

SAISI SAICE



G R O U N D P R O F I L E G R O N D P R O F I E L

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A.G.M. Panel Discussion

The contractor considers present foundation drilling practice FINE; the general consultant considers it FAIR; the specialist consultant considers it FOUL. This was the basic proposition put forward by the Chairman, Oskar Steffen for panel discussion, following the recent Annual General Meeting of this Division.

Further points which he proposed be considered were : whether standard drilling practice has kept pace with the demands of society; whether present contractual documents and pricing and costing arrangements are realistic and equitable and productive; whether communication between contractor and client was satisfactory; and finally, is our present *modus operandi* such that the correct result is achieved at a cheap or at least reasonable cost.

Cliff McMillan opened the discussions by giving the structural engineer's viewpoint; in essence he pointed to the need to balance the dangers of obtaining too much expensive information that is useless and having too little to safely design the structure.

The gist of Professor Jennings's contribution was that 90% of foundation investigation and design can satisfactorily be achieved by using large auger holes and *in situ* inspection; from which it follows that the quality or lack thereof, of soil samples, affects only a very small percentage of soil investigations but of course these are the crucial jobs where accurate information is vital and the heavy costs justifiable. At least this should be the case if the Geotechnical Engineer is not drilling with negligent extravagance.

Harold Weber slated certain consultants when answering the following question : Does the engineer know what he wants from soil exploration and does he generally get it ? Harold maintained that some do know but some don't and this idea was echoed later in the proceedings when Cliff McMillan stated that the root cause of so much expensive - either to the client or the contractor - drilling was a result of sloppy drafting of tender documents, to the production of which far too little attention and thought had been given.

Indeed John Weaver went even further by quoting clauses from contract documents for drilling, which clauses were positively ludicrous not to say unbelievably petty, and obviously had as a result an inflationary effect on tender prices. Certainly it appears as though too great a part of tender and contract specifications are concerned with the size of the box into which samples should go and too small a part concerns the actual quality of drilling. Yet the general consensus of opinion was that there was no need for any form of standard tender document. And such a decision is to be welcomed for it means that the responsibility still lies where it is intended to be, that is on the shoulders of the Geotechnical Engineer who after all was engaged to exercise his professional skill and expertise to boldly and intelligently handle the diversities and vagaries of site investigation, a field where standardisation in the sense of structural engineering is just not possible. As Cliff McMillan so aptly put it, there are very few sites where by means of intelligent forethought, planning and the careful use of graded levels of intensity of site investigation it is not possible for the engineer to have a reasonably good idea of what is going to be encountered when engaging in drilling and sophisticated sample recovery operations.

This of course means greater and more careful attention to detail and professional application on the part of the Geotechnical Engineer; but that is the gut stuff of engineering.

On the question of whether present tendering systems as regards in particular the pricing of jobs on the basis of footage achieved, lead to competitive prices, there was much heated debate. Andy Robertson proposed a system of pricing based on varying percentage costs allocated to day work or footage achieved, depending on the quality of sample and information required. For example, where disturbed percussion sampling was acceptable the major portion of payment would be for footage whereas when the quality of samples was high the major payment would be for time involved. This suggestion was supported, even in a sense initiated by Harold Weber, but Cliff McMillan was adamantly opposed to any form of tendering on a time basis, maintaining again that careful drafting by the consultant should result in a document and price based on a footage rate which should vary by no more than 25%.

