REPORT OF THE DEPARTMENT OF SOILS INVESTIGATIONS

C A HOGENTOGLER, *Chairman*

Progress made by the Department of Soils Investigations during the past year has been mainly in the establishment of projects, selection of personnel, and formulation of a working procedure

Included in the personnel of the Department and of the project committees are representatives of the fields of research, teaching, design and construction, and industry The scope of the department's work is indicated by the list of project committees on page 14, and the distribution of the membership is shown by the following list of organizations which they represent

Government Departments Bureau of Public Roads, Forest Service, Corps of Engineers U S Army, U S Navy, Bureau of Reclamation, National Park Service

Highway Departments California, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, Ohio, Pennsylvania, South Carolina, Texas, Wisconsin, District of Columbia, Onandago County, N Y

Universities and Colleges Illinois, Harvard, California Institute of Technology, Ohio, Michigan, Yale, Iowa State, Missouri, Columbia, Cornell, Dartmouth, Massachusetts Institute of Technology, George Washington

Cities Springfield, Massachusetts, Los Angeles, California

Industry International Salt Company, Solvay Process Company, Asphalt Institute, Koppers Products Company, Portland Cement Association, Calcium Chloride Association, Canadian Industries, Ltd , Moulding-Brownell Corporation, Bethlehem Steel Corporation, Great Lakes Steel Corporation, National Crushed Stone Association, National Slag Association, National Sand and Gravel Association

Foreign Lands Switzerland, Canada, Argentina, Germany, Austria

PROCEDURE

In the performance of its work the aim of the Department is threefold. (1) to compile information on what has been accomplished in the field of soil research, including both that which can be considered as established to an extent warranting its practical application and that on which further research is desirable, (2) to determine what new information is needed and to plan methods of attack whereby it may be acquired, and (3) to correlate the work of the Department with that of other technical organizations having committees on soils

The foregoing purposes are accomplished principally by receiving and reviewing reports of research on soils, which may originate in several ways as follows.

(1) The Director of the Board may request information on specific phases of the work, (2) the Director of the Board, members of the Department and members of the project committees may contribute at any time reports on any phase of soil investigational work which has been completed, is in progress, or should be performed, (3) projects may be assigned to project committees or to members of the Department by the Department, or by agreement between the project committees or members and the Department chairman; and (4) other organizations or branches of the industry may present reports for review by the Department at any time

A proposed procedure after the submission of such reports is as follows: Reports of groups 1, 2 and 3 should receive full consideration by the project committees interested in the phases of work covered by the report and should then be reviewed by the members of the Department When finally approved and submitted to the Director, such reports

should embody the best thought of the Department, with the responsibility shared equally by the members

Reports of group 4 should be reviewed as such for technical aspects and if approved by the Department and published, should be labeled in such a manner as to indicate that they are not reports sponsored by the Department but instead have the approval of the Department only as concerns the specific technical details presented in the report

Reports should first be turned over to Project Committee No 1 for review to determine whether or not the material is within the scope of the Department.

A statement of the functions of the different organizations interested in soils will be of assistance to this committee Briefly, they are:

1 *Highway Research Board, Department of Soils Investigations:*

In the performance of its work the Department has as a guide the general purpose of the Highway Research Board, which is "to provide a national clearing house for highway research activities and information" "In its practical workings the functions of the Board have been: to provide a forum for the discussion and publication of the results obtained by individual research workers; to organize committees of experts to plan and suggest research work and to study and correlate results, to publish and disseminate research information, to provide a research information service; and to carry on fact-finding investigations when special funds are available."

2 *American Society of Civil Engineers, Soil Mechanics and Foundations Division:* The scope of the activities of this organization, as stated in its constitution, is "confined to the study of soil mechanics and foundation engineering

"Soil mechanics shall include the adequacy of soil slopes, external loads on structures supporting soil and soil foundations of structures.

"Foundation engineering shall include, in addition to the soil mechanics features thereof, principles and methods of the design and construction of the foundations of structures"

3 *American Society for Testing Materials, Committee D-18 on Soils for Engineering Purposes·* According to its by-laws the functions of this committee are "to establish methods of sampling and methods of testing soils for engineering purposes, to consider the use of test results in specifications, to select acceptable nomenclature and definitions, and to promote research activity in the general field of properties and behavior of soils for engineering purposes"

4. *American Association of State Highway Officials, Committee on Materials: Division I, Subgrades, Foundations and Soil Bound Roads.* This organization is interested primarily in the formulation of specifications for soils and soil materials used as subgrades, road surfaces, base courses, and embankments, and in the standardization of methods of testing soils for highway purposes

5 *American Road Builders Association: Committee on Stabilized Road Construction and Committee on Roadway Drainage* These committees are interested primarily in the application of soils information to the design and construction of highways and drainage systems

6 *Society for the Promotion of Engineering Education Civil Engineering Division* The chief interest of this organization is the determination of what phases of soil work are definitely enough established to be presented to undergraduate students, at what point in their educational careers it should be given and how it should be taught

