

## TESTING FORUM

### ASTM D-18 News

#### Comments from the Chairman of Committee D-18

This year marks the 50th Anniversary of Committee D-18 on Soil and Rock. From small, but auspicious beginnings in 1936, Committee D-18 has grown into an active, forward looking Committee of 600 members. We have kept abreast of current developments in the field by organizing new Subcommittees to respond to the need for standards in new areas. A few examples are marine geotechnics, waste management, geotextiles, and frozen soils and rock.

Our Committee has been innovative in developing training courses in soil identification, and in initiating a contract with the Nuclear Regulatory Commission to expedite the development of standards in rock mechanics. Details of these and other activities of Committee may be read in the History of Committee D-18, published in the June 1978 issue of the *Geotechnical Testing Journal* (Vol. 1, No. 2, pp. 65-71), and the update of the History which is in this issue of the Journal. Incidentally, the *Geotechnical Testing Journal* is one of the most successful activities initiated by Committee D-18.

I doubt that few, if any, of the present members of our Committee will be around to celebrate our 100th Anniversary, but I have no doubt that in another 50 years our Committee will be active and in the forefront of standards development for soil and rock.

Woodland G. Shockley  
Chairman, Committee D-18

#### 50th Anniversary Celebration of Committee D-18

At the Annual Meeting of ASTM this last June in Louisville, KY, a luncheon was held to celebrate the 50th Anniversary of Committee D-18 on Soil and Rock. It was fitting that the luncheon was held in the rotating dining room on the top floor of the Galt House Hotel. In the course of the luncheon, all were treated to a beautiful view of the Ohio river as they cycled through several full revolutions.

Like the restaurant, Committee D-18 has completed many cycles of establishing standards for soil and rock. With each cycle, some of the "view" remains unchanged while other parts are new. Some of the original Standards produced by Committee D18 were

- D 420 Surveying and Sampling Soils for Highway Subgrades
- D 421 Preparing Soil Samples for Mechanical Analysis and Determination of Subgrade Soil Constants
- D 422 Mechanical Analysis of Soils
- D 423 Liquid Limit of Soils
- D 424 Plastic Limit and Plasticity Index of Soils
- D 425 Centrifuge Moisture Equivalent of Soils
- D 426 Field Moisture Equivalent of Soils
- D 427 Shrinkage Factors of Soils

Nearly all were first produced in the 1935-39 era as Tentative Standards and then first adopted as Standards in 1939. If one looks in the *1986 Annual Book of ASTM Standards*, all essentially remain the same except D 426. In 1984, D 423 and D 424 were combined and given the designation D 4318. The first members of Committee D-18 made a significant contribution to the practice of engineering by producing these Standards.

Over the years, these Standards were revised and up dated. In several cases, the original figures in the first Standards exist in the latest versions (dispersion cup for hydrometer test, centrifuge apparatus, and apparatus for determining the volumetric change of subgrade soils). To comply with the requirements for SI units, conversion tables were added below these figures.

At the luncheon, a number of the "old timers" were on hand. Below, in the photograph (Fig. 1), are those who have been in Committee D-18 for more than 30 years. Among the guests at the luncheon were three past chairmen of Committee D-18: Earl Hall, Ivan Johnson, and Adrian Pelzner. Earl and Ivan qualify as "old timers" and are in the picture. Later during the week, Carl Crawford arrived but Earl Hall had to leave. In Fig. 2 the past Chairmen of Committee D-18 (with the exception of Earl Hall) are pictured with the current Chairman, Woodie Shockley. Among them, they account for the leadership in Committee D-18 for about 40% of its existence. Many could recall vivid memories of early Committee activities. Earl B. Hall commented that voting on issues in the 1945-54 era "very closely simulated Omaha Beach landings in WW II" . . . and the "meetings sometimes resembled the kangaroo courts of the territorial days."



FIG. 1— "Old Timers" at Anniversary Luncheon. From left to right: Page Fisher, Jr., Charles W. Britzius, Edward A. Abdun-nur, Woodland G. Shockley, A. Ivan Johnson, Earl B. Hall, and William A. Goodwin (past President of ASTM).

