

N.Z. GEOMECHANICS NEWS

No. 10

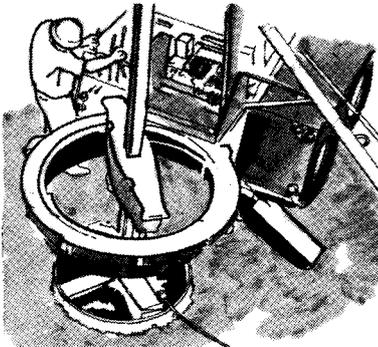
MAY 1975

A NEWSLETTER OF THE N.Z. GEOMECHANICS SOCIETY

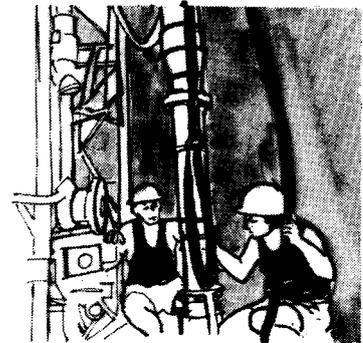
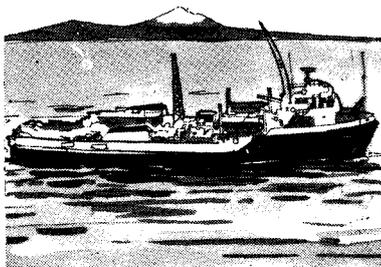
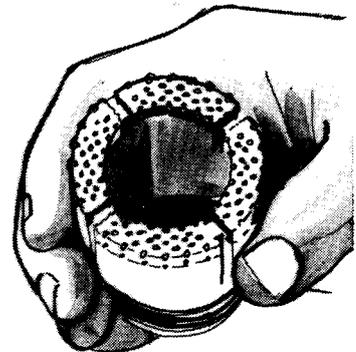
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N.Z. GEOMECHANICS NEWS

No. 10, May 1975

A Newsletter of the N.Z. Geomechanics Society

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THIS IS A RESTRICTED PUBLICATION

"N.Z. Geomechanics News" is a newsletter issued to members of the N.Z. Geomechanics Society. It is designed to keep members in touch with recent developments. Authors must be consulted before papers are cited in other publications.

Persons interested in applying for membership of the Society are invited to complete the application form at the back of this newsletter. Members are required to affiliate to at least one of the following international societies; Soil Mechanics, Rock Mechanics or Engineering Geology.

EDITORIAL COMMENT1. The Use of Stereographic Projections

In this issue the first of a two part article on the Analysis of Geological Structures using Stereographic Projection is presented. The first part serves as an introduction to the technique while the second part, to be presented in the next issue, will give a practical application of the method.

Stereographic projection is a technique which, by all accounts, is not well understood by a large number of engineers. It is hoped that this two part article will give a better understanding of the method. The article has been written by Mr I.R. Brown, an engineering geologist employed by the D.S.I.R., and currently engaged on work involving the mapping of rock defects and rock slope stability problems.

2. Local Geomechanics Activities

This issue presents a review of recent Geomechanics Society activities in Auckland and Wellington. Previously local group activities had been publicised infrequently but it is hoped to prevent reviews of these activities on a regular basis.

If local groups in other centres are meeting regularly or engaging in organised activities, the Editor would welcome notification of these events for publication in Geomechanics News.

In July and August of this year Dr C.P. Wroth is to make a brief visit to New Zealand for the purpose of delivering the Second Geomechanics Lecture. The Lecture will again be delivered in Auckland, Wellington and Christchurch. Further details are given in this issue of Geomechanics News. Members and friends are urged to attend the Lecture series.

3. Field Instrumentation

Part 2 of this series is included in this issue of Geomechanics News. The series of article has been written by Mr P.R. Barker of Soil Bureau, D.S.I.R. Mr Barker gained a Winston Churchill Memorial Trust Award and spent 12 months from July 1972 in the United Kingdom studying types and uses of *in situ* field instruments and their application to site investigation procedures.

4. Geomechanics Society Participation at N.Z.I.E. Annual Conference, February 1975

Two sessions were held at the Annual Conference in Auckland this year. In the first session papers were presented by Prof. P.W. Taylor and Dr M.J. Pender on foundation design for a multi-storey building, and probabilistic design of a retaining wall, respectively. The session was well attended with even available standing room completely occupied.

The second session was a panel discussion on the N.Z. Provisional Standard 4205P:1973, "Code of Practice for Foundations of Buildings". A report on that session is presented in this issue of Geomechanics News.

The statements attributed to various speakers in the report have been condensed from notes taken at the meeting. It has not been possible to check the accuracy of the reported statements with their authors before the publication deadline. The N.Z. Geomechanics Society therefore apologises for any misreporting which may have occurred and would welcome written comment from reported authors to correct, or amplify, the record.

5. I.S.S.M.F.E. Executive Committee Meeting, Istanbul, 1975

Recently Prof. P.W. Taylor attended the Executive Committee Meeting of The International Society for Soil Mechanics and Foundation Engineering, in Istanbul, as regional Vice-President of the Society. A report of that meeting is included in this issue.

6. Contributions Wanted

Contributions to New Zealand Geomechanics News may be in the form of technical articles, notes of general interest, letters to the Editor, or books reviews, and may cover any subject within the fields of Soil Mechanics, Rock Mechanics and Engineering Geology. Articles on site investigations, construction techniques or design methods which have been successfully used in New Zealand, and which would be of help to other members, would be particularly welcome.

All contributions should be sent to:

The Editor,
New Zealand Geomechanics News,
C/- New Zealand Geomechanics Society,
P.O. Box 12241,
WELLINGTON.

I.M. Parton
EDITOR

STOP PRESS

VISIT TO NEW ZEALAND BY DR. E. HOEK

The Ministry of Works and Development and the NZ Geomechanics Society have been able to arrange for Dr. E. Hoek to present two lectures in Wellington later this year.

Date: TUESDAY 18th November 1975

Place: Rm 303, Kirk Building, Victoria University.

Time: 1.30 p.m. "The Stability of Rock Slopes with Particular Reference to Weathered Rock Slopes in Earthquake Regions."

3.15 p.m. "Underground Excavation for Hydro Electric Projects."

ANALYSIS OF GEOLOGICAL STRUCTURES
USING STEREOGRAPHIC PROJECTIONS

I.R. Brown

1. Introduction

In rock mechanics problems, the behaviour of the rock mass is controlled by natural discontinuities such as joints, shears, faults, crushed zones, bedding planes and cleavage planes. Although the structural geologist has definite criteria for the recognition of each type of discontinuity and each has a genetic significance, for rock mechanics purposes the various discontinuities may be loosely grouped under the term 'rock defects'. Rock defects may be considered to be more or less planar and their directional properties cause anisotropic rock mass strength, deformation moduli, and permeability.

This article describes methods of measuring and analysing the directions of rock defects using stereographic projections. The boundaries of unit rock blocks are defined by the three most prominent defect directions and unit block size is determined from defect orientation and spacing. Other factors such as three dimensional extent and continuity, roughness and the properties of defect filling materials must also be considered in a rock mechanics analysis.

2. Field Measurement of Defect Orientations

The orientation of a defect is described by an azimuth (either strike, or dip direction) and dip. Strike is defined as the azimuth of the intersection of the defect plane with a horizontal plane; dip is the maximum angle between the defect plane and the horizontal plane. The azimuth of dip direction is normal to the strike azimuth. When working in terms of dip and strike, the general azimuth of dip must be stated. The use of dip direction and dip is preferred; the plane orientation may be defined by 5 digits without further qualification.

Dip direction and dip is directly measured by a rock mechanics clinometer (Fig. 1). The hinged part of the clinometer is placed directly on the plane of the defect and the body of the compass is levelled using the spirit bubbles. The compass then measures the azimuth of dip direction, and angle of dip is obtained from a graduated scale at the clinometer hinge.

