Materials and Research Division

February 28, 1962

Mr. Leon J. Marshall, P. Eng.,
Chief Bridge Engineer,
De Leuw, Cather & Company
of Canada, Limited,
Consulting Engineers,
226 Sparks Street,
Ottawa 4, Ontario.

Dear Mr. Marshall:-

Re: Proposed Queensway Retaining Walls
W.P. 944-59 & 945-59 - District #9

Thank you for your letter of February 21st, 1962, your Ref. 2384-Q-3a, on the above-mentioned subject. The fact that three parties, your Organization, H. Q. Golder & Associates, and the D.H.O. were involved on a problem and tried to give their interpretation without first clarifying whether they were, in fact, talking about the same problem, caused some misunderstanding which is, we believe, now being resolved.

In this letter, we will attempt first, to explain, in short, our general interpretation of the earth pressure problem, and then apply this to the concrete problem of the Queensway retaining wall. In the latter, we seem to agree with your views as expressed in your letter of February 2nd, 1962. Other questions and problems dealt with in your letter of February 21st, are discussed in the latter part of our letter.

If a wall is designed and built in such a way that it is rigid and fixed at the bottom and top - i.e., it cannot move or yield, then the earth pressure acting on that wall will be the earth pressure at rest, a pressure greater than the active and smaller than the passive earth pressure. If a wall is not designed to take this pressure and the boundary deformation conditions are as described above, serious damage may result.

cont'd. /2 ...

Mr. Leon J. Marshall,
Chief Bridge Engineer

February 28, 1962

If, on the other hand, a wall can yield or move laterally or can tip, the pressure on the wall will start to decrease and will reach its lowest value, the active earth pressure, when the wall movement was sufficient to satisfy the conditions for plastic equilibrium of the soil. This wall movement is generally very small, and it amounts to a maximum of 1 p.c. of the wall height, while in some cases, it is as low as 0.1 p.c.

We would agree with you that a wall whose base is dowelled into bedrock, can yield laterally because of the flexibility of the stem of the wall and that this movement could be sufficient to fulfill the conditions for plastic equilibrium and, consequently, the active earth pressure would act on the wall. A coefficient of active earth pressure of 0.3 or 0.29 seems to be a reasonable and practical value for the design.

The above statement is somewhat in contradiction with our statement under (1) in our letter of February 8, 1962, but this is because an unyielding wall was what we had in mind at that time.

A point on which, it seems, we could not agree with you, would be the earth pressure at rest. We would not consider Ko = 0.5 as a theoretical maximum but, rather, as only a value of the coefficient of earth pressure at rest. Considerably larger values have been either indicated or established, both in the laboratory and in the field (Terzaghi - 1925, Langer - 1936, Kjellman - 1936, Smith and Redlinger - 1953, Bishop - 1958, and especially, Skempton - 1961).

I may add that I have personally carried out a number of lab tests on undisturbed clay samples where Ko values greater than 0.5 were recorded. These tests are reported by Dr. A. W. Bishop in 1958.

Since we believe that the coefficients of earth pressure at rest will not be used in your design, we feel that a further discussion on this matter is not necessary. However, if you feel otherwise, we would be very pleased to hear your views and pursue this subject further.

As far as the use of the unit weight of 125 p.c.f. is concerned, we feel that your statement in the letter of February 21st, explains everything.

cont'd. /3 ...

Mr. Leon J. Marshall,
Chief Bridge Engineer

February 28, 1962

The load of 60 tons per a 12 BP 53 pile was suggested by our Section on the basis of a number of pile loading tests which have confirmed this figure as a realistic and practical value. However, the tentative specifications have not yet been changed because such a change is not as simple as it may appear. We would suggest that the pile tips be reinforced and a load of 60 T/pile be used. Bruce Davis is of the same opinion

Attached, I am forwarding the copies of the D.H.O. Standards DD 1218 and DD 1219 which, incidentally, are the same as Drawings BD16-3 and BD16-4.

Yours very truly,

A G Stermac

A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF
Attach. (2)

cc: Messrs. F. I. Hewson
B. Davis

Foundations Office ✓
Gen. Files

DE LEUW, CATHER & COMPANY
OF CANADA LIMITED
CONSULTING ENGINEERS

TORONTO OTTAWA

226 SPARKS STREET
OTTAWA 4, ONTARIO
CENTRAL 3-4075

Our Ref. 2384-Q-3a

February 21st, 1962

Mr. A. G. Stermac,
Principal Foundation Engineer,
Department of Highways of Ontario,
Parliament Buildings,
Toronto 5, Ontario.

Dear Mr. Stermac:

Re: Proposed Queensway Retaining Walls
W.P. 944-59 & 945-59 - District #9

In reply to your letter of February 8th, I believe there is some confusion on the question of retaining wall pressures which I would like to amplify as we understand it.

The coefficient of $K_o = 0.5$ is a theoretical maximum, assuming absolutely no movement of the wall face. When dowelled into rock there would certainly be no rotation of the footing and deflection of the stem would be relatively small. However, this maximum value drops off fairly rapidly in a parabolic form with very little movement until it reduces to the active coefficient of $K_a = 0.3$ for the general conditions applicable to most walls not dowelled into rock.

It is usual for ultimate values to be used in soil mechanics taking into account all possibilities such that a realistic factor of safety of say 1.5 can be used. However, for structural purposes at the present time, ultimate design analysis is rarely used and values are adjusted to suit practical elastic design methods.

For example the maximum tensile value in reinforcing steel is 20,000 psi, whereas the minimum yield stress for intermediate grade is 40,000 psi or for hard grade is 50,000 psi giving a factor of safety of at least 2. The concrete used has a minimum 28 day crushing value of 3000 psi and although the permissible design value in bending would be 1200 psi, we have only been using a value of 750 psi and N = 10 to provide a wall thickness suitable for easy placement of concrete. This also has the advantage of reducing the required amount of reinforcement.

Generally then the wall is designed at conservative stresses and on most soils the criteria is overturning stability (in which case there would be sufficient movement to reduce $K_o = 0.5$ to $K_a = 0.3$) and also the coefficient of friction against sliding. Where founded on rock, toe pressure is not a problem and resistance to sliding can be achieved by keying or dowelling. I would expect a coefficient of about 0.4 would be practical with a slight movement of the stem reducing the factor of safety of the steel from a minimum of 2 to 1.5. Even if the full 0.5 is developed, the factor of safety would still be 1.2 against yield point, not ultimate tensile strength. In all these calculations, the passive pressure in front of the wall is ignored in case of removal for a sewer etc. which could be more serious for sliding than stem failure.

For the past five years the walls on the Queensway have been designed on a value of $K_a = 0.29$ and a unit weight of 125 p.c.f. and standard charts prepared accordingly. The value of 125 p.c.f. has been based on practical field density tests and it has only been on the immediate subgrades to the pavement that the value of 135 has been recorded. Naturally the walls are backfilled with granular material and provided with a perforated drain and weep holes.

For practical design purposes on projects of this size, it was not considered economically justified to use the maximum theoretical coefficients unless we are permitted to reduce our design factors of safety. I would agree that the higher values are more likely to occur for walls dowelled into rock and it would be reasonable to increase the reinforcement in such walls to maintain a higher factor of safety. However, as this is more of a policy decision to be made by the Bridge Division of D.H.O., I would appreciate it if the subject could be discussed with Bruce Davis or Ted Hewson to determine a common procedure among all designers.

With reference to the recommended design load in the Soils report of 45 tons on a 12 BP53, this is based on the maximum A.A.S.H.O. value of 6000 psi on the tip which gives 46.74 tons. However, the tentative standard 4.5.1.1 of the Bridge Division does allow 50 tons.

Your suggested value of 60 tons would give a tip pressure of 7,700 psi which is still less than the 9000 psi permitted by the City of New York Code. This again is a policy matter and to date we have been following the above tentative standard for direct load. However, we do allow for an increase to at least 9,000 psi for direct plus bending stresses at the top of the pile.

Incidently, we would appreciate copies of D.H.O. Standards DD1218 and DD1219. We assume these are similar to D.H.O. drawings Nos. BD16-3 and BD16-4.

Yours very truly,
DE LEUW, CATHER & CO. OF CANADA LIMITED

Léon J. Marshall.

Léon J. Marshall, P. Eng.,
Chief Bridge Engineer

LJM:rm

Materials and Research Division

February 8, 1962.

De Leuw, Cather & Co. of Canada, Ltd.,
Consulting Engineers,
226 Sparks Street,
Ottawa 4, Ontario.

Att'n: Mr. L. J. Marshall,
Chief Bridge Engineer.

Re: Proposed Queensway Retaining Walls,
Station 366+00 to Station 384+00,
District #9 - W.P. 944-59 & 945-59.

