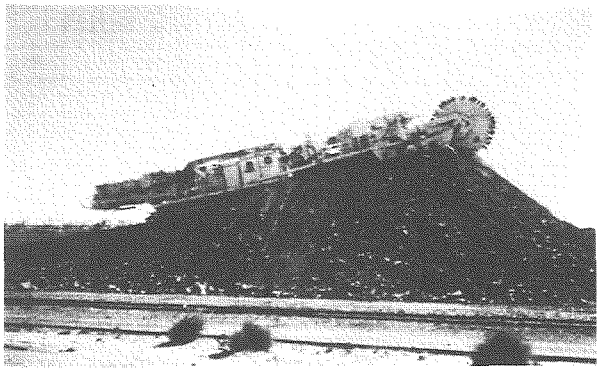

Figure 7: MM130 on 1.5 ramp

JUSTIFYING THE EXPENDITURE

When considering process development it is educational to compare existing practice with what would be achieved idealistically. Pasminco examined the hardrock underground mining process in 1987 making comparisons with underground civil construction and underground coal mines. An example of this work is the study of the workhorse of underground mining - the LHD. The sample investigated was the fleet of 8 yd LHD's in use in the southern operations at Broken Hill comprising fourteen machines that had been built up since the first purchase in 1982.

The poor utilisation of this fleet provided a staggering insight into the lost opportunities.

Since 1987 notable improvements have been achieved with the existing process by:-

* Completing the surface decline in 1990
* Adopting a more preventative attitude to maintenance
* Continuing to reduce the influence of traditional practices.

However the Mobile Miner offers the potential to make further cost savings through its automation and inherent reliability achieved by good design and on board condition monitoring. The project justification provided sensitivity analysis of the performance parameters significant to the operating costs. In order of priority they are:

1. Machine utilisation
2. Cutting rate
3. Cutter costs
4. Number of support crew.

The field trials are directed at building up the knowledge base constantly applied through the machine and its control system. The well structured software based system lends itself to rapid industrial engineering which will increase utilisation and advance rate while reducing cutter costs and the number of support crew.

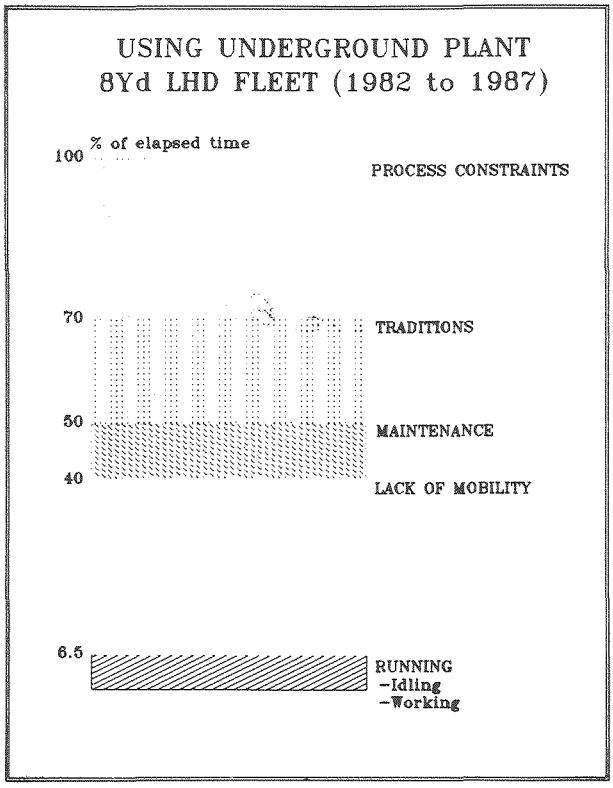

Figure 8: LHD utilisation

MM130 OPERATION

MM130 has six 435 mm rolling disc cutters mounted on the rim of the rotating cutterhead which, in twin, is swung across the rock face. The major design objective is to roll the cutters down the face with a precise depth of cut and accurate displacement of successive cuts across the face. During the design work it was recognised that the machine should achieve the positioning accuracy of a lathe and as a result the 25 T cutterhead can be restrained within 1 mm of the desired position.

The geometry of the cutterhead and its support endowers the mobile miner with the unique ability to optimise rock cutting by selecting the optimum cut at the beginning of the swing and then continuously varying the swing speed to optimise cutter path spacing. Hence the Mobile Miner can work to its potential within design limits over a wide range of rock types.

Rock cut from the face enters the machine conveyor through the opening in the muck blade. It then transfers to the rotating carousel conveyor which lifts it to the bridge conveyor then transfers to the hopper loading conveyor and finally to the storage hopper

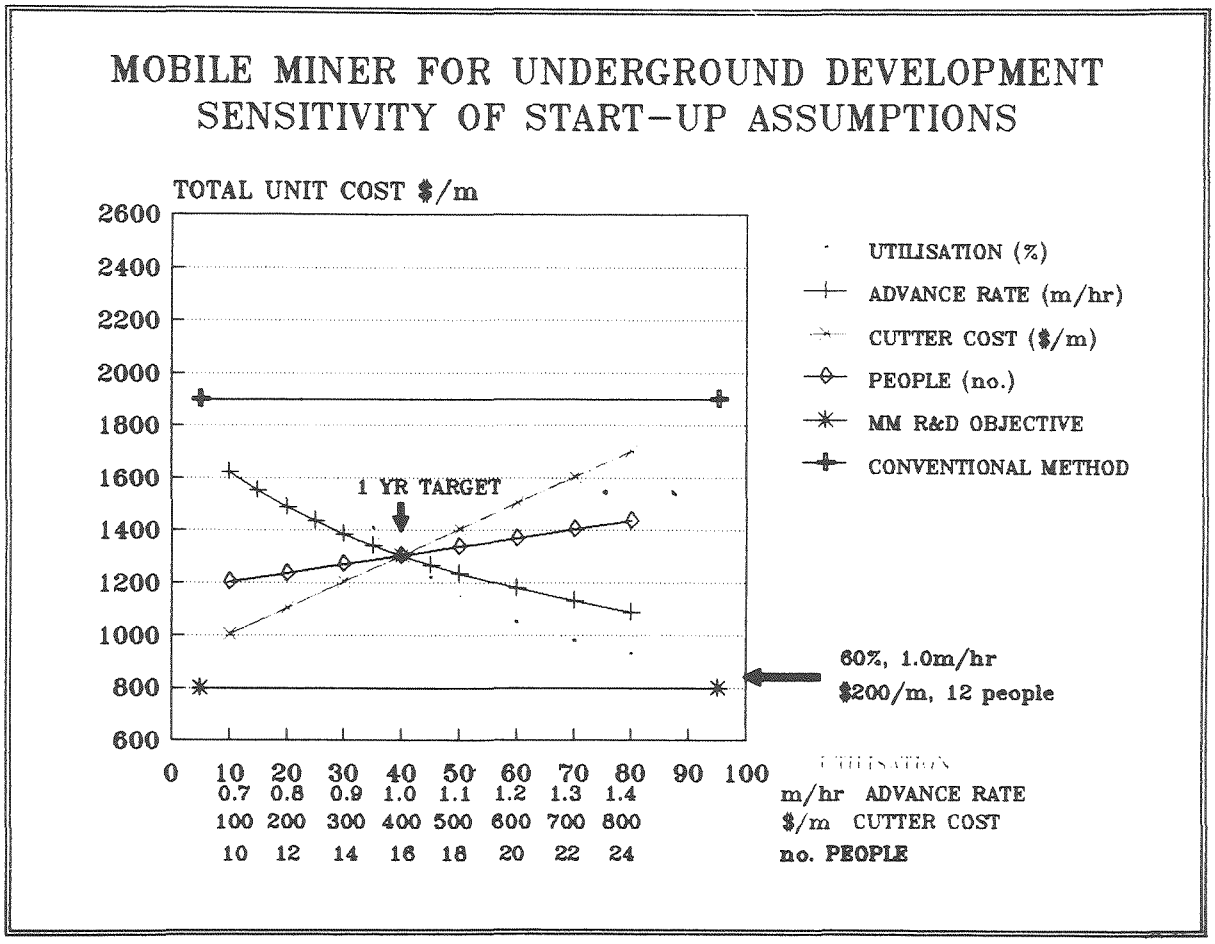

Figure 9: Sensitivity analysis

ready for discharging to a truck. This tortuous path eliminates steeply inclined conveyors enhancing the machine's ability to work on a decline.

The machine is plunged forward at the completion of each swing by thrusting from the rear. When the 750 mm stroke is completed the rear gripper is released and drawn forward to be re-gripped. During the re-grip cycle the machine remains locked in the tunnel by maintaining upward thrust on the tracked stabiliser and this is reacted through the lower tracks. The machine can correct its line and grade by manipulating the guide tube within the rear gripper. This enables precise adjustment of line, grade and camber of the tunnel.

FUTURE REQUIREMENTS

Initially the Mobile Miner operation will be disrupted by the need to rock-bolt the roof so a number of options are being investigated to provide non-disruptive ground support.

One area being considered is on-board monitoring which could accurately assess roof conditions and therefore the need for immediate support. In most cases it is not necessary to provide support at the machine but unless conditions can be accurately assessed the potential losses through roof failure balance the decision in favour of immediate support.

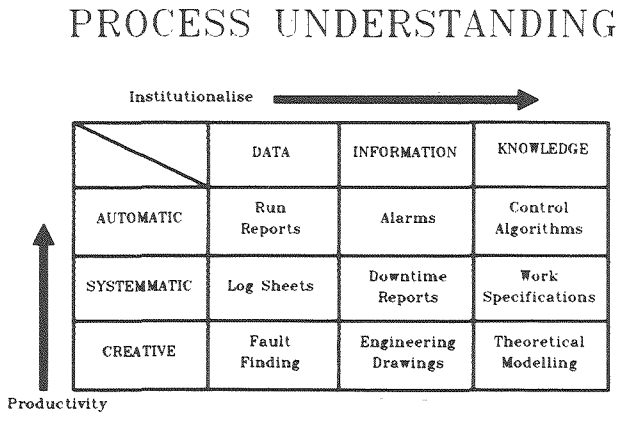

Figure 10: Application of knowledge

Hence ground assessment and on-board ground support are areas for development in the immediate future.

A significant aspect of the Mobile Miner is the relatively small and consistently sized muck produced. The material is immediately suitable for conveyor transport. Accordingly route flexible and extendable conveyors are being assessed for their applications to materials handling behind the machine.

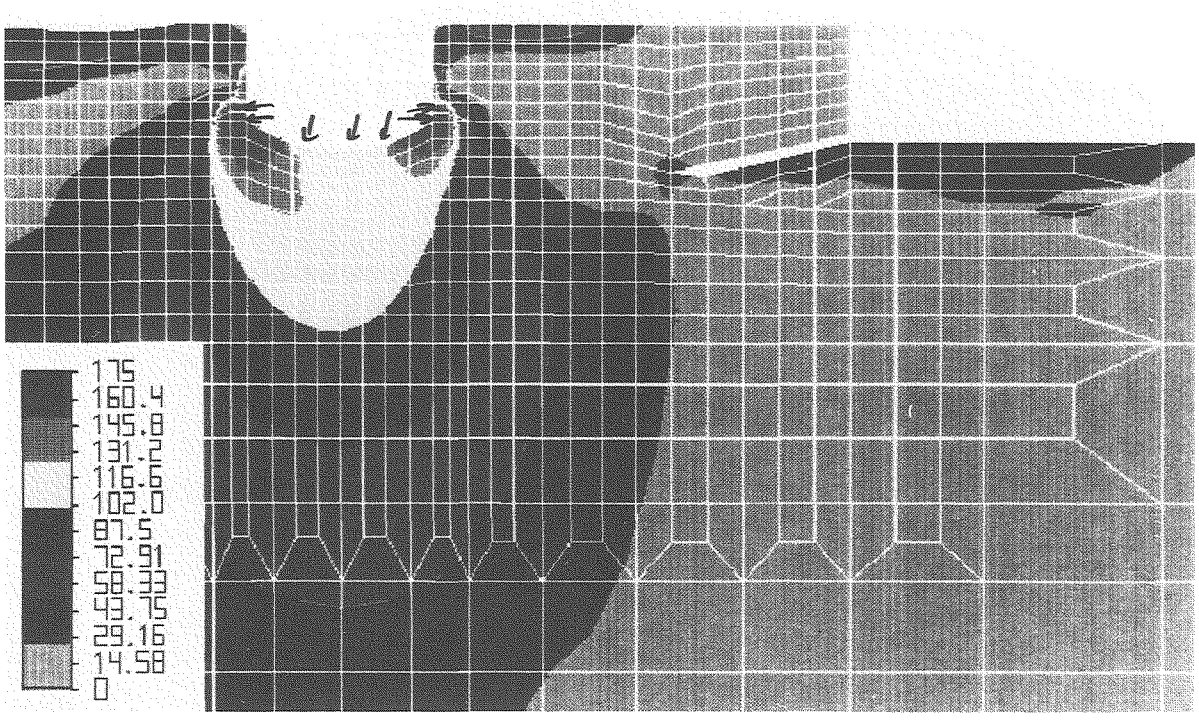

Figure 11: FEA of Rock

As a mining machine it is envisaged the Mobile Miner will work in a cut-and-fill operation. All machine ground pressures have been designed to enable operation on fill. However guidance of the machine through the orebody to achieve optimum recoveries is a task which should be readily automated given the proper information and tools for collecting it.

ACKNOWLEDGMENT

MM130 is a significant advancement over MM120 and as such represents a large risk. Many people contributed to the innovation apparent in the design but two people stand out in providing the wisdom necessary to achieve major milestones in an R&D project of this scale.

Reg Fraser ensured a supportive corporate environment and Dave Sugden bettered the most difficult engineering challenges.

CONFERENCE REPORTS

The Hague, The Netherlands was the venue for the **Fourth International Conference on the Application of Stress-Wave Theory to Piles** held on September 21-24, 1992.

The conference was attended by over 200 participants from 35 countries. The participants consisted of academics, consultants, contractors and the mixture of the three certainly added a variety of discussion to the application of Stress Wave Theory to Piles.

The Australian contingent was 13 strong - disproportionately high for Australia's size. There were representatives from Wagstaff Piling, Frankipile, Golder Associates, Maunsell Consultants, the University of Western Australia, Queensland University and Monash University.

The proceedings for the conference consisted of 112 papers accepted for final publication. Seven Australian papers were accepted for the proceedings, three of which were presented at the conference.

The conference lasted 4 days. The first, third and fourth days were dedicated to the Scientific Programme. This consisted of presentations, discussions, poster sessions and an indoor exhibition. The second day was a Testing and Demonstration day. The day included outdoor demonstrations and exhibitions of pile installation and instrumentation techniques.