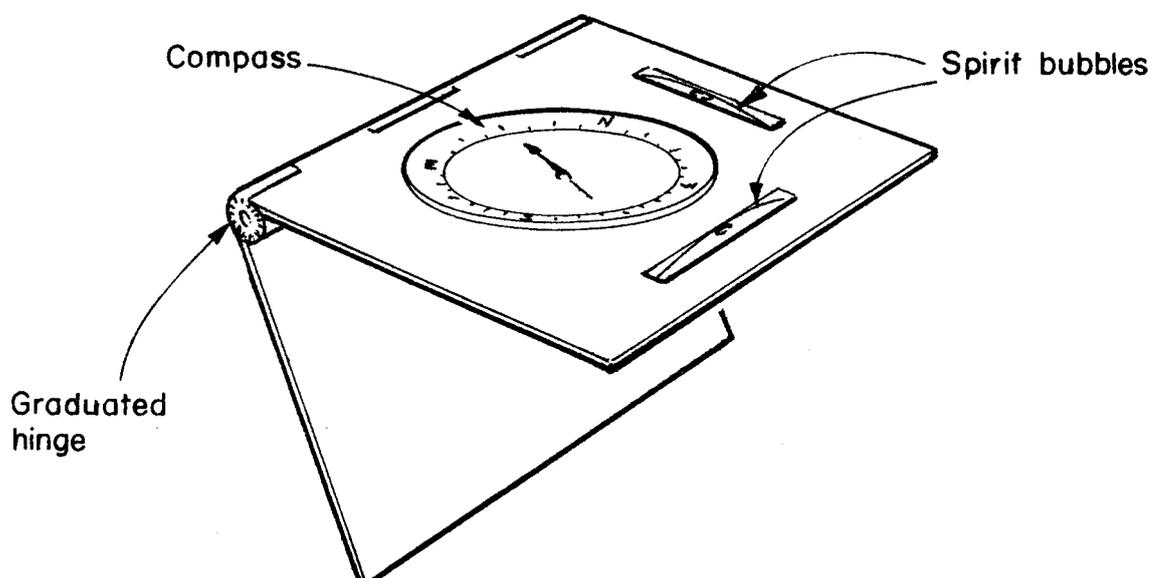


Figure 1. Clinometer

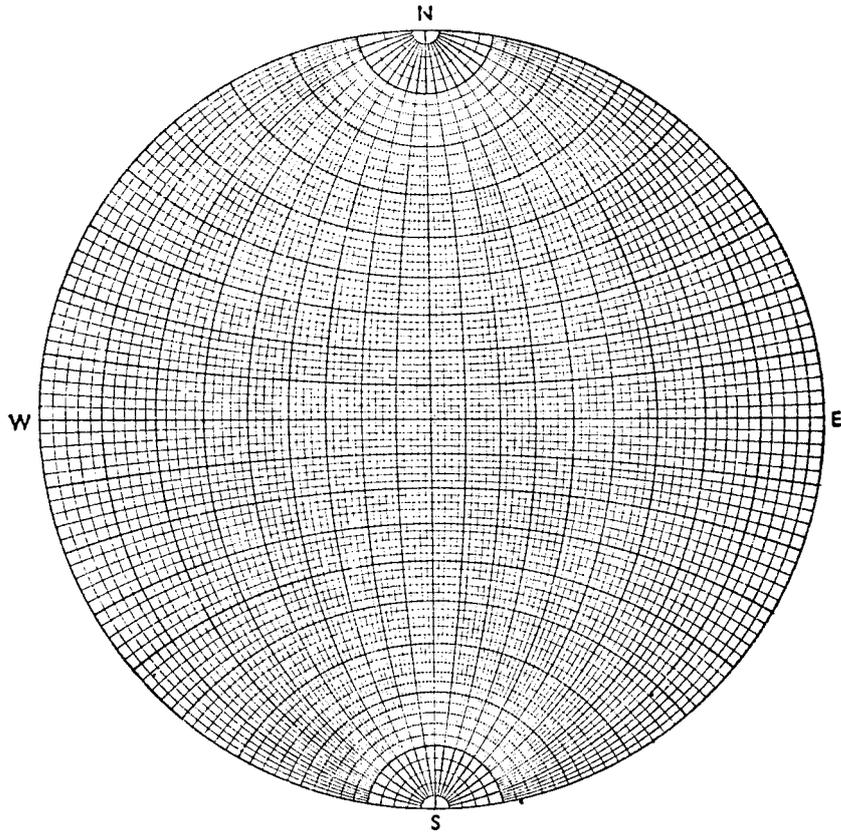


Figure 2. Equal Angle Projection

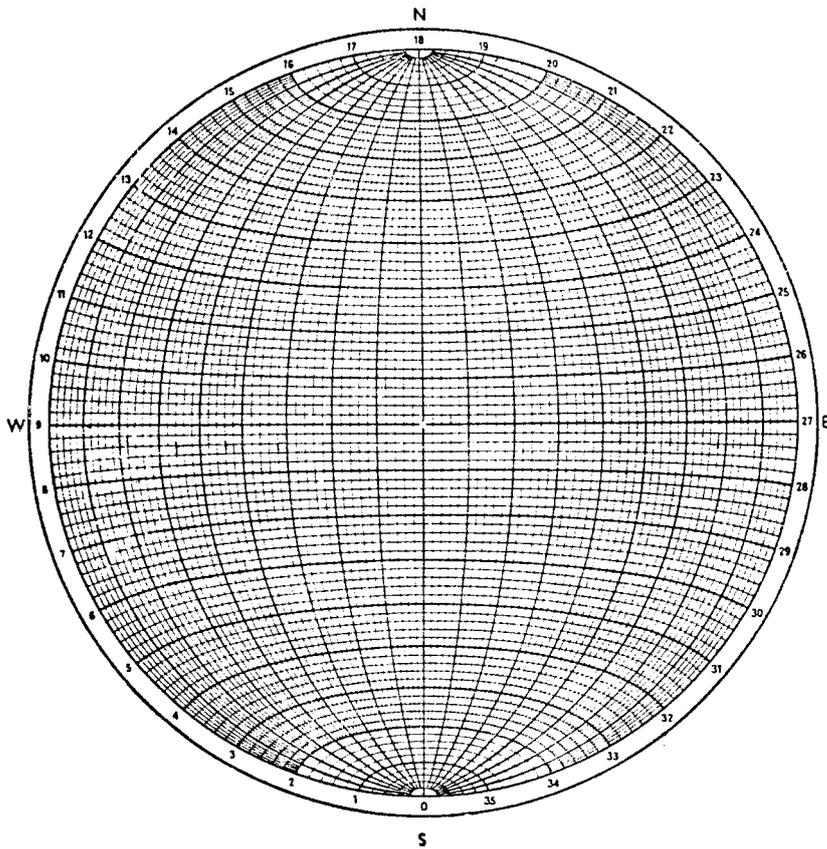


Figure 3. Equal Area Projection

Rock defect orientations are influenced by large scale regional structural directions. At any one location it might reasonably be assumed that the directions defining the unit block are constant, however over the area of an engineering structure these directions may change. A defect survey should show whether such variations occur. To begin with, the area of study is divided into numerous domains within which directional homogeneity may be anticipated (possibly on the scale of one domain per outcrop). The prominent directions within each domain may be compared and if similar results are obtained the limits of a domain may be increased in size.

In some cases the results of a defect survey may be biased towards those defects that are readily observable in the plane of the outcrop. Terzaghi (1965) presented a method that compensates for such bias. In practice, recognition of the problem and the use of judgement tends to limit the degree of bias in orientation measurements, as most outcrops have surface irregularities that allow a three-dimensional view of the structure.

3. The Stereographic Projection

A stereographic projection is simply a projection of a sphere on a plane surface. Two types of projection are commonly used; the equal angle or Wulff projection (Fig. 2) and the equal area or Schmidt projection (Fig. 3). In an equal area projection a unit of area anywhere in the projection represents the same fraction of the total area of the reference hemisphere. In an equal angle projection increasing distortion occurs with increasing distance from the centre of the projection circle.

If an inclined plane passes through the centre of a sphere, the intersection of the plane and the outside of the sphere will describe a great circle (Fig. 4). The intersection of the inclined plane with the horizontal diametral plane will give the line of strike of the inclined plane. A stereonet (Figs. 2 and 3) is comprised of the projection on to the diametral plane of great circles with north-south strike and varying dip. Small polar circles are also shown on the stereonet. The horizontal diametral plane divides the sphere into hemispheres and any plane may be fully represented in a projection of just one of the hemispheres; in rock mechanics a projection of the lower hemisphere is generally used.

To plot a plane on a stereographic projection the following procedure is used. A sheet of paper is laid over the stereonet and tacked to the centre. The north-south axis of the projection is marked on the tracing paper as is the azimuth of strike of the plane to be plotted.

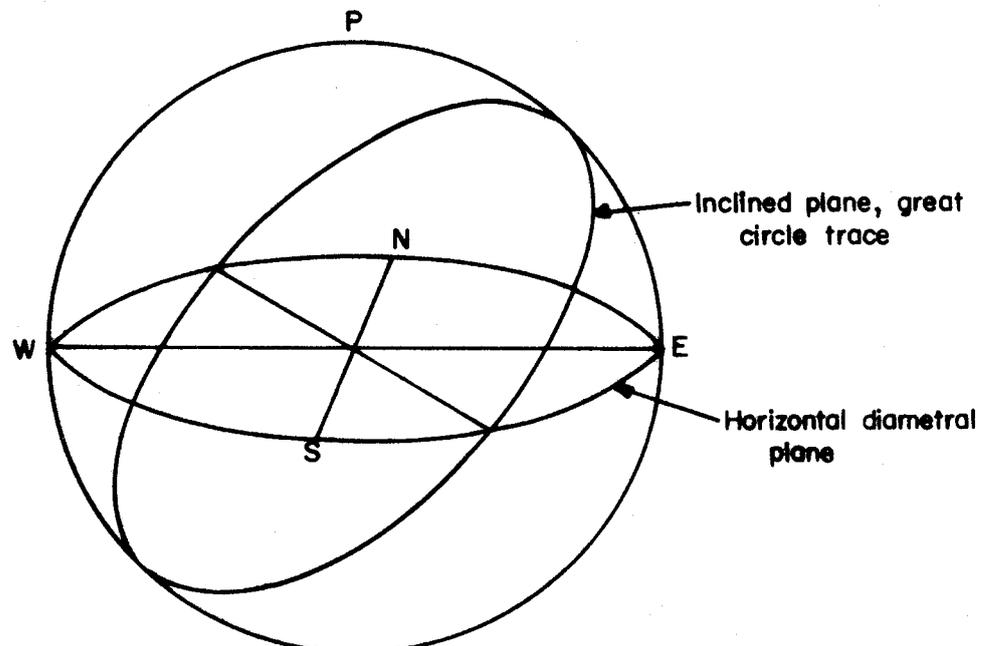


Figure 4. Basis for Stereographic Projection

The tracing paper is rotated until this point coincides with the north-south axis of the stereonet and the great circle corresponding to the dip of the plane is traced. Planes may also be represented by poles of planes, the pole being the projection of a line that passes through the centre of the hemisphere and is normal to the plane (Fig. 5). When the orientation of numerous planes are to be plotted, a clearer diagram results if only poles are plotted.

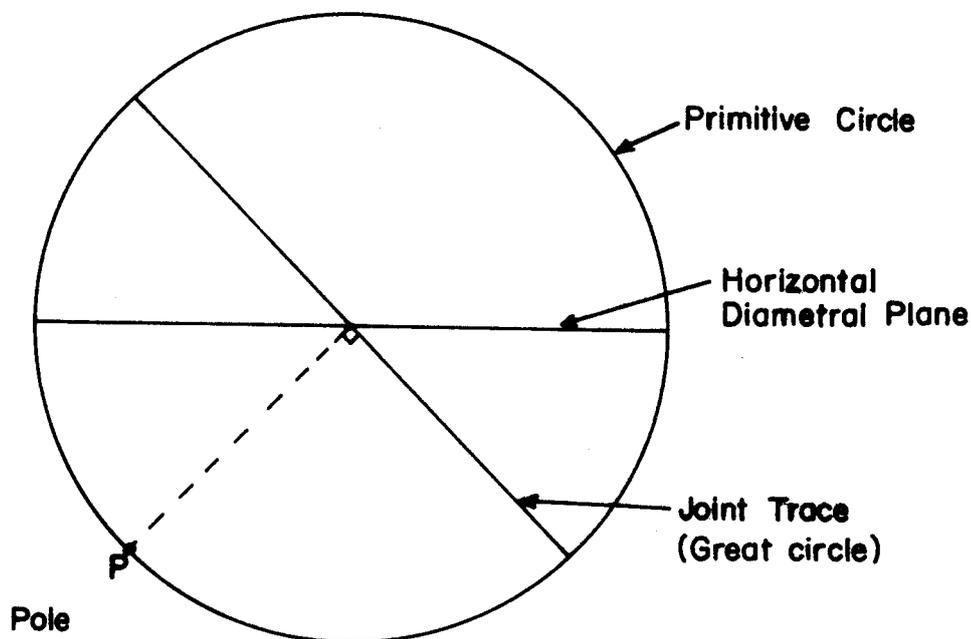


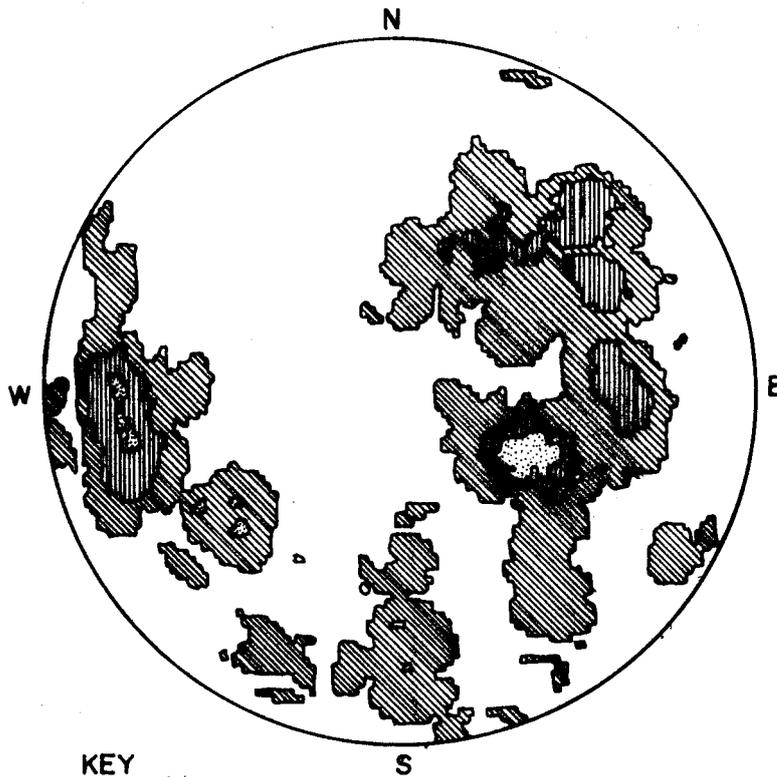
Figure 5. Pole Illustration

The use of stereographic projections is limited to problems involving angular relationships between planes and lines in space. Problems involving true distances must be solved using an orthographic projection. The equal angle or Wulff stereonet should be used for problems involving accurate angular measurement, and the Schmidt stereonet where rock defect orientation densities are to be measured. An equal area stereonet is constructed such that a unit of area anywhere on the projection represents the same fraction of the total area on the reference hemisphere. To achieve this criterion, there is angular distortion of the stereonet which is greatest at the edge of the primitive circle (note the distortion of the polar small circles in Figure 3).