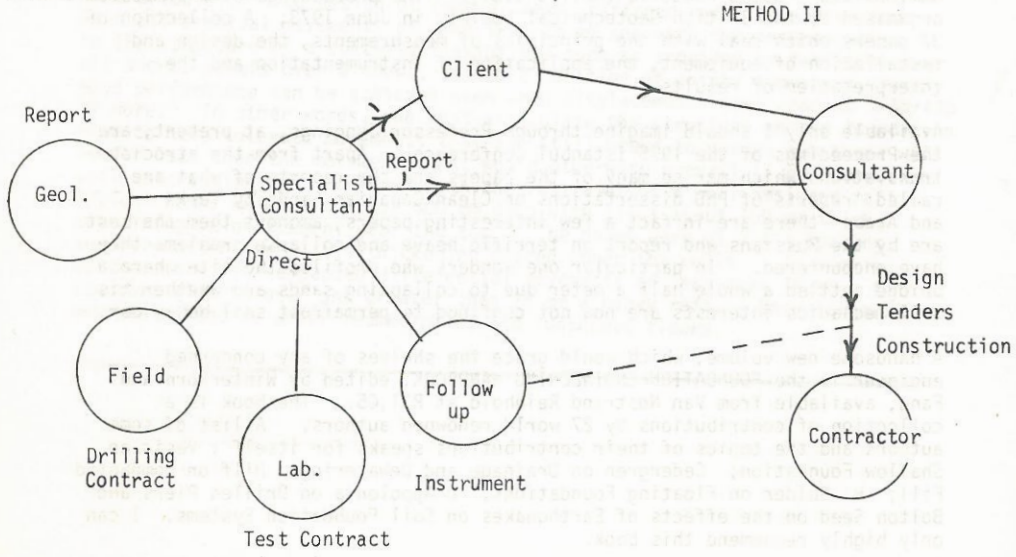
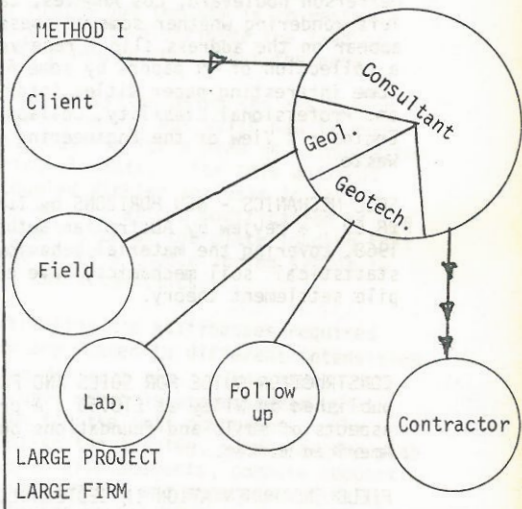
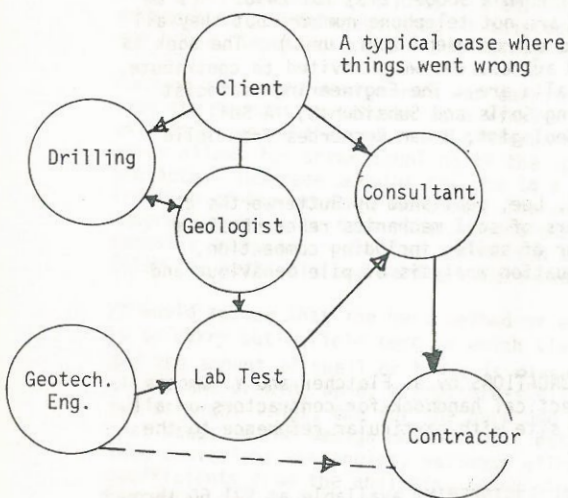
Ultimately no agreement was reached on this point.

On the less contentious side, there was some discussion of the innovations at present available and being used in special circumstances. Emmanuel Rocha, a distinguished and welcome guest from Portugal, who attended the meeting spoke on his country's method of obtaining oriented core samples (by introducing and fusing a steel rod into the rock, which is then cored as an integral unit). He spoke of research being done on methods of determining the permeability tensor for rocks (and this method would no doubt be equally applicable to fissured clay deposits) and finally he mentioned the advances being made in the use of the Minard Pressure Meter.

Harold Weber, too, discussed the increased use of piezometers and sensitive pressure meters, the increasing use of the Nkana Spoon, shear vanes and particularly in the Durban area, where the influence of British engineers is felt, the use of the U4 thick walled sampler (originally developed for use on the London blue clays).

One important point mentioned but not considered in detail, but which surely was central to the whole issue supposedly under discussion, was the problem of procuring and training suitable drilling operators. It was pointed out that the job is not a 'nice' one and yet required men of high ability and integrity. Accordingly good drillers were virtually unobtainable and very expensive to boot. The driller is the man who gets the very sample from which the engineer makes his decisions yet the training of this man who holds, as it were, the key to the success of a drilling operation was avoided with a few scant remarks.