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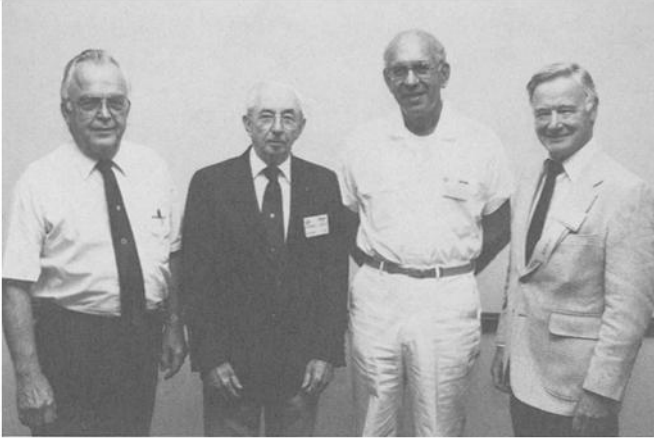


FIG. 2—Committee D-18 Chairmen. From left to right: A. Ivan Johnson (1976–81), Woodland G. Shockley (current chairman), Adrian Pelzner (1982–85), Carl B. Crawford (1964–68).

A request to them was made for old photographs of Committee D-18 action. About the oldest that could be produced are Figs. 3 and 4. These were provided by A. Ivan Johnson who appears in both photographs. The first was taken in 1963 at the Symposium on Laboratory Shear Testing of Soils in Ottawa Canada and the second was taken at the Fifth Pacific Area Conference on Rock Mechanics in Seattle in 1965. Only a few faces in each photograph are familiar to the Editor. Assistance by the readers in identification of these people would be appreciated. Send the information to the Technical Editor.

Besides serving the profession and society with Standards and symposia, Committee D-18 has benefited those who have participated with warm memories and lasting friendships. All of these must be cited when reviewing the accomplishments of Committee D-18.

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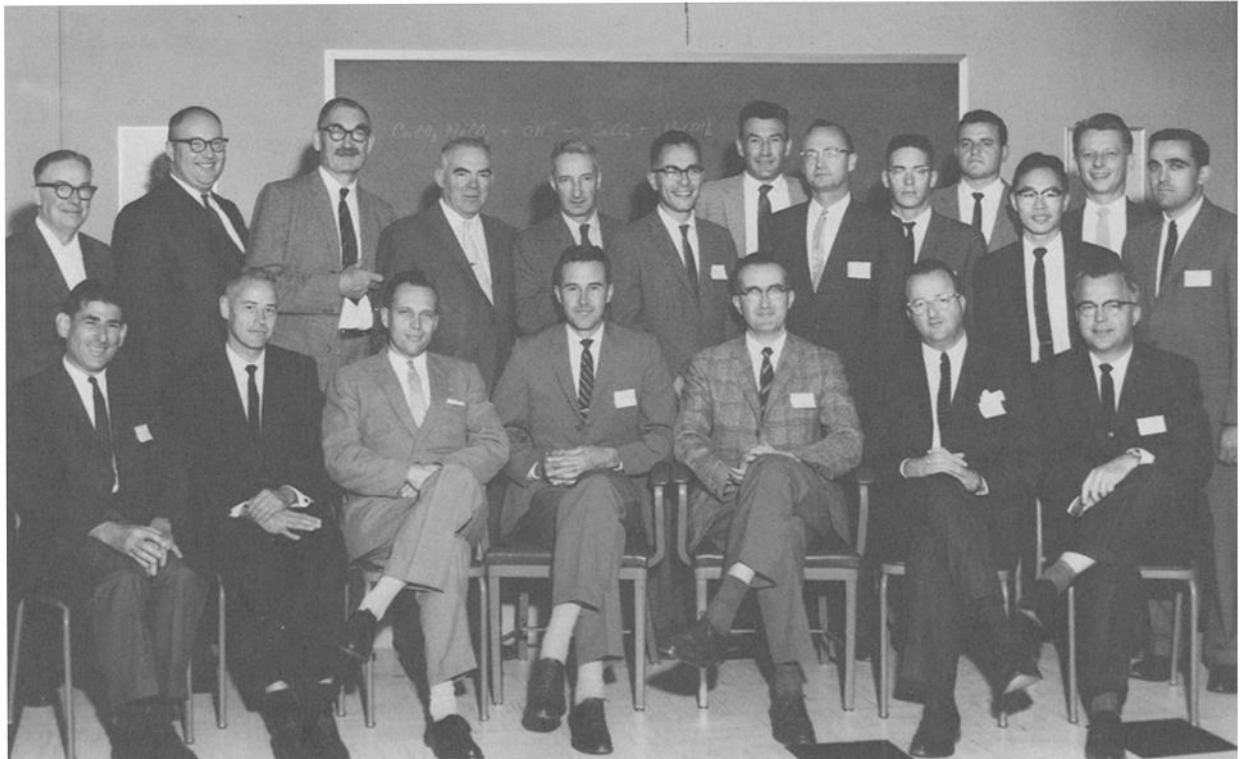


