Instrumentation

John Dunnicliff

Introduction

This is the eighteenth episode of GIN. There are no accompanying articles this time, but two have been promised for the next issue of *Geotechnical News.* One will be a follow up to the article from Switzerland in the December 1998 issue, *Automatic Control and Data Acquisition for Optical Digital Levels and Motorized Total Stations,* and will be a case history, by engineers in France, describing automatic survey monitoring during a construction project in Puerto Rico. The other article will also be a case history, about misbehaving liquid level settlement gages on a project in Florida. I'm working with both the user and the manufacturer to evaluate some strange data, in the hope of concluding with positive recommendations for the future. Watch this space!

The ASTM Affair - Agreement on Caveats

In earlier episodes of GIN, some of you expressed your opinions on the possible impact of ASTM standards on the freedom of our profession to exercise professional judgment. The discussion centered around standards being written by ASTM Subcommittee D18.23 on Field Instrumentation, both in general, and also relating to proposed standards on use of inclinometers and on measurement accuracy. 40 of you responded to a questionnaire *(Geotechnical News, June 1998, page 38),* and indicated many concerns and very little support for the subcommittee's actions.

In the last issue of *Geotechnical News* (December 1998, page 23), ASFE reported on a June 1, 1998 agreement with ASTM about caveats that would be included in some future standards. The ASFE article included the wording of the caveats, which indicate that the 'standard' does not recommend a specific course of action, and should be used in conjunction with engineering judgment. To quote: "The word 'Standard' in the title of this document means only that the document has been approved through the ASTM consensus process". This is an excellent step, and shows what can be achieved by wise negotiation among people who began with very different views. However, the June 1 agreement did not indicate which standards would include the caveat - this determination would be made during the following months.

Despite this hurdle Terry Hawk, the Chairman of ASTM Committee D18 on Soil and Rock (of which the instrumentation subcommittee is a part), wrote to all D18 Subcommittee Chairmen as early as June 15, providing the caveat wording and instructing them to include the caveat in "all Standard Guides and Standard Practices that require professional judgment for implementation". A reminder about ASTM's definitions is appropriate here.

ASTM defines a 'Standard Guide' as "Offers a series of options or instructions, but does not recommend a specific course of action", and a 'Standard Practice' as "A definitive procedure for performing one or more specific operations or functions that does not produce a test result".

Mr. Hawk instructed the subcommittee chairmen to include the caveat in **all** Standard Guides, and to adopt the following procedure for all Standard Practices (reprinted here with his permission):

The subcommittees are to incorporate the practice caveat to those practices that they believe require professional judgment for implementation. To determine whether the practice requires professional judgment, consider the following:

- *If the practice produces a report, it most likely requires professional judgment. If the practice does not produce a report, it most likely does not require judgment.*
- *If the title contains such wording as cleaning, or specimen preparation, it most likely does not require professional judgment.*
- *If the title contains words such as characterization, or evaluation, it most likely does require professional judgment.*

If you are in doubt, it is better to err by including the practice caveat rather than excluding the caveat.

In my view this is an outstandingly clear and sensible instruction, and deserves acknowledgement by those of us who have been concerned about the impact of 'Standards' on our profession, when the dictionary definition is used. Thank you, Terry Hawk. In discussing the letter with him, Terry Hawk indicated to me that there may be some clarifications to the language and procedure after the issue has been discussed by the ASTM Board, but that for D18 the instruction would have the same message.

Date Change for Instrumentation Course in Florida

I had previously announced that the next in the series of instrumentation courses at Cocoa Beach, Florida, was scheduled for January 17-20, 2000. This has now been changed to November 1-4, 1999. For technical content please contact me. For registration, price, and other issues, please contact *Ole Nelson at the University of Florida, tel: (352) 392-1701, ext. 244; fax: (352) 392-6950; e-mail: onelson@doce.ufl.edu; web-site: http://www.doce.ufl.edu/conf&sem*