The Scientific Programme was broken down into 4 sessions each with a specific theme. The session themes are listed below:

Session 1
Geotechnical and Environmental Aspects
(soil-pile modelling, displacements, vibration, noise)

Session 2
Dynamic Testing
(equipment, data acquisition and interpretation)

Session 3
Performance During Installation
(equipment, hammer-pile-soil system, drivability)

Session 4
Reliability of Predictions
(theory versus experiment, measurement, modelling)

An excellent keynote presentation was given by Prof. Mark Randolph entitled "Dynamic and static soil models for axial pile response". Mark described the development of a one-dimensional soil model for the analysis of the axial response of piles, for both static and dynamic loading. He then compared models derived from empirical means to those derived from continuum analysis of the soil and pointed out the relative merits of the various methods.

He concluded that the continuum soil model, using fundamental soil properties does not necessarily provide a better simulation of actual pile response than empirical models, but provides a more secure basis for analysis. Further work is necessary to bridge the gap between the two types of model development.

Another very interesting keynote presentation was given by K.R. Massarsch of Belgium titled "Static and dynamic soil displacements caused by pile driving".

This presentation looked at the vibrations caused by pile driving highlighting the transfer of pile hammer energy from the pile head to the surrounding soil. The author discussed the effect of vibrations on the soil and surrounding structures and offered guidelines to predict vibrations and settlements in the ground. He also presented a semi-empirical relationship for the assessment of permissible vibration levels in buildings.

In conclusion the author stated that ground distortion, which is caused by the passage of waves below buildings and structures, can cause damage due to repeated sagging and hogging motion. This presentation touched on a topic which is not fully understood but is of vital importance to environment aspects of piled foundations.

To continue the Australian flavour, David Klingberg of Wagstaff Piling presented his joint paper with Julian Seidel entitled "The instantaneous liquefaction of silty soils during installation of displacement piles". Slav Tchepak of Frankipile Australia also presented his paper "Dynamics and sonic integrity testing - A contractor's experience".

On a lighter note the Demonstration day was both interesting and entertaining. The day's programme was as follows:

1. The simultaneous driving of slender prestressed concrete piles with 4 different piling rigs using different types of pile hammers under competition conditions. Attention was given to vibration and noise emission during driving. Unexpectedly, an old double-acting diesel hammer won the day in front of more high-tech hammers, and even seemed the quietest.

2. Different vibratory techniques to drive and extract sheetpiles and various monitoring systems on sheetpile interlocking.

3. Demonstration of dynamic load test techniques on piles (Statnamic and Pseudo-static).

4. Application of sonic integrity testing on piles with prefabricated defects and verification of the predictions afterwards by revealing the actual pileshapes.

An additional highlight on the day was the international competition for driving a timber pile in the traditional way as it was done 150 years, with a timber A frame and the "monkey" hoisted by a group of men pulling on a rope bundle.

Australia competed, but with only 10 of 13 delegates - Mark Randolph was having his afternoon nap, Andrew Deeks says he took the wrong bus and ended up in town, and Jon Cannon was too busy integrity testing the defective piles for the prediction exercise. (He did come in equal second with Julian Seidel).

David Nolan was present but was late because he could not easily be extracted from the SPT all-terrain vehicles which he spent most of the day in.

New dynamic testing equipment from Pile Dynamics, TNO and IFCO were on display at the Conference. The equipment is reducing in size at a remarkable rate with units now lunch-box size - amazing for those of us who remember boarding planes with 200 kg of excess baggage. Although the packaging has changed dramatically, the units essentially operate the same way as the original PDA units of 10 years ago.

In conclusion, the conference was a success, and gave a good opportunity for old friends (and foes) from around Australia and the world to mix in a related atmosphere.

Anyone wishing to obtain a copy of the proceedings (published by Balkema) or the results of the prediction exercises and driving competition (yet to be published) should contact Julian Seidel at Monash University on (03) 565 5581.

UPCOMING LOCAL CONFERENCES

CONFERENCE ON GEOTECHNICAL MANAGEMENT OF WASTE AND CONTAMINATION
22-23 MARCH, 1993
NIKKO POTTS POINT HOTEL

The AGS and I.E.Aust. sponsor this conference on Geotechnical Management of Waste and Contamination. The conference will be of interest to all who are involved in waste and contamination, but particularly to geotechnical engineers, engineering geologists, hydrogeologists and environmental engineers and scientists.

Topics for the conference include:

Site Investigation and Monitoring Techniques for Contaminated Sites and Potential Waste Disposal Sites; Groundwater Contaminant Flow in Soil and Rock; An Overview of Regulatory and Non Regulatory Control for Contaminated Sites; Remediation of Contaminated Sites; Ground Modification Techniques; Foundations for Reclaimed Landfill Sites; Design and Management of Landfills; Seepage and Contamination from Mine Waste.

Registrations can be made at the conference. Further information can be obtained from:

The Convention Manager
Conference on Geotechnical Management of Waste and Contamination
AE Conventions
Engineering House
11 National Circuit
Barton ACT 2600

AUSTRALIAN CONFERENCE ON GEOTECHNICAL INSTRUMENTATION AND MONITORING IN OPEN PIT AND UNDERGROUND MINING
21-23 JUNE, 1993
KALGOORLIE, WESTERN AUSTRALIA

The Western Australian School of Mines (WASM) organised this conference and workshop following discussions held at an early Conference on Mining Geomechanics at WASM in 1992. The conference will provide a discussion forum for professionals in Mining Engineering, Mining Geomechanics, Engineering Geology, Civil Engineering and Environmental Engineering. The Conference will make a contribution to the advancement of theory and practice of geotechnical instrumentation and monitoring, and will provide a basis for safe production, better resource utilisation and better environmental control in the mining industry.

The Conference topics will include Monitoring Systems (Advanced Warning Systems; Remote Controlled Systems; Survey Methods of Monitoring; New Techniques in Monitoring), Slope Stability Monitoring (Monitoring Networks; Slope Stability and Design; Failure Mechanisms; Case Histories), Instrumentation and Monitoring in Underground Mining (Rock mass Behaviour; Monitoring Pillar Stability; Mining Induced Subsidence; Estimation of Geotechnical Parameters), Monitoring of Rock Support and Reinforcement (Monitoring Reinforced Rock Mass Performance; Monitoring of Strain in Bolts; Instrumentation of Support; Optimisation of Support and Reinforcement), Geophysical/Seismic Monitoring and Stress Measurement (Seismic Activity Monitoring; Stress Measurement; Blast Monitoring; Case Studies), Monitoring of Model Studies and Experiments (Post Failure Pillars Behaviour; Monitoring of Rock Drillability; Modelling of Slope Stability; Prediction of Subsidence).

The Conference and Workshop registration fee is $650 and is required before 30 May 1993. For further information contact:

Course Director
Trevor Little
Western Australian School of Mines
Tel: (090) 805 155
Fax: (909) 805 151

THE FIRST AUSTRALIA-NEW ZEALAND YOUNG GEOTECHNICAL PROFESSIONALS CONFERENCE FEBRUARY 1994 SYDNEY

Aim

To bring together young geotechnical engineers and engineering geologists so they may become more aware of the work of others (similarly and more experienced) in their field. To provide young geotechnical professionals with a more active role in Australasian geomechanics societies (i.e. AGS & NZGS) and prepare them for a future leading role in their affairs.

Location and time

Three days and three nights in February 1994 at the University of New South Wales, Kensington, NSW. It is hoped that organisations from both New Zealand and the Pacific will sponsor registrants to this first conference. It is expected that the second conference will be held in 1998.

Target audience

One or two fully funded registrants from each of the sponsoring organisations. It is expected that each organisation will cover the full conference cost for their registrants, this will include: accommodation, meals, conference and travel. Registrants are expected to contribute their time from leave entitlements and should be 35 years old or younger. The number of registrants will be limited to about 30 to ensure a relatively relaxed atmosphere. If too many applications are received then applicants will be selected on the basis of maintaining an equitable distribution between organisations and on a review of the synopses submitted by intending registrants. If more stringent selection is required then the organising committee will select applicants between five and ten years from initial graduation. Organisations should select potential registrants with a view to encouraging those they see as having a future leading role in the ANZ geotechnical community. It should be seen as an honour to be selected by your organisation to attend the conference.

Format

The conference format will be:

- The conference will be residential even for those registrants who reside in the Sydney, registrants arriving on Wednesday after 6pm and departing Saturday after 4pm.

- Each day there will be a single paper presented by an experienced geotechnical professional on: professional practice, interesting case studies, or new topic areas (e.g. environmental geomechanics, soft rocks, etc). These speakers will be carefully selected, invited and will act as mentor for the day, along with the organising committee. The audience will therefore be, say, four or five senior professionals and the young registrants.

- Each registrant will have to submit to the conference (for prior inclusion in a limited distribution proceedings) a 3 to 5 page "paper" on a project on which they had been involved (research or work related). The registrants will then present a 15 to 30 minute discussion of the project to the conference. This is not meant to be onerous but will provide valuable experience in preparation and presentation of papers and enable the ready transfer of experience between registrants. This activity is a requirement of all registrants.

- Two half day site visits to local projects of interest led by experienced geotechnical professionals and visits to local university geotechnical engineering departments.

- Evenings will be informal social gatherings; the programme is yet to be finalised but may include: first, registration and drinks; second, barbecue; third, meal at local restaurant. University college breakfasts and lunches.

No single commercial organisation will dominate the conference and access by senior staff will be limited so each organisation need not be concerned that the conference will become a recruiting forum for the opposition. Hopefully each sponsoring organisation will be confident of their ability to keep their own staff.

Cost

Registration cost will be kept to an absolute minimum and will include:

College accommodation, breakfasts and lunches.
Three evening functions.

Proceedings.

Registration cost should be between $300 and $400, subject to more careful costing.

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Are you interested?

There will be no general distribution of bulletins nor call for papers; this notice will be the main request for expressions of interest. If you or your organisation are interested in participating/ sponsoring please write to or fax:

Mr Garry Mostyn
Chairman, Organising Committee
First ANZ Young Geotechnical Professionals Conference
C/- The School of Civil Engineering
University of New South Wales
P.O. Box 1, KENSINGTON, NSW, 2033
Fax: (02) 663 2188 Int'l fax: 612 663 2188

and further particulars will be sent to you in due course. In the first instance please provide the following details:

1. Organisation name 2. Postal address 3. Fax number 4. Contact name & phone number 5. Possible nominee registrant (if known, leave out if selection pending) and 6. Likelihood of sponsoring one or more nominees.

CENTRIFUGE 94
AUGUST 31 - SEPTEMBER 2 1994
SINGAPORE

The Internal Conference on Geotechnical Centrifuge Testing, CENTRIFUGE 94, will be held in Singapore from 31 august to 2 September, 1994. This is a continuation of two previous conferences held in 1988 in Paris, France and in 1991 in Boulder, USA.

The conference is organised by the National University of Singapore in collaboration with International Society of Soil Mechanics and Foundation Engineering (ISSMFE) Technical Committee TC2 on Centrifuge Testing. The conference is also sponsored by Australian Geomechanics Society, Institution of Engineers Singapore and Southeast Asian Geotechnical Society.

The themes of the conference include:

1. Centrifuge modelling in the study of natural and man-made disasters, as a contribution to the International Decade of Natural Disaster Reduction.

2. Latest developments in centrifuge modelling facilities and equipment.

3. Centrifuge modelling of geotechnical problems with special attention to those which are relevant to Southeast Asia and Australia.

Important dates:

1. Submission of 300-word abstract - 30 April, 1993

2. Notification of abstract acceptance - 30 June, 1993

3. Full paper for review - 30 September, 1993

4. Notification of reviewers' comments - 31 January, 1994

5. Submission of camera-ready manuscript - 30 April, 1994.

For enquires, please contact:

Dr. C.F. Leung
Chairman, CENTRIFUGE 94
c/- Department of Civil Engineering
National University of Singapore
10 Kent Ridge Crescent
SINGAPORE 0511
Tel: (65) 772 2281
Fax: (65) 779 1635
E-mail: cvelcf@nusvm.bitnet

STATE GROUP REPORTS

VICTORIAN GROUP

The 1993 Committee comprises:

Chairman	
Ian Pedler	Coffey Partners Int. Pty. Ltd.
V-Chairman	
Dr. C. Haberfield	Dept. of Civil Engineering, Monash University
Secretary	
Don Raisbeck	Kinhill-Doris Joint Venture
Treasurer	
Robert Smith	Australian Construction Services
Civil Board Rep	
Dr. Bill Bamford	Dept. of Civil & Environmental Engineering, Melbourne Univ.
Dr. Sandy Bennet	Connell-Wagner Rankine & Hill (Vic) Pty. Ltd.
Dr. B. Chandler	Maunsell Pty. Ltd.
Donald Jordan	Faculty of Engineering, Vic. University of Technology
Ian McKenzie	
Peter McDonald	D.J. Douglas & Partners
Dr. W. Power	CSIRO, Division of Geomechanics
Ray Sanders	Coffey Partners Int. Pty. Ltd.
Keith Seddon	MPA Williams & Associates
Julian Seidel	Dept. of Civil Engineering, Monash University
Peter Thornton	Golder Associates Pty. Ltd.
Heather Wardlaw	Gutteridge Haskin & Davey
(Ex-officio)	
Max Ervin	Golder Associates Pty. Ltd.

REPORT ON RECENT MEETINGS

JULY 8 1992

Dr. Zu Yu Chen

Visiting Senior Research Fellow to Monash University from the Institute of Water Conservatory and Hydro Power Research, Beijing China

Dr. Chen presented a series of case studies on major slope stability problems encountered over the past twenty years associated with the development of China's hydroelectric power generation programme. The volumes of unstable material have been as much as 7.0 x 10^6 m^3, and have both involved serious loss of life, and successful anticipation of imminent failure, with subsequent saving of many lives.

The case studies included cases of documented regional instability going back thousands of years, instability caused by changes in the groundwater regime due to dam-filling; instability through poor construction techniques and failures due to geological features not identified or appreciated during the design process.

Dr. Chen outlined the analytical methods employed by his Institute, and described some of the probabilistic approaches used to incorporate defect continuity into these analyses. Methods of prediction of time of collapse for slopes already suffering instability movements were also presented. The new centrifuge just commissioned at the Institute was also described.

Contact:

Dr Zu Yu Chen
Senior Geotechnical Engineer
Institute of Water Conservancy and Hydroelectric Power Research
10 West Chegongzhuang Road
PO Box 366, Beijing, China
Phone: +86-1-841-2173
Fax: +86-1-841-2316

AUGUST 12 1992

The Development of Soft Ground Tunnelling Around Melbourne

A. Nelson, Melbourne Water

This meeting was on the Campus of RMIT and covered the history of tunnel construction and current experiences of the speaker in tunnelling operations.