Dear Sir:-

This is to acknowledge receipt of your letter addressed to Mr. F. I. Hewson, Consultant Liaison Engineer of the Department of Highways, in connection with the Foundation Reports by H. Q. Golder and Associates, for the above-mentioned proposed structure.

We would like to make certain comments regarding the recommendations contained in these reports:-

1. Earth Pressures:

We have recently discussed this matter with the consultants and were informed that they intend a value of $K_o = 0.5$ to be used only for retaining walls founded directly on the bedrock and dowelled in, whereas in other cases, a value of $K_a = 0.3$ should be used. We agreed with the consultants on this matter.

2. Bulk Density:

We note that you have used a value of 125 p.c.f. for the unit weight of backfill material. The consultant has recommended a value of 135 p.c.f. Would you please let us know the reasons for this change.

cont'd. /2 ...

De Leuw, Cather & Co. of Canada, Ltd.
Att'n: Mr. L. J. Marshall

February 8, 1962.

3. Piled Foundation:

We are of the opinio that the design load of 45 tons as recommended by the consultant, is low for a 12 BP 53 steel "H" pile driven to bedrock or practical refusal. We suggest a design load of 60 tons per pile be used. It should be specified that the piles be driven to refusal on the bedrock or practical refusal in the till stratum. In the latter, pile driving should be controlled by means of the Hiley Formula and in accordance with D.H.O. Standards DD 1218 and DD 1219.

We believe that the above covers all the items we have to comment upon. However, should there be any additional matters you would like to discuss with us, please do not hesitate to contact our Office.

MD/McdeF

Yours very truly,

A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.
Per:

M. Devata

M. Devata,
SR. PROJECT FOUNDATION ENGR.

cc: Mr. F. I. Hewson
H. Q. Golder & Assoc.

Foundations Office
Gen. Files.

Murty: please file this with our memo in the proper file Feb 12.1962

DE LEUW, CATHER & COMPANY
OF CANADA LIMITED
CONSULTING ENGINEERS
TORONTO OTTAWA

226 SPARKS STREET
OTTAWA 4, ONTARIO
CENTRAL 3-4075

Our Ref. 2295-Q-3b
February 2nd, 1962

A G Stermac

Mr. ~~F. L. Hewson~~,
~~Consultant~~ Liaison Engineer,
Department of Highways of Ontario,
Parliament Buildings,
Toronto, Ontario.

Dear Mr. Hewson:

Re: Br. #18 at Bronson - W.P. 944-59
Br. #19 at Percy - W.P. 945-59
Site Investigation - Queensway

Enclosed please find four copies of Site Investigation Report #6146, prepared by H.Q. Golder & Associates Limited, for the above structures. This is a supplementary report to both the previous reports, BA-1246 and BA-1255 respectively.

You will note this report provides additional site information, necessitated by new and extended portions of retaining walls as shown on preliminary plans D5001-P1 & P2 and D4966-P1 & P2 together with the results of the previous investigations to cover all retaining walls in this area.

Please refer to page 14 of the report under section "Earth Pressure". A value for the coefficient earth pressure of 0.3 to 0.5, depending on the rigidity and expected degree of movement, has been recommended for the design of retaining walls. This is a modification and/or a clarification of their recommendations contained in the two previous reports. We have designed all retaining walls on the Queensway using a coefficient of active earth pressure of 0.29 in conjunction with a granular backfill unit weight of 125 pounds per cubic foot. A safety factor of two has been provided, in all structural components (based on yield-point stresses) and for stability which we feel incorporates sufficient allowance for uncertainties in earth pressure phenomenom.

Your comments on the above would be appreciated.

Yours very truly,
DE LEUW, CATHER & CO. OF CANADA LIMITED

Léon J Marshall

Léon J. Marshall, P. Eng.,
Chief Bridge Engineer

GSS:rm
Encls.

H. Q. GOLDER & ASSOCIATES LTD.

CONSULTING CIVIL ENGINEERS

H. Q. GOLDER
V. MILLIGAN

2444 BLOOR ST. W.
TORONTO 9
RO. 7-9201

REPORT

TO

DELEUW, CATHER & COMPANY OF CANADA LIMITED

ON

SITE INVESTIGATION

PROPOSED RETAINING WALLS

OTTAWA QUEENSWAY

STA. 366+00 TO STA. 384+00

OTTAWA ONTARIO

Distribution:

10 copies - DeLeuw, Cather & Company of Canada Limited,
Ottawa, Ontario.

2 copies - H. Q. Golder & Associates Ltd.,
Toronto, Ontario.

January, 1962

6146

ABSTRACT

The results of an investigation carried out for the proposed Queensway retaining walls between about stations 366+00 and 384+00 in the area of Percy Street and Bronson Avenue in Ottawa, Ontario, are reported.

It was found that the site is covered by a surface layer of loose to compact heterogeneous granular fill, 1 to 9 feet in thickness. The fill between stations 370+00 and 380+00, approximately, is underlain by about 4 feet of soft peat followed by up to 10 feet of loose organic silt and fine sand to sandy silt resting on a stratum of generally dense sandy glacial till. To the west of about stations 370+00 and 375+00 on the north and south sides of the Queensway, respectively, the fill is directly underlain by compact to dense medium to silty fine sand up to about 15 feet in thickness followed by glacial till. The sandy glacial till rests on limestone bedrock which was proved at the Percy Street and Bronson Avenue bridge structure locations.

To ensure the stability of both the retaining walls and embankment fills, it is recommended that the soft peat and loose organic silt strata across the site be completely excavated and replaced by granular material compacted in place.

The retaining walls to the west of station 370+50 may be founded on strip footings in the compact to dense sand with a bearing pressure of 3 tons per square foot or directly on bedrock where it is near ground surface. To the east of station 370+50 it

is recommended that the retaining wall footings be carried down to the glacial till, which is about 10 to 15 feet below ground surface, or supported on piles driven through the granular backfill material replacing the peat and organic silt strata and into the till or to bedrock. For footings founded in the till an allowable bearing pressure of 3 tons per square foot may be used.

Comments on earth pressures to be used in the design of the retaining walls and on construction procedures in excavations below the ground water level are given in the report.

TABLE OF CONTENTS

INTRODUCTION

H. Q. Golder & Associates Ltd. has been retained by DeLeuw, Cather & Company of Canada Limited, Consulting Engineers, to carry out a site investigation for the proposed Queensway retaining walls in the area of Percy Street and Bronson Avenue in Ottawa, Ontario. The purpose of this investigation, which covered the area between about stations 369+00 and 384+00 along the Queensway, was to determine the soil and water conditions at the site and to provide information for the foundation design of the proposed retaining walls.

The results of previous investigations carried out at the Percy and Bronson bridge structure sites have been presented in our reports 6104 and 6105, respectively. The Bronson Avenue report covered retaining walls extending east up to station 369+00. This report provides additional site information necessitated by new and extended portions of retaining walls as shown on your Drawings C44N-HI, C44Y-HI, C44N-Pl and D4966-Pl together with the results of the previous investigations to cover all retaining walls in this area between stations 366+00 and 384+00.

PROCEDURE

The field work for this investigation was carried out during the periods November 7th to November 16th, 1961 and November 30th to December 6th, 1961 using mobile power auger boring equipment. A total of 18 sampled boreholes with accompanying dynamic penetration tests and one further auger boring were put down across the site. The borings were generally carried down until refusal to the auger was met.

The locations of all the borings put down in this investigation together with the borings located at or near the lines of the proposed retaining walls from the previous investigations are shown on Figure 1. Sections of the inferred soil stratigraphy along the north and south retaining walls are given on Figure 2. Detailed logs of each boring from this investigation are given on the Records of Boreholes.

The samples obtained during the investigation were brought to our laboratory for examination and testing. The results of the laboratory testing are shown on the Records of Boreholes and on the figures.

All elevations given in this report were determined by DeLeuw, Cather & Company of Canada Limited, and are referenced to Geodetic datum.

SITE TOPOGRAPHY AND GEOLOGY

The proposed Bronson Avenue and Percy Street overpass structures are located within the centre town section of the Ottawa Queensway. The area under investigation extends east from Bronson Avenue about 1,000 feet to Percy Street and continues for a distance of about 900 feet beyond Percy Street. The proposed Queensway centreline in this locality follows an existing railroad consisting of several track lines. Along the railroad the ground surface is essentially flat at about elevation 225. Outside the railroad right of way the ground surface slopes down gently from south to north.

