Annual report of the Canadian Section of the International Society of Soil Mechanics and Foundation Engineering: June 1951-June 1952

Technical Memorandum (National Research Council of Canada. Associate Committee on Soil and Snow Mechanics); no. 26, 1952-12

NATIONAL RESEARCH COUNCIL OF CANADA

ASSOCIATE COMMITTEE ON SOIL AND SNOW MECHANICS

ANNUAL REPORT

of the

CANADIAN SECTION

of the

INTERNATIONAL SOCIETY OF SOIL MECHANICS

AND FOUNDATION ENGINEERING

(JUNE 1951 - JUNE 1952)

SOIL MECHANICS BULLETIN NO. 4

(Technical Memorandum No. 26)

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FOREWORD

This Annual Report covers the activities of most of the Canadian members of the International Society of Soil Mechanics and Foundation Engineering, for the period June 1951 to June 1952. Its primary purpose is to serve as an annual report of the Canadian Section of the Society, as required by statutes.

Its publication will serve another purpose, however, by keeping Canadians informed of those soil mechanics investigations which are being conducted in their own country. In this way, it will assist in overcoming the natural handicap offered by the widespread geographical distribution of soil mechanics work in this country. In this, it will supplement Annual Canadian Soil Mechanics Conferences, which have now been held for five years under the auspices of the Associate Committee on Soil and Snow Mechanics.

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SECTION I

THEORIES, HYPOTHESES, CONSIDERATIONS OF A GENERAL CHARACTER.

Prairie Farm Rehabilitation Administration,
Department of Agriculture of Canada,
Saskatoon.
(Members listed in Appendix)

General equations have been derived, by the theory of elasticity, for stresses and deformations of a conduit through an earth dam. Assumptions were that the dam was founded on an elastic foundation which was underlain by a rigid and rough boundary.

SECTION II

LABORATORY INVESTIGATIONS

Prairie Farm Rehabilitation Administration,
Department of Agriculture of Canada,
Saskatoon.

(Members listed in Appendix)

Proposed South Saskatchewan River Dam

The dam as proposed is an earth fill 210 feet high and containing approximately 35,000,000 cubic yards of fill. At river level the valley is approximately 2,000 feet wide and the soil is a sand, varying from a few feet in depth near the edges of the valley to nearly 100 feet in depth at the centre. This sand in the valley bottom and the thin overburden on the abutments are underlain by soft Bearpaw shale. The river sand and the shale are, therefore, the two major materials to be considered where the dam foundation is concerned.

The Bearpaw shale is of marine origin and is described as a clay shale, although many engineers would be more inclined to regard it as a stiff overconsolidated clay. It has been subjected to pressure by the weight of several thousand feet of sediment and ice in earlier times. The water content varies from 35 per cent at the surface, where it has softened, to about 20 per cent in the firm unweathered material. The corresponding range of wet density is 110 to 130 pounds per cubic foot. The Atterberg limits based on air drying are: liquid limit 110, plastic limit 20. The shale shows joints and slickensides.

Preliminary studies of this clay shale have revealed many unusual properties and special tests have had to be devised to evaluate these properties.

It soon became evident that the liquid limit test was very sensitive to the drying procedure. On one sample the liquid limit varied as follows depending on the method: air dried, 160; natural water content, 130; and oven dried, 100. This information, coupled with the fact that routine tests indicated variations, led to a research programme to determine the most practical procedure to be followed.

Consolidation and swelling tests indicated high swelling pressures. It was also evident from the test that the secondary time effect was very great in comparison with the primary. In view of this, special long-time consolidation tests are being carried out.

The shear strength of the shale, based on laboratory tests, appears to be considerably greater than the shear strength computed from actual slides although the assumptions on the depth

of the sliding surfaces may be in error. The shale tends to soften at the surface and the presence of several zones of consistency has been established, that is, soft, medium and hard from the surface downward. If the sliding planes occur mainly through the soft surface shales, a better correlation exists between laboratory strengths and strengths indicated by stability studies. Laboratory tests also give reduced strengths with increased time of loading when the samples are held at constant water content.