FIG. 3—Group of ASTM D-18 and NRC of Canada members meeting to discuss standards for ground-water level and pressure measurements at the Symposium on Laboratory Shear Testing of Soils, Ottawa, Canada, 9–11 Sept. 1963.

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FIG. 4—Fifth Pacific Area Conference on Rock Mechanics in Seattle WA in 1965. Top: 7th from right Page Fisher. Bottom: 3rd and 4th from right A. I. Johnson and R. Karol.

### Update of the History of ASTM Committee D-18\*

The History of ASTM Committee D-18 was published in the *Geotechnical Testing Journal*, Vol. 1, No. 2, June 1978, pp. 65–71. It is fitting that the History be updated in this year of 1986, since it marks the 50th Anniversary of Committee D-18. The years between 1978 and 1986 have been productive ones for Committee D-18 in terms of new standards, growth in membership, publication of Special Technical Publications, and reorganization to meet the needs of our developing society. This update is an extension of the original article, and the reader is referred to that publication for the early history of the Committee.

#### Committee Activities, 1977–1986

In June 1977 a task group on “Committee D-18 Objectives and Organization for the Eighties” was formed under the chairmanship of E. B. Hall; A. Pelzner took over as chairman in 1979.

The second mid-year meeting was held in Jan. 1978 in Atlanta, GA. At this meeting a new administrative Subcommittee D19.94 on Education and Training was authorized with R. H. Karol as Chairman. This subcommittee is concerned with standards for the

education and training of geotechnical testing and inspection personnel.

During this period there was a reassignment of responsibilities between Subcommittees D18.03 on Texture, Plasticity and Density and D18.08 on Special and Construction Control Testing, which resulted in several sections being moved out of D18.08 to form a new Subcommittee D18.15 on Stabilization with Admixtures, with M. C. Anday as Chairman.

It was reported that the U.S. Department of Defense had approved eleven standards of Committee D-18 for use by its agencies.

At the annual meeting in June 1978 in Boston, the Committee established a new award, “Committee D-18 Outstanding Service Award,” which consists of a bronze plaque in Marshall Hall at ASTM Headquarters.

Approval was granted to form a new Subcommittee D18.16 on Grouting, and in 1979 two more subcommittees were approved. These were D18.17 on Rock for Erosion Control and D18.18 on Peats and Organic Soils.

The increasing use of geotextiles by the engineering profession emphasized the need for standards for these materials and their behavior in the environment. Accordingly, a new Subcommittee D18.19 on Fabrics for Geotechnical Applications was approved. This subcommittee worked jointly with Subcommittee D13.61 on Geotechnical Fabrics of Committee D-13 on Textiles, and in 1984 the two subcommittees combined to form a new ASTM Committee

\*The Update of Committee D-18 was prepared by Woodland G. Shockley, Chairman of Committee D-18.