4. Contoured Stereonets

The density of poles on an equal area stereonet may be measured by moving a counting circle (generally having an area 1% of that of the primitive circle) progressively across the stereonet in increments of one counting circle radius and recording the number of poles lying within the counting circle at that position. When the counting circle crosses the primitive circle, the poles diametrically opposite must be counted as well. The numbers recorded on the diagram are then used as a basis for drawing contours such as shown on Figures 6 and 7.

Defect orientations are uncommonly, if ever, uniformly distributed. Two distinct contoured patterns may occur - point maxima where the poles are clustered around a central point (Fig. 6), or girdle patterns in which the poles are distributed along a great circle (Fig. 7). Between these two extremes gradations are more likely to occur. Elongation of point maxima are common.



KEY

Pattern	%
Diagonal lines (top-left to bottom-right)	0.84 - 3.36
Vertical lines	3.36 - 5.87
Stippled pattern	5.87 - 9.23

Figure 6. "Clustered" Contour Plot

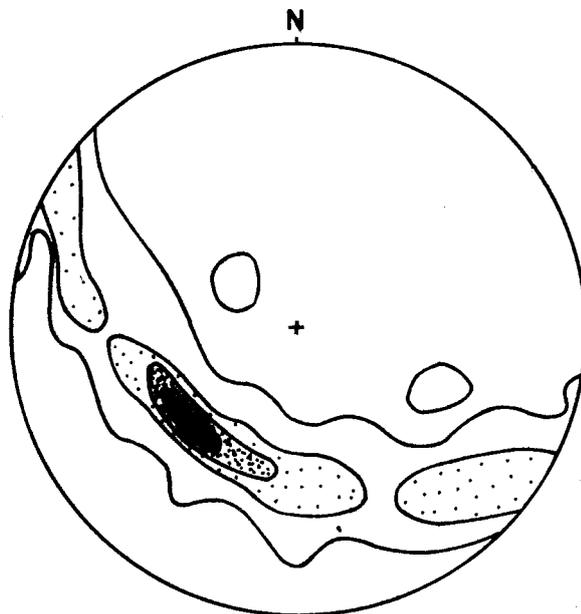


Figure 7. "Girdled" Contour Plot

The shape of a contoured plot is used by structural geologists to understand tectonic patterns. In rock mechanics it is necessary to define the modal values for defect sets - this can be readily done by visual inspection of the contoured diagrams.

5. Reference

TERZAGHI, R.D. 1965 : Sources of error in joint surveys
Geotechnique 15 : 287

Sources of Additional Reading:

RAGAN, D.M. 1968 : Structural geology - an introduction to Geometrical
Techniques John Wiley & Sons

TURNER, F.J. 1963 : Structural analysis of the metamorphic tectonites
WEISS, L.E. McGraw-Hill, New York

PHILLIPS, F.C. 1971: The use of stereographic projection in structural
geology. Arnold, London

LOCAL GEOMECHANICS ACTIVITIESWELLINGTON

One meeting has been held this year, which was a panel discussion on legal problems associated with Geotechnical activities. Three speakers introduced topics which were then thrown open for general discussion. The meeting was organised in conjunction with the local N.Z.I.E. branch. A review of 1974 activities was presented in Geomechanics News No. 9.

Topics discussed at the April 1975 meeting were:

"Legal Aspects of Geotechnical Works",
Mr W.L. Ellingham

"Water and Soil Legislation as it Affects Some
Geotechnical Works",
Mr W.R. Howie

"The Problems facing an Expert Witness",
Mr K.H. Gillespie

AUCKLAND

Since the previous article on this subject was published (N.Z. Geomechanics News No. 7, November 1973), the N.Z.I.E. Auckland Branch Geomechanics Technical Group has continued with a number of activities under the chairmanship of Mr R. Gilmour. These activities have included:

- Updating the booklet on "House Foundations" originally produced by the Committee.
- Maintaining the House Foundations exhibit at the Auckland Building Centre.
- Maintaining the card index system of borehole information in the Auckland area held in the Engineering School Library.
- Maintaining an interest in geomechanics matters of public interest and concern in the Auckland area.
- Maintaining an interest in Standards Association of N.Z. publications on building foundations and on earthworks as they relate to the Auckland area.
- Convening meetings and discussions for people in the Auckland area who are interested in geomechanics.

Meetings held in 1974 and in 1975 to date were as follows:

March 1974: "Some Fundamental Aspects of the Liquefaction of Sands". Subject introduced by Dr G.R. Martin followed by discussion. An outline was given of Dr Martin's recent research work which has the objective of developing new criteria to judge whether or not sands will liquefy during an earthquake (attendance 27).

July 1974: Panel Discussion on Ground Anchors. Written papers were circulated to those at the meeting and the presentations were followed by general discussion. The papers were each presented by the author as follows:

"Some Practical Aspects of Drilling Techniques Used for Ground Anchors" B.C. Hadfield.

"Some Practical Aspects of Installing Ground Anchors" P. Goldsbro'

"Ministry of Works, Auckland, Experience with Rock and Soil Anchors" T. Russell

(Attendance 37)

November 1974: "Sand Drains for Soil Stabilization". Subject introduced by Mr G.R.W. East followed by discussion. Three papers written by Mr East were circulated to those present at the meeting and the presentation of the papers was followed by discussion.

The papers presented were:

"The Use of Sand Drains for Stabilization"

"Further Notes on the Use of Sand Drains for Stabilization"

"Tristram Avenue Interchange Case History"

(Attendance 24)

April 1975: "Symposium on House Foundations in the Auckland Area". The 2½ hour symposium consisted of three prepared papers followed by invited contributions from the floor from interested groups (N.Z. Institution of Architects, Auckland Municipal Works Officers Guild and Master Builders Association (Auckland Branch), followed by general discussion. The three prepared papers were as follows:

"Geotechnical Aspects of House Foundations" G.A. Pickens

"The Building Inspectors Responsibilities to the Local Authority" T.E. Webb

"The Viewpoint of the Builder and of the Subdivider" D.A. Roadley.

The large gathering of interested people showed that this must be regarded as the most successful meeting to date organised by the Group. The particular problems caused to house foundations because of the shrinkage/swelling characteristics of the clays of high plasticity commonly found in the Auckland area were highlighted. Methods of overcoming these problems at the time of building the house and the additional cost of these foundations was discussed. It was pointed out that it is always far more costly to carry out remedial work at a later date when this proves to be necessary and the end result is never as satisfactory as if the foundations are installed during construction. Discussion also took place on the adequacy of the types of foundations proposed in NZS 4204 P "Draft Code of Practice for Foundations for Buildings Not Requiring Specific Design". The topic of land stability in the Auckland area was also discussed at some length. It was generally agreed that more careful controls should

be imposed on building in areas which may be potentially unstable and also that the purchasers of existing houses do not generally consider very carefully, if at all, whether there may be any potential foundations or site stability problems before they invest their life savings in a house. This is really a most surprising conclusion and one which should be remedied by education of the general public.

It is hoped to prepare a brief publication on the Proceedings of the Symposium to include the prepared papers, and a summary of the invited contributions from the floor and the general discussion which took place. This will be sold to interested people for about \$3.00.

(Attendance approximately 110)

Further events planned for 1975 are as follows:

- August: Panel Discussion on the Provisional N.Z. Standard Code of Practice for Earth Fill for Residential Development (NZS 4431 P : 1973).
- October: Further Discussion on the Design of Retaining Walls with Particular Reference to Auckland Soil Conditions.

CURRENT ENGINEERING GEOLOGICAL WORK IN THE
N.Z. GEOLOGICAL SURVEY, DSIR

In Auckland, Ian Brown is attached to the Auckland Rapid Transit Project and has been working with the New Zealand Railways and Ministry of Works and Development engineering team on site investigations and route selection. He is also mapping dam abutments at Mangatangi for the Auckland Regional Authority, and is assisting with a rock slope stability project being undertaken by Auckland University's Department of Civil Engineering. Other work includes an evaluation of existing sub-surface data for the preparation of a detailed large scale geotechnical map of the central Auckland City area.

Also in Auckland, Les Kermode has been continuing with the compilation of the 1:25,000 Industrial Series Geological Map of New Zealand, the Howick Sheet of which is now in press. He has also been involved with investigations of landslide terrain at Poro-o-tarao, south of Te Kuiti, for the replacement of the existing tunnel on the main trunk railway.

At Turangi, activity on the Tongariro Power Development has been directed more towards investigations for the Rangipo Scheme. Graham Hancox is involved with the underground powerhouse investigations. During 1973 a shaft was sunk from an investigation drive to powerhouse level, about 270 ft below the level of the Waikoko Stream. From investigations to date it appears that the rock in the machine hall chamber will be jointed greywacke sandstone with minor interbedded argillite. The shaft excavation suggests that numerous clayey crush and shear zones will be encountered though these are likely to be of only local significance. Moderately high ground water inflows (total 250 gpm) made the shaft excavation difficult and pointed to water problems during excavation of the powerhouse and ancillary structures. Recently a drilling chamber was excavated at the base of the shaft and a diamond drilling programme is currently in progress. With these additional drillholes it is hoped that the limits and orientation of the machine hall can be finalised. Preparations for the access tunnel into the powerhouse are underway and a start underground should be made within the next few weeks. Exploratory drilling will precede portal establishment. A 600ft hole is currently being drilled at the site of the proposed upstream surge chamber. Recently purchased wire-line (NQ & HQ) equipment is being used for this hole but unfortunately bit and water supply problems have limited the kind of progress normally expected from this sophisticated type of gear.