Geological information indicates that bedrock in the immediate vicinity and to the west of Percy Street is a Trenton limestone of the Ottawa Formation, Cobourg Series and to the east of Percy Street is a black shale of the Billings Formation. Bedrock outcrops immediately to the west of Bronson Avenue and to the east is covered by overburden. The lower portion of the overburden consists of a layer of glacial till deposited by the Labradorean Glacier during the Wisconsin stage of glaciation. Immediately following retreat of the ice, the area was inundated by the Champlain Sea by way of the Gulf of St. Lawrence. During this period sand, silt and clay were deposited over the glacial till. In certain localized areas more recent deposits of sand and peat cover the Champlain soils.

SOIL CONDITIONS

The following main soil strata were encountered by the borings put down at the site.

Heterogeneous Fill

A layer of dark brown to grey heterogeneous granular fill was encountered at ground surface in all the borings. The thickness of the fill ranges from 1 to 2 feet at the eastern and western extremities of the site reaching a maximum of about 9 feet to the east of Percy Street. The fill is comprised of predominantly fine to medium sand sizes with some silt but is heterogeneous in that it contains gravel, cinders, occasional pockets of clay, pieces of brick, ashes, partially decayed wood and the like irregularly distributed throughout. A thin layer of cinders generally forms the upper portion of the fill layer..

Standard penetration tests carried out in the fill gave 'N' values ranging from about 3 to 32 blows per foot. Based on these results together with the dynamic penetration test results, the fill varies from very loose to dense and is generally loose to compact.

<u>Peat</u>

Underlying the surface layer of fill, a stratum of dark brown peat was encountered. The peat extends laterally across the site between about stations 370+00 and 380+00 along the north line of the retaining wall and between about stations 375+50 and 380+00 along the south line. The thickness of the stratum between the above stations reaches a maximum of approximately 7 feet at about stations 372+00 and 377+00 and is generally 3 to 4 feet. The peat is essentially non-fibrous and in a decomposed state except near the base of the stratum at several borehole locations where it is fibrous in structure. The stratum generally contains some thin horizontal layers of grey fine sand about 1/8 to 1/4 inches in thickness. Occasional lenses or pockets of fine sand and pieces of wood are present throughout the peat.

Standard penetration tests carried out in the peat generally gave manual push resistance values and occasional 'N' values of up to 10 blows per foot. The 'N' values greater than manual push were obtained in that portion of the peat stratum which contains sand seams and lenses. Based on the standard penetration tests together with the results of the dynamic penetration tests the peat is essentially soft.

Organic Silt

Beneath the peat, between about stations 370+00 and 374+00, along the north retaining wall line and beneath the fill in borehole B12, at about station 374+00 on the south line, a layer of organic silt was encountered. The layer ranges from about 1 to 3 feet thick and has an average thickness of about 2 feet. The layer is essentially comprised of grey organic silt with generally a trace of fine sand and clay. In borehole B2, at about station 371+75 on the north side, the layer is comprised of layered silt and clayey silt to silty clay with organic matter. The individual layers or seams are each about 1/16 to 1/8 inches thick. The organic content in the layer is comprised of semi-decayed small fibres, roots and twigs. Shells up to about 1/16 inch size are present throughout the silt layer.

A grain size distribution curve on a clayey sample from the layer obtained in borehole B2 is shown on Figure 3. Atterberg limits carried out on this same sample gave a liquid limit of about 37 and a plastic limit of about 22 at a corresponding natural water content of 59 percent. The high water content value obtained is due to the presence of organic matter.

Standard penetration tests gave two 'N' values of 3 and 6 blows per foot and three values of manual push force. Based on these values together with the dynamic penetration test results the organic silt is generally loose.

Sand to Sandy Silt

Underlying the fill, peat or organic silt a stratum of sand was encountered in the majority of boreholes put down across the site. The sand was not encountered along the north retaining wall line between about stations 372+00 to 374+00 and stations 377+00 and 379+00. The stratum increases in thickness to the east from several feet at Bronson Avenue to about 15 feet at station 370+00. At Percy Street the sand remains about 15 feet thick on the south retaining wall line but is only about 5 feet thick on the north side. Beyond about station 381+00 on the north side the thickness is of the order of 15 to 20 feet. The stratum is generally grey in colour throughout except in a few boreholes where the colour in the upper few feet is grey brown due to oxidation.

The composition of the stratum which ranges from a medium sand to a sandy silt with a trace of clay is variable across the site. In general the stratum between Bronson Avenue and about station 371+00 is a fine to medium sand grading into a silty fine sand in an easterly direction. The fine sand generally predominates in this area. The silt content for this portion of the stratum tends to increase with depth as well as laterally to the east. Grain size distribution curves on samples from the stratum obtained to the west of station 371+00 are shown on Figures 4 and 5.

Beyond about station 371+00 to the east the particle sizes comprising the stratum are finer than in the western part of the site. The stratum in this portion of the site varies from generally a fine sand to a sandy silt with a trace of clay. Grain size distribution curves on samples from this portion of the stratum to the east of station 371+00 are given on Figures 6 and 7.

The stratum to the west of station 371+00 is generally distinctly stratified with layers ranging from 1/16 up to several inches in thickness. These layers represent a minor variance in grain size, colour and grain shape. To the east of station 371+00 the stratum exhibits only occasional horizontal stratification which was observed in the samples obtained near the vicinity of Percy Street. This eastern portion of the stratum contains a trace of organic matter and shells dispersed erratically throughout.

The stratum across the site contains occasional gravel up to about 1½ inches in size. In a few boreholes the presence of gravel sizes increases to about 30 percent by weight forming local pockets generally concentrated in the upper portion of the stratum. The individual sand and gravel sizes in the stratum are generally subrounded to subangular in shape.

Standard penetration resistance or 'N' values ranging from 16 to 93 blows per foot with an average representative value of about 30 blows per foot were obtained in that portion of the stratum west of about station 370+50 on the north retaining wall line and west of about station 375+00 along the south line. Based on this, together with the dynamic penetration test results, the stratum in this western section of the site varies from compact to very dense and is generally compact to dense. To the east of the above stations 'N' values ranging between manual push force and about 15 blows per foot with an average representative value of 9 blows per foot were obtained in the stratum. This eastern portion of the stratum, based on the standard and dynamic penetration test results, varies from very loose to compact and is generally loose.

The stratum may be divided into two sections based on its in-situ density and composition. The portion of the stratum west of about stations 370+50 and 375+00 along the north and south retaining wall lines, respectively, has been classified as a compact to dense medium to silty fine sand. East of the above stations the stratum is a loose fine sand to sandy silt with a trace of clay.

Silty Sand with Gravel

Underlying the peat in the vicinity of station 378+00, the organic silt at about station 373+00 and the sand elsewhere, a stratum of grey silty sand with gravel was encountered. The stratum in this investigation was not completely penetrated as refusal to the power auger equipment was generally met after penetrating several feet into the stratum. From the previous investigations, where the stratum was completely penetrated using a diamond machine drillrig, the thickness was found to range from a few feet at Bronson Avenue up to about 10 feet at Percy Street.

The stratum, which is typical of the basal till overlying bedrock in the Ottawa area, consists of a well graded composite of silt, sand and subangular gravel up to 3 inches in size with occasionally a trace of clay. From the performance of the power auger during boring it is known that cobble and boulder sizes are present within the stratum. The general predominance of sand sizes allows classification as a sandy till, essentially non-plastic.

Typical grain size distribution curves obtained on samples from the stratum are shown on Figures 8 and 9.

Standard penetration resistance values ranging from 14 to greater than 100 blows per foot with an average representative value of about 35 blows per foot were obtained in the stratum. These values together with the results of the dynamic penetration tests indicate that the glacial till varies from compact to very dense and is generally dense.

Bedrock

Bedrock was not proved in this investigation but from the previous investigations is known to underlie the glacial till at a depth of about 25 feet below ground surface at Percy Street. At Bronson Avenue bedrock outcrops to the west and is several feet below ground surface immediately to the east. It is estimated, based mainly on the pattern of soil stratigraphy across the site, that bedrock beyond Percy Street to the east is within 25 to 30 feet below ground surface.

Bedrock where it was core drilled at Bronson Avenue and Percy Street in the previous investigations is generally a sound dark grey limestone. Geological information indicates that, at the site, bedrock to the east of Percy Street could be shale.

WATER CONDITIONS

Water level observation pipes were installed in most of the boreholes put down in this investigation and readings taken during and for a period following completion of the field work.

Similarly water level readings were taken in the boreholes during the previous investigations at Percy and Bronson carried out during March and April of 1961. The stabilized ground water level for each borehole in this investigation is given on the Records of Boreholes and on the sections in Figure 2 for all the boreholes located along the lines of the proposed retaining walls.

In general the ground water level across the site slopes from west to east and is about 3 feet below ground surface at station 369+00 and 10 feet below ground surface at station 383+00.