After the deliberations of the particular project committees have been completed, the reports should be distributed among the members of the Department for review with respect to questions such as. (1) If the subject has been covered in a report published previously by the Board, should the new report be pub-

lished as a substitute for, or a supplement to, the old report? (2) In either case does the report contain all the desired material representative of our present knowledge of the subject? (3) Are the facts which have been definitely established by research clearly distinguished from the items on which more information is desired? Question (2) involves consideration of (a) Pertinent information furnished by handbooks, textbooks, and reports by other organizations, the technical press and by scientists in other fields, (b) information furnished by the Proceedings of the Board and developed by the informal discussions at the annual meetings of the Department, and (c) information furnished by new research and experience in practice

Reports when finally approved by the Department (in revised form if deemed necessary) will be submitted to the Board

Other methods of equal importance for accomplishing the purposes of the Department include (1) presentation at the annual meeting of reports on the results of investigations conducted by individual members of the Department or others engaged in soil research and (2) open meetings of the Department for informal discussions in which all members and visitors in attendance are free to participate These methods, particularly the informal discussion, provide wide sources of information on what has been accomplished, progress that is being made, new problems for study, and methods whereby their solution may be attacked

The first of the open meetings of the Department was held on November 17, 1936 to provide an opportunity for frank discussion between three different groups of engineers, those interested in design and construction, those interested in teaching, and those interested in research. The purpose was to determine if the research carried on intensively for the past decade had been productive of results which could be readily applied in engineering work, therefore just as much effort was made to discover those phases of the work in which the practising engineer or teacher has not been assisted as those which he has found profitable

The stenographic record of the meeting, which contains unusually valuable material for those engaged in teaching, research, and construction is being prepared for distribution to the interested participants

The program of future work of the Department is suggested by the following outline which was used in the discussion.

A GENERAL TOPICS

1 *Scope of work and relation to other organizations*

a What kinds of information on soils are most needed by the practising engineer?

b Into what general groups can the various phases of soil work be arranged?

c If such arrangement is practical and desirable, in which particular groups of work is each national or international organization most interested?

2 *Terminology*

a For what phases of soil work is it desirable to standardize nomenclature and symbols?

b Which of the symbols defined in the list distributed to the members of the Department are generally acceptable?

3 *Exploring and sampling soil*

a To what extent are subgrade surveys used in road construction?

b To what detail should such surveys be made?

c What effort and personnel is involved in the making of subgrade surveys?

d What are the essential features of apparatus for use in obtaining cores of undisturbed soil?

e Is the use of vacuum or air pressure necessary?

f. What practical difficulties are likely to be encountered in sampling soils of different types?

4. *Testing and classifying disturbed soils*

a Which of the routine subgrade tests have been found most useful?

b In which of the tests have troubles due to experimental error been found?

c In what ways has the subgrade classification used by the Bureau of Public Roads been of value?

B SOIL MECHANICS

1 *Bearing value, compressibility and shear*

a What methods of test are utilized in practice?

b What procedures have been established for utilizing test data in design and construction?

c What has experience shown regarding agreement between estimates of settlements based on test data, and actual performances of buildings, bridges or embankments?

C SOIL STABILIZATION

1 *Physico-chemical phenomena*

a What methods of test have been proven suitable for determining the character and thickness of adsorbed films?

b What progress has been made in changing the surface characteristics of soil particles in order to increase the adhesion between the particles and binder materials?

c What is known regarding the permanency of such treatments?

2 *Design of soil mixtures*

a Do the present specifications based on grading, liquid limit and plasticity index satisfy the design requirements for stabilized soil road surfaces and base courses?

b. Is there a need for new or additional tests in the design of soil mixtures?

c Should the same designs be used for base courses and road surfaces? Is this true for all or only certain types of soil binders?

3 *Insoluble binders*

a What methods of tests are best suited to indicate the value of the water insoluble binders in soil stabilization?

b What is the procedure for determining the amount of the various binders required for satisfactory results?

c What are the particular construction features essential to securing good results?

d What has been the experience with each of the binders and methods?

4 *Deliquescent chemicals and electrolytes*

a What have laboratory tests shown regarding the increased moisture content of graded mixtures due to the use of deliquescent chemicals?

b How many experimental data have been produced to show the effect of this increase of moisture for facilitating the compaction of soil mixtures?

c Is there any evidence to indicate that the grading of mixtures should be varied because of the use of admixtures which change the physical properties of soil or film thicknesses on the soil particles?

5 *Drainage of highways*

a What are the relative effects of film moisture, capillary moisture and gravitational water for causing soils to lose stability in the absence of frost? For producing heave due to frost?

b What methods of test are suited for disclosing the drainage properties of soils?

c What has experience shown regarding the use of drainage for preventing loss of stability? Frost heave? Stopping landslides?

d In cases where drainage has failed to furnish benefit, what courses can be followed in order to determine whether the particular design of drainage used is faulty or if the soil cannot be drained?