Long-time unconfined compression tests have been started to determine the relationship between the long-time and the quick unconfined compression strengths of Bearpaw shale. In these tests a fraction of the estimated quick unconfined compression failure load is applied and maintained until failure occurs.

Ripley and Associates,
Consulting Engineers,
Vancouver.

In connection with consulting engineering in the field of soil mechanics in British Columbia, subsoil investigations for buildings and damsites together with laboratory tests of soils have been carried out.

R. C. Thurber,
Department of Public Works,
Victoria.

Work in the field of soil mechanics has consisted of routine testing and some research of minor nature on test methods. A slide rule for computing hydrometer tests has been developed and its accuracy investigated.

Division of Building Research,
National Research Council,
Ottawa.

(Members listed in Appendix)

Varved Clays

There is little information concerning the engineering properties of varved clays, which are encountered in construction in many parts of Canada. An excellent exposure of varved soils has been uncovered with the development of Steep Rock Iron Mine in northwestern Ontario. With the full co-operation of the mining company, a study of these soils is being made. So far, work has been directed towards determining variations in the separate dark and light layers of soil to assess the effect of these variations on the properties of the entire soil mass. Grain size, plasticity and water content have been investigated to date.

Samples of varved soils have been obtained from other locations, and comparison tests between these samples and the samples from Steep Rock are being made.

(Reported by W.J. Eden)

Testing Laboratories,
Department of Public Works of Canada,
Ottawa.

(J.W. Lucas, J.D. Paterson)

Work has consisted of the routine testing of soil samples from sites in various parts of Canada, parallel with the acquisition of several pieces of equipment. The new equipment consists of a triaxial soil testing machine, and a four-unit consolidation device designed primarily to run tests on samples from 2-inch diameter thin-wall tubing.

SECTION III

FIELD INVESTIGATIONS

Civil Engineering Soils Laboratory,
University of Manitoba,
Winnipeg.
(Members listed in Appendix)

Soil testing has been carried out in connection with foundation investigations for various defence installations, hydro-electric power developments and flood control structures. Research work has included the construction of an experimental ground-supported floating slab for the Division of Building Research of the National Research Council as part of a study of this type of house foundation construction under various climatic conditions in Canada. Further work has been conducted on ground movement gauges for measuring seasonal changes in the shrinking and swelling of local clays. A special ground movement gauge suitable for using under highway pavements has been developed.

E.H. Bronson,
Consulting Engineer,
Toronto.

The supervision and evaluation of boring work for a gold mine in northern Quebec has successfully been completed and showed that a soil investigation has eliminated the necessity of buying some expensive land from an adjacent mine company for the erection of the mill.

N.D. Lea,
The Foundation Company of Canada,
Montreal.

Tests were made to compare the strength of clays as obtained by various methods. Samples taken with the Swedish steel foil sampler gave much higher strengths than those obtained by other procedures. In some cases the difference between the strength of the foil samples and thin-walled tube samples was noticeable even by visual inspection. On some of the sensitive clays in eastern Canada, however, strength tests on samples from the Swedish steel foil sampler give considerably lower results than strengths obtained in situ by vane tests.

The use and interpretation of vane tests has been studied, in particular a method in which the stress-strain curve is automatically recorded and in which there is control of the stress. A method of estimating the precompression load from the results of the vane tests has been found. This is discussed in a paper prepared for the Third International Conference on Soil Mechanics and Foundation Engineering.

An extensive study of the strength of a 40-foot deposit of varved clay has been made and the results of measurements of the performance of a steel sheet piling bulkhead have been compared with computations by different procedures. The results of this work have also been included in the above-mentioned paper.

J.A. Pihlainen,
Division of Building Research,
National Research Council,
Ottawa.

Observations on a field trip made in 1951 to the Northwest Territories were made to study permafrost conditions as interpreted from aerial photography. This project was sponsored by the U.S. Corps of Engineers and the Canadian Defence Research Board together with the Division of Building Research. During the following winter the field data was analysed and preliminary plans made for a permafrost Research Station in the Northwest Territories.

R. Quintal,
Construction Borings Limited,
Montreal.

Activities of this member, when employed by the City of Montreal, included the preparation of boring specifications and the supervision of boring work; then, when employed by the Montreal Transportation Commission, soil exploration work for a proposed subway; and, when employed by Construction Borings Limited, the supervision of boring work and the analysis of results in the light of proposed designs and laboratory test results.