Brian Paterson has been investigating the site of the Rangipo headrace tunnel intake structure. During the last few months six cored holes have been drilled to investigate the properties and distribution of the three soil and rock types in the area - Tongariro River alluvium, andesite and greywacke. These investigations, which have almost been completed, have proved a foundation of compact coarse alluvium. At the completion of these investigations, drilling will commence along the Waihohonu tunnel line. Investigations by Bernard Hegan of the headrace and tailrace tunnel alignments have included detailed geological mapping and co-ordinating seismic surveys and diamond core drilling in areas where detailed knowledge of tunnel geology is necessary. Bernard is also recording geological conditions in the Kaimai Tunnel as tunnelling proceeds. On the east side, where the tunnelling machine is operating, core samples are being taken from the tunnel walls for strength testing, with the aim of correlating these results with the performance of the machine. On future tunnelling projects this work may enable a more objective assessment of likely machine performance to be made from a similar study of investigation drill cores.

At Lower Hutt, Les Oborn recently returned from a period overseas. While away he attended the 2nd I.A.E.G. Conference in Sao Paulo, Brazil, and

after visiting a number of geological surveys and universities in Europe, spent four months in Oakland, California, studying the effects of engineering geological hazards, especially those related to active faulting and earthquakes on nuclear power plant siting and urban development. Bruce Riddolls and Nick Perrin are involved with a number of projects. Construction of the Terrace Tunnel commenced recently for the final stages of Wellington's motorway. Because of the poor rock condition, caused by weathering and faulting, exposures created during construction are being logged and correlated with the previous investigations, so that the maximum amount of data is available for prediction of tunnelling conditions. Near Waimiha in the King Country unstable slopes in soft mudstone terrain affecting the main trunk railway have been drilled to determine the materials involved in the slumping, and inclinometer tubes installed to monitor rates and depths of movement. This work is aimed at selecting suitable stabilization measures. In the same area, work has continued on the assessment of subsurface data for the location and design of the replacement tunnel at Poro-o-tarao, where landslides are a conspicuous feature.

Lynnette Cumming was appointed recently to work in the geomechanics laboratory at Lower Hutt. Present facilities permit basic rock properties such as water content, density, porosity, and grain-size to be determined, while slake-durability and point-load apparatus are available for index tests. Rock strength can be determined both with a shear box, and triaxial cells. Current work includes an investigation of the characteristics of the widely occurring weak Tertiary sediments or "papa", one aim of this project being to interpret the geotechnical properties of these rocks in relation to the diverse sedimentary and tectonic environments in which they have developed.

At Twizel, Stuart Read and Jim McLean are occupied with engineering geological requirements of the Upper Waitaki Power Development. Most of the structures are founded on glacial deposits which form a thick cover over the area. Extensive subsurface investigations have been undertaken at the site of the Pukaki High Dam, the construction of which is well advanced. Recent work has also included investigation of deposits of outwash gravels as a source for suitable canal-lining material. Nearby, in the Fairlie area, three proposed sites for irrigation dams have also been studied.

Further south, Royden Thomson was engaged recently to do geological work relating to power development on the Clutha and Kawarau Rivers. Drilling has so far been concentrated on determining the most suitable dam site immediately downstream from Cromwell. Attention is also being given to assessing the likely influence of raised water levels on the stability of valley slopes, many of which show evidence of instability under geologically recent and existing conditions.

B.W.R.

THE SECOND NEW ZEALAND GEOMECHANICS LECTURE

The "Second New Zealander Geomechanics Lecture" will be given by Dr C.P. Wroth, reader in soil mechanics at Cambridge University. Dr Wroth is widely known for his many papers on soil mechanics topics and as co-author of the text "Critical State Soil Mechanics". The Lecture is being organised in conjunction with local branches of the NZIE.

Dr Wroth is to speak on the settlement of engineering structures, and in particular, soil-structure interaction, the estimation of differential settlement and the assessment of damage to structures resulting from settlement. Dr Wroth will include consideration of relationships between allowable distortion and the geometry of structures. Structures considered will include framed buildings, buildings with load bearing walls and brick walls subjected to hogging deformations.

The Lecture will be of interest to architects, structural engineers and geotechnical engineers.

The title of the Lecture will be:

"A FRESH LOOK AT THE DAMAGE CAUSED TO BUILDINGS BY SETTLEMENT"

The Lecture will be given:

- i. IN AUCKLAND on Thursday July 31 at the Professional Club -
 - 5.30 p.m. Social Hour
 - 6.30 p.m. Dinner
 - 7.30 p.m. Lecture
- ii. IN CHRISTCHURCH on Tuesday August 5 in Room E9 at the Engineering School, University of Canterbury.
 - 8.00 p.m. Lecture
- iii. IN WELLINGTON on Thursday August 7 at Wool House, Featherston Street.
 - 5.15 p.m. Social
 - 5.45 p.m. Lecture

Dr Wroth will also be giving a colloquium at each of the three centres. In these colloquia it is hoped that Dr Wroth will speak on the application of "Critical State Soil Mechanics" to practical problems.

The History of the NZ Geomechanics Lectureship begins with the profit made by the organising committee for the Fifth Australia - New Zealand Conference on Soil Mechanics and Foundation Engineering held in Auckland in 1967. The money was invested by your Management Committee to provide an income to be devoted towards the promotion of Geomechanics in New Zealand. The decision was that income from the investment should be put towards the "Geomechanics Lectureship", to be held approximately biennially at three different centres in New Zealand.

Although it is only a little over a year since Mr J W Ridley MP delivered the First New Zealand Geomechanics Lecture, it was decided to invite Dr Wroth to New Zealand after he has attended the Second Australia - New Zealand Conference on Geomechanics in Brisbane in July of this year.

In addition to the sponsorship by your Society, Dr Wroth's visit is being sponsored by the MWD, DSIR and Universities of Auckland and Christchurch. Your Management Committee has organised the Lecture in conjunction with local NZIE branches. Members are urged to attend and to bring the Lecture to the attention of their associates - architects, structural engineers and geotechnical engineers.

FIELD INSTRUMENTATION

PART 2 : MEASUREMENT OF GROUND MOVEMENT

P.R. Barker

Introduction:

Measurements of ground movement are concerned with the accurate determination of settlement, heave, lateral displacement and changes in length. Part 2 of this series gives a brief description of some of the techniques and equipment used to make the above measurements. A list of recent references is included, many of which are published in readily available journals. Part 1 of this series appeared in Geomechanics News No.9.

Measurements by Conventional Surveying Techniques:

The survey techniques commonly used are: measurement of offset distances from a line of sight, both horizontally and vertically; taping distances between observation pillars; triangulation.

These techniques require the installation of a datum benchmark (Fig.1) located well away from the area of ground movement being studied and fixed well below the zone of daily and seasonal ground surface movement. Important features of a datum benchmark are; isolation of the reference rod from the borehole by means of the casing, spacers, and possibly oil filling; access at the top to a specially machined reference; and a robust protective vandal-proof cover.

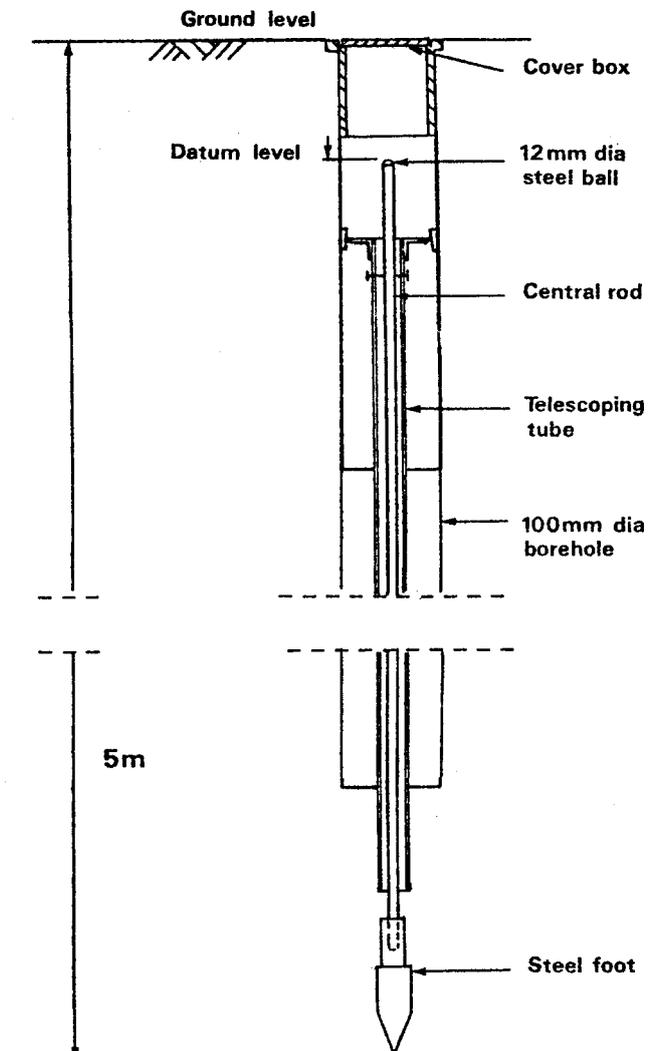


Figure 1.
Datum Benchmark

The actual design of the settlement point or displacement point will depend on what precision of measurement is required, and site conditions.

Having established the necessary benchmarks and reference points, optical levelling techniques are used to determine elevations and theodolites and tape to determine lateral movements. Third or second order levelling accuracy is sufficient to obtain closing errors of about 1 mm, but where a high degree of accuracy is needed, first order levelling must be used. Theodolites with a resolution of 1 second of arc are commonly used for offset measurements.

Steel tape, if laid along the ground surface, give an accuracy of about 5 mm in 30 m. However, when suspended and corrections are applied for tape sag, tension, temperature and ground slope, an accuracy of about ± 1 mm in 30 m can be achieved.

Other techniques using electro-optical distance measuring equipment, laser beams and photogrammetric methods are available.

Measurements Using Special Equipment

Settlement Gauges

For situations (such as at depth within a soil mass) where it is not possible to measure settlement using conventional survey techniques, other techniques are available.

A cell which operates on the principle of a water monometer is shown in Fig.2. The measuring cell is buried and connected to a remote vertical standpipe by a water overflow tube. A drain tube and air tube are also connected to the cell. The initial elevation of the cell is determined by optical levelling during installation. Subsequently, elevations of the overflow level can be read on the scale attached to the vertical standpipe. An accuracy in elevation reading of about ± 0.5 mm is possible.