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D35 on Geotextiles and Related Products. Close ties are maintained between this new committee and Committee D-18.

The task committee on Committee D-18 Objectives and Organization for the eighties submitted their final report in which it was concluded that there was a need for accelerated development of standards, that the committee should seek outside assistance and financial aid in developing standards, and that a new position of vice-chairman for standards development should be created to implement these recommendations. W. G. Shockley was subsequently appointed to the new vice-chairman position. The task committee also emphasized that symposia sponsored by Committee D-18 are strong points, but stated they should be oriented more toward standards development.

Almost coincidentally with the report of the task committee, ASTM received a proposal from the Nuclear Regulatory Commission to enter into a contract to develop standards in the area of rock mechanics that were badly needed by the Commission. Task committees were set up by H. J. Pincus, Chairman of Subcommittee D18.12 on Rock Mechanics, agreement was reached on standards to be developed, and a contract signed with ASTM that provided funds for meetings of task committees so as to expedite development of the standards. Phase III of that contract is nearly complete. The NRC contract up to 1986 has resulted in the production of 22 draft standards, 8 of which have been approved; the remainder are in various stages of balloting. This effort demonstrates how standards may be expedited effectively through outside financial support.

In 1981 another subcommittee was added to Committee D-18. This was Subcommittee D18.20 on Impermeable Barriers, set up to satisfy the need for standards related to barriers to underground movement of water or soluble toxic materials.

Committee D-18 broke new ground in May 1982 by developing and putting on a training course on visual soil classification in Philadelphia. The course was so successful that it was repeated in Denver in 1984, and it has served to encourage the ASTM Standards Technology Training Program.

Committee D-18 had grown to over 500 members, and with 20 technical and 9 administrative subcommittees, it was becoming difficult for the officers and Executive Subcommittee to keep close track of standards activities. Accordingly, Subcommittee D18.96 on Research and Standards Development was asked to study a possible reorganization of Committee D18. The report of this study was made in 1984, and it recommended that Committee D-18 have five vice-chairmen, each to oversee designated groups of subcommittees. This would provide better communication between the subcommittees and the Executive Subcommittee, and give better control over standards maintenance and development. The recommendation was approved and the new officers were appointed in 1985.

The Executive Subcommittee became concerned about the value of symposia and seminars sponsored by the committee, and also about the needs for training subcommittee officers and committee members relative to committee operations and the processes of

standards development. A questionnaire on these subjects sent to committee members had good response, and showed that symposia and seminars were desired, that there was need for better internal communication, and there was a need to speed up standards development. All of these are being currently addressed by the committee reorganization. The NRC contract has demonstrated one way in which standards may be expedited.

In response to developing needs, in 1986 a new Subcommittee D18.19 on Frozen soil and Rock was established, with C. W. Lovell as Chairman. Committee D-18 also became active in coordinating with other ASTM Committees in developing standards relating to ground water, through participation in the Ground Water Standards Coordinating Task Group and the Coordinating Committee for Environmental Concerns.

## Membership Honors and Recognition

Four members of Committee D-18 have been granted Honorary Membership in the Society, 16 have won the coveted ASTM Award of Merit, 22 are Honorary Members of Committee D-18, 5 have received the Committee D-18 Outstanding Service Award, and 69 have received the Special Services Award of the Committee.

In 1983 A. I. Johnson received the Frank W. Reinhart Award for his work on terminology, and E. T. Selig received the Committee on Publications Award for Editorial Excellence for his work on the *Geotechnical Testing Journal*.