G. Rankin,
Dept. of Resources and Development,
Ottawa.

Work consisted of analysing boring data in connection with the construction of a bath house at Radium Hot Springs in the Kootenay National Park and two walk-in freezers in the Northwest Territories, where permafrost occurs.

Prairie Farm Rehabilitation Administration,
Department of Agriculture of Canada,
Saskatoon.
(Members listed in Appendix)

A programme was initiated to observe several structures built on Bearpaw shale, mainly dam spillways. A permanent benchmark was established adjacent to each structure and observation points placed in retaining walls and slabs, in order to observe any changes due to swelling or compression of the shale caused by changes in load or by frost action and wetting and drying.

Proposed South Saskatchewan River Dam

In view of the doubtful value of laboratory shear tests in assessing stability problems, it has been decided to study natural slopes, particularly those where movement has occurred. Based on experience to date, a study of aerial photographs is the best method of locating the boundaries of active slide area. In addition, it is necessary to locate the slide surface and to study the material both above and below the slide surface. This has been done by means of bore holes, deep test pits and a test drift. Surprisingly, it is often extremely difficult to locate the surface of movement, particularly in material such as this which is jointed and slickensided. A careful study of water content profiles with determinations at intervals of 3 to 6 inches appears to be useful in locating the slide surface. In an area where no sliding has occurred, the water content generally decreases uniformly with depth below the weathered zone. Where sliding has occurred there is generally a very abrupt reduction in the water content profile below the sliding surface. This would seem to indicate that the material immediately above the slide surface has been reworked resulting in an increased water content. In addition to the water content profile, the consistency index has also been found to be useful for this purpose.

Test pits up to 160-feet deep have been utilized in connection with studies of the shale for purposes of examining the material in place and obtaining large undisturbed samples for testing. It has been found that safety precautions are extremely important when working to this great depth.

Pressure Test Section

The Proceedings of the Fourth Canadian Soil Mechanics Conference (1950) contain a brief description of the test drift in the shale at this damsite and mention is made of a pressure section to measure the vertical and horizontal force exerted on a continuous lining by the shale. The details of the pressure test section and the test drift are contained in P.F.R.A. report entitled "Geological Test Drift, Damsite No. 10" December, 1951. The following covers a brief description of the pressure test section along with the readings which have been recorded to date.

The pressure test section is located at the end of the drift and consists of a 20-foot length lined with precast concrete slabs. The slabs are 2 feet-wide, approximately 6 feet-long and 8-inches thick. The horizontal and vertical slabs are staggered so that the joint between two horizontal slabs falls at the centre of a vertical slab. Each pair of opposite slabs is held in place by pipe struts provided with a screw jack. A pair of horizontal struts is used to hold two opposite vertical slabs and a pair of vertical struts to hold two opposite horizontal slabs. The excavation and the placing of the slabs were carried on continuously and it was therefore possible to make the entire installation in a period of ten days. Dry

packed grout was used to backfill the irregular space between the back of the slabs and the mined surface of the shale. When the installation was completed a predetermined pressure was applied through the screw jacks onto the slabs. Initially a load approximately equal to 130 per cent of the overburden stress (overburden above drift, 64 feet) was applied to both the horizontal and vertical slabs. The screw jacks were left unchanged and load readings taken periodically. The load tended to drop off on both the vertical and horizontal slabs for a period of about three months and then began to increase very slightly. The present load on the vertical struts is approximately equal to overburden and the present load on the horizontal struts is approximately equal to the initial applied load. It would therefore appear as was originally suspected, that the horizontal stress in this heavily preconsolidated shale is greater than the vertical and that such a stress distribution might be expected upon a tunnel lining.

The load in each strut is determined by means of strain measurements utilizing a 20-inch Berry strain gauge. Initially all 40 struts were calibrated in the laboratory and stress-strain curves determined. However, during the course of the readings it has become evident that there are some errors in this system, believed at present to be less than 10 per cent. In the near future, however, it is proposed to recheck the calibration of each strut by temporarily reducing the load to zero. It will then be possible to appraise the accuracy of the method being used.