SEPTEMBER 16 1992

Engineering Geoleogy of Melbourne

The purpose of this seminar was to launch the book 'Engineering Geology of Melbourne'. Work on this book was initiated by the Victorian Group in 1989, with the aim of extracting, collating and integrating the available geotechnical data and the relevant geological information. The seminar was attended by over 150 people and involved the following speakers and topics.

Geological Setting and Basement Geology
Dr. N. Archbold, Faculty of Science
Deakin University - Rusden Campus
662 Blackburn Road, Clayton

Tertiary and Quaternary Geology
Mr. J. Neilson
55 Glyndon Road, Camberwell, 3124
(Previously with Geological Survey of Victoria)

Hydrogeology
Mr. R. Lakey
Department of Water Resources

Geological Hazards
Prof. W. Peck
RMIT Department of Civil and Geological Engineering
GPO Box 2476, Melbourne

Geotechnical Engineering Parameters
Mr. K. Seddon
MPA Williams and Associates
533 Nepean Highway, Bonbeach, 3196

Geotechnical Projects
Dr. J. Morgan
Golder Associates Pty Ltd
25 Burwood Road, Hawthorn

Construction Materials
Mr. I. McHaffie
Department Energy and Minerals
Geological Survey Division
115 Victoria Road, Melbourne

OCTOBER 14 1992

Engineering Problems with Soft Clay

Peter McDonald (VICROADS) introduced the topics with a brief overview of the history of soft clay geotechnology. As might be expected, some of the most significant initiatives in this area followed major settlement or landslide problems in various parts of the world. Some dramatic examples of these problems were shown, including massive quick clay slides and bearing capacity failures of silo structures. Max Ervin of Golder Associates then presented some detailed information on the engineering properties of Melbourne's problematic Coode Island Silt and described how these properties could be interpreted to allow reasonable predictions of foundation behaviour. Peter McDonald returned in the final segment to present some field and laboratory examples illustrating particular interpretation problems and characteristics of soft clays. He concluded by summarising the main design and construction solutions adopted for soft clays, including a vivid description of bog-blasting for embankment construction.

Contacts:

Peter McDonald
Manager-Geotechnical
Vicroads
Materials Technology Department
60 Denmark Street
KEW VIC 3101
Ph: (03) 854 2054

Max Ervin
Manager-Victoria
Golder Associates Pty Ltd
25 Burwood Road
HAWTHORN VIC 3122
Ph: (03) 819 4044

NOVEMBER 11 1992

A Brief Overview of the A.G.S., Victoria Group

I. V. Pedler, Coffey Partners International Pty. Ltd.

The lecture outlined the development of geomechanics in Australia which culminated in the formation of the Australian Geomechanics Society in 1970. Contributions by the founding and subsequent members of the Victoria Group Committee were acknowledged together with those members who have served on the National Committee.

Speakers that have addressed regular technical meetings were presented. A list of publications prepared by the Victoria Group over the years, assembled with the assistance of the Victoria Group publicity officer, Robert Smith, was circulated to the meeting.

Following a brief summary of current developments in geomechanics research and practice the future developments of geomechanics in Victoria was addressed. It was concluded that geomechanics activity appears to be moving away from public sector groups to provide industry with the emphasis on road and rail infrastructure. A number of recently announced projects were cited and discussed.

FUTURE MEETINGS

FEBRUARY 10 1993: Tunnels and Shaft Excavations in Tertiary Basalts and Clay, *John Braybrook, D.J. Douglas and Partners P/L*

MARCH 10 1993: Recent Developments in Geophysics for Engineering Applications, *Dr. Bob Whitely, Coffey Partners International Pty Ltd.*

APRIL 14 1993: Hong Kong Airport, *Dr. J. Endicott, Maunsell Geotechnical Services Ltd.*

MAY 12 1993: Joint ACADS/AGS Seminar on Slope Stability.

SPECIAL PROJECTS AND PUBLICATIONS

- The book "Engineering Geology of Melbourne" was published by Balkema in September.
- The Foundations and Footing Society (Vic). A.G.S. has had representation on the organizing committee.
- Piling Sub-committee reported on the safety issues associated with inspections of bored piles. Another Sub-committee was formed to give comment on the SAA draft Piling Code.

SYDNEY GROUP

At the Annual General Meeting on 11 November, 1992, the following Committee was elected for 1993.

Chairman	
Bruce Walker	Jeffery & Katauskas
Secretary	
Peter Andrews	D.J. Douglas & Partners
Committee	
John Braybrooke	D.J. Douglas & Partners
Hendrick Buys	Arup Geotechnics
Prof. John Carter	Sydney University
Simon Dale	Knight Piesold
Prof. Robin Fell	University of NSW
Dr. Charles Gerrard	Golder Associates

Jack Hodgson	Jack Hodgson Consultants
Andrew Leventhal	Longmac Associates
Dr. Neil Mattes	Coffey Partners Int.
Jim Millar	J.A. Millar & Associates
Garry Mostyn	University of NSW
Dr. Tony Phillips	Arup Geotechnics
Prof. Harry Poulos	Coffey Partners Int.
Dr. John Small	Sydney University
Patrick Wong	Coffey Partners Int.

REPORT ON RECENT MEETINGS

Technical meetings in the second half of 1992 were as scheduled in the last issue of Australian Geomechanics. All meetings were attended by between 40 and 60 people. Summaries of the meeting topics are:

JULY 8 1992

Malanjkhand Copper Project

Andrew Leventhal, Longmac Associates Pty Ltd

The Malanjkhand Copper Mine is located in central India in the State of Madhya Pradesh and is India's largest base-metal open-cut mine. The open pit is currently 120 metres deep and produces about 2 million tonnes of ore and 11 million tonnes of waste rock annually. As part of a study for the optimum exploitation of the deposit, geotechnical studies were undertaken to determine open pit batter slopes for a possible open-cut to 200 metres depth and conditions for underground mining to 600 metres. The investigation extended to depths of 700 metres. The talk presented details of the geotechnical drilling, hydrogeological instrumentation and monitoring, and results of rock mechanics testing performed both in India and Australia. Details of the design approach for both kinematic and statistical analyses for slope stability of 200 metre deep open pit batters were presented. The underground mining method required the reverse philosophy in that slope instability was necessary to promote economic mining of the resource. The assessment of the onset of failure of the hanging wall was discussed.

AUGUST 12 1992

Rock Bolting and Anchors

Dr. Charles Gerrard, Golder Assoc and Mr. Ross Seedsman, ACIRL

Rock bolting and anchoring are used to provide support for excavated faces and obviate the need for other, more traditional methods, in many cases offering considerable cost savings. The discussion covered the bases for determining the orientation, length and amount of bolting and anchoring required for typical excavations. A range of case histories, for both hard and soft rock, were discussed to illustrate some of the important practical aspects related to the use of rock bolts and anchors.

SEPTEMBER 9 1992

Recent Geotechnical Research at the University of Sydney

Prof. John Carter, Director, Centre for Geotechnical Research, University of Sydney

Recent research carried out within the Centre for Geotechnical Research at the University of Sydney has been wide-ranging. It includes further work in the more conventional areas of soil mechanics foundation engineering, rock mechanics and soil-structure interaction as well as the newer areas of offshore and ocean engineering, and environmental geotechnics, including the problems of waste disposal and pollution migration. The talk described this work and presented some of the recent findings. The relevance of the research to geotechnical practice and the collaboration with industry was highlighted.

OCTOBER 14 1992

A Study of the Rippability of Rock

Prof. Robin Fell & Garry Mostyn, University of NSW

A research project which examined the factors affecting the rippability of rock was carried out at the University of NSW with funding from the RTA. The aim of the project was to improve methods of predicting rippability. A large database of geological, seismic and ripping data was collected from several different construction sites in NSW. Scale modelling of the ripper penetration was carried out in the laboratory on artificial sandstone. A full size bulldozer tyne was instrumented in order to measure the forces required to break the rock during ripping. Numerical modelling of the ripping process was carried out using a three dimensional discrete element program, 3DEC. Data from each of the areas of investigation was analysed in order to determine which factors were significant in the process of ripping rock. Existing prediction methods were then compared with these results. A new method was proposed for assessing ripping productivity and limit of rippability conditions.

NOVEMBER 11 1992

Significant Contributions to Geotechnical Engineering in Relation to Local Practice

Bruce Walker, Jeffery and Katauskas

Although many university courses now formally teach geotechnical engineering as a science, the practice still remains an art to some degree. The science attempts to formally describe behaviour of the ground within a framework of constitutive equations based on various simplifying assumptions. However, the ground is variable and as yet has not passed any university exam as to the science of its own behaviour. Nonetheless, over the years practitioners have been able to come to grips with fundamental aspects as to the ground's behaviour based on the breadth of their experience combined with their own skill and powers of observation. The talk outlined some of the advances that have occurred to

transform the art to science, particularly over more recent years, by reviewing some of the contributions made by practitioners. These were related to local problems and their solutions.

FUTURE MEETINGS

The following meetings are scheduled for the first half of 1993. All meetings will be held in the Auditorium, Eagle House, Milsons Point at 6.00 pm unless noted otherwise.

FEBRUARY 10 1993

Use of Soil Nailing in Stabilisation of a Freeway Embankment

Gregory Won, Roads and Traffic Authority (NSW) Geotechnical Group

The Roads and Traffic Authority successfully completed a major soil nailing project at Mt White on the F3 Sydney to Newcastle Freeway, 56 km north of Sydney during 1990. The Freeway embankment is approximately 30m high, composed of compacted clayey silty sands and ripped sandstone with armour rocks for slope protection. The slope became unstable due to prolonged heavy rains in 1989. The head of the slip threatened the integrity of the upper embankment and pavement. A detailed geotechnical investigation was undertaken and a number of slope repair schemes proposed. The soil nailing method was adopted based on expediency, practicality of construction and cost. The use of this new technology resulted in cost savings of 40% over alternative schemes. The soil nailing aspect of the work protected the upper section of the road embankment from further deterioration enabling stabilisation of the remainder of the embankment by slope regrading to be undertaken. The presentation will cover aspects of the design, construction and performance monitoring of the soil nailed structure. The slope repair work consisted of progressive excavation of four benches in a terraced arrangement of the upper embankment. Benches were 2m high and 1.5m wide. The total height of the structure is 8m and 140m long. A total of 400 soil nails each 12m long were used. A 10 minute video will be included in the presentation. The project received a highly commended award in the 1991 Institution's Engineering Excellence Awards (Newcastle Division) for this innovative slope repair method.

MARCH 10 1993

Subsidence of Cliffs due to Mining

Don R. Kay, Subsidence Engineer, Department of Mineral Resources, NSW

A significant proportion of current and future coal mining proposal is affected by subsidence issues relating to steep slopes or cliff lines. However, in 1989, there was no monitoring data on the movements of steep slopes or cliff lines as they were being undermined and there were no guidelines to assist in predicting subsidence near cliff lines or the effects of the subsidence on the cliffs. In November, 1989, the Department of Mineral Resources was awarded a grant under the National Energy Research Development and Decentralisation Programme to study the Effects of Subsidence on Steep Topography and Cliff Lines. The objective of the project was to improve the understanding of the strata mechanisms involved when a steep slope or cliff is undermined and then to formulate appropriate methods which could predict the ground movements near such topography. The project comprised the following phases:

(i) the detailed monitoring of steep slopes and cliff lines using reflectors attached to the cliffs and precise EDM surveying techniques;
(ii) the analysis of the monitored data and the formulation of possible mechanisms to explain the observed ground movements;
(iii) the running of numerical models to assist in understanding the strata mechanisms;
(iv) the collation of available data on mining induced cliff falls and the identification of factors that affect the risk of cliff falls; and
(v) the development of predictive models of the effects of subsidence on cliffs and steep topography.

The talk will cover all the above study phases and will include background information, a summary of the monitoring data, modelling results and the conclusions to the study.

APRIL 15 1993

New Airport at Chek Lap Kok, Hong Kong

Dr. John Endicott, CEO, Maunsell Geotechnical Services Ltd

Hong Kong has perceived a need for a new airport since the 1970's when site selection studies were undertaken. These identified a site at Chek Lap Kok requiring levelling of two islands and filling in the sea with reclamation. In 1982 a trial reclamation and test embankment were constructed and the instrumentation has been monitored for 10 years. In 1990 Greiner from USA and Maunsell were appointed to prepare the Master Plan for a new international airport with capacity for use up to the year 2040 forecast passenger demands. The appointment included an extensive advanced works contract and the detail design for the site preparation. In August, 1992, a price of HK$9.07 billion was agreed as the result of competitive tender for the site preparation contract. The work involves excavation of some 90 million cubic metres of dry fill, the removal of some 80 m cubic metres of mud dredged from the reclamation area, and the import by sea of over 80 million cubic metres of fill. Over 12 kms of seawall construction are included. This will be a joint meeting with the Civil Panel.

MAY 12 1993

Salinity in the Murray-Darling Basin

Don Blackmore, Chief Executive, Murray-Darling Basin Commission

The Murray-Darling Basin initiative was developed after a meeting of Ministers in 1985. It was formally established in legislation on January, 1988. The administrative/ management arrangements consist of political, agency and community involvement and decision-making and implementation. The Murray-Darling Basin covers 1.06 million square kilometres or approximately one-seventh of the area of Australia and is equivalent to the area of France and Spain combined. The Basin is Australia's most important agriculture region, accounting for approximately half of the nation's gross agricultural production. The Basin has undergone major change in the last two hundred years. This change has resulted in significant degradation which needs to be addressed at a Basin scale if progress is to be made for their resolution. In recent years the role of groundwater as a major contributor to degradation has been realised and efforts made to determine the likely impact of further changes in groundwater status. The talk will canvass the outcomes of these investigations, their impact on land and water management strategies in the Murray-Darling Basin.

JUNE 9 1993

The Great Debate - Geotechnical Engineering should be Standardised

Speakers For:	**Speakers Against**
Dr. Neil Mattes	Dr. Tony Phillips
Coffey Partners Int	Arup Geotechnics
Mr. Dick Kell	Mr. Jim Williams
McMillan Britton & Kell	Roads & Traffic Authority
To be advised	Mr. John Ryder
	Ove Arup & Partners

Have you ever been concerned by the wide variety of methods adopted by the geotechnical community? Worried about the increasing rigidity of Australian Standard? Then "The Great Debate" should interest you. The debate will be conducted under the formal rules of debating with adjudication and comment offered after the teams close. Subsequent discussion from the floor will be welcome. The speakers have been requested to be penetrating, informative and amusing, i.e., much better than television, so come along.

CONFERENCE

A conference will be organised by the Sydney Group on the "Geotechnical Management of Waste and Contamination", at the Nikko Hotel, Potts Point, on 22 and 23 March, 1993.

The conference will consist of eight theme papers from invited authors and over 30 papers from individual authors. The theme papers are designed to cover all aspects of geotechnical engineering in waste and contamination.