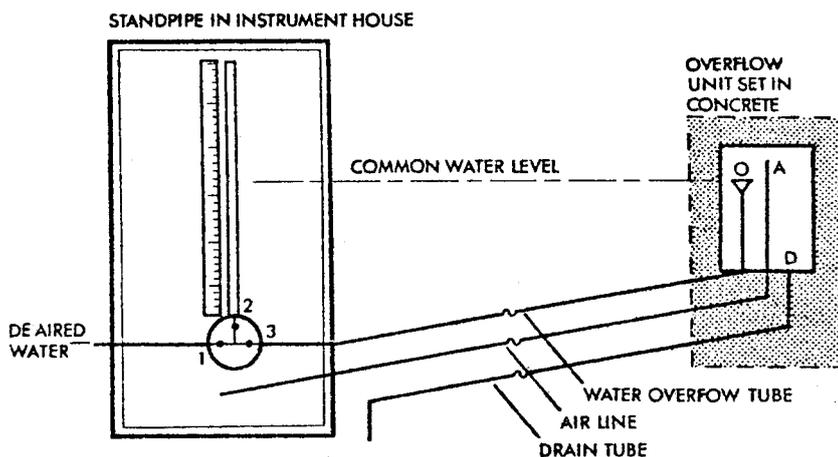


Figure 2. Water Settlement Gauge

Multipoint settlement cells have also been developed. A simple but precise multipoint settlement gauge (Fig. 3) consists of a permanent circular magnet axially magnetized which acts as a marker in the ground, and a reed switch sensor. As the reed switch moves axially into the central field of the magnet it snaps shut actuating an indicator light or buzzer.

The equipment is used in boreholes of about 100 mm diameter. A central plastic tube for guiding the reed switch sensor is placed in the borehole and the magnet holders are slipped over the tube and placed at the required depths.

The magnet holders are held with strong springs to the side of the borehole which is then back-filled with a thick bentonite slurry.

The accuracy of this method, which is controlled by the steel tape attached to the probe is approximately 1-2 mm. Greater accuracy can be obtained by installing a permanent string of reed switches.

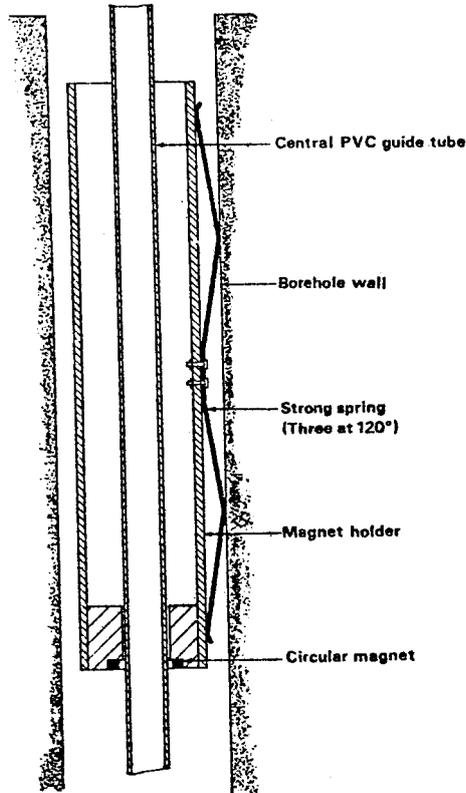


Figure 3. Multipoint Settlement Gauge

Profile Settlement Gauge

This instrument measures settlement within an embankment. A flexible access tube is buried along the section where the settlement is to be measured (Fig.4). A probe comprising a liquid filled bladder surrounded by air at atmospheric pressure, is moved through the access tube. The probe is connected to a pressure transducer by a nylon tube filled with the liquid. Changes in level of the probe cause changes in pressure at the transducer whose output is usually calibrated to read settlement directly. The system is capable of measuring up to 3 m of settlement and is sensitive to changes of about 15 mm.

It is also possible to extend the use of this gauge to measure horizontal movement. This is done by placing aluminium plates containing permanent magnetic rings around the settlement tube at selected intervals where the horizontal movement is to be measured. The displacement probe contains reed switches which operates as it passes through the magnetic ring (see Fig.4). As with the magnetic settlement gauge already described horizontal movements of about 1-2 mm can be detected.

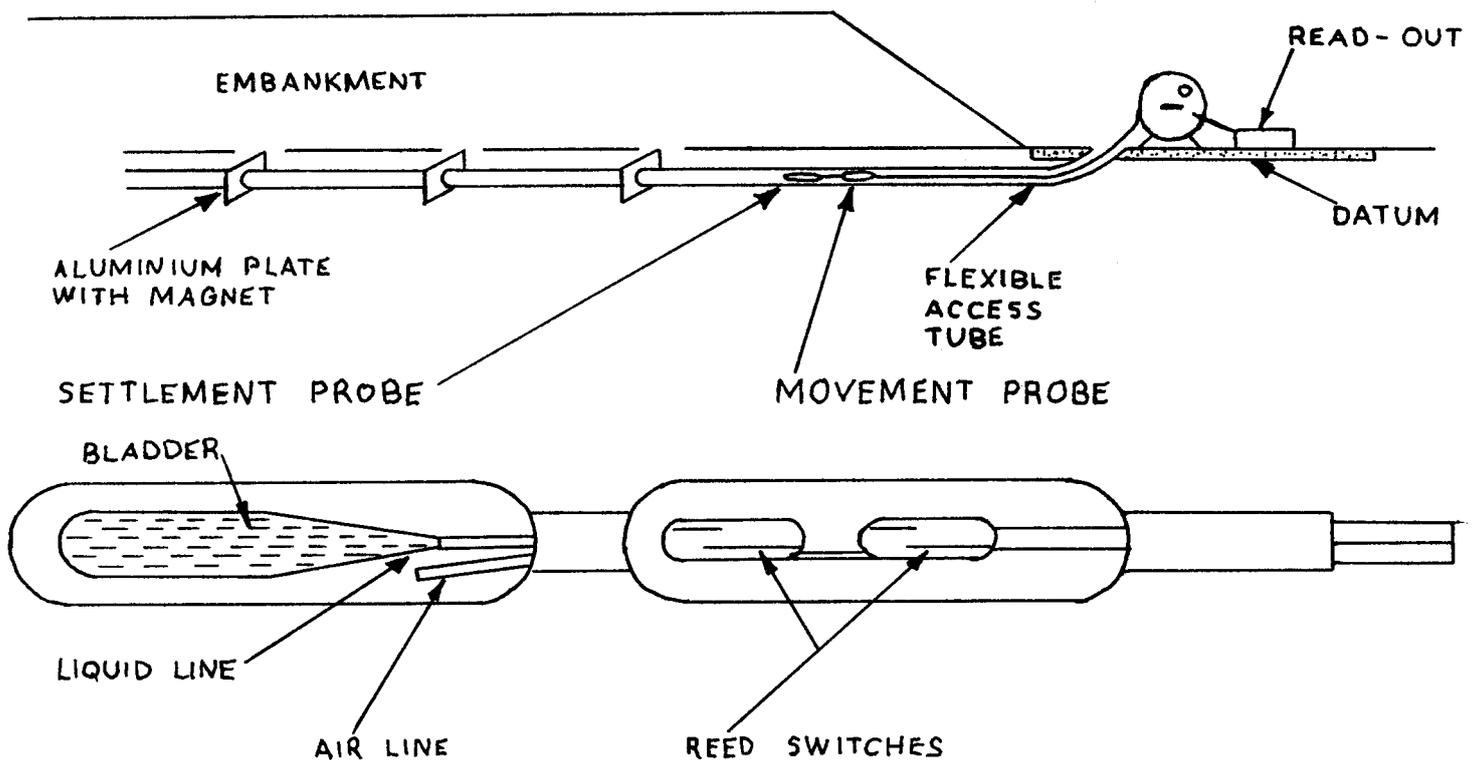


Figure 4. Profile Settlement Gauge

Horizontal Movement Gauges

The measurement of lateral movement within a soil mass requires the installation of devices such as telescoping tubes, tensioned wires and strain meters as well as conventional surface points.

A telescoping tube with 300 mm square steel plates attached at pre-determined intervals has an electrical torpedo passed through it to locate the position of the plates with respect to one end. Accuracies of about $\pm 5-10$ mm can be expected.

Tensioned wire devices consist of steel wires or cables attached to anchor zones and conducted through guide pipes to measuring points where the movement of points on a cable is observed. The tension in the wire remains constant. This is most simply achieved by passing the wire over a pulley and attaching a weight to the end. The rise and fall of the weight indicates the horizontal movement at the other end of the wire. The accuracy of the system depends, among other things, on the length of the extensometer but is about 0.1 mm.

Strain Meters

The most common strain meters used by foundation engineers are portable extensometers. A telescoping rod and tube with a micrometer attached or a tensioned steel tape, is used to measure changes in the distance between markers fixed in the ground.

Embedded soil extensometers are also available and consist of a strain sensing device mounted on an element connected to anchor plates. One type of extensometer has a rectilinear resistance potentiometer housed in a sealed, oil-filled steel case. The unit is set in a concrete block which is connected

by a rod to an adjacent concrete block. The extensometer is connected via an electrical cable to a sensitive direct reading bridge. Both compressive and tensile strains can be measured. One such instrument has an accuracy of about 0.1 mm over a range of 150 mm.

Another type (shown in Fig. 5) uses vibrating wire strain gauges. When the beam arms move, the tension in the helical spring changes thus causing a change in the frequency of vibration of the tensioned wire element. Such extensometers commonly span 1.8 m and have movement ranges of about 150 mm to an accuracy of ± 0.5 mm.

Inclinometer

Inclinometers can provide a continuous record with depth, of horizontal movement within a soil mass. (They may also be used to measure tilting of structures above ground.) They have been used in many situations including dams, embankments, cuttings, diaphragm walls, bridge abutments and piles.

Most of the instruments (Fig. 6) consist of a cantilever pendulum which actuates a bridge circuit of resistance strain gauges, enclosed in a water-tight torpedo. The torpedo is lowered down a special casing installed in the ground (or attached to a structure). The inclinometer is positioned at known intervals in the casing and any angular changes cause movement of the pendulum. The resulting changes in output from the bridge are fed to a readout unit. From a set of such readings, the deflected shape of the tube (in two perpendicular planes) may be drawn. Such instruments commonly have a measuring range of $\pm 25^\circ$ and a sensitivity of 100 microstrain/degree.

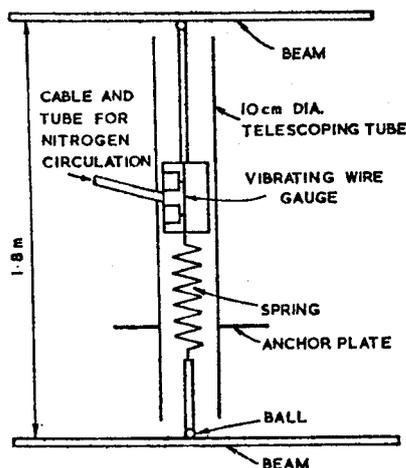


Figure 5. Strain Meter

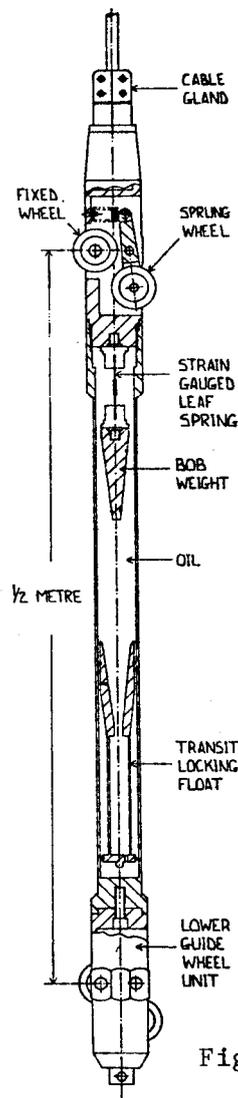


Figure 6. Inclinometer

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WATER AND SOIL LEGISLATION AS IT AFFECTSSOME GEOTECHNICAL WORKSD.C. Best

In Geomechanics News No. 9 an article, written by Dr I.M. Parton, drew attention to a decision of an English Court on the subject of subsidence caused by interference of a groundwater flow and level. The comment by two New Zealand solicitors omitted any reference to the Water and Soil Conservation Act (1967) and its amendments, particularly the 1973 amendment. While conceding that there is no settled case law on the subject, and the applicability of the Water & Soil Conservation Act to the matter is perhaps tenuous, it is probably worthwhile to outline some of the provisions of the Act which are relevant.