## APPENDIX I

### Officers and Executive Committee Members (1978-1986)

#### 1978

Chairman: A. I. Johnson  
First Vice Chairman: J. W. Guinnee  
Second Vice Chairman: E. T. Selig  
Secretary: R. G. Packard  
Membership Secretary: W. G. Shockley  
Past Chairman: E. B. Hall  
Members-at-large: B. B. Gordon, R. E. Gray, R. W. Lounsbury, A. Pelzner, N. O. Schmidt, M. R. Thompson

#### 1979

Chairman: A. I. Johnson  
First Vice Chairman: J. W. Guinnee  
Second Vice Chairman: E. T. Selig  
Secretary: R. G. Packard  
Membership Secretary: R. J. Stephenson  
Past Chairman: E. B. Hall  
Members-at-large: V. P. Drnevich, R. E. Gray, A. Pelzner, N. O. Schmidt, M. R. Thompson, D. A. Tiedemann

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## *1980-1981*

Chairman: A. I. Johnson  
First Vice Chairman: A. Pelzner  
(appointed to replace E. T. Selig)  
Second Vice Chairman: R. E. Gray  
Third Vice Chairman: W. G. Shockley  
(appointed Jan. 1981)  
Secretary: D. A. Tiedemann  
Membership Secretary: R. J. Stephenson  
Past Chairman: E. B. Hall  
Members-at-large: R. C. Deen, V. P. Drnevich, R. S. Ladd, R. G. Packard, N. O. Schmidt, M. R. Thompson

## *1982-1984*

Chairman: A. Pelzner  
First Vice Chairman: R. C. Deen  
Second Vice Chairman: R. E. Gray  
Third Vice Chairman: W. G. Shockley  
Secretary: D. A. Tiedemann  
Membership Secretary: R. J. Stephenson  
Past Chairman: A. I. Johnson  
Members-at-Large: V. P. Drnevich, F. M. Fuller, R. S. Ladd, R. G. Packard, C. O. Riggs, T. F. Zimmie

## *1984-1985*

Chairman: A. Pelzner  
First Vice Chairman: R. C. Deen  
Second Vice Chairman: R. E. Gray  
Third Vice Chairman: W. G. Shockley  
Fourth Vice Chairman: P. M. Jarrett (appointed June 1985)  
Fifth Vice Chairman: H. J. Pincus (appointed June 1985)  
Secretary: R. J. Stephenson  
Membership Secretary: R. S. Ladd  
Past Chairman: A. I. Johnson  
Members-at-Large: C. W. Lovell, C. H. McElroy, R. G. Packard, C. O. Riggs, M. L. Silver, J. R. Talbot

## *1986*

Chairman: W. G. Shockley  
First Vice Chairman: R. E. Gray  
Vice Chairmen: R. C. Deen  
P. M. Jarrett  
H. J. Pincus  
R. S. Ladd  
Secretary: R. J. Stephenson  
Membership Secretary: H. F. Hanson  
Past Chairman: A. Pelzner  
Members-at-large: R. T. Donaghe, T. S. Hawk, C. W. Lovell, C. H. McElroy, M. L. Silver (V. P. Drnevich appointed to replace Silver, Jan. 1986), J. R. Talbot

## APPENDIX II

### Committee D-18 Special Technical Publications (1978-1986)

- 670 Behavior of Deep Foundations (1979)
- 740 Laboratory Shear Strength of Soil (1981)
- 750 Acoustic Emissions in Geotechnical Engineering Practice (1981)
- 777 Geotechnical Properties, Behavior and Performance of Calcareous Soils (1982)
- 820 Testing of Peats and Organic Soils (1983)
- 835 Laterally Loaded Deep Foundations: Analysis and Performance (1984)
- 869 Measurement of Rock Properties at Elevated Pressures and Temperatures (1985)
- 874 Hydraulic Barriers in Soil and Rock (1985)
- 883 Testing of Marine Sediments: Laboratory and In-Situ Measurements (1985)
- 892 Consolidation of Soils: Testing and Evaluation (1986)
- 950 The Pressuremeter and Its Marine Applications (1986)