Tony Williams recently cooked up the little balloon diagrams that appear on this page. He was attempting to define the position in the process and the precise and best *modus operandi* of the specialist consulting geotechnical engineer. Believing that the diagrams are interesting, fun and pretty nearly self-explanatory, I offer them for your interpretation, consideration and comment.



RECENT PUBLICATIONS

News of the following publications has come to hand since the last issue of this newsletter; however with the exception of the last two volumes reported I have not personally seen copies of the volumes and all comments regarding these books have been gleaned from publicity pamphlets.

GEOMECHANICS by Prof. Haber-Schaim. Available at \$8 soft cover, \$15 hard cover, from Mrs. R. Feldhom, RN, 189 Hergel Street, Rehovot 76270, Israel, this book presents the results of 45 years of field tests and theoretical formulation in the subject of settlement and deformation of civil engineering structures.

GEOLOGY, SEISMICITY, AND ENVIRONMENTAL IMPACT AT \$15.95 from the Association of Engineering Geologists Special Publications, University Publishers, 1113 West Jefferson Boulevard, Los Angeles, California 90007 (213) 731-2496. (I am left wondering whether some of these are not telephone numbers but they all appear on the address slip I received so recommend their use.) The book is a collection of 49 papers by some 60 authors who were invited to contribute. Some interesting paper titles inter alia are: The Engineering Geologist and Professional Liability, Collapsing Soils and Subsidence, A Soil Engineer's View of the Engineering Geologist, Urban Resources from Solid Waste.

SOIL MECHANICS - NEW HORIZONS by I.K. Lee, published by Butterworths at £8.50: a review by Australian authors of soil mechanics research since 1968, covering the material behaviour of soils, including compaction, statistical soil mechanics, wave equation analysis of pile behaviour and pile settlement theory.

CONSTRUCTION GUIDE FOR SOILS AND FOUNDATIONS by G. Fletcher and V. Smoots published by Wiley at £10.60: A practical handbook for contractors on all aspects of soils and foundations on site with particular reference to the American market.

FIELD INSTRUMENTATION IN GEOTECHNICAL ENGINEERING available at R21,60 through Universitas - Books Pretoria (Tel. 3-4981). The proceedings of a Symposium organised by the British Geotechnical Society in June 1973; A collection of 37 papers which deal with the principles of measurements, the design and installation of equipment, the application of instrumentation and the interpretation of results.

Available only I should imagine through Professor Jennings, at present, are the Proceedings of the 1975 Istanbul Conference. Apart from the atrocious translations which mar so many of the papers and the reports of what are called 'reports of PhD dissertations on Clean Canadian Sands by Turks and Arabs' there are in fact a few interesting papers, amongst them the best are by the Russians who report on terrific heave and collapse problems they have encountered. In particular one wonders who profiled the site where a bridge settled a whole half a meter due to collapsing sands and whether his soil mechanics interests are now not confined to permafrost soil behaviour.

A handsome new volume, which would grace the shelves of any concerned engineer is the **FOUNDATION ENGINEERING HANDBOOK**, edited by Winterkorn and Fang, available from Van Nostrand Reinhold at R31,05. The book is a collection of contributions by 27 world renowned authors. A list of some authors and the topics of their contributions speaks for itself: Vesic on Shallow Foundation; Cedergren on Drainage and Dewatering; Hilf on Compacted Fill; H. Golder on Floating Foundations; D'Appolonia on Drilled Piers and Bolton Seed on the effects of Earthquakes on Soil Foundation Systems. I can only highly recommend this book.

Notes on a Lecture given by Dr P. Walsh, Division of Building Research, C.S.I.R.O., Melbourne, Australia on April 21, 1975 at the University of the Witwatersrand

The talk given by Dr Walsh was based very largely on a recent Technical Paper No.5 by the Division of Building Research of the CSIRO, Australia. This deals with the selection and design of a reinforced slab stiffened with edge and interior beams cast integrally with the raft, for use with light residential house construction. This slab-on-ground construction provides a satisfactory foundation system for a house and depends largely on the advantage gained by considering the actual interaction of subgrade soil and superimposed foundation which achieves a reduction in the differential movement that would otherwise occur on a completely free soil surface. Such a stiffened raft is thus not entirely rigid, but the aim is to restrict movement at points where most of this occurs, and to distribute the load of the house, imposing a small but fairly equal pressure throughout the area.