DISCUSSION

General

The proposed Queensway Expressway is to be elevated in this area to overpass Bronson Avenue at about station 365+00 and Percy Street at about station 374+50. Bridge structures are to be provided at Bronson and Percy for this purpose and fill is to be used elsewhere. The height of embankment fill across the site under investigation is to decrease uniformly from about 20 feet above existing ground surface at Bronson to about 10 feet above existing ground surface at station 384+00 to the east of Percy. Because of space restrictions for the Queensway, retaining walls are to be provided to support the embankment fills between the bridge structures. The retaining wall along the north side of the Queensway will extend from station 366+00 to 384+00 and on the south side of the Queensway will extend from Bronson Avenue at station 366+00 east to station 371+00. A short retaining wall forming the wing wall of the Percy bridge structure is to be provided on the south side. The extent of the retaining walls is shown in plan on Figure 1. West of station 378+00 the concrete retaining walls are to be poured in place and east of station 378+00 are to be of precast cribs.

To ensure the stability of the supporting retaining walls it is essential to have an adequate foundation for both the walls and the embankment fills. Consequently it is necessary to completely excavate the soft peat and loose organic silt strata underlying the site and replace by granular material compacted in place. The surface cover of granular fill across the site may be used as backfill material.

Foundations

Recommendations for foundation design of the retaining walls are given below. Because of the variation in the soil conditions across the site, particularly in the relative density of the sand stratum and due to the presence of the peat and loose organic silt in one portion, the site has been divided into two separate areas for this purpose. The first area referred to below as the Bronson Avenue area covers the complete south Bronson retaining wall and the north Bronson retaining wall west of station 370+50. The other area covers the north retaining wall for that portion of the site east of station 370+50.

Bronson Avenue Area

As discussed in our report No. 6105, it is recommended that footings for the retaining walls in this area be founded in the compact to dense sand underlying the surface cover of fill using a maximum allowable bearing pressure of 3 tons per square foot. Where bedrock is near ground surface as in the vicinity of station 366+00 the walls should be founded on the bedrock, with the maximum design loads not to exceed 20 tons per square foot. For adequate frost protection at least 6 feet of overburden cover should be provided to the underside of the footings on the exterior side of the wall.

The south retaining wall in this area adjacent to the Coca-Cola plant is now to be situated about 6 feet from the face of the building. The boring put down next to the plant during the previous investigation for the Bronson Avenue structure was located about 25 feet away from the building. With our present knowledge that the footings for the plant are founded on bedrock along the complete length of the building, it is recommended that the retaining wall footing adjacent to the plant be carried to bedrock or supported on piles driven to bedrock. This measure is to prevent the possibility of founding in sand disturbed during construction of the plant footings or on backfill material. The retaining wall footing to the east of the plant may be stepped up and founded in the sand as discussed above.

Area East of Station 370+50

Because of the loose density of the fill, peat, organic silt and sand strata covering this portion of the site, it is recommended that the retaining wall footings be carried down into the underlying glacial till which is about 10 to 15 feet below ground surface, or supported on piles driven into the till or to bedrock. For footings founded in the till an allowable bearing pressure of 3 tons per square foot may be used in design. If the footings are founded on piles a variety of pile types would be suitable. For example, considering 12 BP53 lb. steel H piles driven to practical refusal in the lower portion of the till or to bedrock, a design load of 45 tons per pile may be used. If a piled foundation is employed to support the retaining wall it is further recommended that the piles be driven through the granular backfill material replacing the soft peat and loose organic silt strata across the site. Further, for adequate frost protection, the underside of the pile cap footing should be placed at least 6 feet below final ground level on the exterior side of the retaining wall.

Earth Pressure

As discussed under "General" above, it is essential to completely remove the soft peat and loose organic silt strata covering the western portion of the site and replace with granular backfill compacted in place. Excavation of these soft and highly compressible strata should be carried out under the complete area of the embankments and retaining walls. This procedure is necessary not only to ensure the stability of the Queensway fills but also to eliminate the high earth pressures which would be imposed on the retaining walls due to the presence of the soft strata.

The sustained earth pressures imposed on a retaining wall are dependent on the density and character of both the retained and foundation material, the rigidity of the retaining wall and the degree to which the wall can be allowed to yield. In order for an active pressure condition to be obtained, the retaining wall must yield an amount sufficient to develop the full shearing resistance of the backfill. For a granular backfill, such as compact to dense sand, an average total displacement of $\frac{H}{200}$ at the top of the wall (where H is the height) will develop full active pressure. Where the yield of a wall structure, due to its rigidity or support, is prevented, the full shear strength of the compacted backfill material can not be mobilized. The pressure in this case is usually taken as that of the soil at rest. Between these two extremes of limit to possible movement, the shearing resistance of the soil may be partially mobilized and a small degree of movement at the top (after the backfill is placed) can essentially reduce the coefficient of earth pressure from a value of at rest to one approaching the active. This small degree of movement which follows completion of the backfill can, in certain cases, be as low as $\frac{H}{1,000}$.

For compact to dense sand backfill material the coefficient of active earth pressure, Ka, is of the order of 0.3. The coefficient of the at rest pressure, Ko, lies between the magnitude of the active and passive conditions and for compact to dense sand is normally taken to be about 0.5.

Thus the calculation of earth pressure to be used in the design of the retaining walls will be dependent on the type of structure adopted and the degree of movement which can be allowed.

It is recommended that at least 6 feet, in horizontal extent, of non-frost susceptible and free draining granular material be placed behind the walls.

Construction Procedures

For adequate construction stability, the side slopes of the general excavation to be made across the site in the removal of the peat and organic silt should be no steeper than 3 horizontal to 1 vertical, considering no surcharge loading. Where the side of the excavation borders an existing structure or will carry surcharge loads such as heavy construction equipment, braced sheeting should be employed or the side slope reduced to maintain stability. Normal water seepage in the general excavation can probably be controlled by pumping from sumps located within the approximate central portion of the excavation.

The ground water level as measured during the course of the field investigation ranges from about 3 feet below ground surface in the vicinity of station 370+00 to about 10 feet below ground surface at station 383+00 and is generally within the soft peat or loose sand to sandy silt strata. Where excavations for footings, to be founded in the compact to dense sand or glacial till, are made below the ground water level, precautions should be taken to ensure that the in-situ density of the material at the base and sides of the excavation is not reduced due to water seepage. To safeguard against a reduction in the density of the material in the excavation, it is suggested that closed steel sheeting placed on each side of the excavation be employed. The sheeting should be driven to a sufficient depth below final excavation level to prevent a "quick action" of the soil at the base of the excavation.

The in-situ density of the subsoil may also be maintained by the lowering, prior to excavation, of the groundwater level below final excavation level. This may be accomplished by an efficient vacuum wellpoint system. Because of the variable composition of the sand stratum across the site and the presence of silt and clay sizes in the stratum, the vacuum wellpoint installation may have to be operated for a week or so to lower the water level below final excavation grade.

J. L. Seychuk, P. Eng.

JLS/jb
6146

V. Milligan, P. Eng.

January, 1962

LIST OF STANDARD ABBREVIATIONS

The standard abbreviations commonly employed on each "Record of Borehole", on the figures, and in the text of the report are as follows:

SAMPLE TYPES

A.S. – Auger Sample	R.C. – Rock Core
C.S. – Chunk Sample	S.T. – Slotted Tube
D.O. – Drive Open	T.O. – Thin-walled, Open
D.S. – Denison Type Sample	T.P. – Thin-walled, Piston
F.S. – Foil Sample	W.S. – Wash Sample

PENETRATION RESISTANCES

Dynamic Penetration Resistance – The energy required to drive a 2 inch diameter, 60 degree cone attached to the end of the drilling rods into the ground: expressed in blows per foot, where each blow represents 4,200 inch-pounds of energy.

Standard Penetration Resistance, N – The number of blows by a 140 pound hammer dropped 30 inches required to drive a 2 inch drive open sampler one foot into the ground.

Sampler advanced by static weight	– weight, hammer	– Wh
Sampler advanced by pressure	– pressure, hydraulic	– Ph
Sampler advanced by pressure	– pressure, manual	– Pm

SOIL DESCRIPTION

The standard terminology for the descriptions of the relative density of cohesionless soils and the consistency of cohesive soils is as follows:

Relative Density	N, Blows/ft.	Consistency	c, lb/sq. ft.
Very Loose	0 to 4	Very Soft	Less than 250
Loose	4 to 10	Soft	250 to 500
Compact	10 to 30	Firm	500 to 1,000
Dense	30 to 50	Stiff	1,000 to 2,000
Very Dense	over 50	Very Stiff	2,000 to 4,000
		Hard	over 4,000

SOIL TESTS

C – Consolidation Test	Q – Undrained Triaxial
H – Hydrometer Analysis	Qc – Consolidated Undrained Triaxial
M – Sieve Analysis	S – Drained Triaxial
MH – Combined Analysis, Sieve and Hydrometer	U – Unconfined Compression
	V – Field Vane Test

Note: Undrained triaxial tests in which pore pressures are measured are shown as Q' or Q'c.

