The Engineering Geologist

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Chairman's Message -- Optimism and Realism

With the imminent approach of the Society's annual meeting, and with it the election of new officers of the Division, it is both appropriate and opportune to reflect upon some of the events of the past year that bear upon the future of the Division. However, prior to such reflections I would like to take this opportunity to express my sincere thanks to all who contributed to the activities of the Division during the past year as officers, appointed liaison representatives, committee chairmen and contributors to Division publications. Each in his or her way has provided a measure of interest and effort that is, collectively, so essential for the continuing success of the Division.

In the February issue of the Newsletter I commented upon some of the actions taken by the Management Board at its 1980 meeting. Such actions as the continuing regular publication of the Newsletter, increasing liaison of the Division with AEG, US National Committee on Engineering Geology and through it liaison with IAEG, involvement of those with an interest in environmental geology in the programs of the Division and planning for the GSA Centennial. These among others were more than sufficient to cause your Chairman to begin his term of office with a great measure of optimism for the continuing development of the Division. For the most part the optimism remains, due in large measure to the support that I have received throughout the year from the executive of the Division and from numerous others who have accepted responsibility for specific contributions to publications or liaison assignments. While these contributions clearly indicate a level of interest and vitality within the membership that augurs well for the future, it is worthwhile to speculate on the potential within the Division for even greater participation.

Approximately 10 per cent of the over 12,000 Members, Fellows and Student Associates that constitute the membership of GSA, identify their primary interest as engineering and/or environmental geology. This percentage is the largest of any interest category within the Society; thus, the Division possesses the potential for being one of the most, if not the most dynamic Division of the Society. At present, the notable achievements of the Division are attained by something less than 5 per cent of the Division's membership and therein lies reality. It seems to me that an increase in the level of participation by about 1 per cent per year over the next few years would not be overly optimistic yet would result in a very real gain in the value of the Division to the membership.

It has been my pleasure to serve the Division as Chairman during the past year which office has brought with it the reward of meeting new and interesting friends and working with excellent colleagues in the Division executive and management board. Your support for the incoming executive and the planned activities of the Division is sincerely sought and I remain optimistic that, collectively, we can realistically attain the prominence within the Society that the potential within the Division affords.

John S. Scott
Geological Survey of Canada

Rock Mechanics Research--'Inadequate' for Engineering Practice

Dams, tunnels, large buildings, nuclear-waste depositories, missile silos, and other major engineering projects can be only as sturdy as the rock that supports them. But the foundations of rock mechanics--the science and art that attempts to predict the behavior of rock--are themselves not very firm, according to a National Research Council panel's report.

The Panel on Rock-Mechanics Research Requirements--of the National Research Council, U.S. National Committee for Rock Mechanics--looked at rock-mechanics research under seven separate subpanel areas and concluded that "there are no well-understood procedures by which laboratory data can be used to predict reliably the behavior of rock masses in situ."

Laboratory tests cost less and take less time than field tests, and variables are better controlled in the laboratory, but removing a sample of rock from its original location alters its mechanical behavior, and small samples do not reflect discontinuities in the rock mass. Comparisons of laboratory results with realistic field projects are needed. One way to accomplish that would be to add rock-mechanics tests to construction projects in progress according to the panel. However, equally critical in writer's judgement is the need to increase the participation of mature, field-experienced geologists in the evaluation of a rock mass being investigated. This approach incorporates the geologic insight/rational factor into the analysis of any test results--which invariably strengthens the overall assessment of the inherent properties of a rock mass.

The panel reported its findings in Rock-Mechanics Research Requirements for Resource Recovery, Construction, and Earthquake-Hazard Reduction.[1] The study was sponsored by the National Science Foundation, the U.S. Department of Energy, and the U.S. Geological Survey.

Much is known about rock mechanics, and the properties of rocks under various conditions. But improvements in fundamental understanding of rock

[1]Rock Mechanics Research Requirements, U.S. National Committee for Rock Mechanics; National Research Council (National Academy Fress, 1981; 248 pp.; available from NTIS: NRC/RM-81-1).

behavior are needed. So are new tools for rock-mechanics studies.