Push-in Piezometers

Push-in piezometers are, in many cases, an attractive alternative (as opposed to conventional installations in boreholes with bentonite and grout seals) for installations in soft soils. The installation time, and hence the cost, will usually be very much less. However, when consid-

ering this alternative it is imperative that sealing criteria are satisfied, and that the transducer has adequate proven longevity in the installed environment. Section 9.16 in the red book includes some suggested methods of sealing. In my experience it is either necessary to attach a length of 'sealing pipe' above the piezometer, with a diameter no less that the diameter of the body of the piezometer itself, or to ensure adequate sealing by using an appropriate grout that does not contaminate the measurement zone. I limit use of a sealing pipe to installations in soft clays that are free from coarse grains, because in other soils a hydraulic short circuit can occur along the outside of the sealing pipe.

When considering use of push-in piezometers, I believe that the user should ask the supplier at least the following questions, and should be satisfied with **all** the answers:

- *If a sealing pipe is used, what is its diameter compared with the diameter of the body of the piezometer?*
- *If the piezometer body or bottom shoe has a larger diameter than the sealing pipe, how can I be assured that the soil will 'fall in' and seal against the sealing pipe (or against the cable if a sealing pipe is not used)?*
- *What is the length of the sealing pipe?*
- *Is the connection between the piezometer and the sealing pipe fully watertight for the life of the piezometer?*
- *How is the push-pipe disconnected from the sealing pipe, so that the final placement of the piezometer is not disturbed?*
- *If a sealing pipe is used, is grout placed above the point at which the push-pipe is disconnected from the sealing-pipe?*
- *If a sealing pipe is not used, how is adequate sealing ensured?*
- *If a grout is used, what are its ingredients, mixing method, mixing sequence and placement method?*
- *If a grout is used, how is contamination of the measurement zone avoided?*
- *Is it possible to monitor the piezometer during pushing, to ensure that it is not over-ranged (pushing normally generates pore pressure at the tip)?*
- *What **field** evidence is there that the piezometers will be adequately sealed in the type of soils that occur at my site, for the full period of my measurement need?*
- *Has the transducer been designed to provide stable and reliable data in an in-soil environment over the full period of my measurement need?*
- *What type of signal is produced by the transducer?*
- *How is the transducer signal affected by any damage to the cable insulation?*
- *What **field** evidence is there that the transducer will provide stable and reliable data in an in-soil environment over the full period of my measurement need?*

Prior to finalizing for publication, this suggested list of questions was submitted for comment to several suppliers of push-in piezometers. I will welcome any comments from others.

As a related point of interest, during some recent installations of push-in piezometers in desiccated clay, the temperature sensors within the piezometers showed temperatures up to 85 degrees C, created by friction between soil and piezometer during the push. **This experience rings an alarm bell.** In such a situation the piezometer is subject to 'temperature transients' (see *Geotechnical News* Vol. 14, No. 3, September 1996, page 27), such that the pressure measurements are incorrect. **What does this do to piezocone data? Any comments?**

New Book on Time Domain Reflectometry

The June 1996 issue of *Geotechnical News* (page 37) included an article by Kevin O'Connor of GeoTDR, Inc., *Geotechnical, Environmental and Infrastructure Applications of Metallic Time Domain Reflectometry.* TDR is a technique developed by the telephone industry for locating cable breaks, and has been enhanced for use in the mining industry to determine locations of roof falls. TDR technology is now available for monitoring deformation in soil and rock by grouting a coaxial cable in a borehole (both axial and shear deformation), water levels in a borehole, contaminant transport, and volumetric water content.

A new book, written by Kevin O'Connor, and Chuck Dowding of Northwestern University, will be available in February from *CRC Press, titled GeoMeasurements by Pulsing TDR Cables and Probes. ISBN: 0-8493-0586-1. Price $69.95. CRC web-site: http://www.crcpress.com. GeoTDR web-site: http://idt.net/~gtdr29/.*

ASCE Publishes Corps of Engineers Manual

ASCE has, in recent years, published some of the U.S. Army Corps of Engineers 'Engineer Manuals', which provide well-respected guidelines on numerous civil engineering topics. Within the next few months ASCE will publish the 30 June 1995 EM 1110-2-1908, *Instrumentation of Embankment Dams and Levees.* This is a comprehensive guide, and includes information on modifying instrumentation in existing dams as well as instrumentation for new dams. ASCE's web-site is http://www.asce.org.