Undisturbed Sand Samples

Undisturbed samples of the sand of the valley bottom were required to determine density and observe stratification. However, this was extremely difficult because the material is below the water table. The U.S. Waterways Experiment Station method for recovering undisturbed sand samples below the water table, described in Bulletin No. 35 of the Station, was used and found satisfactory. It involves drilling a 5-inch diameter hole using rotary equipment and a heavy drilling mud to prevent caving of the hole. The samples are recovered using a 3-inch Shelby tube piston sampler. It has been found that the drilling mud penetrates only a very short distance into the sand.

St. Mary Dam

The St. Mary Dam has now been completed and during the past year the reservoir has been almost full for a short period. Some seepage has occurred through bedrock in the abutments and a grouting programme to cut this off is nearly completed.

The test apparatus which was installed in this dam has provided very interesting data. From the soil mechanics point of view, the impervious central section of the dam, which was constructed of glacial clay having a liquid limit of 35 and a plasticity index of 14, is by far the most interesting. This material was placed in 6-inch lifts and compacted by 12 passes

of a sheepsfoot roller exerting unit pressures of about 500 pounds per square inch. A deliberate attempt was made to compact the material slightly on the dry side of the optimum moisture content for field compaction and several per cent below the Proctor optimum in order to avoid the danger of future high pore water pressures. Standard Proctor tests indicated an optimum moisture content of 15 per cent at a dry density of 114 pounds per cubic foot. The average dry density as placed was about 110 pounds per cubic foot at a water content of 12 to 14 per cent.

The Bureau of Reclamation type settlement gauges have revealed that the total compression within the impervious section with a height of 200 feet is now of the order of 8 feet and consolidation is still going on at a reduced rate. However, in spite of this relatively high settlement there has been no indication of excessive pore pressure, which is attributable to the fact that the water content during compaction was kept as low as possible without causing serious reduction in density as placed. It is calculated that the density in the lower layers of the fill has now increased to 120 pounds per cubic foot.

Publications:

1. Studies of Some Low Earth Dam Failures - R. Peterson and N. L. Iverson.

2. Steel Sheet Piling Studies - J. L. Jaspar and A. S. Ringheim

(Both papers were prepared for presentation at the Third International Conference on Soil Mechanics and Foundation Engineering, 1953.)

3. Studies of Bearpaw Shale at a Damsite in Saskatchewan - R. Peterson

(This paper was presented at the American Society of Civil Engineers' Convention, September 1952.)

4. Report on the Geological Test Drift - Soil Mechanics and Materials Division, P.F.R.A., December 1951.

Ripley and Associates,
Consulting Engineers,
Vancouver.

Electrical resistivity equipment has been used for the exploration of subsoil conditions. Earth and asphalt construction work for embankments, airports and dams has been supervised.

Division of Building Research,
National Research Council,
Ottawa.

(Members listed in Appendix)

Soil Temperatures

The analysis of results in this study was brought up-to-date during the year for the presentation of a paper "Soil Temperatures in Water Works Practice" to the Canadian Section of the American Water Works Association. This paper presented data accumulated from a joint study of the problem by the City of Ottawa and the Division of Building Research of the National Research Council. Measurement of soil temperatures in sand and clay test pits is continuing.

The value of empirical studies of the relation between air temperatures and frost penetration has become apparent. For this reason the project is being extended to include frost penetration observations at locations across Canada. Questionnaires were sent out in order to find suitable organizations which would contribute data for the general study. It is expected that two or three years will be required for the accumulation of data for the publication of a general analysis.

(Reported by C.B. Crawford)

Soil Temperatures in Water Works Practice - R.F. Legget
C.B. Crawford
(Journal, American Water Works Association, Vol. 44, No. 10, October 1952.)

Research on Toronto Subway Construction

Research on this project was continued and partly completed with the return of the staff member to the Division in Ottawa. A report on the strain measurements on the temporary road deck is being prepared. The recording of the soil profile along the subway excavations has been largely completed and will be prepared for publication both from an engineering and geological point of view. In addition to the glacial tills which were mainly uncovered at first, a variety of inter-glacial and post-glacial deposits, including many varved clays and sands, were later encountered. Some special soil problems in connection with construction work were also dealt with.