Questions about porosity, permeability, and fluid flow touch almost all aspects of rock mechanics and applied geology. Ground subsidence and motion along a fault can be influenced by fluid movements induced by man. Consequently study of fluid flow in very-low-permeability rock is important in analyzing groundwater movement through deep-lying rock that might be used as a nuclear-waste-disposal site.

Yet variations in permeability, porosite, and other fluid-flow characteristics that occur with changes in temperature are little understood, according to the panel. One problem is a lack of borehold instruments that can withstand high temperatures and high pressures.

Stresses that tend to compact, shear, and pull rock apart are not understood, according to the panel. Sensitive, highly stable instruments that can record stress-related changes over tens of years are needed, as are techniques to measure stress in rock too deep to drill.

The mechanical and hydrological behaviors of large masaes of rock are affected principally by naturally occurring fractures. Electrical conductivity techniques now used to detect interconnection of fractures are "not satisfactory," and alternative methods are needed "urgently." Furthermore, methods of detecting deep fracturing, including single fractures, are needed.

Recovery of hydrocarbons from oil shale, tar sands, and other sources requires understanding the effects of high temperatures on complex sedimentary rocks. Heat generated by nuclear wastes may fracture the rock of deep depositories. Concerns such as these have given rise to an urgent need to study basic physical, mechanical, and chemical properties of rock that is subjected to high temperatures.

Because the correlation between test data and the field behavior of rock is not adequately understood, the performance/reaction of a rock mass to the construction/operation of an engineering project cannot be predicted reliably through use of numerical modeling. Current models either are "inadequate or involve prohibitive computer costs" when faced with such conditions as large displacements and strains in rock mass, strong discontinuities, and simultaneously occurring processes such as thermal, mechanical, and hydrological interactions.

Overall, the panel concluded, "present knowledge of the behavior of rock masses is not of the quality or certainty normally required for good engineering practice."

George A. Kiersch, GSA Reprasentative
USNC/Rock Mechanics

Engineering Geology Division Dues Increase Anticipated

At the May meeting of the GSA Council a motion was passed giving division management boards the option of raising dues to a maximum of $5.00. In order that any such increase become effective for 1982 a decision from the management board was required by headquarters by 1 June 1981. Since the Division's management board was not scheduled to meet until November the matter of a dues increase is being deferred until that time.

While the decision of the board cannot be anticipated the probability is great that such a dues increase, to become effective for 1983, will be approved. A factor that will have a strong bearing upon the board's decision is the present financial deficit carried by the Division and occasioned in the previous year by an unexpected substantial increase in the cost of publishing the Division's Newsletter.

The present executive of the Division and the Newsletter editor have been very conscious of the high costs of publication and they have taken all possible precautions to ensure that publication costs have been kept to a minimum while endeavouring to ensure a maximum of benefit to the membership through the publication of the Newsletter.

New Index to Information on Nation's Water

The most complete compilation of information on surface- and ground-water data collected at more than 100,000 sites across the United States and bordering areas of Canada and Mexico is now available in a new edition of the index to the catalog of information on water data, released by the U.S. Geological Survey, Department of the Interior.

Based on information provided by hundreds of participating federal, state, and local agencies across the country, the index presents selected information from the catalog, a comprehensive computerized file of information about water-data acquisition activities in the United States, its territories and possessions, as well as activities in parts of Canada and Mexico.

"The catalog is a basic tool for coordinating and planning water-data acquisition programs, and is designed to aid investigators in determining the location, frequency, and type of measurements being made of the quantity and quality of the nation's surface- and ground-water resources," said Porter E. Ward, chief of the USGS Office of Water Data Coordination, Reston, Va.

"The catalog does not contain the actual data," Ward said, "but does provide information on where and by whom data are being collected, the type or types of data acquired, and how these data can be obtained."

As in the previous editions, the information presented in the new seventh edition, is published in 21 regional volumes, representing the 18 largest drainage basins of the United States, plus Alaska, Hawaii and Puerto Rico. These 21 regions, designated by the U.S. Water Resources Council, include such river basins as the Missouri, Mississippi and Rio Grande.

Each regional volume is divided into four informational sections -- streamflow and stage, quality of surface water, quality of ground water, and areal investigations and miscellaneous activities.

Copies of any of the 21 separate volumes of the "Index to the Catalog of Information on Water Data," are available free upon request from: Office of Water Data Coordination, U.S. Geological Survey, 417 National Center, Reston, Va, 22092.