Changes at Slope Indicator Company

Peter Fordyce became Slope Indicator's general manager in June, 1998. Peter has a post-graduate degree in materials engineering and has worked at Boart Longyear's Technical Research Centers in South Africa and Ireland. **Dr Hai-Tien Yu** is heading up a new customer/applications support team. Dr. Yu is a chartered engineer with over 20 years of experience in engineering geology, rock mechanics, technical computing, and instrumentation. Before joining Slope Indicator in 1994, Dr. Yu was senior project engineer and head of the geotechnology department at Trafalgar House Technology Research and Development Center in England. Also, **Erik Mikkelsen** has returned to Slope Indicator part time as a consultant on inclinometer systems and applications.

The Puzzler

No responses so far to the puzzler in the last issue of GIN:

A challenge, but no prize!

Please let me know if you have any ideas or solutions.

- *An embankment on soft ground*
- *Concern for stability, with a possible failure surface primarily through one of the subsurface layers*
- *Open standpipe and vibrating wire piezometers in that layer. Enough of them to give confidence in the data, based on consistency*
- *After all piezometers reached equilibrium (settling down after installation, and after enough time for the open standpipe piezometers to overcome time lag), the open standpipe readings of piezometric elevation were all much higher, by many feet, than the vibrating wire readings.*

Do you need a clue? Significant organic content in the layer in question. But what mechanism is taking place, and how to be certain that reliable measurements of pore **water** pressure are available for an effective stress stability analysis? Come on now, when I started GIN I said that I was not willing for this to be a one way street — let's have some feedback!

New 'Multilevel' Piezometer

For many years I've discouraged people from installing more that one piezometer in a single borehole, except under some special circumstances. This recommendation is usually greeted with dismay (and sometimes with scorn!) because of the consequent increased boring costs.

My concern relates to the uncertainty of obtaining a good seal around and between two or more cables, tubes or pipes, particularly where they are allowed to 'snug together' - some test results by Guarino (1985) that support this concern are reported in Section 9.17.8 of the red book. Many colleagues have told me of poor performance after multilevel installations have been used. A new piezometer has been developed, by Geokon, Inc. in conjunction with Gordon E. Green, Geotechnical Engineering and Instrumentation Consultant, Seattle, WA, allowing several to be installed in a single borehole. The vibrating wire piezometer is lowered into position and a spring-loaded mechanism is actuated to force a curved filter into contact with the wall of the borehole.

Other piezometers are installed sequentially above the first, and the entire borehole is then grouted with a special sealing grout, via a tremie pipe from the bottom upwards. No sand or granular bentonite placement is required, and the needs for a sounding hammer and repeated depth measurements are eliminated. In my view, an exciting and much needed development!

Jim Gould

Some very sad news is reported on page 17. What do I remember most strongly about Jim? His enormous range of knowledge about the practice of geotechnical engineering, and his commitment to sharing this knowledge with us by lecturing and by writing papers.

When opening a conference program announcement, or a volume of papers, there he was again, so many times. And not esoteric things, but real-world practical 'how to do it' things. The slides used during his lectures, hand-drawn by Jim, visually attractive and clear. His wonderful and outrageous use of the American language. His sense of humor. His friendship. And yes, as reported on page 18, "his picturesque expressions of incredulity", the remembrance of which brings a smile to my face.

On a more personal note, it was Jim who dragged me out of a back room in 1970, to co-author a paper with him. This is a great loss to those of us who knew him, and to our geotechnical profession.

Closure

Please send contributions for GIN to me at the following address:

Beaumont,
Mill Street,
Chagford,
Devon TQ13 8AW,
England
Tel: +44-1647-432209.
Fax: +44-1647-432379
johndunnicliff@ibm.net (send as an E-mail attachment in msword please).
Saude! (Brazil)