SOIL PROPERTIES

γ – Total Unit Weight	K – Coefficient of Permeability
γ_d – Dry Unit Weight	c – Undrained Shear Strength (½ Compressive Strength)
γ_b – Submerged Unit Weight	St – Sensitivity
L_L – Liquid Limit	ϕ' – Effective Angle of Shearing Resistance
P_L – Plastic Limit	c' – Effective Cohesion Intercept
W – Natural Water Content	Cc – Compression Index
G – Specific Gravity	Cv – Coefficient of Consolidation
e – Void Ratio	

PROJECT No. [illegible]

RECORD OF BOREHOLE B 1

LOCATION SEE FIGURE 1 BORING DATE NOV. 7. 1961 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	LAB. TESTING
221.5	GROUND LEVEL				
0.0	LOOSE DARK BROWN SILTY SAND FILL	1	2" D.O.	8	
219.3 / 2.2	SOFT DARK BROWN PEAT	2	"	4	
		3	"	PM	
215.2 / 6.3	LOOSE GREY LAYERED ORGANIC FINE SAND AND SILT				
213.5 / 8.0	COMPACT GREY SAND AND GRAVEL WITH SOME SILT	4	"	19	
		5	"	28	M
207.7 / 13.8	END OF HOLE REFUSAL BOULDER OR BEDROCK				

ELEVATION SCALE: 225, 220, 215, 210, 205

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100

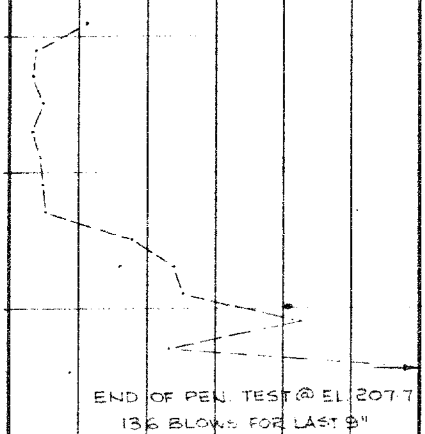
SHEAR STRENGTH C, LB. / SQ. FT.

LIQUID LIMIT L_L

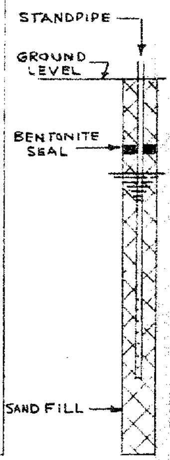
PLASTIC LIMIT P_L

WATER CONTENT W

WATER CONTENT, PER CENT



STANDPIPE INSTALLATION



W.L. IN STANDPIPE @ EL. 218 - NOV. 20, 1961

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.
CHECKED [illegible]

PROJECT No. 6146

RECORD OF BOREHOLE B 2

LOCATION SEE FIGURE 1 BORING DATE NOV. 7, 1961 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	LAB. TESTING
221.2	GROUND LEVEL				
0.0	LOOSE TO COMPACT BLACK TO GREY CINDER AND SAND **FILL**	1	2" D.O.	21	
218.6 / 2.6	SOFT DARK BROWN **PEAT**	2	"	8	
		3	"	4	
		4	"	PM	
210.9 / 10.3	LOOSE GREY LAYERED **ORGANIC SILT AND CLAYEY SILT**	5	"	PM	MH
209.2 / 12.0	COMPACT TO DENSE GREY **SILTY SAND WITH GRAVEL**	6	"	16	
206.0 / 15.2	END OF HOLE REFUSAL **BOULDER OR BEDROCK**				

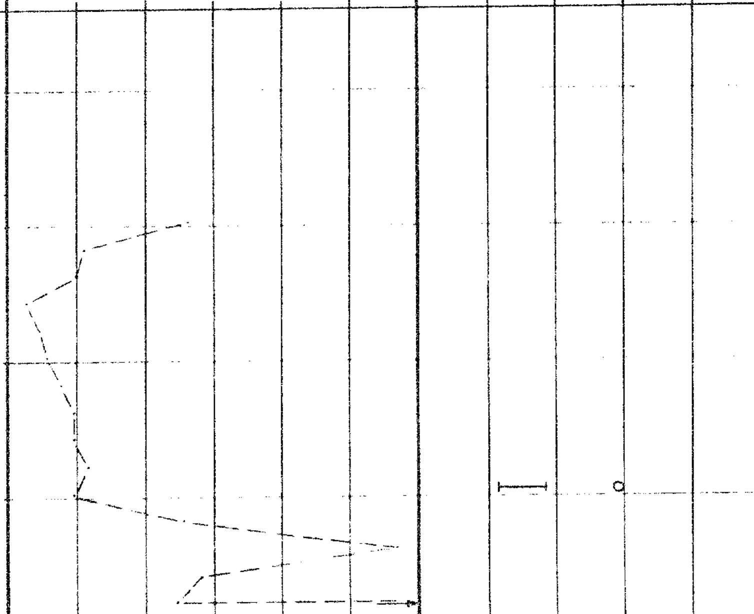
ELEVATION SCALE: 225, 220, 215, 210, 205

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH C, LB./SQ.FT.

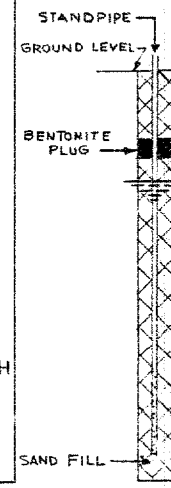
LIQUID LIMIT L_L PLASTIC LIMIT P_L WATER CONTENT W

WATER CONTENT, PER CENT 20 40 60 80



END OF PEN. TEST @ EL. 206.0
51 BLOWS FOR LAST 3"

STANDPIPE INSTALLATION



W.L. IN STANDPIPE @ EL. 217.2 - DEC. 12, 1961

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.
CHECKED [illegible]

PROJECT No. 6146

RECORD OF BOREHOLE B 3

LOCATION SEE FIGURE 1 — BORING DATE NOV. 8 1961 — DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING — BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES — PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	LAB. TESTING
					225	
223.2	GROUND LEVEL					
0.0	LOOSE TO COMPACT DARK BROWN CINDER AND SAND FILL	1	2" D.O.	12		
		2	"	4	220	
218.8 / 4.4	SOFT DARK BROWN PEAT	3	"	PM		
		4	"	PM	215	
213.7 / 9.5	LOOSE GREY ORGANIC SANDY SILT	5	"	PM		
212.3 / 10.9	LOOSE TO COMPACT GREY SILTY VERY FINE SAND	6	"	21	210	MH
		7	"	21		
					205	
		8	A.S.	—		
202.7 / 20.5	END OF HOLE REFUSAL PROBABLY BEDROCK					
					200	

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100

SHEAR STRENGTH C, LB./SQ.FT.

LIQUID LIMIT L_L — PLASTIC LIMIT P_L — WATER CONTENT W — P_L W L_L

WATER CONTENT, PER CENT

END OF PEN TEST @ EL. 218.8
75 BLOWS FOR LAST 5"
REFUSAL ON TIMBER

STANDPIPE INSTALLATION

STANDPIPE
GROUND LEVEL
BENTONITE PLUG
SAND FILL

W.L. IN STANDPIPE @ EL. 219.8 - DEC. 4, 1961.

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.
CHECKED

PROJECT No. 6146

RECORD OF BOREHOLE B4

LOCATION SEE FIGURE 1   BORING DATE NOV. 8. 1961   DATUM GEODETIC

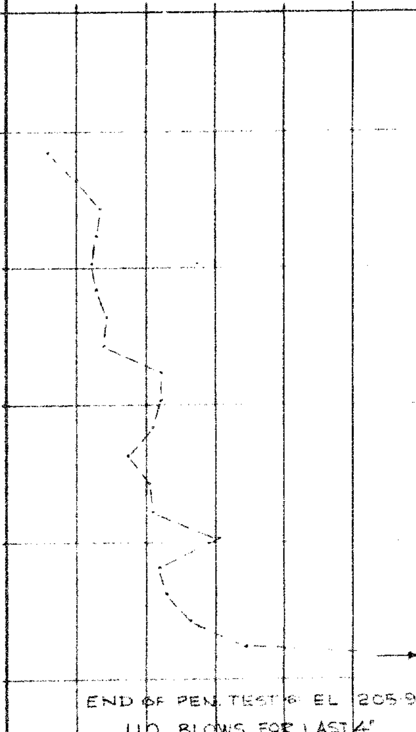
BOREHOLE TYPE POWER AUGER BORING   BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES   PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLES – NUMBER	TYPE	BLOWS / FT.	ELEVATION SCALE	LAB. TESTING	REMARKS
225.2	GROUND LEVEL						W.L. IN BOREHOLE @ EL. 220.2 AFTER COMPLETION
0.0	LOOSE TO COMPACT DARK BROWN CINDER AND SAND **FILL**	1	2" D.O.	17	225		
222.7 / 2.5	COMPACT GREY-BROWN TO GREY **SILTY FINE SAND**	2	"	23			
		3	"	17	220		
		4	"	36			
		5	"	30	215	MH	
		6	"	25	210		
205.9 / 19.3	DENSE **SILTY SAND WITH GRAVEL**				205		
204.5 / 20.7	END OF HOLE REFUSAL **PROBABLY BEDROCK**				200		

DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 — SHEAR STRENGTH C, LB./SQ.FT.