The eight theme papers are:

- Site investigation and Monitoring Techniques for Contamination Sites and Potential Waste Disposal Sites
- Groundwater Contaminant Flow in Soil and Rock
- An Overview of Regulatory and Non-Regulatory Control for Contaminated Sites
- Remediation of Contaminated Sites
- Ground Modification Techniques
- Foundations for Reclaimed Landfill Sites
- Design and Management of Landfills
- Seepage and Contamination from Mine Waste

SOUTH AUSTRALIA GROUP

As usual the South Australian Group held a full program of technical meetings, on the third Monday of each month in Chapman Hall, Institution of Engineers, 11 Bagot Street North Adelaide.

Meetings held in 1992 are listed below. Meetings have generally been well attended; notably the March '92 meeting with Civil College eminent speaker, Murray Gillon, which attracted about 60, the August joint meeting with Footings Group (75) and the seminar (55). Murray Gillon spent the weekend in Adelaide and was entertained by various members of our group including a night at the 'Opera in the Park' and a visit to several of Adelaide's Dams and lunch in the Barossa.

A program for 1993 is being formulated and details will be published in the SA Insert of Engineers Australia for January.

Office Bearers for 1992

Chairman		
Bob Newman	EWS	226 2510
Deputy Chairman		
John Morris	DME	274 7688
Hon. Secretary		
Dr Patrick Lun	PPK	212 5733
Committee		
Paul Peter	CSIRO	274 9209
Peter Bayetto	Koukourou	363 0022
Lindsay Ballantyne		31 6356
Don Cameron	Univ. of SA	343 3128
Richard Cavagnaro	Herriot	272 0777
Ed Collingham	EWS	226 2279
Ian Hosking	Coffey	352 1744
Dr Peter Mitchell	PPK	212 5733
Dr Maurice Arnold	Retired	
Dr William Kaggwa	Adel. Univ.	228 5333
Charles Fitzhardinge	Golders	364 2777

There were no retirements from the committee at the end of the 1991.

Members of the Committee have been involved with the Institution's Mentor Scheme for undergraduate students, careers advice to school students, and Institution working groups.

REPORT ON RECENT MEETINGS

FEBRUARY 17 1992

Modelling Interactive Load Deformation and Flow Processes in Soils, Including Unsaturated and Swelling Soils (Repeat of the John Jaeger Memorial Lecture)

Dr Brian Richards, CSIRO: Chief research scientist now based in Brisbane

A repeat of the award lecture presented to the 6th ANZ Conference on Geomechanics, in Christchurch in February 1992.

This lecture has been published in full in the proceedings of the 6th ANZ Conference, p18-.

Also at this meeting Dr Peter Mitchell circulated a summary of the highlights of the 6th ANZ Conference Christchurch NZ, Feb 3-7, 1992. (Attendance 30)

MARCH 23 1992

Geotechnical Aspects Associated with Clyde Dam, NZ

Murray D Gillon: Group Engineer, New Zealand Works Projects Services - responsible for the investigation and design of major remedial works and the preparation of lake filling procedures for the Clyde Power Project.
Murray was the IE Aust Civil College Eminent Speaker for 1992.

Murray gave an illuminating address on this complex and troubled project. The 60m high concrete gravity dam is built over a fault zone. It is also is in a valley with significant slope instability which requires considerable remedial stability works to avoid potential failure during filling and operation of the reservoir.

A slip joint has been incorporated into the dam wall aligned with the observed fault. The joint can accommodate a movement of up to 1m without catastrophic failure.

The reservoir perimeter has potential and actual slips over 25% of its length. This has involved extensive geotechnical investigations including tunnel adits. The complex hydrogeologic regimes have required extensive drainage works to ensure stability. Other slips have also been buttressed with fill.

Later in 1992 (October) the South Australian Group also received a presentation from Mr Don McFarlane who provided even more detail on the geotechnical works. (Attendance 55)

APRIL 27 1992

1. Application of the Physical Chemistry of Swelling Soils to the prediction of Movements

Kevin Mills, University of SA

Studies in this area have been stimulated by the need to understand the impact that stormwater retention may have on foundations for residential structures in expansive clay areas.

It is recognised that the presence of certain soluble salts in clays will influence the way in which the clays undergo volume changes and in turn affect the behaviour of structures bearing on these soils, Long term changes to salt concentrations will occur from the combined effects of water infiltration and seepage and the extraction of ground water by vegetation.

Research is being undertaken to determine these parameters and the extent to which the salts affect such volume changes. Both field and laboratory measurements are being undertaken together with the development of a computer simulation of the behaviour of the clays for use in design and forecasting of such movements.

2. Side Friction on Beams in Swelling Soils

Jae Li: Post Graduate Student, University of SA

Conventional modelling of slabs on expansive soils ignores the contribution of side friction on the overall behaviour of the slab. For example, centre heave analysis assumes the slab is free to cantilever at its ends. If beam friction is significant, then the slab will undergo greater differential deflection than would otherwise be anticipated. Beam friction is likely to be significant with deeply embedded beams that would typically be used on Class E sites.

The talk presented experimental data from beam pull-out tests in a black earth soil. The tests were conducted under a variety of site moisture conditions and provided information on variations of side friction with changing depth and soil suction. The field tests were complemented by a series of laboratory interface shears tests.

It was found that beam friction was relatively small, regardless of the moisture state of the surrounding soil. The reason for this low level of friction was a thin local wetting zone which was observed at the concrete-soil interface in all the field experiments. (Attendance 25)

MAY 18 1992

Geotechnical Investigation for Adelaide Refineries - Pt. Stanvac, Single Buoy Mooring and Pipeline

Ian Hosking: Coffey Partners International Pty Ltd Tel: (08) 352 1744

Mr Heinz Vohma, Contracts Manager, Transfield Construction (SA) Pty Ltd

Mr Hosking presented a brief description and summarised the offshore investigations undertaken. The new facilities will allow fully laden oil tankers to offload at Adelaide; previously depth restrictions caused larger tankers to partially offload elsewhere before coming to Adelaide.

The project involved the construction of a two kilometre long pipeline, launched from the shore using a temporary rail track, and the installation of a single buoy mooring (SBM) at the seaward end of the pipeline moored with six pile anchor chains. The investigations included hydrographic survey of the pipeline route and the 1.5 kilometre radius "watch circle" around the buoy, geophysical investigations using pinger, boomer and a bottom towed seismic refraction eel developed by Coffeys, shallow investigations using hand methods by divers, and deep drilling in up to 26 metres of water using a jack up barge. The gulf floor was found to be underlain by recent beach sands over basement rock near the shoreline. A major fault, interpreted as the extension of the Eden Burnside fault, was found during the seismic reflection work along the pipeline route. The SBM site was found to be underlain by about 10 to 15 metres of very loose calcareous sands then very dense quartz sands with interbedded clays.

Mr Vohma showed slides of construction including calcrete blasting for anchor points, pile driving of 18 metre long 1.1 metre diameter steel tubes, pipeline towing and pipe jacketing with concrete. the project was successfully completed in August 1992.

JUNE 15 1992

Geotechnical Studies and Pile Load Tests at Three Major Sites in SA

Lindsay Ballantyne: Consultant Engineer Tel (08) 31 6356

Lindsay presented the results of work at Torrens Island Power Station, Port Augusta Power Station and BHAS Smelter Chimney Stack at Port Pirie. The analysis involved assessment of seismic risk potential, in particular the torsional effects of loading. Lindsay described the interpretation of site investigation information and the results of construction of piles and the subsequent pile loading tests. The use of Barettes and complicated diaphragm walls was described. The use of several approaches to the design theories was discussed. (Attendance 16)

JULY 20 1992

Chowilla Salinity Mitigation and Environmental Rehabilitation

Bob Newman, Engineering and Water Supply Dept, SA
Tel: (08) 226 2510 Fax: (08) 226 2161

The Chowilla region of the Murray is on the border of NSW, Victoria and South Australia. It is an important contributor of salt to the lower Murray. When a proposal to control salt by regulating some of the creek anabranches was released to the public through an Environmental Impact Statement the message was returned loud and clear: "Control salt, but not at the expense of the environment".

Bob Newman described the groundwater and hydrologic investigations together with the community consultation that resulted in response to this public criticism. The objectives of the proposal have been broadened and now include rehabilitation of degraded floodplain environment and management of grazing and recreational pressures on the land. An integrated resource management plan has now been adopted for the area. Under the auspices of the Murray-Darling Basin Commission the Governments of NSW and SA are now operating to reclaim this area and manage it for conservation objectives. It is now proposed to control salinity by pumping the highly saline groundwater (>50 000 mg/L) from tubewells to a disposal site out of the valley.

A report on the consultation process and outcomes has been published. Copies are available from the MDBC or E&WS Adelaide. (Attendance 32)

AUGUST 17 1992

Defining the Risk of Footing Failure on Expansive Soil (Joint Meeting with Footing Group)

Dr Peter Mitchell, Director Geotechnical Division, PPK Consultants Pty Ltd, Tel: (08) 212 5733

Dr Mitchell outlined the results of a study of a large number of engineered house footings built on expansive soils. This study led to a probabilistic design approach providing the engineer with some guidance on the level of risk of footing failure.

The probability of footing failure was quantified in terms of the soil type and house type. It was found that for normal site conditions, the probability of a problem developing for commonly used footing sizes was approximately 1%, but this increased to 7% for more severe site conditions. The probability method helps to quantify the effects of trees, and the differences between Code methods of design. The probability approach defines the degree of uncertainty and level of risk that exists in all designs of footings on expansive soil.

His paper on this work, which was co-authored by Dr JN Kay, now of the University of Hong Kong, was awarded the 1991 RW Chapman Medal by the Institution of Engineers Australia for "Contribution to the Science and Art of Structural Engineering". (Attendance 75)

SEPTEMBER 21 1992

Annual Seminar: Environmental Geomechanics

Environmental Site assessment and clean-up: some financial considerations.
WL Pump, AGC-Woodward Clyde, Melbourne
DP Finlayson, AGC-Woodward Clyde, Adelaide

Use of the hand held Photo-ionisation Detector (PID) at sites contaminated with volatile organic compounds.
Ian Hosking, Coffey Partners International

Geo'LOGIC' and the impacts of salinity on the River Murray environment.
Bob Newman, Engineering & Water Supply Dept

The Sydney Olympics 2000 - A Gold Medal Project.
Dr David Cruikshanks-Boyd, PPK Health Ltd

Upsetting the balance of salinity in the River Murray environment.
Dr Ian Jolly and Dr Glen Walker
CSIRO Centre of Groundwater Research, Adelaide

Mount Taylor - Kingston (Brisbane) - Site recovery project.
RJ Morphet, CFR Fitzhardinge, AJ McConnell
Golder Associates, Brisbane and Adelaide

OCTOBER 13 1992 (Special Meeting)

New Zealand - Clyde Dam Landslide Stabilisation

Mr Don McFarlane, New Zealand

Twenty five percent of the shoreline of this power supply reservoir is recognised as active landslide. Don McFarlane has been responsible for the extensive geotechnical investigations undertaken to determine the stabilisation requirements prior to filling. Some slides are creeping at 90 mm per year prior to filling of the reservoir.

The hydrogeology of many of the slides was found to be complex; occasionally remoulded slip material was forming aquifer boundaries holding heads of up to 150 metres. The installation of sophisticated multi-point piezometers was found to be very useful. 992 piezos were installed together with some 5000 instruments. Drilling fluid records (Pressure v Depth plots were found to give useful first indicators of complexity but interpretation was not always easy without the multi-point piezos. Hydrochemical data from a downhole probe measuring temp, pH, EC and DO2 was also useful. Some aquifer compartments showed temperature differentials of up to 6°.

Following mapping of the geology and aquifers, using both drill holes and surface mapping, risk assessment of slope failure was done. Remedial work often consisted of drainage (including adits and drill holes); occasionally butressing was required involving large earthworks. Some 60km of adits were excavated. The drainage work had a major impact on groundwater levels which were found to have been sustained by relatively small recharge in this arid area of NZ. The Lake is currently 50% full.

OCTOBER 19 1992

Research at University of Adelaide & University of SA

Dr William Kaggwa, Don Cameron and students

(Attendance 35)

NOVEMBER 16 1992 - Annual dinner meeting

The Origins of the Murray Darling Basin

Steve Barnett, hydrogeologist SA Dept of Mines & Energy Tel: (08) 274 7583

Steve has coordinated South Australia's contribution to the better understanding of the hydrogeology of the Murray Basin. In his presentation Steve outlined the geologic processes which have developed the basin and can now be used to explain why the Murray Basin is so sensitive to the actions of European settlement including land clearance and irrigation. Mistakes have been made in ignorance; with our current understanding some difficult decisions need to be made before our practices become sustainable.

The Murray Darling Basin Commission is publishing a series of 1:100 000 hydrogeologic maps to cover the basin. This is a major undertaking involving the collation of masses of data. Also a series of groundwater models are being developed to assist with management decisions. The recent publication by the Bureau of Mineral Resources in Canberra,(now Australian Geological Survey Office) on the Geology of the Murray Basin is a worthwhile reference. Hopefully Steve Barnett's thesis will soon be available. (Attendance 20)

TASMANIAN GROUP

The Committee

The Committee for 1992 was as follows:

Chairman
Brian Cousins
Deputy Chairman
David Brett
Secretary
Fred Baynes
Committee
Ralph Rallings
Rick Donaldson
Bram Knoop
David Wilson
Tom Bowling
Dick Barnett (Retiring)

Brian Cousins was elected as Chairman for 1993 at the committee meeting of 20 October. The Committee members were re-elected at the AGM of 9 November apart from Dick Barnett who was replaced by Randal Colman of the HEC.

REPORT ON RECENT MEETINGS

JULY 13 1992

Dam Safety

Dick Barnett (ex HEC)

Dick Barnett talked about dam safety Issues including improvements in techniques, surveillance methods and instrumentation.

SEPTEMBER 14 1992

The Guangzhou Pump Storage Scheme, Guangdong Province, China

Mr. C.M. Johnson

Mr. Malcolm Johnson, a former HEC senior tunnels engineer, has recently completed a two year contract as a tunnel design expert at the Guangzhou Pump Storage Scheme construction project for SMEC. Mr. Johnson presented an overview of the pump storage scheme which consists of two substantial reservoirs formed by two large dams, a series of high pressure tunnels, an underground power house with access tunnels and a low pressure tail race tunnel.

The hydraulic tunnels total 3.9 km in length and have been designed to pass a flow of 273m^3/sec at a gross head of 520m. The pressure tunnel has an 18m diameter surge shaft which is located at the upstream end of one of two steep (50°) declines. The power station is equipped with four 300 MW reversible Francis turbine/pump units. The tail race tunnel is equipped with an underground surge tank. The underground works were generally excavated in a medium to macro crystalline granite rock.

The upper storage reservoir is formed by a 68m high concrete face rockfill dam (CFRD), the lower reservoir is formed by a 43m high roller compacted concrete gravity dam (RCCD).