Under section 21 of the main Act, damming of a river or stream, diverting or taking natural water, discharging natural water or waste into natural water, or to use natural water, requires a water right to be obtained, - except for taking water for domestic needs, needs of animals, firefighting or diverting, taking or using sea-water. Natural water is defined to include groundwater and artesian water. Except for Crown rights (which are granted by the National Water and Soil Conservation Authority) these rights are granted by the Regional Water Boards.

Provision for objection to the granting of the water right is made and, if an objector considers he has grounds, he can appeal to the Town and Country Planning Appeal Board against the granting of the right.

In granting a water right for taking and using groundwater the Regional Water Board would no doubt bear in mind the likely effect on adjoining properties particularly if undesirable side effects were brought to the Board's attention by an objector. The likely outcome would be the granting of the water right with specified conditions which would safeguard adjoining interests.

The 1973 amendment to the principal Act deals in Part 1 with underground water. It gives Regional Water Boards power to make by-laws and lists a number of purposes for which they can be made. Among them is the control, regulation, limitation and prohibition on the whole or specified parts of the region for any boring, pile driving, drilling, dredging or digging which would or might affect underground water which is within the region. Although such a by-law would not be made specifically for the control of subsidence at a particular building site, it if was known that an area contained say peat lenses, and caution was required to guard against local lowering of the water table, in these circumstances it would be well within the jurisdiction of the Regional Water Board to make by-laws which could be invoked for specific cases within the area designated.

The concern which has been expressed recently about large scale earthworks for urban development, particularly in respect of stability of cut batters and fills, and the silt runoff from exposed areas, has drawn attention to the need for adequate controls and safeguards. Whilst many of the controls and safeguards may be provided in the approval of the subdivisional plan and contract documents, the requirement to obtain water rights where natural water has been affected by the development is an added measure of control. Further, although it has not been widely used in the urban scene, Section 35 of Part II of the Soil Conservation and Rivers Control Amendment Act (1959) provides for safeguards against erosion by landslip, water, wind or otherwise. In order to check erosion, the Act empowers the Soil Conservation and Rivers Control Council to restrict or control the use

of land affecting the conservation of soil, the stability of detritus, or the depositing of material in watercourses. The owner of any such land may object in writing to proposed changes or controls in the use of land, e.g. afforestation, control of stock or wildlife, etc.

From the foregoing it can be seen that although water and soil legislation has not been tested in protecting interests requiring support from groundwater there appears to be provision for some safeguards. The development of arguments using English case law and New Zealand case law prior to the Water and Soil Conservation Act should be tempered by the provisions in the Act. It may be found that there is now no parallel between English and New Zealand law for such cases since the passing of the Water and Soil Conservation Act.

REPORT ON GEOMECHANICS SOCIETY PANEL
DISCUSSION AT N.Z.I.E. CONFERENCE, 1975

CODE OF PRACTICE FOR THE DESIGN OF FOUNDATIONS FOR BUILDINGS

N.Z.S. 4205P : 1973

A. Report on Discussion

About 80 people attended the discussion session on 12 February, 1975 concerning NZS 4205P:1973. In opening the session, the Chairman, Professor P.W. Taylor (University of Auckland) posed these questions:-

Do we need a Code?
What is the purpose of the Code?
What should it contain?
Who should write it?

Three speakers from the Auckland City Council were then invited to give their views.

Mr G.A. Hutchinson said that foundation design is varied and difficult to codify, and too strict adherence to a Code takes away the engineer's initiative. In checking and approved structures for permit purposes the City Council would not be put in a strait-jacket by the Code.

Mr F. Kratky considered that the checking of building foundation designs by the local authority was particularly important for large structures. Usually, reports on investigations and recommendations for specialist firms of consultants were accepted. He would not enforce blind adherence to the Code.

The Chairman then asked Mr C.G. Geldard on what grounds a local authority could disallow a proposed foundation design, without a Code. Mr Geldard replied that a permit is not issued unless the local authority is satisfied with the design. Generally, however, discussion resulted in a compromise being found.

The attitude of the building contractor's engineer was then presented by Mr W. Bullock (Auckland). He, personally, did not believe that a Code was necessary, as a Contractor, he was rarely involved in foundation design, but was called upon to construct works designed by other engineers, some of whom did not appear to know much about the design of foundations. He considered that the Code should contain basic guidelines for design.

When bidding for a building contract, the contractor would like to receive as much information as is available on foundation conditions. Often the information was scant, badly presented and hedged with a disclaimer clause. (Such clauses, he averred, could not be legally upheld). Mr Bullock considered that any foundation code should consider design and construction together; the construction industry should be represented on the code formulating committee; and the code should include the format for information which should be made available for tenderers.

Mr C.M. Strachan, (Wellington) who was chairman of the SANZ committee which prepared N.Z.S. 4205P was then asked to give his views. He stated that few people knew how a code was written. Representation was invited from all interested parties and comments were invited on all proposals, a process which could go on for years. He considered that the Code was not too restrictive and, in any case, it did not stop experts in foundation

engineering from using other values of bearing pressure. He believed the Code to be an advance on previous codes, particularly in its treatment of the liquefaction problem.

The committee which had drawn up the Code included a very capable local body engineer. One item included at his suggestion, Mr Strachan continued, was damage to neighbouring property due to foundation construction. This aspect had taken three meetings to resolve and legal opinions were obtained.

His committee had considered overseas codes, including Japanese and American codes, before compiling their own. The basic idea, Mr Strachan said, was to help those who know very little about foundation design. Recommendations from foundation experts for a proposed structure would seldom be turned down by a local authority. He believed, however, that there were very few such experts even within the N.Z. Geomechanics Society.

Mr Strachan considered that the Code would have been a real advance, if it had been published as soon as it had been written. Publication had been delayed by the restructuring of SANZ. He thought that the discussion meeting should have been held some years ago. It was too late to make major revisions in the Code, he said, and it should be printed in its present form.

In thanking Mr Strachan for his comments, the Chairman agreed that it would be impossible to produce a Code on this topic which would be fully acceptable, without criticism, to all concerned. The present discussion was, at least publicising the Provisional Code which had been unread by many engineers engaged in foundation design.

Mr R.M. Tonkin (Auckland) who had been an N.Z.I.E. representative on the Code preparation committee, said that he was not entirely happy with some of the Code provisions as published. In particular, he felt that the table of allowable bearing pressures could be misleading to engineers without experience in Soil Mechanics. Also some of the detailed recommendations given tended to mitigate against the use of more modern methods of foundation design.

Dr J.M.O. Hughes (University of Auckland) considered that a thirty-page Code could not possibly replace the vast knowledge of foundation engineering which had accumulated, and that people without a good background knowledge possibly should not be doing foundation engineering.

The Chairman suggested that while the Code provisions might be adequate for nine out of ten routine jobs, an engineer who was not a specialist in the field of foundation design should be able to recognise a problem where more specialised knowledge should be applied.

Certain inconsistencies in nomenclature were criticized by Mr M.T. Mitchell (Hamilton) who also objected to the mandatory use of the Hiley Piling formula.

Mr B.D. Cashin (SANZ, Wellington) then outlined the current philosophy for the preparation of Codes. There was now a short by-law and the Code was a means of compliance with that by-law. This only became effective after adoption by the local authority. The authority could still accept a design which did not comply with the Code if it could be persuaded that good engineering practices had been followed. Minor errors and inconsistencies in the draft Code could be rectified on reprinting.

In summarising the trend of discussion, Professor Taylor said that he believed there was a consensus that it was necessary to have a code for foundation design. While considerable dissatisfaction had been expressed with the provisional Code of Practice, it was fully appreciated that much

time, energy and thoughtful consideration had gone into its preparation. Foundation engineering was undoubtedly one of the most difficult subjects to codify. The most satisfactory procedure, it appeared, was to accept the Provisional Code, and to set up machinery for modifying it in accordance with current trends of thought.

B. Analysis of Questionnaire Replies

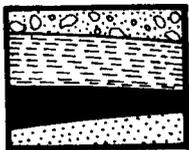
It was a little disappointing that only 20 participants at the discussion on this Code bothered to fill in the questionnaire, out of about four times that number who attended the session.

On one point there was unanimous agreement; that it is indeed necessary to adopt a national Code of Practice.

Of the 4 people who rated themselves as specialists in foundation design, 3 had studied the provision code closely and 1 cursorily. Three considered that it should be modified, while the other recommended adoption of the British code. All four were in agreement that the code should provide criteria for acceptance of foundation designs by local building authorities and also act as a check-list of points to be considered by the designer. They were equally divided as to whether or not the topic of earthworks should be included.

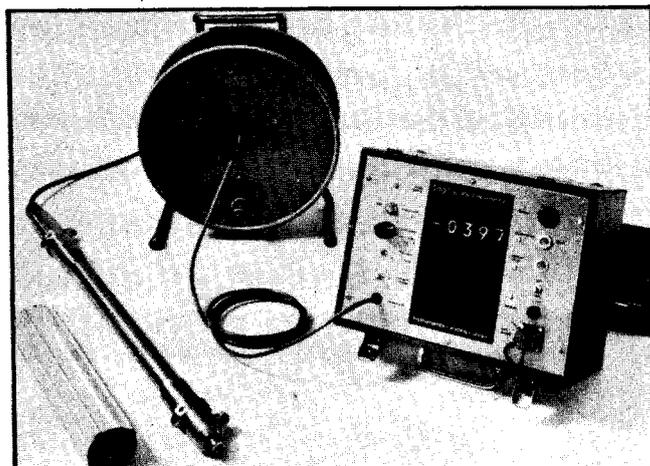
Those who rated themselves as experienced in foundation design numbered 8, 4 of whom had read the provisional code closely and 4 cursorily. Only 1 considered this code satisfactory in its present form, 6 thought it needed revision while 1 suggested adoption of the British code. Six agreed that the purpose was to provide acceptance criteria for building authorities, 4 to act as a check-list for the designer, 2 to provide a self-contained text on the subject and only 1 to "provide mandatory clauses setting out numbers and depths of boreholes, methods of calculation, factors of safety, etc." This group also was equally divided as to whether or not the topic of earthworks should be included.

There were 8 replies from those who rated themselves as inexperienced, only one of whom had read the provisional code closely, and 2 cursorily. Seven considered the purpose was to provide a check-list for designers and 4 to provide acceptance criteria. The vote was 6 to 2 against the inclusion of earthworks.