LIQUID LIMIT L_L — PLASTIC LIMIT P_L — WATER CONTENT W — WATER CONTENT, PER CENT



VERTICAL SCALE 1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.
CHECKED JJY

PROJECT No. 6146

RECORD OF BOREHOLE B 5

LOCATION SEE FIGURE 1 BORING DATE NOV 9 1961 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	LAB. TESTING
222.0	GROUND LEVEL				
0.0	LOOSE BROWN SAND FILL	1	2" D.O.	3	
		2	"	6	
215.2 / 6.8		3	"	7	
	SOFT DARK BROWN PEAT	4	2" T.O.	PM	
211.2 / 10.8	LOOSE GREY SILTY FINE TO MEDIUM SAND TRACE OF CLAY	5	2" D.O.	PM	
207.9 / 14.1		6	"	PM	MH
	DENSE GREY SAND AND GRAVEL WITH SOME SILT	7	"	49	
206.0 / 16.0	END OF HOLE				
	REFUSAL BOULDER OR BEDROCK				

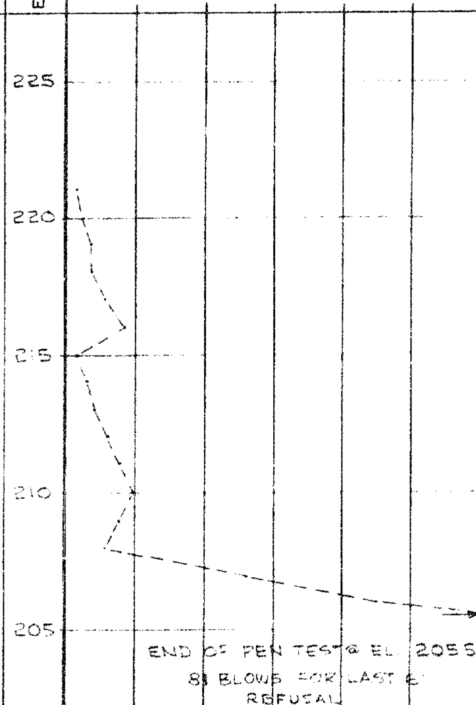
DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH C, LB./SQ.FT.

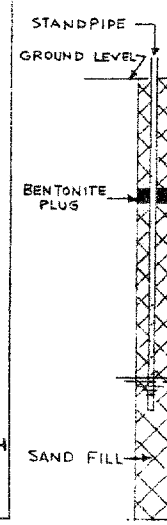
LIQUID LIMIT L_L PLASTIC LIMIT P_L WATER CONTENT W

WATER CONTENT, PER CENT

ELEVATION SCALE 225 220 215 210 205



STANDPIPE INSTALLATION



W.L. IN STANDPIPE @ EL. 211.1 - AFTER COMPLETION

VERTICAL SCALE 1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.

CHECKED [illegible]

RECORD OF BOREHOLE B6

LOCATION SEE FIGURE 1 | BORING DATE NOV. 10, 1961 | DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING | BOREHOLE DIAMETER 4.5".

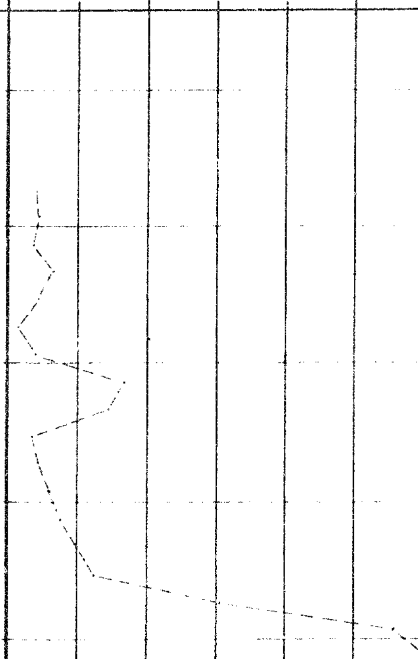
SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES | PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	LAB. TESTING
222.3	GROUND LEVEL				
0.0	LOOSE BROWN SAND FILL	1	2" D.O.	5	
		2	"	4	
		3	"	3	
214.7 / 7.6	SOFT DARK BROWN PEAT	4&5	2" D.O. & D.F.	PM	
		6	2" D.O.	PM	
		7	"	PM	
207.5 / 14.8	DENSE TO VERY DENSE GREY SAND & GRAVEL TRACE OF SILT	8	"	55	M
205.4 / 16.9	END OF HOLE				
17.8	END OF PEN. TEST REFUSAL BOULDER OR BEDROCK				

ELEVATION SCALE: 225, 220, 215, 210, 205, 200

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100

SHEAR STRENGTH C, LB./SQ.FT.



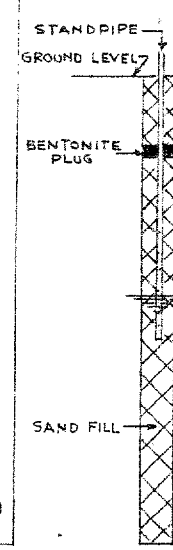
END OF PEN. TEST @ EL. 204.5
120 BLOWS FOR LAST 8"

LIQUID LIMIT L_L
PLASTIC LIMIT P_L
WATER CONTENT W

P_L W L_L

WATER CONTENT, PER CENT

STANDPIPE INSTALLATION



W.L. IN STANDPIPE @ EL. 214.3 - AFTER COMPLETION

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.
CHECKED

PROJECT No. 6146

RECORD OF BOREHOLE B7

LOCATION SEE FIGURE 1 BORING DATE NOV. 10 1961 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE: DESCRIPTION	SAMPLES: NUMBER	TYPE	BLOWS / FT.
223.1	GROUND LEVEL			
0.0	LOOSE BROWN SAND FILL	1	2" D.O.	10
		2	"	8
		3	"	10
214.7		4	"	7
8.4	SOFT DARK BROWN PEAT			
213.2		5	"	>100
9.9	END OF HOLE REFUSAL BOULDER OR BEDROCK			

ELEVATION SCALE: 225, 220, 215, 210

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
20 40 60 80 100

SHEAR STRENGTH C, LB./SQ.FT.

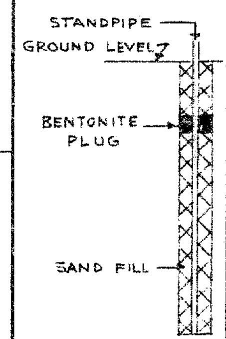
END OF PEN TEST @ EL. 213.2
65 BLOWS FOR LAST 10"

LIQUID LIMIT L_L
PLASTIC LIMIT P_L
WATER CONTENT W

P_L W L_L

WATER CONTENT, PER CENT

STANDPIPE INSTALLATION



BOREHOLE DRY AFTER COMPLETION

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN AT & J.A
CHECKED

RECORD OF BOREHOLE B8

LOCATION SEE FIGURE 1   BORING DATE NOV. 10 & 13 1961   DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING   BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES   PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
223.5	GROUND LEVEL			
0.0	LOOSE DARK BROWN CINDER AND SAND FILL	1	2" DO	11
1.1	LOOSE GREY - BROWN TO GREY **SILTY FINE SAND** TRACE OF CLAY AND ORGANIC MATTER WITH DEPTH	2	"	12
		3	"	10
		4	"	7
		5	"	11
		6	"	9
209.7 / 13.8	COMPACT GREY **SILTY SAND WITH GRAVEL**, TRACE OF CLAY	7	"	14
204.6 / 18.9	END OF HOLE REFUSAL **BOULDER OR BEDROCK**			

ELEVATION SCALE: 225, 220, 215, 210, 205, 200

DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT: 20, 40, 60, 80, 100

SHEAR STRENGTH C, LB./SQ.FT.