Construction on the project was started in September 1988 and is expected to be completed early in 1993. The project cost is currently estimated at approximately $US 430M. It is planned to duplicate the scheme in the near future.

NOVEMBER 9 1992

Design and Monitoring of the Darwin Dam, King River Power Development, West Coast of Tasmania

Dr. Sergio Giudici and Mr. Steven Li

Dr. Sergio Giudici, a former Rhodes scholar, is the Hydro Electric Commission's General Manager Consulting, Mr. Steven Li has a Masters Degree in Engineering Science and is Principal Engineer Dams.

Dr. Giudici presented an overview of the design of the Darwin Dam which is a 20m high gravel fill embankment type saddle dam on Lake Burbury. The dam had to be constructed on a complex foundation comprising gravels, silts, limestone and sandstone. The site was intersected by several major geological fault zones. Extensive site investigations had been carried out which showed that the permeability of the gravels was quite low, that the interface between the top of the limestone and the overlaying silts and gravels was very irregular, and that the piezometric pressure in the limestone was generally less than that indicated by the water table as measured in the gravels above. The piezometer measurements also showed a steep pressure gradient in the vicinity of the downstream side of the saddle. Several possible embankment axis locations had been considered. However, it was finally decided to locate the axis virtually along the saddle where the depth of gravels was considerably greater rather than further upstream where the depth to limestone was less. An extensive embankment grouting programme had been considered to improve the water tightness of the cut-off. However, in the end only a trial grouting programme was embarked upon, i.e. to prove the method of grouting in case high embankment leakages later necessitated such a programme.

Mr. Li presented details of the embankment monitoring system which included approximately 48 vibrating wire and Carlson type piezometers. These instruments had been installed along four main cross sections in the embankment. The piezometers together with an extensive leakage measuring system were being regularly interrogated by an on-site data logger. The data logger was off loaded onto a portable computer for further analysis. From the data collected during the first year of operation the embankment appeared to be functioning properly. The base leakage was estimated at approximately 1 l/s. Mr. Li also presented a detailed description of the backup grouting programme.

1993 COMMITTEE

Chairman
Brian Cousins
Deputy Chairman
David Brett
Secretary
Fred Baynes
Committee
Randal Colman
Rick Donaldson
Bram Knoop
David Wilson
Ralph Rallings
Tom Bowling

FUTURE MEETINGS

MARCH 8 1993: Geotechnical aspects of Forestry Management

MAY 10 1993: Pipe Jacking under a Freeway in Melbourne and possibly other interesting geotechnical problems

JULY 12 1993: Critical State Analysis as a Conventional Design Tool

SEPTEMBER 13 1993: Seminar on Geotechnical Assessment of Subdivisions Covering Risk Analysis and AS 2870

NOVEMBER 8 1993: Tailings Dams, Geotechnical and Environmental Design Solutions

MEMBERSHIP

Tasmanian group membership currently is 32. Average attendance at meetings during 1992 has been 14 members and 15 non-members. It is intended to target non-members who consistently come to meetings. A notice has been produced to be included in the Institution's magazine to advertise our topics.

SUB-COMMITTEE ON GEOTECHNICAL ASSESSMENT OF SUBDIVISIONS

The sub-committee is attempting to collect and collate information on house damage due to geotechnical hazards in Tasmania with the hope that the results of the survey will form part of the seminar during 1993. Consultants, Councils and other authorities within the Greater Hobart area have been approached to provide details.

To date there have been some promising results but concerns about confidentiality have had to be allayed.

The Sydney group has started work on a more elaborate landslip risk assessment paper than the 1985 Geomechanics Study and we will be kept informed.

QUEENSLAND GROUP

The 1993 Committee comprises:

Chairman	
Robert Morphet	Golder Associates Pty Ltd
Vice Chairman/Secretary	
Bruce White	D.J. Douglas & Partners P/L
Committee Members	
John Beal	Engineering Geological Services Pty Ltd
Gavin Blakey	Brisbane City Council - Materials Section
Paul Glover	Hollingsworth Dames & Moore
Ian Gordon	BHP Engineering
Roger Grounds	Coffey Partners Int.
Burt Look	Queensland Transport
Michael Neighbour	D.J. Douglas & Partners P/L
Peter Stocker	Golder Associates Pty Ltd
Paul Wallis	Arup Geotechnics Pty Ltd
K.Y. Wong	Univ. of Queensland
Michael Yau	Engwell Pty Ltd

REPORT ON RECENT MEETINGS

JULY 1992

Design and Construction of Barettes

Peter Openshaw and Tony Philips

Peter Openshaw of Bachy presented a summary of modern construction methods and potential/foreseeable problems. Tony Philips of Arup Geotechnics presented an enlightened case history of the ACL cement silo in Newcastle for which rigorous settlements analyses were carried out.

AUGUST 1992

Dinner Meeting

Following a pleasant meal, Glenda Flannery, winner of the 'Downunder Humorous Speech Contest' spoke on the topic "Engineers: A Bad Idea or a Mistake".

SEPTEMBER 1992

Centrifuge Modelling on Geomechanics with Applications in Mining

Prof. Mark Randolph

Prof. Mark Randolph of the University of Western Australia discussed some of the projects in which they have used the recently acquired centrifuge to simulate geomechanical problems associated with gravitational loading. Scale model tests in stability of rock slopes, mining subsidence, mine tailings management, and lateral loading of piled bridge abutments were discussed. The centrifuge seems to provide the connecting link between reality and mathematical analysis.

The Queensland A.G.S. Group would like to thank BHP Engineering (CSIRO Division of Geomechanics) and Golder Associates Pty Ltd for sponsoring Mark's visit and enabling us to cover Mark's travel costs. Mark's presentation is on videotape for any interested colleague.

OCTOBER 1992

E.H. Davis Memorial Lecture

Assoc. Prof. Ian Johnston

Assoc. Prof. Ian Johnston summarised his topic titled "Geomechanics and the Emergence of Soft Rock Technology". Ian presented results and properties of "soft rock" and discussed where "soft rocks" belong in the broad spectrum of soil mechanics and rock mechanics.

NOVEMBER 1992

Annual General Meeting

Rob Morphet summarised the year's past activities and the 1993 committee was elected.

DECEMBER 1992

Committee Dinner

The outgoing committee and the new members for 1993 treated themselves and their non-geotechnical spouses to a memorable outing at a local restaurant.

FEBRUARY 1993

Piezocone Probing

Dr. John Simmons

Dr. John Simmons of BHP Engineering presented an informative an interesting discussion on the benefits of CPTU testing over CPT testing and some of the projects where he has used CPTU testing. John also gave his thoughts on which correlation curves are appropriate to commercial analysis of CPTU results.

FUTURE MEETINGS

MARCH 10: Retaining Structures and Underpinning for Basement Construction - Joint meeting with structural panel.

MARCH 18: Iran: of Tales and Tailings, *John Beal.*

APRIL 22: Limit State Design in Foundation Engineering.

MAY 20: Advances in Engineering Geophysics, *Bob Whitely.*

JUNE 16: Joint meeting with Geological Society.

JULY 15: Current Trends in Open Pit Design, *John Read.*

AUGUST 19: Dinner/Debate.

SEPTEMBER 16: Recent Innovations in Geomechanics Computing

OCTOBER 21: Case Studies - Southeast Queensland

NOVEMBER 18: Annual General Manager.

DECEMBER 16: Committee Dinner

In 1994, the Queensland Group proposes to carry out a symposium on the Engineering Geology of Brisbane (similar to what the Victorian Group recently compiled). Any colleagues interested in presenting a paper or who may have suggestions for papers should contact either Rob Morphet, Paul Wallis, Paul Glover, Michael Yau or Bert Look, who are on the sub-committee organising the event.

We would also welcome suggestions for topics for other technical presentations in 1994. Please forward your thoughts to any members of the Committee.

WESTERN AUSTRALIA GROUP

The 1992 Committee is as follows:

Chairman
Ian Smith
Secretary
Mark Randolph
Committee Members
Trevor Osborne
Martin Fahey
Peter Lilly
Colin Bradbury
Tony Abbs
Charles Waterton
Geoff Cocks
Peiter Zwaan
Andrew Cray
Steve Brice

REPORT ON RECENT MEETINGS

FEBRUARY 13 1992

Analytical Methods in Geomechanics

Professor John Booker, Univ. of Sydney

The talk covered a range of problems than can be approached using analytical and semi-analytic methods, demonstrating the power of such methods for investigating complex loading conditions and constitutive behaviour, as well as to enhance predominately numerical techniques of analysis. Applications covered in the talk included: bearing capacity of a jointed rock mass; settlement of rectangular foundations on non-homogeneous elastic soil; consolidation of a deep porous elastic stratum; finite element analysis of axisymmetric solids under asymmetric loading; boundary element analysis of thermo-elastic problems; pollutant migration from landfills.

MARCH 24 1992

Geotechnical Problems Associated with the Clyde Dam

Murray Gillon - New Zealand Works Project Services

Investigations for the Clyde Dam and surface power station began in 1967 and construction commenced in 1979. The 102 m high concrete gravity dam and the 432 MW power station are effectively complete but filling of the reservoir has been delayed due to a series of geotechnical problems. The major problem is associated with potential slip areas in the unstable countryside surrounding the reservoir. Stabilisation of areas around the reservoir estimated at NZ$3 million in 1988 has recently been estimated to cost NZ$423 million. A further NZ$60 million has been spent on stabilising a road relocated because of the reservoir.

The geotechnical problems associated with the Clyde Dam and reservoir are of a major nature and have resulted in a new approach to project investigation for power schemes in New Zealand. The talk described the background to the geotechnical design of the dam, the manner in which the dam was engineered to accommodate faulting in the foundation materials, and the extensive stabilisation works that have been undertaken to ensure the successful operation of the dam and reservoir.

APRIL 14 1992

Residue Area Grouting

Trevor Osborne, Osborne Geotechnical

The 'red mud' residue from the extraction of alumina from bauxite is impounded in lined tailings ponds, where consolidation will occur over a number of years. Monitoring of the groundwater beneath the residue areas has detected some leakage through the base linings. The talk presented details of procedures developed (a) to detect and map regions where leakage was occurring, and (b) to reduce the extent of leakage using chemical grouting techniques.

MAY 12 1992

Using the seismic cone and pressuremeter tests for settlement analysis

Dr. Martin Fahey, Univ. of Western Australia

Current methods of predicting settlements of structures in sand are based on assuming linear elastic behaviour, even though the stress-strain behaviour of many soils is highly non-linear. The seismic cone test is a relatively new method of carrying out downhole seismic tests, with the capability of measuring shear wave velocity Vs for individual soil layers. From this the "small strain" or true elastic stiffness (G_o) of the soil can be determined. The value of G_o cannot be used directly to calculate deformations, because of the non-linearity of the soil stress-strain curve.

The self-boring pressuremeter (SBP) test can be regarded as an in-situ loading test with very accurately-measured load-deformation behaviour. The loading and unloading-reloading sections of the tests are affected by the non-linearity of the stress-strain response, and can therefore be used to "calibrate" a non-linear stress-strain curve.

The talk described the procedures and analysis of seismic cone tests and presented typical results with derived G_o values. An example of combining G_o values with pressuremeter unload-reload tests to derive a complete non-linear stress strain curve was discussed, showing how the combination of the two tests offers a logical method of improving prediction of settlement in sand.

JUNE 9 1992

Seismic Analysis of Earth Structures

David Elias, Dames and Moore

Although Western Australia is not, by world standards, particularly active seismically, it is still necessary to assess the design and performance of earth structures - particularly water and tailings dams - when subjected to seismic loading conditions. The talk presented a procedure for seismic analysis of such structures based on the current state of practice used in California, with the aim of providing an appropriate level of analysis whilst maintaining simplicity.

JUNE 25 1992

Geotechnical Database for the Perth Central Business District

Steve Brice, Dept. of Minerals and Energy

The increase in building activity in the Central Business District (CBD) of Perth over the last decade has led to a large volume of geological and geotechnical data being available from the numerous site investigation studies that have been carried out. The vast quantity of factual data available is not generally in a form that is useful to geotechnical engineers, structural or design engineers, or town planners.

The Geological Survey of Western Australia has established a trial database of geotechnical information as a pilot project for a larger scale database of this type. The pilot project involved the acquisition of a large volume of data from a variety of digital and non-digital sources. A Geographic Information System (GIS) approach is being adopted to permit a thorough analytical investigation through interrogation and manipulation of the various stored datasets. The talk described the current state of the database, and plans for its future maintenance and development.

JULY 23 1992

Mining Research - A CRA perspective

Gary Lye, CRA Advanced Technical Development

CRA, like most large mining companies has recognised that its long term survival depends on the competitiveness of its existing operations and its ability to find or acquire and then develop first class mineral deposits. Research and development is seen to play an important role in all aspects of this business plan.

Advanced Technical Development (ATD) is an organisation set up by CRA to focus on the research needs of its business units. The talk gave an overview of ATD's research direction and in particular that of the Mining Technology Section which to date has carried out projects in rock breakage (both explosive and non-explosive), mining geomechanics, and mine systems analysis.

AUGUST 11 1992

Liquefaction of Tailings Dams

Prof. P.K. Robertson, Univ. of Alberta

Impressive progress has been made in the last 25 years in recognising liquefaction hazards, understanding liquefaction phenomena and analysis and evaluating the potential for liquefaction. Tailings impoundments are often highly susceptible to liquefaction. Flow type failures have been observed in tailings impoundments and have been caused by both dynamic (earthquake) and static trigger events. The talk defined what is meant by liquefaction and described the behaviour of sands under both monotonic and cyclic loading within a consistent framework. This framework was used to explain what caused liquefaction and how in-situ testing can allow evaluation of the potential for liquefaction. Methods were also described briefly that can be used to evaluate post-liquefaction deformations.

SEPTEMBER 8 1992

Site Contamination Assessment Techniques

Pieter Zwaan, Golder Associates
Mike Hillman, Coffey Partners Int.
Greg Street, World Geoscience Corporation

The talk outlined both conventional and innovative techniques for assessing site contamination. Pieter Zwaan described conventional sampling methods, including health and safety requirements and equipment and sampler cleaning. Mike Hillman discussed the use of the gas chromatograph and the photoionisation device to map hydrocarbon contamination. Greg Street concluded the presentation by describing geophysical methods of investigating subsurface contamination such as buried drums, solute, etc.

OCTOBER 13 1992

Blasting

Trevor Little, School of Mines, Curtin Univ.

The Western Australian School of Mines has been undertaking research in the area of blasting for over five years. Most of this research has been in close boration with the CSIRO Division of Geomechanics. A major MERIWA project was undertaken in the Kalgoorlie-Boulder area in 1988/89 and since then many other industry sponsored projects have been completed.