## APPENDIX III

### Papers Selected for the C. A. Hogentogler Award (1978-1986)

#### *1978*

L. P. Dunnigan and R. S. Decker—Development and Use of the Soil Conservation Service Dispersion Test

#### *1979*

V. P. Drnevich, B. O. Hardin, and D. J. Shippy—Modulus and Damping of Soils by the Resonant-Column Method

#### *1980*

M. I. Esrig and R. C. Kirby—Soil Capacity for Supporting Deep Foundation Members in Clay

#### *1981*

D. H. Shields and J. L. Briaud—A Special Pressure Meter and Pressure Meter Test for Pavement Evaluation and Design

#### *1982*

No award made

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1983

H. R. Hardy—Applications of Acoustic Emission Techniques to Rock and Rock Structures

1984

T. Berre—Triaxial Testing at the Norwegian Geotechnical Institute

1985

P. LaRochelle and A. O. Landva—Compressibility and Shear Characteristics of Radforth Peats

1986

W. Cox, B. Murphy, and D. A. Dixon—Lateral Load Tests on 25.4-mm (1-in.) Diameter Piles in Very Soft Clay in Side-by-Side and In-Line Groups

## APPENDIX IV

### Honors to D-18 Members (1978–1986)

#### ASTM Honorary Members

E. B. Hall (1981)

#### ASTM Award of Merit

W. G. Shockley (1979)  
N. W. McLeod (1980)  
A. I. Johnson (1982)  
J. W. Guinnee (1983)  
E. T. Selig (1984)

#### Committee D-18 Honorary Membership

W. G. Shockley (1978)  
B. B. Gordon (1979)  
R. W. Lounsbury (1980)  
P. C. Smith (1981)  
J. W. Guinnee (1983)  
A. I. Johnson (1984)  
W. A. Goodwin (1985)  
A. Pelzner (1986)

### D-18 Outstanding Service Award

E. T. Selig (1979)  
J. W. Guinnee (1980)  
W. G. Shockley (1981)  
R. H. Karol (1982)  
H. J. Pincus (1983)

### D-18 Special Service Awards

|                              |                          |
|------------------------------|--------------------------|
| M. L. Silver (1978)          | G. Rauman (1982)         |
| D. A. Tiedemann (1978, 1984) | K. L. Saucier (1983)     |
| J. W. Guinnee (1978)         | P. M. Jarrett (1984)     |
| E. J. Deklotz (1978)         | W. Wiesner (1984)        |
| R. Lundgren (1979)           | S. Richardson (1984)     |
| E. R. Podneiks (1979)        | R. C. Horz (1984)        |
| H. J. Pincus (1979)          | M. C. Anday (1984)       |
| R. C. Deen (1980)            | A. K. Howard (1985)      |
| F. M. Fuller (1980, 1984)    | B. R. Christopher (1985) |
| A. Pelzner (1980)            | L. Kaufman (1985)        |
| C. O. Riggs (1980)           | E. Winter (1985)         |
| T. F. Zimmie (1980)          | A. I. Johnson (1986)     |
| H. E. Davis (1981)           | R. K. Frobel (1986)      |
| R. G. Packard (1981, 1983)   | N. J. Cavalli (1986)     |
| J. H. Schmertmann (1981)     | C. B. Pettersson (1986)  |
| F. Steiger (1981)            | J. R. Talbot (1986)      |
| R. N. Yong (1981)            | R. C. Chaney (1986)      |
| F. C. Townsend (1981)        | R. J. Ebelhar (1986)     |
| K. S. Pearson (1981)         | C. W. Britzius (1986)    |
| K. R. Demars (1982)          | H. L. Von Quintus (1986) |
| V. P. Drnevich (1982)        | N. O. Schmidt (1986)     |
| R. E. Gray (1982)            |                          |

## Subcommittee Spotlight

This section is provided for information requests, announcement of new activities, new sections, task groups, or other items of interest. Items may be submitted to Carl Tockstein, D-18 News Editor, 3200 Walnoaks Rd., Knoxville, TN 37921.

### Symposium Complimented

The Symposium on the Pressuremeter and Its Marine Applications held 2–3 May 1986, at Texas A&M received good reviews at the Louisville D-18 Executive Subcommittee meeting. Organizers Jean-Louis Briaud and Jean M. Audiebert were commended for their fine effort. The symposium was co-sponsored by Subcommittee D18.13. STP 950 containing the symposium proceedings is available from ASTM.

