Computer Analyses in Soil Mechanics;Present and Future

Le Calcul sur Ordinateur en Mécanique du Sol ; Présent et Futur

R.L.Schiffman Prof., University of Colorado, U.S.A.

This Specialty Session was organized as an informative session. Its purpose was to provide the conference participants with an overview of current computational capabilities and to look towards the future of the use of computer-based techniques in geotechnical engineering.
The session was divided into three parts as follows:

1) The use of computers to solve complex analysis and design problems.
2) New uses of computers.
3) Software coordination.

The session was organized around a series of prepared presentations and a panel discussion. A bibliography of the prepared papers and the panel members is presented below.

Analysis and Design

A series of short presentations were made on the use of computer-based techniques as an aid in geotechnical engineering analysis and design. These presentations were largely centered on the use of numerical procedures to analyze engineering problems involving complex geometries and variable soil and rock properties. The use of finite element techniques in a variety of applications was discussed. Particular emphasis was placed on the power of this method as a numerical tool. The use of finite difference procedures was discussed as another of the numerical tools at the disposal of the geotechnical engineer.

The panel acknowledged the power of computer-based techniques in geotechnical engineering but expressed a concern that often the use of computer methods overshadowed the proper concern with the use of appropriate constitutive behavior. It was further emphasized that numerical analysis was but one of a variety of means of providing solutions to geotechnical engineering problems. A concern was expressed that all too often computer methods were being applied to problems when analytical solutions were readily available.

[1]Professor of Civil Engineering, University of Colorado, Boulder, Colorado, U.S.A.

New Uses of Computers

This part of Specialty Session 12 addressed two topics:

1) Uses of computers as field instrumentation devices.
2) The use of new generations of computing devices.

The use of computers to monitor field behavior during, and after construction was extensively discussed. Presentations were made on specific applications to the use of real-time computer systems to provide construction control. In these systems a computer system was connected to field sensors. By use of graphical output devices, the behavior of the structure during construction was monitored on a real-time basis. It was pointed out that the use of real-time systems can provide substantial cost savings in reducing the design redundancies required when such monitoring is not present.

The use of real-time systems in relatively dynamic situations such as the setting of off-shore platforms was discussed. Real-time systems, in this case, provide essential information for field control.

Two salient points of real-time systems were emphasized. First, it is essential that the entire system of sensors, computers, and output devices be thoroughly proven prior to installation. The time constraints are such that it is virtually impossible to debug the system during operation. The second point concerned the relative cost of hardware and software, especially when mini-computers are used. The costs of computer related hardware are decreasing, while the cost of software development is increasing. As a result, the software costs are tending to overshadow hardware costs.

A presentation was made on the use of programmable, hand-held calculators in solving geotechnical engineering problems. This presentation pointed up the rapid advances in computer technology. Pocket (hand-held) calculators, are currently capable of performing computations which, a few years ago, were the exclusive province of large systems. In

the future, it is anticipated that hand-held calculators will be capable of performing complex computations, and will relieve the engineer of the burden and inconvenience of the use of a centrally located computer installation. This implies, among other things, that advanced computational techniques are no longer limited to highly sophisticated and industrialized regions, and can be brought to any place in the world.

Software Coordination

Rapid developments of computer-based techniques and the proliferation of computers throughout the world are producing a chaotic situation with regard to software developments. There is a rapid, uncontrolled, development of computer software resulting in massive duplication. Furthermore, there is a lack of information on the availability of software. Two presentations were made on software coordination efforts, one in Canada and one in Switzerland. Other coordination efforts exist in Australia, the United States, France, The Netherlands, Israel, the Federal Republic of Germany, and elsewhere.

The reported Canadian effort is centered on the development of comprehensive, maintained, well documented software packages. These packages have been successfully implemented in a variety of installation. It was emphasized that an essential ingredient to software coordination was an educational effort centered on the algorithms implemented by the software and the use of the programs to solve problems.

The development of a software coordination effort in Switzerland was described. This effort involves the collection, analysis and cataloging of available application packages. It was commented that the bulk of the available software was in the analysis and design area, in which the computer was used as an extension of hand calculations. It was observed that full advantage of the power of the computer is not utilized to advance the state of theoretical knowledge. Furthermore, the power of the computer, as an information processing device is in its infancy with regard to geotechnical engineering applications.

Panel Members

E. D'Appolonia
M. Dysli
J. Lysmer
M. Tominaga
C. P. Wroth

Prepared Papers

Akai, K. and Tamura, T., "Numerical Analysis of Stress Path under Multi-Dimensional Consolidation".

Awoshika, K. and Reese, L.C., "Nonlinear Analysis of a Foundation Consisting of a Group of Piles".

Birnbaum, A., Komornik, A., Wiseman, G. and Zeitlen, J.G., "The Use of Computer Based Techniques in Solving Foundation Engineering Problems - The State of the Art in Israel".

Dysli, M., "Usage en Suisse De L'Informatique Appliquee a la Geotechnique".

Eisenstein, Z., "Computer Analyses in Earth Dam Engineering".

Fredlund, D.C., "Slope Stability Software Usage in Canada".

Lysmer, J. and Seed, H.B., "Finite Element Computer Programs for Seismic Soil-Structure Interaction Analysis".

Marr, W.A. and Lambe, T.W., "Predicted and Measured Pore Pressures in a Dam".

Shaw, D.E., Rizzo, P.C. and D'Appolonia, E., "The Role of Finite Element Techniques in Applied Soil Mechanics and Foundation Engineering".

Tominaga, M., Echigo, Y., and Hashimoto, M., "Realtime Construction Control Computer Simulation System".

Wiseman, G., "Slope Stability Analysis with the Aid of a Programmable Pocket Calculator (HP-65)".