The presentation covered the measurement and control of blasting nuisances (e.g. airblast and vibration) and initiation performance monitoring. Blasting for selective mining and the development of an expert system for open pit blast was also presented.

OCTOBER 20 1992

QVI Office Tower - Foundation System

Prof. Mark Randolph, Univ. of Western Australia

The QVI Office Development incorporates a 42 level office tower supported in five individual pile assisted raft foundations. The talk outlined the background to the development of this unique foundation systems and discussed methods used to estimate the settlements for the five individual foundation elements. The results of loading tests on the bore pile were presented, with discussion of how back-analysis of the initial stiffness of the pile responses was used to refine estimates of settlement. The talk concluded with a comparison of predicted performance with the actual performance observed through settlement monitoring during and after construction of the office tower.

NOVEMBER 10 1992

Geomechanics and the Emergence of Soft Rock Technology

Assoc. Prof. Ian Johnston, Monash University

(Presentation of E.H. Davis Memorial Lecture)

Engineering problems involving soft rocks have traditionally been solved by extrapolating from the historically separate technologies of either soil mechanics or rock mechanics. This has generally lead to tenuous, conservative solutions which have contributed little to the overall understanding of soft rock behaviour.

The talk argued that soft rocks are not vague extensions of these two geotechnical sciences but are in fact central to one continuous science extending from soft soils through to hard rocks. All geotechnical materials behave according to the same engineering principles, with obvious differences a 8function of degree rather than of fundamental nature. Consequently, it was demonstrated that for soft rock technology to emerge as a rational engineering form, the established methods of soil mechanics and rock mechanics should be applied together and not in isolation.

KALGOORLIE GROUP

The 1992 Committee comprised:

Chairman
T. Szwedzicki
Secretary
T. N. Little
Committe Members
P. Loubsher
G. Auld
D. Fotakis

REPORT ON RECENT MEETINGS

MARCH 3 1992

New Solutions in Geomechanical Instrumentation and Monitoring

C. Viska, Slope Indicator Co. SINCO.

Mr. Viska discussed geotechnical instrumentation used for slope stability monitoring. Special emphasis was put on application of piezometers for water table monitoring in the vicinity of mines.

APRIL 7 1992

Cable Bolting and Geotechnical Instrumentation

D. Minchin, Rock Engineering Pty. Ltd.

The presentation was focused on cable bolting in open pits. Different type of cable bolts were presented and case studies were discussed. Mr. Minchin also covered application of geotechnical instrumentation in open pits.

JUNE 8-10 1992

Western Australian Conference on Mining Geomechanics

Professor E.T. Brown had an Opening Address on "Australian Mining Geomechanics - Development, Achievements and Challenges".

Papers were presented in sessions on: Underground Mine Geomechanics, Open Pit Mining Geomechanics, Rock Testing and Geotechnical Modelling, Rock Characterisation, Fragmentation and Blasting, and Environmental Geomechanics. The Conference was attended by some 100 delegates and 54 papers were published in the Proceedings.

JUNE 24 1992

Radio Imaging Methods in Mining

S. Thompson, Mining Exploration Technical Services Pty. Ltd.

Mr. Thompson presented the most recent achievements of underground void detection using radio imaging methods.

JULY 22 1992

New Technologies for Geotechnical Instrumentation

Dr. I. Follington, CSIRO Div. of Geomechanics

Dr. Follington presented new systems for remotely operated geotechnical instrumentation in underground mines.

AUGUST 20 1992

Probabilistic Stability Analysis of Slopes

Dr. R. Halatchew, Univ. of Mining & Geology, Sofia, Bulgaria

The new theory on probabilistic slope analysis was discussed and application of the methods in Bulgarian open pit mines was presented.

NOVEMBER 11 1992

Geomechanics and the Emergence of Soft Rock Technology

Prof. I. Johnston, Monash University (E.H. Davis Memorial Lecture)

The lecture covered a wide range of subjects concerned with soft, weak and weathered rock and represented the results of research into the behaviour of these materials.

NOVEMBER 17 1992

Large Scale Mining

Dr. Oscar Steffen & Dave Ortlepp, Steffen, Robertson and Kirsten (Republic of South Africa)

Dr. O. Steffen presented study cases of large failures of slopes in open pits and Mr. D. Ortlep discussed seismicity problems in a large underground mine.

FUTURE MEETINGS

JANUARY 27 1993

Assessment and Management of Risk in Geotechnical Engineering

Dr. Barry McMahon, McMahon Associates.

FEBRUARY 3 1993

The State of the Art and Application of Fracture Mechanics

Professor H.P. Rossmanith, University of Technology Vienna

FEBRUARY 10 1993

Soil and Rock Slope Remediation

Professor M. Hausmann, University of Technology, Sydney

MAY 11 1993

Geotechnical Instrumentation

J. Lakeland, Geotechnical System Australia Pty. Ltd.

Geotechnical Instrumentation

JUNE 20-23 1993

Australian Conference on "Geotechnical Instrumentation and Monitoring in Open Pit and Underground Mining"

Over 70 abstracts from 10 countries have been received and papers will be presented in sessions on: Monitoring Systems, Instrumentation and Monitoring in Underground Mining, Slope Stability Monitoring, Monitoring of Rock Support and Reinforcement, Geophysical/Seismic Monitoring and Stress Measurement, and Monitoring of Model Studies and Experiments. A number of geotechnical workshops and short courses will accompany the Conference.

OCTOBER 18-19 1993

Centenary Blasting Workshop

Topics: Selective Mining Blast Design, Open Pit Blasting, Underground Blasting, Advanced Explosive Technology, Blast Monitoring and Blasting Research.

GEODIARY*

CONFERENCES, COURSES, SEMINARS, SYMPOSIA, WORKSHOPS, ETC.

MARCH 22-23, 1993

Sydney, NSW, Australia

CONFERENCE ON GEO-TECHNICAL MANAGEMENT OF WASTE AND CONTAMINATION

Topics: Site investigation and monitoring techniques for waste disposal and contaminated sites; Groundwater contamination flow in soil and rock; Legislative controls and "safe" contaminant levels; Site remediation and chemical cleanup; Ground modification techniques, eg clay and geomembrane liners, dynamic compaction, vibroflotation, grouting; Foundations for reclaimed landfill sites; Design of landfills and their rehabilitation; Mine tailings disposal and rehabilitation, eg prediction of properties, impact of operation phase and long-term seepage, safe contaminant levels, seepage minimisation techniques.

APRIL 5-7, 1993

Istanbul, Turkey

INTERNATIONAL SYMPOSIUM ON ASSESSMENT AND PREVENTION OF FAILURE PHENOMENA IN ROCK ENGINEERING

Themes: 1 - Failure Phenomena and Their Mechanisms: Model tests; Surface Structures (slopes, foundations, dams); Underground openings. 2 - Theoretical Approaches: Strain localisation; Fracture mechanics; Damage mechanics; Plasticity and visco-plasticity theory. 3 - Numerical Approaches: Finite element method; Boundary element method; Other methods. 4 - Case Studies: Slopes and open-pit mines; Foundations; Dams; Tunnels; Underground caverns; Underground mining. **Language:** English. **TS:** Papers - 30/9/1992. Post-symposium tours to mine and civil engineering construction sites will be arranged, including to Cappadocia, with its underground cities, which are unique examples or rock engineering in ancient times.

Prof. A. Günham Paamenhmetoglu, Middle East Technical Univ. (ODTÜ), Dept. of Mining Engineering, TR-06531 Ankara, Turkey, TLP: 90/4/2237, Ext. 2654, or 2233054 (fax); TLX: 42761 ODTK.

APRIL 6-8, 1993

Paris, France

INTERNATIONAL CONFERENCE ON THE ENVIRONMENT AND GEOTECHNICS

Topics: Legislative and legal apsects; Ground water and sub-soil protection; Site decontamination, treatment and land reclamation; Recognition and construction in reclaimed areas.

Prof. F. Schlosser, L'Ecole Nationale des Ponts et Chausees, Paris, France.

APRIL 19-22, 1993

Amsterdam, Netherlands

OPTIONS FOR TUNNELLING

Topics: A – Soft Ground Tunnelling: 1 - Cut and cover methods; 2 -Underground methods; 3 - Immersed tunnels; 4 - Comparative case studies; B – Rock Tunnels: 1 - Conventionally driven tunnels (in hard rocks, using drill-and-blast excavation; technical developments in the design and construction of lining systems, and integration with the rock surround); 2 - Mechanically driven tunnels (using road headers, conventional TBMs, and shielded TBMs; TBM equipment, especially the automation and robotisation; design and construction of the lining and supports as in integrated system with the TBM); 3 - Comparative case studies (in choosing between several options for tunnelling; examples are: suitability and applicability of drill-and-blast versus mechanised methods, excavation and lining optimisation methods, use of one-pass lining methods versus initial excavation support and subsequent cast in-situ linings); C – Submerged Floating Tunnels; D – General Topics: 1 - Cost optimisation; 2 - (Private) financing of tunnels; 3 - Research (on soft ground, rock, and structural behaviour, equipment, and excavation, with particular reference to integrated excavation and lining systems). **Language:** English. **TS:** Papers - 01/11/1992. An exhibition, presenting research institutes, consulting engineers, contractors and suppliers of equipment for tunnelling and underground works, will be held. Technical excursions to at least 3 tunnels under construction are being organised. Tours for accompanying persons are foreseen.

OFT 1993, c/o Congress Office Kivi, P.O. Box 30424, NL-2500 GK The Hague, Netherlands, TLP: 31/70/3919890 or 3919840 (fax).

MAY 2-6, 1993

Niagara-on-the-Lake, Ontario, Canada

SHOTCRETE FOR UNDERGROUND SUPPORT VI

Themes: Design of Shotcrete for Tunnel Support; Dry-Mix Process Developments; Wet-Mix Process Developments; Shotcrete Additives -the Chemistry of Shotcrete; Reinforcement in Shotcrete; Case Histories; Robotics and Shotcreting; Soil Nailing - Shotcrete for Ground Support.

Mr. Charles V. Freiman, Director, Engineering Foundation, 345 East 47th Street, New York, NY 10017, USA. TLP: 1 212 7057835 or 7057441 (fax).

Abstracts: Prof. David F. Wood, Conference Chair, Univ. of Toronto, Sudbury, Ontario, Canada. TLP: (705) 6736532 (fax).

MAY 4-8, 1993

Singapore

11th SOUTHEAST ASIAN GEOTECHNICAL CONFERENCE

Theme: Soft Ground Engineering. **Topics:** Soil Characterisation and testing; Engineering geology; Slope Stability and landslides; Ground improvement; Shallow and deep foundations; excavation and buried structures; environmental geotechnics. **Language:** English. Conference Manager, 11 SEAGC, 150 Orchard Rd, #07-14 Orchard Plaza, Singapore. Tel: (65) 7332922 or (65) 2353530 (fax).

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* More commonly referred to as Geodiarrhoea.

MAY 5-8, 1993

Cologne, Germany

GEOTECHNICA '93

An international specialty fair and congress for geosciences and geotechnique.

Registration: Geotechnica '93, c/o C.C.M. Cologne Congress Management GmbH, Postfach 180 180, 5000 Köln 1, Germany.

MAY 24-28, 1993

Xian, China

ACMIRME '93

Themes: Numerical and analytical methods and applications in tunnelling and underground openings, dams, slopes and foundations, mining engineering; Mechanical behaviour of rocks and joints -- modelling and applications in computer procedures; Physical and computer modelling; Comparison of model tests, measurements and computer analysis; Field measurement and monitoring techniques, instruments, data processing and utilisation; Inverse problems, including back analysis; Optimisation techniques; Computer codes in geomechanics, including numerical analysis, expert systems, CAD/CAM; Use of microcomputers and personal computers. **Language:** English. **TS:** Papers - 03/09/1992; Final acceptance - 30/10/1992. A small tabletop exhibition of publications, instruments, software and hardware relevant to symposium themes, in being organised.

Prof. Liu Huaiheng, ACMIRME 93, Xian Inst. of Mining and Technology, 14 Yanta Road, TJ-710054 Xian (Shaanxi), China. TLP: 86/29/752034, 752056 or 711585 (fax).

Prof. Zhou Wei Yuan, Dept. of Hydroelectric Engineering, Tsinghua University, TJ-100084 Beijing, China. TLP: 86/1/ 2552451, 2553626 or 2562768 (fax).

MAY 24-28, 1993

Xian, China

INTERNATIONAL SYMPOSIUM ON APPLICATIONS OF COMPUTER METHODS IN ROCK MECHANICS AND ENGINEERING

Prof. Zhou Weiyan, Dept. Hydroelectric Engineering, Tsinghua Univ., Beijing, CHINA 100084. TLP: (01) 255-2451 or (01) 256-2768 (fax) or Prof. Liu Huaiheng, Kian Inst. of Mining and Technology, 14 Yanta Rd., Xian, CHINA 710054.

MAY 26-28, 1993

Copenhagen, Denmark

SPECIALIST SYMPOSIUMON LIMIT STATE DESIGN IN GEOTECHNICAL ENGINEERING

Topics: Existing practice in the use of LSD; Major problemsin its use; Interaction between design in structural and geotechnical engineering.

Dr. Niels Krebs Ovensen, Director Danish Geotechnical Institute, 1 Maglebjergveg, PO Box 119, DK-2800, Lyngby, Denmark.

JUNE, 1-4, 1993

Ghent, Belgium

2nd INTERNATIONAL SEMINAR - DEEP FOUNDATIONS ON BORED AND AUGER PILES

Topics: Design, installation and monitoring; in-situ testing; Pile-raft interaction; Settlement; Case studies.

Secretariat of B.A.P.I.I., Laboratory of Soil Mechanics, Prof. W.F. Van Impe, Grostesteenweg-Noord2, 9052 Zwijnaarde, Ghent, Belgium. Tel: 32 91 64 5723 Fax: 32 91 64 5849.

JUNE 1-6, 1993

St. Louis, Missouri, USA

INTERNATIONAL CONFERENCE ON CASE HISTORIES IN GEOTECHNICAL ENGINEERING

Themes: 1 - Case Histories of Foundations; 2 - Case Histories of Slopes, Dams and Embankments; 3 - Case Histories of the Geotechnical Earthquake Engineering; 4 - Case Histories of Man-Made Vibration Problems; 5 - Case Histories of Retaining Structures and Deep Excavations; 6 - Case Histories of Geological Engineering and Rock Engineering; 7 - Case Histories of Soil Improvement, Geosynthetics, Dynamic Compaction, Vibroflotation, Blasting and Other Methods; 8 - Case Histories of Forensic Engineering "Case Histories Where Things Went Wrong"; 9 - Case Histories of Geo-Economy - Adequate Geotechnical Solution; 10 - Case Histories of geotechnical and Hydrological Management of Solid, Hazardous and Low-Level Radioactive Wastes; 1 - Case Histories of Geotechnical and Hydrological Remediation of Solid, Hazardous and Low-Level Radioactive Wastes; 12 - Case Histories of Liner and Final Cover Systems for Solid, Hazardous and Low-Level Radioactive Waste Manage Facilities; 13 - Case Histories of New Solutions to Traditional geotechnical Problems, State-of-the-art Lectures: J.B. Cooke, D. Daniel, M.T. Davisson, W.D.L. Finn, G. Gazetas, A. Hendron, J.M. Jamiolkowski, I.K. Lee, K.R. Massarch, J. Mitchell and T. Yamanouchi.