(Reported by W.R. Schriever)

SECTION IV

Stability and Deformations of Earth Construction

D.F. Coates,
McGill University,
Montreal.

Assistance has been given in the design of several earth dams, among others of a dam on the Tobique River of about 200,000 cubic yards. The section of the dam is homogeneous, of glacial till, with gravel blankets and riprap over the gravel on the upstream side.

P.B. Lawrence,
Milton Hersey Company Limited,
Montreal.

Work has included evaluating the suitability of soils for highway construction in connection with the Trans-Canada Highway in Newfoundland, the examination of building sites in the Montreal area and the redesign of foundations, and the analysis of a slope stability problem of a recently filled building site in Montreal. A paper dealing with the relation between mineralogical content of soils and their engineering properties is in preparation.

R.C. Thurber,
Department of Public Works,
Victoria.

Two landslides were investigated and corrective measures recommended.

SECTION V

Earth Pressure; Stability and Displacements of Retaining Constructions

N.D. Lea,
Foundation Company of Canada,
Montreal.

The stability of a steel sheet piling bulkhead in varved clay has been investigated and measurements of the performance compared with computations by different methods. The results of this work are presented in a paper to the Third International Conference on Soil Mechanics.

SECTION VI

Foundation Pressure and Settlements of Buildings on Footings and Rafts

Division of Building Research,
National Research Council,
Ottawa.
(Members listed in Appendix)

Study of "Floating" Concrete Slabs on Ground

Basementless houses on concrete slabs laid on the surface of the ground have come into use recently in many localities in Canada in an attempt to economize in house construction, but as yet no rational design for such slabs has evolved. An experimental field installation has therefore been made for the prime purpose of finding a slab design suitable for construction on clays which are subject to volume change. Two full-scale unreinforced concrete slabs were built, one on an 18-inch gravel mat and one directly on ground, both being provided with a superstructure which was heated in cold weather.

Continuing records are being kept of ground moisture (by direct sampling), ground temperature, and vertical movement at various depths. In addition, vertical movement of the slabs, ground water elevation, and supply of available soil moisture (Thornthwaite system) are being recorded.

No structural damage to the concrete slabs is apparent so far. The effect of heat from the radiant heating system of the slabs on soil temperatures and moisture is being studied.

(Reported by F.L. Peckover)

Study of Building Settlements

In addition to buildings which have been under observation, a new structure has been added to this study: the National Museum of Canada, which has had considerable differential settlement since it was built in 1910.

Borings have been made and testing is under way. The purpose of this particular study is to compare predicted settlement and bearing capacity, as determined by engineering soil tests, with actual performance of the building foundation.

A paper is being prepared for submission to the Third International Conference on Soil Mechanics and Foundation Engineering.

(Reported by C.B. Crawford)

A New Water Tube Level for Measuring the Settlement of Buildings
- F.L. Peckover
(Technical Report No. 11 of the Division of Building Research, DBR No. 28, February 1952)

The Hydro-Electric Power Commission of Ontario, Toronto.
(Members listed in Appendix)

The foundation of a seven-storey structure in the Toronto area, now under construction, and founded on a combination pile and mat foundation in a soft to medium glacial till was studied. Although this soil is relatively insensitive, the somewhat novel foundation design was required to minimize settlement and thereby keep the stonework of the structure in line with that of an adjacent building. In order to verify computations and predictions regarding the behaviour of the supporting soil, it was decided to instrument the structure and observe movements and load distributions as the building was erected. The instrumentation included measurements of foundation swelling as the excavation was made, of recompression and consolidation as the building load was applied, of the loads taken by the piles and transmitted by the slab to the soil, and measurements of loads in sheet piling used to support portions of the excavation.

Measurements of the elevations of deep bench marks spotted at several locations over the site indicated a subsoil swell of from 1 to 3 inches during the period of 2 months before the foundation mat was poured. A record of recompression and settlement will be obtained using a permanent installation of copper water pipes. An electrical hook-up to this system will be made so that all recordings of differential movement can be obtained at one central station. Measurements of pressures between the foundation mat and the soil are being obtained with Carlson pressure cells. Pile dynamometers, a development of the Research Division to overcome zero drift in strain gauges, have been installed on the piles.