EGD Past Chairman Joins Rolla Faculty

Division Past-Chairman (1980), Allen W. Hatheway, has left consulting practice to join the faculty of the University of Missouri at Rolla, as full Professor of Geological Engineering. Beginning with the Pall 1981 semester, Allen will be in residence as the seventh member of the Geological Engineering faculty, further strengthening the Department of Geological Engineering in the areas of engineering geology and hydrogeology applied to the geotechnical option. This will include his specialties of practice in radioactive, hazardous and special waste management, critical facility siting, rock engineering and underground construction, seismic risk assessment, remote sensing interpretation, geologic hazards mitigation, and conduct of professional practice. Allen has resigned from the partnership of Haley & Aldrick, Inc., where he has served for five years as Vice President and Chief Geologist.

Teaching is not a new endeavor for our Past Chairman, having been an adjunct Assistant Professor of Civil Engineering at the University of Southern California (1971-1974) and as adjunct Associate Professor of Geology at Boston University (1979-1981). For twenty years he has actively promoted military geology as a member of the United States Army Reserve, now serving as a Mobilization Designee as Deputy District Engineer, US Army Engineer District, New York, in the grade of Colonel. Allen is a graduate of the University of California at Los Angeles (1961) and the University of Arizona (1966 and 1971).

Letter to the Editor

Dear Mr. Fickies:

I read with interest John S. Scott'a article in the February 1981 issue of the newsletter particularly as it related to environmental geology. Although I have no particular feelings about changing the name of the division, much of the work in which I am now engaged is a fairly equal mix of engineering and environmental geology.

In much of the current literature, less attention is given to geology as it applies to mining. I'm not referring to reserve definition and analyais but to hydrogeology, overburden analysis (i.e., acid producing potentials), selection of rock units to serve as substitute topsoil replacement, analysis of rock units for construction of large volume valley fills, and so on. Many geologists are now engaged in evaluating the geology of surface coal mines in light of Federal Surface Mining Act, P.L. 95-87, for these and other aspects combining both engineering and environmental geology.

Technology snd methodologies in these areas are now only in their earliest stages. Consequently, it appears to me that the Engineering Geology Division would be doing a great service to the membership in disseminating information on such areas of interest. Individuals in positions similar to mine are extremely interested in investigative techniques and methods of interpretation in these particular fields. The marriage of engineering and environmental geology is a fact of life to me, and as the role of the division continues to evolve, I hope that the interrelationship of these two disciplines is recognized and emphasized.

I hope that these thoughts are helpful, and if I may be of any assistance, do not hesitate to contact me.

Best regards,

Terry L. Sole, CPG
Senior Environmental Engineer
Diamond Shamrock Corporation

Updating Subsurface Sampling of Soils and Rocks and Their In-Situ Testing

January 3 - 8, 1982

The Engineering Foundation will sponsor a conference on "UPDATING SUBSURFACE SAMPLING OF SOILS AND ROCKS AND THEIR IN-SITU TESTING", to be held at the Miramar Hotel, Santa Barbara, January 3 - 8, 1982. Surendra K. Saxena of the Illinois Institute of Technology will serve as the Chairman of the conference.

The principal objective of the conference will be to focus on the newly developed practices of soil and rock sampling and in-situ testing and provide a discussion on their merits or demerits and on optimum ways of implementation to get quality results. The usual Engineering Foundation Conference format will be followed which reserves mornings for plenary sessions and presentations of feature lectures or topics for discussion and evenings for intensive discussion sessions. The afternoons are generally left unscheduled so that the conferees can organize impromptu technical sessiona or enjoy the surroundings.

Topics being considered for inclusion in the program are:

A. Site Investigations
B. Subsurface Investigation by: Surface surveys - New developments like remote sensing surveys and geophysical methods (e.g. Seismic, Electric and gravity).
C. Subsurface Investigation by: Boreholes using different types of samples (which were completely neglected previously and now receiving great attention).
D. Subsurface Investigation by: Test pits - and large diameter boreholes.
E. IN-SITU Tests, Evaluations and Interpretation of Data.

A number of leading workers from practicing as well as academic communities will present feature lectures and act as discussion panel members. Persons who wish to receive an invitation to attend the conference should contact the Engineering Foundation at 345 East 47th St., New York, N.Y. 10017. Telephone (212) 644-7835 or Telex 126022.