Much of the early design work was carried out by Lytton using the assumption that the foundation behaves as a Winkler spring model, but Walsh has improved on this by using the governing differential equation for a beam on a foundation which allows for shear coupling of the spring elements. For this analysis the actual subgrade modulus for use in a coupled Winkler analysis is only a fraction of the standard modulus. The work of Loof allows modification of the subgrade modulus to take into account the small size of the plate loading test normally employed. Another assumption made is of a double spring system to allow for both soft and hard pressure-swell characteristics.

It would appear that the best method of estimating the stiffnesses required is to carry out a field test in which slabs are loaded to different intensities, and the amount of swell or heave is measured for each one. This then allows the drawing up of a pressure-swell curve which is approximated by two straight lines, one for the hard and one for the soft component. The next steps in the design method are: establish the loading, subdivide the slab into convenient rectangles, estimate allowable displacements, compute support coefficients from the analysis, calculate the moments and shears and finally determine the convenient section of a stiffening beam (which can be obtained from a table). The design of such a heavy stiffened raft is said to cope with differential movements of more than 25 mm and with the incorporation in the structure of a suitable flexibility such as provided by fanlights over all doors, panels over windows, suitable location of joints and so on, fairly good performance can be achieved even when displacements have reached SPAN/480 or more. In other words, one must articulate the structure on the foundation slab to help tolerate movements that are still bound to occur, but these will be far less than the movements that would otherwise prevail if no foundation/soil interaction were achieved with the restraint of a well-designed raft. Typical beams were said to be 600 mm deep with slabs about 100 mm thick, containing reinforcement near the top. The beams were at 3-4 m spacing, and very often there is a thickening placed under the walls. In summing up therefore, for expected differential movements of less than 10 mm a thin standard slab is used and greater than 25 mm a heavy raft. Very large movements require under-reamed piles and suspended floors.

RECENT EVENTS

The inventor and guiding star behind the system of reinforced earth Monsieur Vidal recently visited South Africa in connection with the granting to Reef Lefebvre of the sole South African rights to use his system. It is interesting to note that his patent over this system is at present being challenged in the British courts.

At a recent meeting of the Association of Engineering Geologists the topic under discussion was the Ripability of Materials. Of great interest to geotechnical engineers was the contribution by John Weaver who has evolved an ingenious method of assessing the potential ripability of soils and rocks; he bases his system on the standard descriptors used to describe a geotechnical material. This contribution will appear as a technical paper in due course in the CIVIL ENGINEER IN SOUTH AFRICA, so until then interested persons are advised to contact John Weaver at Johannesburg, 22-2100.

Professor Jennings recently returned from Istanbul where he attended both the Istanbul SMFE Conference and a meeting of the Executive of the ISSMFE. At this meeting the question of South Africa's attendance at the next International Soils Conference in Japan was discussed. The matter is now in the lap of the gods but it is interesting to note a recent announcement in the STAR that the Japanese Government is re-evaluating its policy of issuing visas to South Africans to attend scientific and cultural events; in particular the announcement mentioned that this was partially a result of difficulties experienced by a group of South African nutritionists who were barred from attending a conference in Japan.

At the time of 'going to press' a further report in the STAR indicated that the Japanese are adamant about maintaining their ban on South African cultural visitors.

At a recent meeting in Pretoria of the Association of Engineering Geologists, Mr George Donaldson, talking about heaving clays and site exploration made, inter alia, the following points :

- committing an empirical heave indicator to print results in an acceptance of its validity with a biblical degree of faith; for example Van der Merwe's method is based on only eight actual results.
- people are obsessed with numbers giving actual values of heave, rather they should think in categories of the range of likely heave and the associated problems and possible solutions; an engineering usage map is required for townships not a soils engineering map.
- research has only really concentrated on the influence of the clay mineral content, the changes of moisture conditions and volume changes in influencing likely heave whereas it is true that heave is also a function of field density, pressure and lateral drainage pattern.
- any profile should be examined in order to detect conditions which might modify laboratory based predictions of heave.