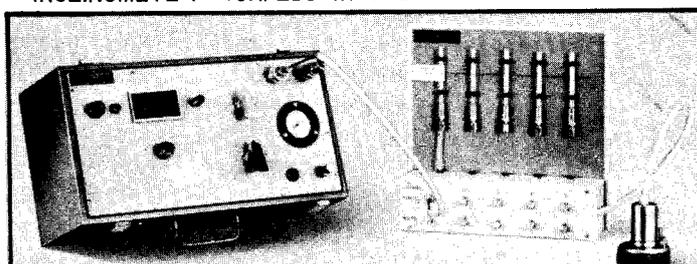
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AUTOMATIC DEAIRING UNITS



PNEUMATIC SETTLEMENT CELL WITH DIGITAL READ-OUT

HYDRAULIC, ELECTRICAL, PNEUMATIC AND MAGNETIC SETTLEMENT GAUGES
INCLINOMETERS

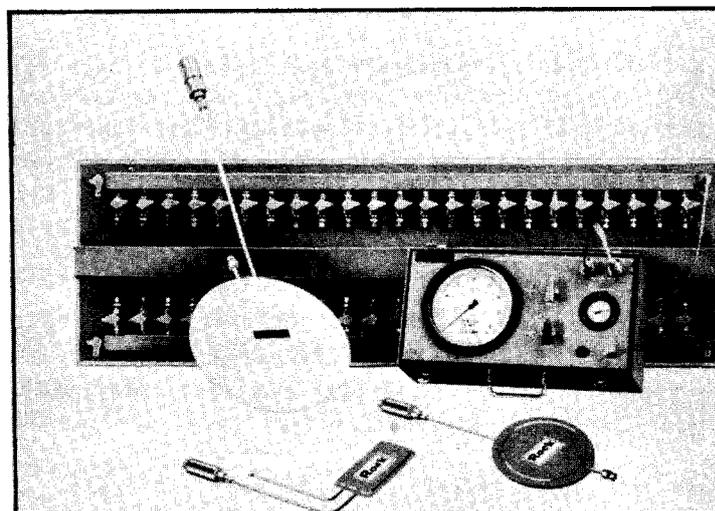
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GEOMECHANICS RESEARCH AT THE UNIVERSITY OF CANTERBURYT.A.H. DoddIntroduction

Since an earlier article with a similar title, published in "N.Z. Geomechanics News" No.3, we have added to our soil mechanics staff in the Civil Engineering Department Dr R.O. Davis from the University of New Mexico whose speciality is continuum mechanics. In the engineering geology and rock mechanics fields Mr David Bell has joined the staff of the Geology Department.

A. Road Research

"Shrinkage and Creep Characteristics of Soil-Cement" by R.J. Dunlop. (Completed Ph.D. study, supervised by T.A.H. Dodd and P.J. Moss). The expectations of this project, first reported in 1971 (NZ Geomechanics News No.3) have been realised. Predictions were made of the shrinkage stresses in a section of soil-cement roadway built in Hamilton in 1963. Starting from the known water table levels and weather conditions, a computer programme was used to find the changes of water content throughout the profile of the soil-cement slab during its first year after construction. The water content changes led to the determination of shrinkage strains, and by using a second computer programme, to the internal stresses set up by shrinkage and temperature effects. Comparing the increase of these stresses with the growth of tensile strength gave the likely age when cracking would have occurred, and this tied in closely with the date when cracking was first observed.

Further, the predicted spacing of cracks in the crack pattern was only about 10% greater than the average crack spacing observed.

"Degradation of Base-course Aggregate" by A. Williman (Research Contract to National Roads Board). The University's captive vehicle has been modified, and re-located, to traverse a circuit where bases made from six different aggregates will be laid on a yielding subgrade. The production of such a subgrade was no small matter since the site of the test track consists of very good quality Canterbury greywacke gravels. A 1 m deep excavation was made under the circuit and backfilled with Port Hills loess at a carefully controlled water content and compactive effort. Unfortunately before the sections of base could be laid, heavy unseasonal rain soaked the subgrade, and the project has had to be abandoned in the meantime. Efforts are now being made to obtain finance to cover the circuit with a roof which should make the track independent of weather and conditions.

"An Investigation into the Segregation of Dry Aggregate" by B.W.Hodge. (Completed M.E. Project, supervised by T.A.H. Dodd). This report describes experiments which were devised to measure the causes and effects of segregation. Aggregates of various gradings, shapes, and densities were poured at a uniform rate, and their segregation behaviour was studied.

The movement of individual particles in the streams of aggregate was monitored in various ways, including still and movie photography and painted tracer stones. The amount of segregation suffered by a given aggregate during pouring was found to be reliably expressed using a parameter called "Hudson's A", derived from sieve analysis of samples taken from the poured pile. A number of devices were built and tested to study the feasibility of using segregation as a means of separating aggregates into size ranges.

The report includes a comprehensive survey of literature on the subject.

B. Compaction of Clays

A surcharge foot has been devised and tested for compacting cohesive soils with the kneading compactor. Evidence so far shows that soils can be compacted satisfactorily at higher water contents with the surcharge foot than without it, and that the density and shear strength of the soil may be greater when the surcharge foot is used. The surcharge foot has the effect of increasing the bearing capacity of the soil being tamped so that a penetration failure of the soil under the tamping foot is prevented. With less remoulding during compaction, the soil particles tend to be less oriented, and better able to resist shear stress.

"An Improved Tamping Foot for Kneading Compaction", by T.A.H. Dodd, 6th Biennial Conference, A.R.R.B., Adelaide, August 1974.
Continuing project.

C. Analytical Studies of Soil Behaviour Under Stress

"Rate-type Constitutive Relationships" R.O. Davis

Soil is treated as a general rate-type material, the stress rate being given by a function of density, stress, and rate of deformation. The resulting description exhibits Coulomb yielding and an ultimately linear volume-logarithm of pressure relationship. Solutions for biaxial deformation and simple shear have been found.
Continuing project.

"A Dipolar Continuum Theory for Granular Media" by G. Mullenger

(Completed Ph.D. study, 1973, supervised by D.G. Elms and R.O. Davis)

In commenting on Rowe's stress-dilatancy theory, Horne suggested that the ability of a granular medium to withstand shear stress is associated with the formation of an anisotropic pattern of intergranular contacts. Recent research at Canterbury University has attempted to model this situation with a dipolar continuum theory. This introduces an anisotropic structure into a fluid medium, enabling it to withstand shear stress in static equilibrium unlike usual fluid theories.

Investigation of a simple boundary value problem using the above model indicated an unexpected variation of stress with position in the body, and a laboratory investigation of this has now been proposed.

D. Analytical Studies of Seismic Loading of Soil

"Response of Soil to Shock Loading", R.O. Davis.

This is a mathematical investigation aimed at synthesis of the stress-deformation response of partially saturated soil when subjected to a shock wave. Soil is treated as a three-constituent mixture of quartz, water, and massless air. Mixture jump equations, together with requirements for thermal equilibrium, lead to a generalised response description. Portions of this work have been published in the American Journal of Physics, the Journal of Composite Materials, and Physics of Condensed Materials.

E. Engineering Geology

The main engineering geology research at the present time is that being carried out by Mr D.H. Bell into slope stability in schist terrain, Central and Western Otago. The locality under current investigation is the Kawarau Gorge, Central Otago, where two dams are planned as part of the Clutha Valley Power Development Scheme. Extensive landsliding is evident in the Gorge, involving failure of both rock slopes and more importantly the

accumulation of deposits of periglacially-derived materials to depths possibly in excess of 100 m. Research is concerned with the origin and geological causes of the observed slope failure, and with the monitoring and stability of certain areas if saturated by the proposed reservoirs.

A second area of current research is the characterisation of the physical properties of certain Tertiary mudstones and related rocktypes, particularly in so far as the stability of slopes in these materials is concerned. The programme is concerned with correlating selected physical parameters (particularly swelling) with mineralogy and texture, and work is proceeding on samples from a number of localities (including Turangi, Dunedin and Castle Hill Basin). Initial work on samples from Turangi has shown that some mudstones display uniaxial swelling strain values in excess of 20% (with complete disintegration of the laboratory specimens), the cause being primarily mechanical swelling pressure rather than due to clay minerals. At this stage, no attempt has been made to relate laboratory behaviour to *in situ* performance.
Continuing project.

LETTERS TO THE EDITOR

The following correspondence has been received by the Editor:

Sir,

THE SCOPE OF GEOMECHANICS

Dr Pender discussed the scope of geomechanics most interestingly in your last issue. He is not alone in finding it ill-defined. At the time when the founding of the Geomechanics Society was under discussion one point of argument was the choice of name. All of us had a more or less definite idea of the scope we wished the new society to cover though those ideas were far from identical. Most of us were engineers and this no doubt strongly influenced the final choice of the name of Geomechanics.

I can only speak for myself in this, but the dominant aspects were that I was interested primarily in the application of knowledge and not in knowledge for its own sake. Secondly, I was interested in the earth. Thirdly, I was a civil engineer and as such was trained in what, in my university days, was broadly classed as "the mechanical sciences". As "application" was my first interest obviously I was only thinking in terms of such parts of the earth as were accessible and these extend from the surface to the bottom of the deepest mine or borehole. Equally, "application" implies some purpose which I don't think I was very clear about at the time - perhaps "progress" or "the benefit of mankind". My "little Latin and less Greek" led me to conclude that "Geomechanics" summed up my second and third interests tolerably, but left me at a loss for a suitable root for my first interest. But having served on the "National Committee of the New Zealand National Society for Soil Mechanics and Foundation Engineering" for some years I realised the value of brevity! So I argued for Geomechanics!

It was not till some time later that I was forced to think further on the question. As chairman of the newly formed Geomechanics Society I was asked to contribute to the opening session of the first Australia-New Zealand Geomechanics Conference in Melbourne. One avowed purpose of this session was to help define in the minds of the public the brand new term "Geomechanics". So first I had to sharpen up my own definition! I found nothing short or simple in literature and in the end developed the following:-

"Geomechanics is the application of the mechanical sciences to the development of the surface of the earth".

This I still find adequate; (though wordier than I would like).

The three touchstones of this definition are "application", "mechanical sciences", and "development of the surface of the earth". All three are needed and thus the bounds of Geomechanics intersect those of many other disciplines and probably include none entirely. For example geophysics is, I believe, a "mechanical science", but only parts of it come within geomechanics. Until it is applied to the development of the surface of the earth it remains outside. And note that "the surface of the earth" is not a fixed location! As mines and wells are deepened this surface thickens and geomechanics penetrates further and further into the realms of geophysics. Mathematics is another good example. So long as a finite element analysis is not applied to a real world situation it remains an exercise in symbolic logic, but apply to to a slope stability problem, and hey presto, it becomes geomechanics! A third example will suffice. Would a treatise on "The Political Commissar in the Salt Mines of Siberia" be within the scope of geomechanics? I say no, for though the extraction of salt from a mine is undoubtedly an "application

of the mechanical sciences to the development of the surface of the earth", "political science" is certainly not one of the "mechanical sciences" (and never will be!).