Dr. Shamsher Prakash, Conference Chairman, III CHGE, 308 Dept. of Civil Engineering, Univ. of Missouri-Rolla, Rolla, MO 65401-0249, USA. TLP: 1/314/3414489 or 3414729 (fax).

JUNE, 2-8, 1993

Kobe, Japan

KIGForum '93. 2nd KANSAI INTERNATIONAL GEOTECHNICAL FORUM ON COMPARATIVE GEOTECHNICAL ENGINEERING

Topic: Excavation, Design, construction and performance of all types of excavation; Geotechnical problems with excavation in urban areas. **Language:** English

Prof. Daizo Karube, Dept. of Civil Engineering, Kobe University, Nada, Kobe, 657 Japan. Tel: 81 78 881 1212 (ext 5178) or 81 78 861 0779 (fax).

JUNE 8-11, 1993

Montpellier, France

GEOCONFINE '93, INTERNATIONAL SYMPOSIUM ON GEOLOGY AND CONFINEMENT OF TOXIC WASTES

Themes: Natural geological barriers; Improvement of containment with treated geomaterials; Cover and surface isolation for disposal sites; Monitoring systems and safety of confinement; new confinement concepts. **Language:** English and French with simultaneous translation.

Michel Barrès, Geoconfine 93 -Secretariat, BRGM Département "Environment", BP 6009, 45060 Orléans Cedex, France.

JUNE 14-16, 1993

Bath, U.K.

6TH INTERNATIONAL CONFER-ENCE ON SOIL DYNAMICS AND EARTHQUAKE ENGINEERING

Elizabeth Cherry, Conference Secretariat-SDEE 93, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton, SO4 2AA, U.K. TLP: 44-0-703-293223 or 44-0-703-292853 (fax).

JUNE 21-22, 1993

Kalgoorlie, WA, Australia

AUSTRALIAN CONFERENCE AND WORKSHOP ON GEOTECHNICAL INSTRUMENTATION AND MONITORING IN OPEN PIT AND UNDERGROUND MINING

Topics: Stability of mining excavations; Geotechnical input into mine design; Prediction of rock mass failure; Interpretation of monitoring results; geotechnical back analysis; new solutions and equipment; Submit Abstract December 15, 1992; Submit paper April 1, 1993.

Dr. Tad Szwedzicki, Dept. of Mining Engineering and Mine Surveying, Western Australian School of Mines, P.O. Box 597, Kalgoorlie, WA. TLP: (090) 805 172 or (090) 805 151 (fax).

JUNE 21-24, 1993

Lisbon, Portugal

EUROCK '93, ISRM SPONSORED INTERNATIONAL SYMPOSIUM

Themes: Safety and Environmental Issues in Rock Engineering Topics: T1. Modelling in Safety Evaluation (Methodologies for safety evaluation; Simulation of discontinuous media; Probabilistic methods; Modelling and control of groundwater flow; Models for Mechanical and hydromechanical behaviour; Dam foundations; Interpretation of monitoring data); T2: Influence of the Environment in Rock Engineering (Global environmental effects; Heat and mass transport in fractured rocks; Contaminant migration; Waste disposal; (Underground storage of waste, hydrocarbons, and energy; Control of vibrations); T3: Stability of Large Underground Structures (Rock mass characterisation techniques; Rock salt mechanics; Design of tunnels and caverns; Blasting and TBMs; Monitoring and data analysis; Maintenance); T4. Contribution of Failures and Incidents to the Progress of Rock Engineering (Hazard scenarios in rock engineering; Criteria for the detection of incidents and failures; Deterioration of dam foundations; Instability of underground structures and rock slopes; Case Histories). **Language:** English, French, German (simul. transl. into English). **Specialised workshops:** W1. Uncertainty, Reliability and Risk; W2. Back-Analysis in Rock Engineering; W3. Expert-Systems as a Tool for Safety Evaluation; W4. Fluid Rock Interaction and Grouting. **Workshop Language:** English. **TS:** Abstracts (about 300 words; 2 fig. max.) - 30/09/1992; Acceptance - 15/11/1992; Bulletin No. 2 - 1992 December; Papers - 28/02/1993.

Mr. Luis Ribeiro e Sousa, EUROCK '93, c/o LNEC, Av. do Brasil, 101, P-1799 Lisboa Codex, Portugal. TLP: 351/1/8482131 or 897660 (fax); TLX: 16760 LNEC.

JUNE 25, 1993

Lisbon, Portugal

2ND INTERNATIONAL WORK-SHOP ON SCALE EFFECTS IN ROCK MASSES

Themes: Scale Effects in the Determination of the: 1. Deformability and Strength of Rock Masses; 2. Internal Stresses in Rock Masses; 3. Hydraulic Properties of Rock Masses. **Topics:** Critical review of data on scale effects in Rock Mechanics; Experimental and theoretical studies on scale effects regarding rock, joint, and rock mass properties; Determination of the test sizes beyond which scale-free values can be found for a given property and rock mass (representative volumes); Definition of laws for the description of the variation of rock mass properties (mean values and scattering) with the test size; Use of laboratory and in-situ tests for estimating the properties of jointed rock masses, taking into account scale effects; Case histories involving the consideration of scale effects, either in the design or emphasised by a back-analysis. **Language:** English. **TS:** Abstracts (about 300 words, 2 fig. max.) - 30/09/1992; Acceptance - 15/11/1992; Bulletin No. 2 - December 1992; Papers - 28/02/1993.

Mr. Antonio Pinto da Cunha, Int. Workshop on Scale Effects, c/o LNEC, Av. do Brasil, 101, P-1799 Lisboa Codex, Portugal. TLP: 351/1/8482131 or 897660 (fax); TLX: 16760 LNEC.

JUNE 26-JULY 11, 1993

St. Johns, Newfoundland

4th CANADIAN MARINE GEOTECHNICAL CONFERENCE

Topics: Foundation analysis; Case histories; Ice-seabed interaction; Soil properties; Centrifuge applications; Instrumentation; Codes and standards; In-situ measurements; International projects; Site investigations; Environmental geotechnics; Monitoring.

C-CORE, Memorial University of Newfoundland, St. Johns, NF, A1B3X5. TLP: (709) 737 8354 or (709) 737 4706 (fax).

JUNE 27-30, 1993

Madison, Wisconsin, USA

34TH U.S. SYMPOSIUM ON ROCK MECHANICS

Key Note Lectures: 1. Fractures in Rock Mechanics (N. Cook); 2. The Role of Pore Fluid in Rock Mechanical Processes (E. Detournay); 3. Rock Engineering Systems (J. Hudson). **Short Courses:** 1. Modern In-Situ Stress Methods; 2. Poroelasticity in Rocks. **Workshops:** 1. Block Theory; 2. Stochastic Methods in Rock Engineering; 3. Borehole Instability and Breakouts; 4. Coupled Fluid/Solid Mechanisms in Rock Mechanical Processes Pertaining to the Oil Industry. **Technical Sessions:** 1. Rock Mechanics in Underground Mining; 2. Rock Mechanics in Tunnelling; 3. Failure Prediction in Rock Mechanics - Underground Caverns, Man-Made and Natural Slopes and Earthquakes; 4. Geophysical Properties of Rocks; 5. Experimental Techniques in Rock Mechanics; 6. Coupled Mechanical and Hydrologic Processes in Rocks; 7. Rock Mechanics of Building stones and/or Quarries; 8. Recent In-Situ Stress Measurements and Applications to the Design; 9. Underground Test Facilities; 10. Rock Engineering and Environmental Problems; 11. Rock Mechanics in the Petroleum Engineering; 12. Recent Advances in Numerical Methods in Rock Mechanics; 13. Rock Engineering in Geotechnical Applications. **TS:** Abstracts - 30/09/1992; Acceptance - 30/11/1992; Papers - 15/02/1993.

Prof. Bezalel C. Haimson, Chairman, 34th U.S. Rock Mechanics Symposium, Geological Engineering Program, Dept. of Materials Science and Engineering. The College of Engineering, Univ. of Wisconsin-Madison, 1509 University Ave, Madison, WI 53706, USA. TLP: 1/608/2620155, 2621478, 2623021 or 2628353 (fax).

JUNE 28-JULY 1, 1993

Anchorage, Alaska

INTERNATIONAL CONFERENCE ON FROST IN GEOTECHNICAL ENGINEERING

Topics: Theory pertaining to prediction of frost penetration and thermal degradation of frozen layer; Application to design and construction; Case histories.

Dr. Arvind Phukan, Chairman Organising Committee, School of Engineering, University of Alaska Anchorage, 3211 Providence Drive, Anchorage, AK 99508-8096, USA.

JULY, 1993

Bolton, England

EUROPEAN SYMPOSIUM ENVIRONMENTAL GEO-TECHNOLOGY (ENGINE '93).

Theme: Waste disposal by landfill.

Prof. R. W. Sarsby, Bolton Institute of Higher Education, SChool of Civil Engineering, Dean Rd, Bolton, England. TLP: 0204 28851 or 0204 399074 (fax).

JULY, 1993

France

INTERNATIONAL SYMPOSIUM ON STORAGE AND CONFINEMENT OF TOXIC WASTE IN GEOLOGICAL MEDIA

Sponsored by IAEG.

JULY 5-7, 1993

Vienna, Austria

FRAGBLAST-4

Topics: Automated image processing: new development and accuracy; Scanning methods for the determination of formulae for the fragmentation calculation: the role of the rock structure; Measurement of the borehole pressure in full-scale blasting techniques and development of theoretical and practical formulae; Calibration of numerical and empirical fragmentation models; Rock blasting control, rock damage, damage criteria and improved prediction; Definition and role of confinement at rock blasting; Explosives properties and their relative importance in the rock blasting: what do we measure and what should be measured?; Bench blasting: optimisation of the sub-drilling depth; Role of strength and toughness in rock blasting: criteria and lab tests versus field tests; Blasting in urban areas: blasting in subway construction work; Tunnel blasting: optimisation of the blast-hole pattern with respect to the rock structure and quality; Rock diggability and blastability; Numerical simulation of blasting on the large and small scales; New theoretical developments in fracture and damage mechanics applied to rock dynamics and blasting; Demolition blasting: new methods and techniques; Blasting and seismicity; Blasting-induced rock falls and bursts: modelling, prediction and alleviation; Blasting in geologically difficult terrain; Influence of the ignition of blasting rounds on the fragmentation; Fragmentation blasting in mining and tunnelling: safety versus production?; Effect of rock structure (type, joints, faults) on blasting performance, quantity and quality of the explosive, prediction and simulation of damage patterns; Failure case studies; Social, legal and environmental issues connected with blasting; Other recent issues of interests in fragmentation blasting. **Language:** English. **TS:** Extended summaries (about 1 p.) - 30/07/1992; Acceptance - 31/08/1992; Papers - 30/11/1992; 2nd Circular - January 1993.

Doz. Dr. H.P. Rossmanith, Chairman, FRAGBLAST-4, Technische Univ. Wien, Inst. für Mechanik, Wiedner Hauptstr. 8-10/325, A-1040 Wien, Austria. TLP: 43/222/ /588015514, 588015519, or 5875863 (fax).

JULY 12-16, 1993

Birmingham, UK

2nd INTERNATIONAL CONFERENCE ON MICRO-MECHANICS OF GRANULAR EDIA - "POWDERS AND GRAINS '93".

Topics: Particle assemblies; Particle interactions; Quasi-static deformation; Rapid granular flow; Aggregation/segregation; Fracture\fragmentation; Particle solids. Abstracts: Sep 1, 1992.

Dr. Colin Thornton Dept. of Civil Engineering, Aston University, Aston Triangle, Birmingham B4 7ET, England. TLP: (44) 21 359 3611 ext 4364 or (44) 21 333 3389 (fax).

AUGUST 3-6, 1993

Sydney, Australia

2ND ASIAN PACIFIC CONFERENCE ON COMPUTATIONAL MECHANICS.

Dr. V. Murti, Secretary, 2nd APCOM, School of Civil Engineering, Univ. of New South Wales, PO Box 1, Kensington NSW 2033.

AUGUST 11-15, 1993

Beijing, China

INTERNATIONAL CONFERENCE ON GEOSCIENCE IN URBAN DEVELOPMENT (Landplan IV)

Themes: General review of geoscience in urban development; Instability in larage cities - natural disasters; Instability in large cities - geo-environment change and induced geohazards; Problems in reconstruction of large cities; Pollution and hazardous waste disposal in larage cities; Engineering geological and geo-environmental investigation for urban planning and construction; Chinese megacities; World megacities.

Prof. Wang Sijing, Chairman LANDPLAN IV, Institute of Geology, Academia Sinica, PO Box 634, Beijing, China 100029. TLP: 86 1 202 7766 or 86 1 491 9140 (fax).

AUGUST 16-18, 1993

Kingston, Ontario, Canada

3RD INTERNATIONAL SYMPOSIUM ON ROCKBURSTS AND SEISMICITY IN MINES

Topics: 1 - Mechanics of seismic events and rockbursts; 2 - Monitoring of seismicity and seismic networks; 3 - Rock mass characterisation in seismically active mines; 4 - Rockburst hazard mitigation and ground control; 5 - Induced seismicity (a cross disciplinary session). **TS:** Abstracts (300 words min. + key fig. or tab.) - 01/07/1992; Acceptance - 01/10/1992; Papers 01/01/1993.

Dr. R. Paul Young, Engineering Seismology Lab., Dept. of Geological Sciences, Queens; University, Kingston, Ont. K7L 3N6, Canada. TLP: 1/613/5456171 or 5456512 (fax).

AUGUST 23-26, 1993

Kingston, Ontario, Canada

INTERNATIONAL CONGRESS IN MINE DESIGN

Theme: Mining into the 21st Century. **Topics:** Open pit and underground planning and design; Slope stability and rock mechanics; Mine feasibility; Mine maintenance; Machinery, automation and materials handling; Mine environment; Computer applications and numerical modelling; Research and development; mine management; Explosives technology and blast monitoring; Underground support and backfill. **Language:** English, French (simul. transl.). **TS:** Acceptance - June 1992; Papers - January 1993.