Frost Heaving of Small Footings.

Another investigation of interest is a field study of methods for minimizing footing heave. Heaving of small footings, founded well below the frost line, causes considerable inconvenience to the Commission during the winter and early spring months. Last winter an installation of 24 footing models, 8-inches square, was installed in a very frost susceptible soil. These footings were treated with low temperature grease, insulated against frost, backfilled with gravel and with lignosol-saturated ground. Although results were not too conclusive, measurements of footing movement suggest that the use of grease has some merit. This year the installation has been expanded and modified to determine what footing load is required to resist heaving. Footings wrapped in ice-resistant polyethlyne, coated with grease, backfilled with gravel and receiving no treatment whatsoever have been subjected to footing loads from 200 pounds to well over 3,000 pounds. Measurements of footing movement this winter should indicate what measures are required to control footing heave.

SECTION VIII

Problems of Road and Runway Construction

Ontario Department of Highways,
Toronto.
John Walter

A statistical analysis has recently been completed to determine whether a relationship exists between subgrade bearing capacity, base course bearing capacity, and base course thickness, which might be used as a design basis. It was found that the design formulae and curves could be developed using data on all locations where base course thickness ranged from 5 to 20 inches. These formulae gave 95 per cent correlation with an accuracy of plus or minus 3 inches in base course thickness. The plus or minus 3-inch probable error is due to the difference in quality and degree of compaction of the various base courses.

A further season of tests for seasonal variation of bearing capacity is being carried out to check present data and to determine whether there is a progressive gain or loss of the bearing strengths in autumn after recovery from spring loss.

The laboratory study of frost heaving is continuing. Indications to date are that surcharge weight has a definite restraining effect on heaving. Since the surcharge weights used are not very great, they will not withstand the forces exerted by growing ice crystals. Therefore, it is thought that the effect of surcharge weights must be active in diminishing the flow of water to the freezing zone from the free water supply in the laboratory test or the ground-water table in the field. If the results found in the laboratory test are borne out in the field, it should prove feasible to replace susceptible soils to a part of the depth of frost penetration only.

J.E. Hurtubise,
Ecole Polytechnique,
Montreal.

Research work on the use of sulphite liquor to stabilize gravel and prevent frost heaving in soils of high capillarity has been continued. Preliminary results indicate that a marked increase in density is obtained in gravel treated with sulphite liquor and that heaving is controlled by injection of the liquor in silty soils.

P.B. Lawrence,
Milton Hersey Company Limited,
Montreal.

The suitability of soils for sub-base, base and surface material in highway construction has been analysed with particular emphasis on frost heaving characteristics. This work was in connection with the Trans-Canada Highway in Newfoundland.

O. Marantz,
Department of Transport,
Winnipeg.

Work for the Department of Transport consisted in participation in a programme of soil testing for the Winnipeg Airport and in soil surveying and the design of stabilized base course.

N. W. McLeod,
Asphalt Technology Division,
Imperial Oil Limited,
Toronto.

Publications:

1. A Discussion of the Paper by J.F. McLaughlin and W.H. Goetz on "Comparison of Unconfined and Marshall Test Results", Proceedings, The Association of Asphalt Paving Technologists, Vol. 21, 1952.

   (By means of a diagram, this discussion demonstrates that due to the dimensions of the Marshall test specimen, the normal plane of failure tends to pass through the cylindrical surface in contact with the testing jaws. Consequently, the friction between the testing jaws and the specimen acts in such manner that it is equivalent to the application of a lateral support to the specimen. This seems to explain why a relationship appears to exist between Marshall stability values and triaxial values at a small lateral pressure. The discussion indicates that even on the basis of this relationship, the Marshall test could still reject bituminous paving mixtures as being unstable although they would actually develop adequate stability in the field, and it could also permit the selection of mixtures as being stable that would be unstable in the field.)

2. "Tire Design, Pavement Design, and Vehicle Mobility", Proceedings, Highway Research Board, Volume 31, 1952.