I also see that the definition can exclude parts of soil mechanics though most regard soil mechanics as one of the basic components of geomechanics. A physicist studying the theoretical thermodynamics of soil suction may consider himself to be deeply involved in fundamental soil mechanics, and I would agree he is. But, until he starts applying his knowledge to the development of the surface of the earth I would not consider him a geomechanicist.

Finally, when I look closely at my own activities these days there seems to be less and less "application of mechanical science". So perhaps, by my own definition, I am phasing myself out of geomechanics!

Yours faithfully,

J.H.H. GALLOWAY.

NEWS FROM THE MANAGEMENT SECRETARY1. MANAGEMENT COMMITTEE 1975

D.K. Taylor (Chairman)	Auckland
D.H. Bell (Vice-Chairman - Rock Mechanics)	Christchurch
J.B. Blakeley	Auckland
W.M. Bullock	Auckland
J.H.H. Galloway	Wellington
J.G. Hawley	Wellington
G.R. Martin (Management Secretary)	Auckland
R.D. Northey (Vice-Chairman - Soil Mechanics)	Wellington
I.M. Parton (Editor - Geomechanics News)	Wellington
B.W. Riddolls (Vice-Chairman - Engineering Geology)	Wellington
P.W. Taylor (Australasian Vice-President, ISSMFE)	Auckland

2. NEW MEMBERS

New members elected to the Society since the last list was published in issue No.9 are as follows:-

E. Bartlett, E. Beable, N.B. Beach, J. Bonning, W.M. Bullock, C. Davidson, R.J. Eyles, H.D. Gough, C.J.M. Harwood, M.R. Lancaster, B. McLister, W.J. Martin, W.S. Slimin, P.R. Struthers, C.W.C. Tilby, P.S. Wells-Green.

3. FORTHCOMING CONFERENCES AND SYMPOSIA

Listed below are Conferences and Symposia in the 1975-76 period which we know about. Members may be interested in attending or obtaining Proceedings. Further details can be made available on request.

1975

22-27	June	A.S.T.M. Symposium on the Preparation of Specimens for Laboratory Testing, Montreal.
14-18	July	Symposium on Recent Developments in the Analysis of Soil Behaviour, University of New South Wales
21-25	July	2nd Australia-N.Z. Geomechanics Conference, Brisbane.
8-12	September	6th Regional Conference for Africa on Soil Mechanics and Foundation Engineering, Durban.
15-18	September	2nd International Conference on Applications of Statistics and Probability to Soil and Structural Engineering, Aachen, West Germany.
15-19	September	1st International Symposium on Induced Seismicity, Banff, Alberta
22-25	September	1st Baltic Conference on Soil Mechanics and Foundation Engineering, Gdansk, Poland
22-24	September	16th Symposium on Rock Mechanics - Design Methods in Rock Mechanics, Minnesota, U.S.A.
2-3	October	24th Salzburg Geomechanics Colloquy, Salzburg, Austria.
27-31	October	5th Pan American Conference on Soil Mechanics and Foundation Engineering, Buenos Aires, Argentina
19-22	December	5th Asian Regional Conference on Soil Mechanics and Foundation Engineering, Bangalore, India.

1976

- | | | |
|-------|-----------|---|
| 1-5 | March | International Symposium - "Tunnelling 76"
London |
| 22-24 | March | 6th European Regional Conference on Soil Mechanics and
Foundation Engineering, Vienna Austria. |
| 10-14 | August | ISRM Regional Conference - Investigation of Stress in
Rock Sydney. |
| 16-26 | August | 25th Session of the International Geological Congress -
Sydney |
| | September | International Symposium on the Geotechnics of Structurally
Complex Formations, Italy. |

Future International Conferences:

- | | | |
|--------|---|-------------------|
| ISSMFE | - | 1977 Japan |
| IAEG | - | 1978 Spain |
| ISRM | - | 1979 Switzerland. |

4. INSTITUTE FOR PUBLICITY AND EXCHANGE OF GEOMECHANICS COMPUTER PROGRAMS

This Institute has been established on behalf of the ISSMFE and the ISRM to assist in the publicity and exchange of computer programs associated with geomechanics problems. Scientists and engineers who have developed, tested and fully documented computer programs, especially those related to mathematical modelling, are invited to submit their programs to the Institute in the required format. Details of the required standards for programming and documentation may be obtained from -

Dr G.D. Aitchison,
Division of Applied Geomechanics
C.S.I.R.O.
P.O. Box 54,
Mt Waverley, Vic. 3154
Australia

The Institute, which is based with the C.S.I.R.O., plans to publish booklets containing the accumulated proformas of accepted programs. These will be distributed free of charge to National groups on at least a twice yearly basis, and also to subscribing individuals or organisations.

5. PROCEEDINGS, WANGANUI SYMPOSIUM ON FOUNDATION ENGINEERING, SEPTEMBER 1972

Copies of the Proceedings are still available from the Management Secretary at a cost of \$8.00 for Society members and \$10.00 for non members.

6. BACK ISSUES, NEW ZEALAND GEOMECHANICS NEWS

Copies of all back issues are available to members at a nominal cost of 50c. per copy from the Management Secretary.

G.R. MARTIN
Management Secretary.

NEW ZEALAND GEOMECHANICS SOCIETY
NOTIFICATION OF CHANGE OF ADDRESS.

The Secretary,
N.Z. Institution of Engineers,
P.O. Box 12-241,
WELLINGTON.

Dear Sir,

CHANGE OF ADDRESS

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

Name: _____

Address to which present correspondence is being sent:

Signature _____

Date _____

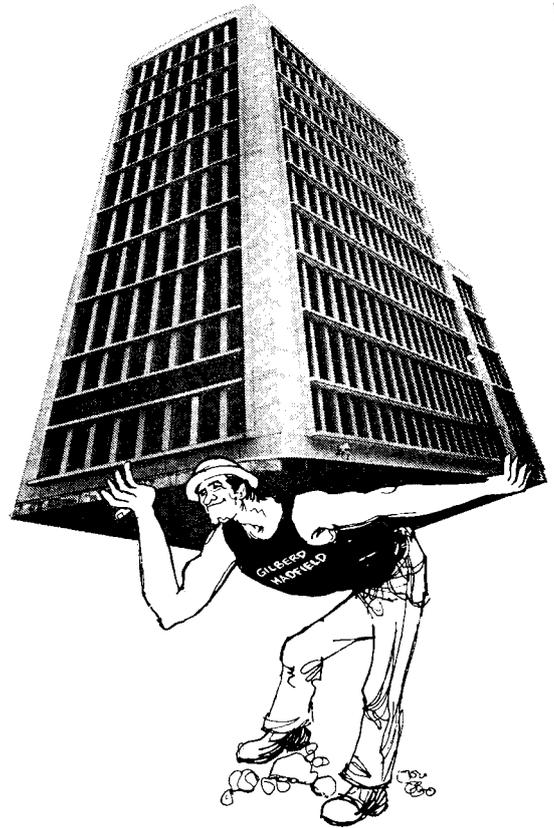
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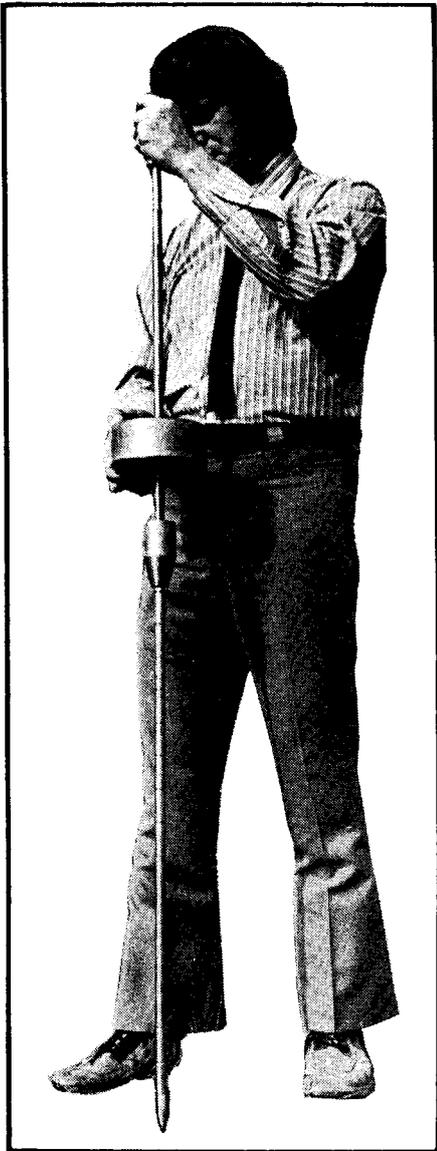
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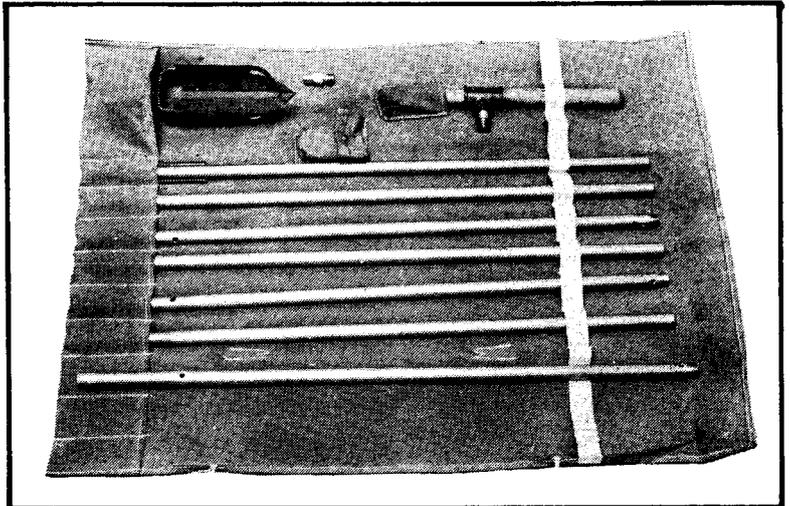
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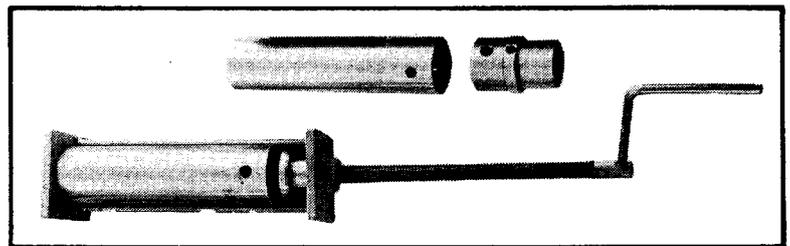
site investigation equipment



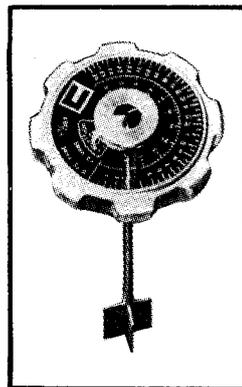
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