END OF PEN TEST @ EL. 205.5
20 BLOWS FOR NO ADVANCE

LIQUID LIMIT L_L
PLASTIC LIMIT P_L
WATER CONTENT W
WATER CONTENT, PER CENT

LAB. TESTING: MH (about El. 212.5), MH (about El. 207)

STANDPIPE INSTALLATION

STANDPIPE
GROUND LEVEL
BENTONITE PLUG
SAND FILL

W.L. IN STANDPIPE @ EL. 215 - DEC. 8, 1961

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A
CHECKED JDG

PROJECT No. [illegible]

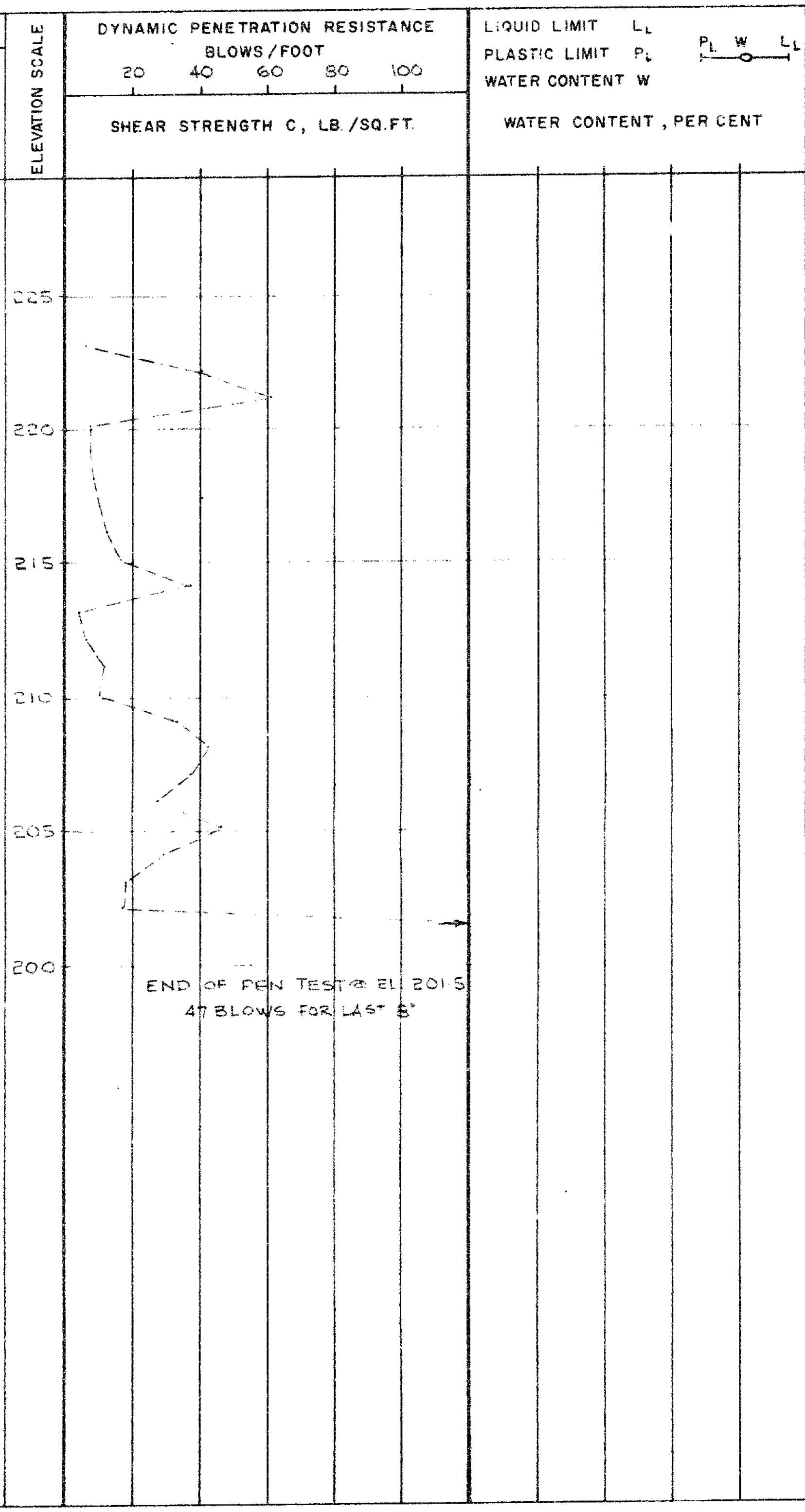
RECORD OF BOREHOLE B9

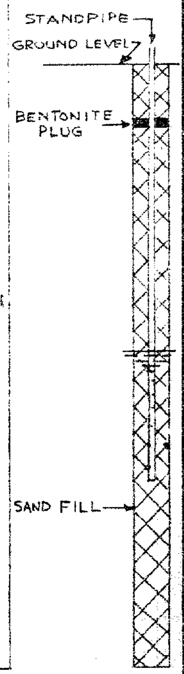
LOCATION SEE FIGURE 1 | BORING DATE NOV 14, 1961 | DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING | BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES | PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE: ELEVN. / DEPTH	DESCRIPTION	SAMPLES: NUMBER	TYPE	BLOWS / FT.	LAB. TESTING
224.2	GROUND LEVEL				
0.0		1	2" DO	14	
0.9	LOOSE TO COMPACT BROWN CINDER AND SAND FILL	2	"	8	
		3	"	11	
	LOOSE TO COMPACT GREY-BROWN TO GREY FINE SAND WITH SOME GRAVEL BECOMING SILTY FINE SAND BELOW ABOUT EL. 213	4	"	14	MH
		5	"	7	
		6	"	11	
		7	"	21	
202.6		8	"	21	
21.6	END OF HOLE				
22.7	END OF PEN. TEST REFUSAL BOULDER OR BEDROCK				
	PROBABLY COMPACT SAND AND GRAVEL				





W.L. IN STANDPIPE @ EL. 213.9 - DEC. 12, 1961

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.
CHECKED [illegible]

RECORD OF BOREHOLE B10

LOCATION SEE FIGURE 1 BORING DATE NOV 14 1961 DATUM GEODETIC

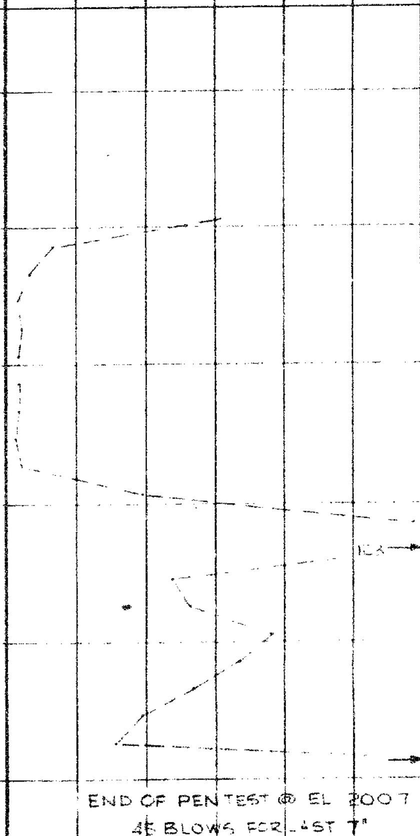
BOREHOLE TYPE POWER AUGER BORING BOREHOLE DIAMETER 4.5"

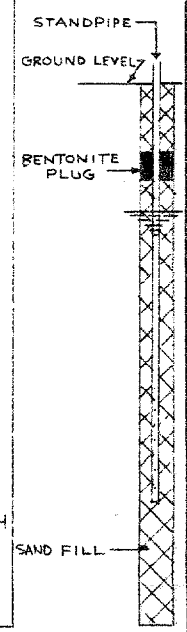
SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE; SAMPLES; ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100; SHEAR STRENGTH C, LB./SQ.FT.; LIQUID LIMIT L_L, PLASTIC LIMIT P_L, WATER CONTENT W; WATER CONTENT, PER CENT; LAB. TESTING; STANDPIPE INSTALLATION

ELEVN. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FT	LAB. TESTING
221.3	GROUND LEVEL				
0.0	LOOSE DARK BROWN TO GREY SAND FILL	1	2" D.O.	18	
		2	"	4	
		3	"	6	
214.5 / 6.8	SOFT DARK BROWN PEAT	4	"	P.M.	
213.1 / 8.2	LOOSE GREY ORGANIC SANDY SILT	5	"	30	
210.8 / 10.5	COMPACT TO DENSE GREY SILTY SAND WITH GRAVEL TRACE OF CLAY	6	"	29	MH
		7	"	84	
201.7 / 19.6	END OF HOLE				
20.6	END OF PEN TEST REFUSAL BOULDER OR BEDROCK				

ELEVATION SCALE: 225, 220, 215, 210, 205, 200





W.L. IN STANDPIPE @ EL. 216.7 - DEC. 12, 1961

VERTICAL SCALE 1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.