   (This paper, which indicates that a close interrelationship appears to exist between pavement design, tire design, vehicle mobility, and soil compaction, is based upon generally accepted principles of soil mechanics, and with respect to bituminous pavement design at least, it provides conclusions that are in agreement with the observed field performance of bituminous pavements.)

3. "A Rational Design of Bituminous Paving Mixtures with Curved Mohr Envelopes", Proceedings, The Association of Asphalt Paving Technologists, Volume 21, 1952.

   (While triaxial data for a great many bituminous paving mixtures can be best represented by straight line Mohr envelopes, it appears that there are certain bituminous mixtures for which curved Mohr envelopes are obtained when the triaxial data are plotted. It is the principal objective of the paper to describe a rational method for determining the stability that the latter mixtures are likely to develop under traffic in the field.)

L.H. McManus,
Alberta Department of Highways,
Edmonton.

Work has consisted of routine testing for field control of compaction on grading base courses and asphalt surface construction.

R.C. Thurber,
Department of Public Works,
Victoria.

Soil surveys prior to construction of important highways were made and frost heaving of highways has been investigated.

SECTION X

Ground Water Problems

Prairie Farm Rehabilitation Administration,
Department of Agriculture of Canada,
Saskatoon.

(Members listed in Appendix)

Steel Sheet Piling Test

In design studies for the South Saskatchewan River Dam, methods of seepage control that were considered included steel sheet piling, an up-steam blanket, and a positive trench-type cut-off to shale. The studies revealed that the positive trench-type cut-off was very costly, difficult to construct and probably unnecessary. The choice, therefore, had to be made between steel sheet piling and an up-stream blanket, or both.

In order to obtain more information on the effectiveness of steel sheet piling in controlling seepage, a series of tests was conducted using various sections of sheet piling and typical river sand. The flow of water through the sheet piling interlocks was measured along with the corresponding drop in pressure for various rates of flow. From these test results the reduction in flow due to the sheet pile wall has been predicted. The details of these tests are contained in a P.F.R.A. report entitled "Steel Sheet Piling Studies", December 1951. On the basis of the studies it was concluded that unless rusting, corrosion, and air-locking occurred in the piling beneath the dam, that a relatively short length of blanket was as effective and much more economical than steel sheet piling.

The present proposal is to use a blanket about 1,200 feet in length, which according to calculations will reduce the seepage to the order of 18 cubic feet per second. It is felt that natural silting in the reservoir will, within a short space of time, reduce the seepage to a small fraction of the flow experienced when the dam is initially constructed. It is also proposed to use drainage wells to provide relief at the down-stream toe of the dam.

Canal and Dug-out Lining Programme

The P.F.R.A. is carrying out an extensive experimental programme on canal and dug-out lining methods. The First Progress Report covering this investigation was prepared in March 1951. Since this Progress Report was prepared, experimental installations of several other types of lining have been tried. These involved bentonitic material sluiced into water, prefabricated asphalt membrane, and catalytically blown asphalt sprayed on to a prepared aggregate base. Based on the studies to date it would appear that where suitable materials are available locally, a compacted clay lining about 12-inches thick and covered with about 12 inches of granular material is the most economical.

SECTION XII

Subjects of a General Character

"Special Foundation Problems in Canada", - R.F. Legget. Proceedings, Building Research Congress, London, 1951, Division I, Part III, p. 165. Reprinted in Technical Memorandum No. 25 of the Associate Committee on Soil and Snow Mechanics of the National Research Council of Canada, Ottawa 1952.

(This paper deals with the foundation problems which are peculiar to Canada, i.e. those which depend on her peculiar geology and climate. The geology of Canada is presented in broad strokes, special attention being paid to glacial clays and silts including "varved clays", glacial tills and muskeg. The climate of Canada is then described, leading to a discussion of foundation conditions found in the great northern areas of Canada where permafrost is present. The problem of frost penetration is of considerable economic importance in Canada. A chapter on future research completes this paper.)

Members of the International Society of Soil Mechanics and Foundation Engineering belonging to organizations as noted in text

Prairie Farm Rehabilitation Administration,
Department of Agriculture of Canada,
Saskatoon.

R. Peterson
L. G. Chan
T. E. Goodwin
N. L. Iverson
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