COMPUTER PROGRAMS

A request has been received from the newly established Institute for Publicity and Exchange of Geomechanics Computer Programs (IPEGCP) that we make known the following :

The Institute has been established on behalf of the ISSMFE and 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 relating to mathematical modelling, are invited to submit their programs to the Institute in the required format (details of which are available from the Secretary of the Institute).

The Institute will evaluate the program documentation and where this is of the required standard, will undertake limited program evaluation.

In return the Institute will twice yearly publish details of programs accepted and available.

The committee entrusted with the organisation is headed by Australia's Dr G. Aitchison and sports well known names such as Giroud, Ladanyi and Schiffman. The address of the Secretary is : IPEGCP, CSIRO Division of Applied Geomechanics, P.O. Box 54, Mt. Waverley, Vic., 3149, Australia.

APPROACHING CONFERENCES

On 22-25 September 1975 the First Baltic Conference on Soil Mechanics and Foundation Engineering will be held in Poland. Sessions cover : Shallow foundations, deep foundations and stability of earth structures on rock. Further details available from the editor.

In Blacksburg, Virginia on the 22-25 June 1976 is to be held the Second International Conference on Numerical Methods in Geomechanics. Topics to be considered include : Theoretical Basis and Formulations; Material Behaviour; Engineering Applications; Geological Applications; From Theory to Practice. Attendance is limited to 150 so if interested, further information from : Engineering Foundation, 345 East 47th Street, New York, New York 10017, U.S.A.

De Verbis

You may or may not have noticed that the name of the division has been changed from that of Soil Mechanics and Foundation Engineering to Geotechnical-plain and short. The motivation prompting such a change, one can only speculate, was to reduce the admittedly cumbersome five words to one. True the term Geotechnical is becoming an increasingly popular one to describe that branch of Engineering which deals with soil as the most central and fundamental of its materials and a previous issue of this newsletter quoted the new and rather quaint definition of the term as applied by the Rhodesian Ministry of Transport. Indeed the term will have reached the zenith of its acceptance when the average South African University Student flings it around with the gay abandon still yet reserved for 'Soils'. Frankly I cannot conceive of a suitable abbreviation for geotechnical engineering that is likely to be so casually used unless it be 'Geo' which sounds like something out of the wild days of the bovine west.

But let us examine this classical Greek sounding term and see if it is truly descriptive. The geo part is the form in which the Greek word for earth 'ge' appeared in combination with other words - all well and good if we are to put blinkers to the word and confine its meaning to that upper crust which usually concerns civil engineers. This is of course what the term geography has done and to an even greater extent for they seldom bother even to dig holes. But if one wishes to retain the pristine purity of the original intent of the word one can argue that its use extends and makes more general and embracing the range of interest of the division than is allowed by the terms soil and foundation. Indeed this is most needed and laudible at a time when civil engineers or may I call them geotechnical engineers, of which more later, are digging deeper and deeper open pits or are extending their interests and activities into the domain of rock mechanics.

The technical part comes from the Greek word tekhnē meaning art, which only goes to show how the meaning of a word can change in the course of time; for what long haired young technician would care to associate himself with a balding artist. At any rate the word reflects the Institution's original definition of Civil Engineering as the art etc.

But of course what is wrong with the word is that in common speech the notion of art as applying to technical has been almost completely lost and indeed in a day and age where so much effort is being expended on herding technicians into their own camp and registering off from the common crowd the engineer there is no little irony in the fact that we appear to be in the process of renaming ourselves Geotechnicals (or is this merely illustrative of the essentially gregarious instincts of mankind).

However, you will protest that we are in fact calling ourselves Geotechnical Engineers thus neatly combining the three elements of art, earth and ingenuity or cleverness and of course the associated idea of one who builds and creates. With this contention there is no argument and if only we can succeed in conveying this notion to the public at large and in living up to the ideals embodied in the very words themselves, then the new name is to be heartily welcomed.

J.A. Caldwell