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## Symposium Set for Cincinnati

Subcommittee D18.12 on Rock Mechanics will sponsor a one day symposium on Rock Classification for Geotechnical Purposes on 25 June 1987, during the D-18 Committee week in Cincinnati, OH. Louie Kirkaldie and Bill Lovell are coorganizers of the symposium.

## Future Meetings

18-21 Jan. 1987

Tampa, FL

with a symposium on In-Situ Vane Shear Applications in a Marine Environment

21-26 June 1987

Cincinnati, OH

with a symposium on Rock Classification (June 25)

22-24 July 1987

Case Western Reserve University

Cleveland, OH 44106

International Workshop on Constitutive Equations for Granular Noncohesive Soils

Contact: Prof. Adel S. Saada, Department of Civil Engineering, 216-368-2427

24-30 Jan 1988

Albuquerque, NM

26-30 June 1988

Baltimore, MD

22-27 Jan. 1989

Orlando, FL

with a symposium on Geotechnical Aspects of Ocean Waste Disposal (two day) sponsored by D18.13

25-29 June 1989

St. Louis, MO

## Awards

An awards luncheon commemorating D-18's 50th anniversary (1936-1986) was held during the June meeting in Louisville, KY. Several D-18 members were honored during the meeting.

Adrian Pelzner, former chairman of D18 received the Committee D-18 Honorary Member Award (Fig. 5).

Special Service Awards were presented to A. Ivan Johnson, Ronald Frobelt, Nicholas Cavalli, C. Bernt Pettersson, James Talbot, Ronald Chaney, Ronald Ebelhar, Charles Britzius, Harold Von Quintus and Norbert Schmidt (Fig. 6).



FIG. 5—Adrian Pelzner former chairman of D-18 (left) receives the Honorary Member Award from Woodland G. Shockley (right).



FIG. 6—Recipients of D-18 Special Service Awards. From left to right: James Talbot, Norbert Schmidt, Harold Von Quintus, Charles Britzius, Ronald Ebelhar, A. Ivan Johnson, and Nicholas Cavalli.

## Obituaries

During the period between the Jan. 1986 and June 1986 meetings D-18 received reports of the deaths of two of its members: Gabriel Fuentes, Jr. of Baymond, Puerto Rico, and James H. Lin, of Albany, CA.

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### **International Workshop on Constitutive Equations Set for the Summer of 1987**

ASTM members in the United States and Canada will be interested to learn about a workshop to be held at Case Western Reserve University (CWRU) 22-24 July 1987 on Constitutive Equations for Granular Non-Cohesive Soils. This workshop, which is organized in cooperation with the Institute of Mechanics of the University of Grenoble is a part of the first U.S.-France Cooperative Project in

Civil Engineering. A data base generated at Case from tests on hollow cylinders and in Grenoble from tests on cubes will be used to investigate the validity of present constitutive equations for sands. Distinguished researchers will discuss their theories and present their predictions to the international geotechnical community. It is expected that the data base will be made public and become a part of the data center created at CWRU. For information contact Prof. Adel S. Saada, Department of Civil Engineering, Case Western Reserve University, Cleveland, OH 44106 (216/368-2427).



# Geotechnical Testing Journal

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## SI Conversion Factors for Geotechnical Engineering

During the past several years, Subcommittee D18.93, through the initiative of Marshall Silver, has developed a table of factors for converting U.S. customary and metric units into SI units. The objective is to assist authors in converting their results into SI units and to promote uniformity in the use of SI units in geotechnical engineering. Additional information on the SI system can be obtained from ASTM Metric Practice Guide (E 380) and "SI Units in Geotechnical Engineering," by R. D. Holtz in the *Geotechnical Testing Journal*, Vol. 3, No. 2, June 1980, pp. 73-79. Comments from the profession are invited as letters either to the editor for publication in the journal or to Subcommittee D18.93 for its consideration.