Mr. Peter Scott, Public Relations, ICMD/Relations Publiques, CICM, Dept. of Mining Engineering/Dépt. de Génie Minier, Goodwin Hall Univ./Univ. Queen's, Kingston, Ont. K7L 3N6, Canada. TLP: 1/613/5452212 or 5456597 (fax).

AUGUST 24-26, 1993

Sydney

VIII AUSTRALIAN TUNNELLING CONFERENCE - "FINDING COMMON GROUND"

Plenary Session Themes: Recent advances in excavation technology; Innovation in aterials handling; Management of poor ground conditions; Contractual sharing of risk; Future exploitation of the underground domain. Nonplenary **Topics:** Contract mining for production operations; Major UG mine installations; Training people for the industries;

Improved public image of UG facilities; Major UG civil projects; The role of R & D in UG construction; Major capital works; UG occupational health and safety; Electrical and mechanical fit-outs; Minimising environmental impact. Abstracts: June 30, 1992. Papers: Mar 31, 1993.

The VIII Australian Tunnelling Conference Secretariat, The Australian Institute of Mining and Metallurgy, PO Box 122, Parkville, Victoria 3052. TLP: (03) 347 3166 or (03) 347 8525 (fax); or Terry Lanz, Conference Convener, TLP: (02) 979 5144 or (02) 979 5239 (fax).

SEPTEMBER 6-10, 1993

Krakow, Poland

4th INTERNATIONAL SYMPOSIUM ON THE RECLAMATION, TREATMENT AND UTILIZATION OF COAL MINING WASTES

Topics: Physical, chemical and geotechnical properties of coal mining wastes and fly ash; Deposition of waste materials; Ecological consequences; Use in civil engineering and hydraulic structures; Use as secondary materials; Reclamation of semi-derelict and derelict land; Frost susceptibility; Reclamation of spoil heaps. Papers: Jan 1993 to: Dr. A.K.M. Rainbow, Head of Minestone Services, British Coal Corporation, Bedewell Park Suite, Victoria Rd, Hebburn, Tyne and Wear NE31 2HQ England. Fax (091) 48 90726. Registration: Dr. Ing. Piotr Michalski, c/o Prof. Dr. Drystyna M. Skarzynska, Dept. of Soil Mechanics and Earth Structures, University of Agriculture, 24 Aleja Micheiwicza, 30-059 Krakow, Poland. Fax: (12) 33 6245.

SEPTEMBER 6-10, 1993

Alès, France

ROCK BLASTING - AN INTERNATIONAL TRAINING COURSE

Topics: Blasting mechanisms and fundamental aspects; Technical and economical approaches, optimisation of blasting patterns; 'Back effects'; Environmental issues connected with blasting; Case studies - specific problems concerning the security and the training of workers.

SEPTEMBER 13-17, 1993

Newcastle upon Tyne, U.K.

INTERNATIONAL CONFERENCE ON ENGINEERED FILLS

Topics: Construction on, in and with engineered fills; Stabilisation and improvement of existing fills; Mechanical and physical properties of fills.

Dr. B. G. Clarke, Department of Civil Engineering. The University, Newcastle upon Tyne, U.K. TLP: (91) 222 6419 or (91) 222 6613 (fax).

SEPTEMBER 20-23, 1993

Athens, Greece

INTERNATIONAL SYMPOSIUM ON HARD SOILS AND SOFT ROCKS

Themes: 1 - Geological Features, Investigation and Classification (Geological description; factors affecting behaviour; Field methods of reconnaissance; Sampling techniques; Engineering classification); 2 - Mechanical Properties and Behaviour (In-situ testing; Laboratory testing; Stress-strain behaviour of intact and compacted materials; Selection of suitable constitutive models); 3 - Foundations, Excavations and retaining Structures (Design parameters; Instrumentation and monitoring; Dewatering); 4 - Slope Stability and Protection (Design principles; Improvement techniques; Remedial measures; Monitoring; Erosion control); 5 - Fills and Embankments (Suitability and design criteria; Compaction methods; Quality control; Improvement and protection methods); 6 - Tunnelling and Underground Openings (Design principles and modelling; Excavation techniques; Construction methods and monitoring: Special cases). A special session on geology, properties and behaviour of soft rocks at elevated stresses, as well as deep drilling will be held. **Language:** English, French (simul. transl.). **TS:** Acceptance - 30/06/1992; Bulletin No. 2 - September 1992; Papers (1 original + 3 copies) 30/11/1992.

The Secretariat, International Symposium on Hard Soils - Soft Rocks (Attn: Dr. N. Kalteziotis), PO Box 20034, GR-11810, Athens, Greece. TLP 30/1/3475830 or 3467455 (fax). TLX: 221199 KEDE.

Dr. A.G. Anagnostopoulos, Hellenic Society of Soil Mechanics and Foundation Engineering, 42 Patission Str. (Polytechnion), GR-10682 Athens, Greece.

Mr. Roger Frank, Co-Secrétaire du Symposium HS-SR, L.C.P.C., 58 Boulevard Lefebvre, F75732 Paris Cedex 15, France.

OCTOBER 11-12, 1993

Salzburg, Austria

GROUTING IN ROCKS AND CONCRETE

Topics: A - Grouting Procedure (Stable or unstable cement suspensions, experiences, advantages and disadvantages; Control of grouting procedure, methods of measurements, evaluation of results; Definition and supervision of the necessary and allowable grouting pressure: at the pump, down the borehole, and within the joint); B - Determination of the Characteristics of Mathematical Models to Describe the Process of Flow (Permeability and groutability of joints in rocks and fissures in concrete; Characteristics of grout materials under actual conditions, of temperature, flow velocity); C - Mathematical and Physical Models Applied to Flow in Joints, Comparison with results. **Language:** English, German (simul. transl.). **TS:** Abstracts (300 words max.) - 30/09/1992; 3rd announcement 31/12/1992.

Dr. Richard Widmann, Österreichische Gesellschaft für Geomechanik, Paracelsusstr. 2/III, A-5020 Salzburg, Austria. TLP: 43/662/875519 (also fax).

OCTOBER 19-21, 1993

Toulon, France

INTERNATIONAL CONFERENCE ON UNDERGROUND TRANSPORT INFRA-STRUCTURES

Topics: Include site investigation for civil engineering projects. **Languages:** English and French.

Journees D'Etudes Aftes, c/o EDF Bureau 4/69, 22-30 avenue de Wagram, F-75008 Paris, France. TLP: 33 1 476484 or 33 1 47 64 7588 (fax).

NOVEMBER 9-12, 1993

Tehran, Iran

2nd INTERNATIONAL SEMINAR ON SOIL MECHANICS AND FOUNDATION ENGINEERING OF IRAN

Themes: Problematic soils - swelling soils - collapsible soils - resdidual soils - dispersive soils - soils containing gypsum; Geotechnical design and construction - retaining structures - deep an shallow foundations - underground structures - soil improvement; In-situ testing and measurements - penetration tests - stress-strain measurements - loading tests - soil behaviour monitoring. **Languages:** Persian and English.

Organsising Committee of 2nd International Seminar on Soil Mechanics and Foudnation Engineering of Iran, Plan and Budget Organisation (Technical Research and Standards Bureau), No. 72nd Alley, Pakistan St., Dr. Beshty Ave, Tehran (15316), Iran. TLP: 0098 021 624630.629368; TLX: 212642.

JANUARY 3, 1994

New Delhi, India

INTERNATIONAL SYMPOSIUM ON UNDERGROUND CONSTRUCION IN SOFT GROUND

Topics: Earth and water pressure on braced walls and tunnel linings; Ground movements associated with underground construction. Abstracts: June 30, 1992. **Language:** English.

Prof. Keiichi Fujita, Dept. of Civil Engineering, Science University of Tokyo, 2461 Yamazaki, Noda, Chiba 278, Japan. TLP: 81 474 241501 or 81 471 239766 (fax).

JANUARY 5-10, 1994

New Delhi, India

XIIITH INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING

Themes: Plenary Sessions: Soils Properties; Foundations; Design and Performance of Retaining and Buried Structures; Embankment Dams and Dam Foundations; Natural Hazard Mitigation; Parallel Sessions; Marine Geotechnology; Computer Applications; Construction Instrumentation and Real Time Management; Environmental Geotechnology; Ground Improvement; Foundations of Old Structures and Monuments; Geotechnical Engineering Education; Professional Practices; Arid Climate Soils; Liquefaction; Geophysical Characterisation of Soils; Road and Track Subgrades; **Language:** English, French. **TS:** Papers - 01/01/1993.

Dr. Shashi K. Gulhati, Prof. of Civil Engineering, Indian Inst. of Technology, Organising Secretary general, XIIIth ICSMFE, Post Bag No. 28, Hauz Khas, IND-110016 New Delhi, India. TLP: 91/11/653798, 6852540, or 6852541 (fax). TLX: 03173087 ITT.

JANUARY 10-14, 1994

Nagpur, India

INTERNATIONAL SYMPOSIUM ON IMPACT OF MINING ON THE ENVIRONMENT - PROBLEMS AND SOLUTIONS

Organised by the Visvesvaraya Regional College of Engineering, Nagpur India and the Earth Resources Centre, Exeter UK.

Dr. M.J. Heath, Earth Resources Centre, Univ. of Exeter, Laver Building, North Park Road, Exeter EX4 4QE, UK. TLP: 44/209/ 216647, 392/263909, 263911 or 263907 (fax). TLX: 42894 EXUNIV.

JANUARY 27-28, 1994

Reno, Nevada, USA

SYMPOISUM ON DYNAMIC GEOTECHNICAL TESTING

Topics: Field and laboratory test methods; Centrifuge testing.

ASTM, 1916 Race Street, Philadelphia, PA 19103-1187, USA.

APRIL 3-7, 1994

Nasr City, Cairo, Egypt

INTERNATIONAL CONGRESS ON TUNNELLING AND GROUND CONDITIONS.

Topics: Recent case histories; Urban tunnelling through water bearing deposits; Underground structures in rock formations; Innovation, new researches and development of underground space; Numerical and experimental modelling; management of underground projects; other tunnelling topics. Call for papers - 500 word abstracts by February 1, 1993, acceptance by May 1, 1993, papers required by October 1, 1993.

International Tunnelling Congress, 1994, Eng. SH.EL BEDAIWY, The National Authority for Tunnels, 56 El Ryad St., El Mohandiseen - Post No 12655, Cairo, Egypt. TLP: 346276-3460458-3467256 or 3477938 (fax); TLX: 93547 METOR UN.

MAY 22-28, 1993

Morgantown, West Virginia, USA

IACMAG 94, EIGHTH INTERNATIONAL CONFERENCE ON COMPUTER METHODS AND ADVANCES IN GEOMECHANICS.

Call for papers current.

Prof. Hema J. Siriwardane. Chairman for IACMAG 94. College of Engineering, 637 Engineering Building, West Virginia University, Morgantown, WV 26506-6101 USA. TLP 304-293-3031 ext. 620 or 304-293-5024 (fax). E-mail HJSIRI@WVNVMS. WVNET. EDU

JUNE 16-18, 1994

Texas A & M University, USA

ASCE SPECIALTY CONFERENCE, SETTLEMENT 94

Topics: Vertical and horizontal deformations for foundations and embankments.

Settlemrent 94, Geotechnical Engineering, Texas A & M University, College Station, Texas 77843-3136, USA. TLP: 409 8453735 or 409 845 6156 (fax).

SEPTEMBER 5-9, 1994

Singapore

5TH INTERNATIONAL CONFERENCE ON GEOTEXTILES, GEOMEMBRANES AND RELATED PRODUCTS

Mr. R.S. Douglas, Secretariat, 510 Thomson Road, No. 0022-03, SLF Building, SGP - 1129 Singapore. TLP: 65/3535511 or 3532424 (fax).

SEPTEMBER 5-9, 1994

Lisbon, Portugal

7TH INTERNATIONAL CONGRESS OF THE IAEG

Themes: 1 - Developments in the Site Investigation and in the Engineering Geological Mapping; 2 - Engineering geology and Naturals hazards; 3 - Engineering Geology and Environmental Protection; 4 - Construction Materials; 5 - Case Histories in Surface Workings; 6 - Case Histories in Underground Workings. **Workshops:** A - Information technology Applied to Engineering Geology; B - Teaching and Training in Engineering Geology. **TS:** 1st circular - June 1992.

Sociedade Portuguesa de Geotecbnia (SPG), c/o LNEC, Av. do Brasil, 101, P-1799 Lisboa Codex, Portugal. TLP: 351/1/ 8473822 or 897660 (fax).

SEPTEMBER 12-14, 1994

Sapporo, Japan

INTERNATIONAL SYMPOSIUM ON PRE-FAILURE DEFORMATION OF GEOMATERIALS-MEASUREMENT AND APPLICATION (IS-Hokkaido)

Topics: Measurement and modelling of shear deformation properties of geomaterials (including those under dynamic and static loading conditions, but excluding purely theoretical work); Case study associated with shear deformation of ground and geostructures. Abstracts: July 31, 1993. **Language:** English.

Secretariat of IS-Hokkaido, Prof. Toshiyuki Mitachi, Dept. of Civil Engineering, Faculty of Engineering, Hokkaido University. North 13 West 8, Sapporo 060 Japan. TLP: 011 716211 ext 6192 or 011 7262296 (fax).

SEPTEMBER 21-23, 1994

Mamaia, Romania

XTH DANUBE-EUROPEAN CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING FOR INFRA-STRUCTURE

Theme: Soil mechanics and foundation engineering for infrastructure.

Prof. I. Manoliu, C.P. 38-71, RO-723021, Buharest Romania.

MAY 28-JUNE 1, 1995

Copenhagen, Denmark

11TH EUROPEAN CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING

Theme: The interplay between geotechnical engineering and engineering geology.

Dr. Jorgen Steenfelt, c/o ICS International Conference Services, Strandvejen 171, DH-2900 Hellerup, Denmark. TLP: 45 31 6121915 or 45 31 2068 (fax).

SEPTEMBER 25-29, 1995

Nakase, Chiba, Japan

8TH INTERNATIONAL CONGRESS ON ROCK MECHANICS

Keynote: Frontiers of Rock Mechanics towards the 21st Century. Main Session Themes: Geology, site exploration and testing; Physical properties and modelling of rock; Near surface excavations, Stability of slopes and foundations;

Excavation and stability of underground openings; Heat, water flow and chemical transport in rock masses; Information system and artificial intelligence in rock mechanics.

Secretariat for the 8th International Congress on Rock Mechanics; c/o Conference and Event Department, Simul International Inc., Kowa Bldg. No.9, 1-8-10, Akasaka, Minato-ku, Tokyo 107, Japan. TLP: 81-3-3586-8691 or 81-3-3586531 (fax).

JUNE 17-21, 1996

Trondheim, Norway

7TH INTERNATIONAL SYMPOSIUM ON LANDSLIDES

Norwegian Geotechnical Society, PO Box 40, Taasen, N-0801, Oslo 8, Norway.