GSA Engineering Geology Division

Data sheet 3

ROCK DESCRIPTION GUIDE
for
TUNNELING PROJECTS

1. Rock type. (Include definitive adjectives such as aplitic, prophyritic, cherty, silty, etc.: also formation name.)
2. Color and range.
3. Grain size and range.
4. Prominent minerals or percent rock clasts: type of cementation.
5. Water inflows or seeps: temperature: pressure: estimated or measured flow in gpm: duration.
6. Rock defects:
   Joints—open or closed, type of filling, cemented (healed), attitudes, spacing, number and orientation of prominent sets.
   Faults—type (dip-slip, normal, reverse, thrust, strike-slip), attitude, displacement, filling (mylonite, gouge, breccia), thickness of zone.
   Weathering and decomposition—degree of mechanical or chemical weathering, hydrothermal alteration, oxidation, etc.
7. Rock structures:
   Sedimentary—stratified, massive, lensed, attitudes, degree of cementa-

and

COMBINED TERZAGHI ROCK
and
SOFT-GROUND TUNNEL CONDITIONS GUIDE
by Richard J. Proctor

1—Hard and intact.
2—Hard stratified or schistose.
3—Massive, moderately jointed; *very firm ground.*
4—Moderately blocky and seamy; *firm ground.*
5—Very blocky and seamy (closely jointed): *may be raveling ground.*
6—Crushed but chemically intact rock or unconsolidated sand; *may be running or flowing ground.*
7—Squeezing rock, moderate depth.
8—Squeezing rock, great depth.
9—Swelling rock.

Notes: In practice, there are no sharp boundaries between these categories, and a range of several Terzaghi Numbers may best describe some rock and soft-ground conditions.

SOURCE OF DATA: Proctor, R.J. (1971) "Mapping Geologic Conditions in Tunnels", Bul. Assoc. Eng. Geol., Vol. VIII, No. 1

DATA SHEET COMMITTEE
B.W. Pipkin, Chairman

Aug. 1981

GSA Engineering Geology Division

Data sheet 4

TYPICAL TUNNEL SUPPORTS required with each TERZAGHI ROCK CONDITION

by

Richard J. Proctor

Rock Condition No.	Typical tunnel supports
1	Unsupported (unless spalling or popping occurs).
2	Unsupported to occasional light support.
3	Unsupported in very firm or massive ground. If jointed condition gives trouble, place ribs on 6-foot centers, or use roof bolts. Rock bolts more economical than ribs under this rock condition. Shotcrete or gunite in arch only.
4	Ribs on 2- to 4-foot centers, or roof bolts. Shotcrete or gunite in arch only. Rock bolts must be longer and more closely spaced than in Rock or Soft-Ground Condition No. 3.
5	Ribs on 2-foot centers or less,* with heavy lagging or liner plates. May require invert struts. Rock bolting may not be effective. Shotcrete or gunite (with wire mesh if stand-up time permits), several layers thick, is very effective in raveling ground.
6	Ribs on 2-foot centers or less;* may require invert struts. Liner plates, steel, or precast concrete lagging replaces wood lagging; heading must be breastboarded or otherwise secured. Rock bolting not effective. Shotcrete or gunite, with wire mesh several layers thick, is often effective in containing running ground. Shield may be required.
7	Ribs on 2-foot centers or less* with invert struts or circular ribs. Rock bolting or shotcrete is effective only if squeeze is very light. Use water-proofing sealant or coat ribs and lagging with gunite immediately after placing to prevent air-slaking and sloughing.
8	See No. 7.
9	Ribs on 2-foot centers or less,* circular or yielding ribs. Rock bolting not effective. Use waterproofing sealant, shotcrete, or coat ribs and lagging with gunite immediately after installation to prevent contact with moist air or desiccation of clay. Initial overexcavation is advisable in swelling rock.

* Steel ribs at 2-foot centers or less are usually uneconomical and should be used for only short distances or until more substantial ribs can be obtained.

SOURCE OF DATA: Proctor, R.J. (1971) "Mapping Geologic Conditions In Tunnels", Bul. Assoc. Eng. Geol., Vol. VIII, No. 1

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