*Ernest T. Selig*  
Technical Editor

| To Convert From   | To   | Multiply By |
|---|--|-------------|
| <b>Length</b>   |  |             |
| inches (in.)  | millimetres (mm)   | 25.4        |
| inches (in.)  | metres (m)   | 0.0254      |
| feet (ft)   | metres (m)   | 0.305       |
| miles (miles)   | kilometres (km)  | 1.61        |
| yards (yd)  | metres (m)   | 0.914       |
| <b>Area</b>   |  |             |
| square inches (in. <sup>2</sup> )                           | square centimetres (cm <sup>2</sup> )                                  | 6.45        |
| square feet (ft <sup>2</sup> )                              | square metres (m <sup>2</sup> )  | 0.0929      |
| square yards (yd <sup>2</sup> )                             | square metres (m <sup>2</sup> )  | 0.836       |
| acres (acre)  | square metres (m <sup>2</sup> )  | 4047        |
| square miles (miles <sup>2</sup> )                          | square kilometres (km <sup>2</sup> )                                   | 2.59        |
| <b>Volume</b>   |  |             |
| cubic inches (in. <sup>3</sup> )                            | cubic centimetres (cm <sup>3</sup> )                                   | 16.4        |
| cubic feet (ft <sup>3</sup> )                               | cubic metres (m <sup>3</sup> )   | 0.0283      |
| cubic yards (yd <sup>3</sup> )                              | cubic metres (m <sup>3</sup> )   | 0.765       |
| <b>Mass</b>   |  |             |
| pounds (lb)   | kilograms (kg)   | 0.454       |
| tons (ton)  | kilograms (kg)   | 907         |
| <b>Force</b>  |  |             |
| one pound force (lbf)                                       | newtons (N)  | 4.45        |
| one kilogram force (kgf)                                    | newtons (N)  | 9.81        |
| <b>Pressure or Stress</b>                                   |  |             |
| pounds per square foot (psf)                                | kilonewtons per square metre (kN/m <sup>2</sup> ) or kilopascals (kPa) | 0.0479      |
| pounds per square inch (psi)                                | kilonewtons per square metre (kN/m <sup>2</sup> ) or kilopascals (kPa) | 6.89        |
| kilogram force per square centimetre (kgf/cm <sup>2</sup> ) | kilonewtons per square metre (kN/m <sup>2</sup> ) or kilopascals (kPa) | 98.1        |
| <b>Liquid Measure</b>                                       |  |             |
| gallon (gal)  | cubic metres (m <sup>3</sup> )   | 0.0038      |
| acre-feet (acre-ft)   | cubic metres (m <sup>3</sup> )   | 1233        |
| <b>Quantity of Flow</b>                                     |  |             |
| gallons per minute (gal/min)                                | cubic metres per minute (m <sup>3</sup> /min)                          | 0.0038      |
| cubic feet per minute (ft <sup>3</sup> /min)                | cubic metres per minute (m <sup>3</sup> /min)                          | 0.0283      |
| <b>Mass Density</b>   |  |             |
| pounds per cubic foot (pcf)                                 | megagrams per cubic metre (Mg/m <sup>3</sup> )                         | 0.0160      |
| kilonewtons per cubic metre (kN/m <sup>3</sup> )            | megagrams per cubic metre (Mg/m <sup>3</sup> )                         | 0.102       |
| <b>Temperature</b>  |  |             |
| °F = 1.8 Temp °C + 32                                       |  |             |
| °C = (Temp °F - 32)/1.8                                     |  |             |



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# ASTM Committee D-18 on Soil and Rock

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The promotion of knowledge; stimulation of research; the development of specifications and methods for sampling and testing; and the development of nomenclature, definitions, and practices relating to the properties and behavior of soil, rock, and the fluids contained therein. Excluded are the uses of rock for building stone and for constituent materials in portland cement and bituminous paving and structures coming under the jurisdiction of other committees. Included are the properties and behavior of: (1) soil-like materials such as peats and related organic materials, (2) geotextiles, and (3) fluids occupying the pore spaces, fissures, and other voids in soil and rock insofar as such fluids may influence the properties, behavior, and uses of the soil and rock materials.

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