CHECKED [illegible]

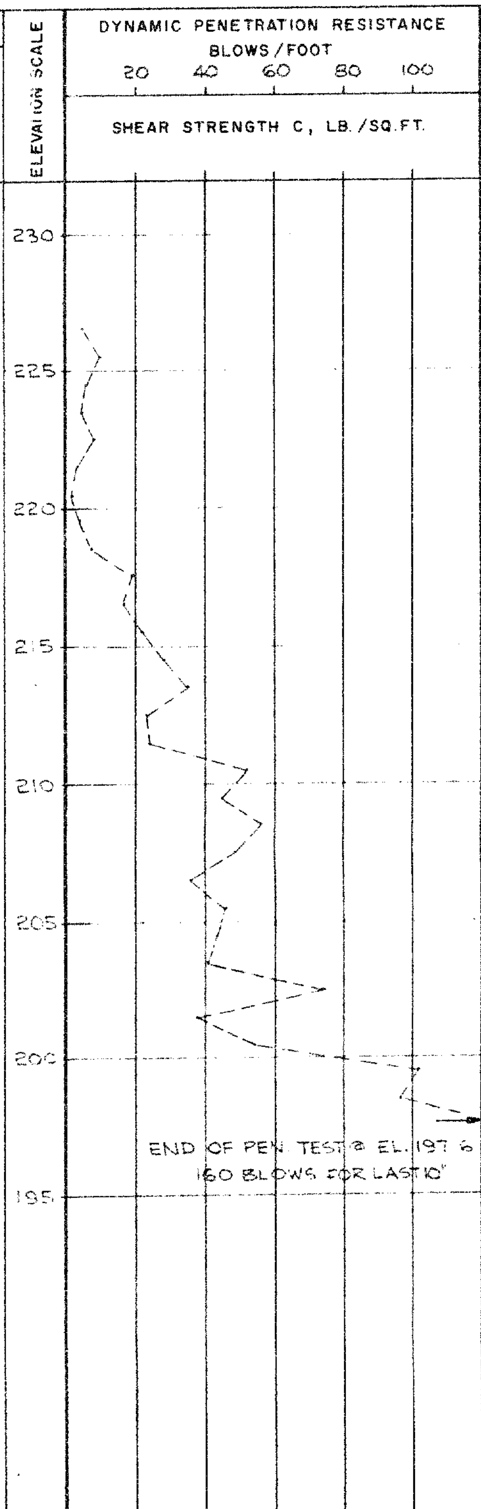
RECORD OF BOREHOLE B11

LOCATION SEE FIGURE 1 — BORING DATE NOV. 15, 1961 — DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING — BOREHOLE DIAMETER 4.5"

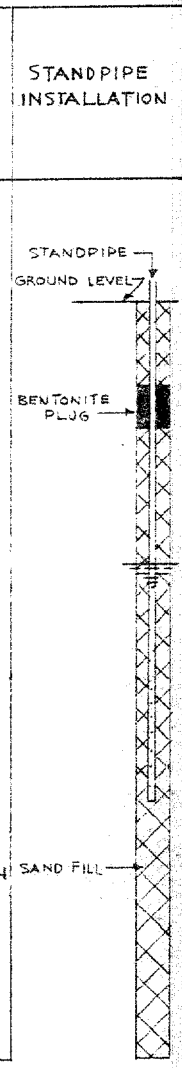
SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES — PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
227.5	GROUND LEVEL			
0.0	LOOSE BROWN SAND FILL	1	2" D.O.	11
		2	"	5
		3	"	8
220.7 / 6.8	SOFT DARK BROWN PEAT	4	"	10
218.0 / 9.5	LOOSE TO COMPACT GREY-BROWN TO GREY FINE SAND TO SANDY SILT	5	"	8
		6	"	8
		7	"	11
		8	"	20
201.0 / 26.5	VERY DENSE GREY SILTY SAND WITH GRAVEL	9	"	65
200.0 / 27.5	END OF HOLE			
197.6 / 29.9	END OF PEN. TEST REFUSAL BOULDER OR BEDROCK			



LIQUID LIMIT L_L
PLASTIC LIMIT P_L
WATER CONTENT W
WATER CONTENT, PER CENT

LAB. TESTING: MH



W.L. IN STANDPIPE @ EL. 218 - DEC. 8, 1961.

VERTICAL SCALE 1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A

CHECKED JGG

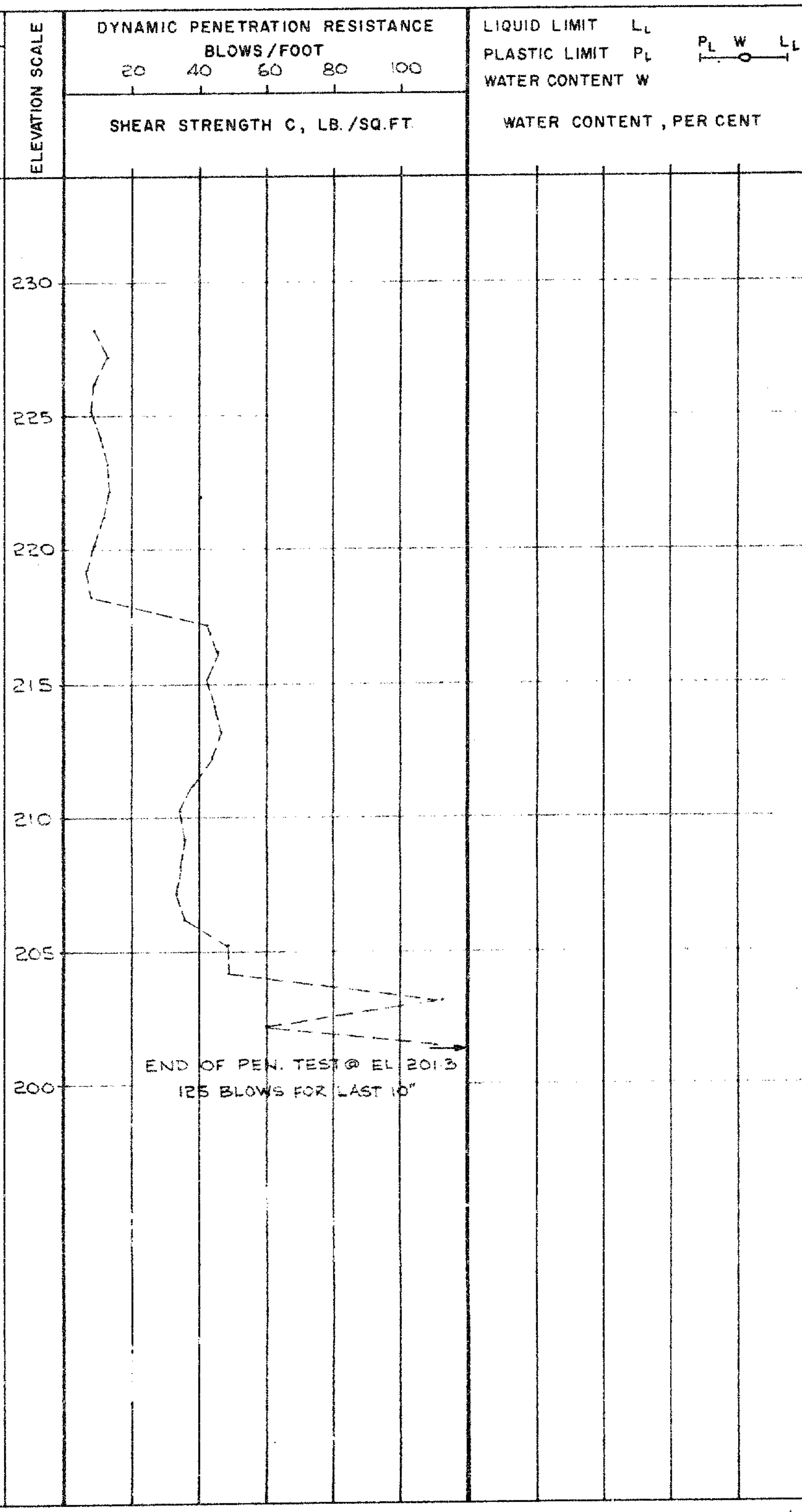
RECORD OF BOREHOLE B 12

LOCATION: SEE FIGURE 1 — BORING DATE: NOV. 15 & 16, 1961 — DATUM: GEODETIC

BOREHOLE TYPE: POWER AUGER BORING — BOREHOLE DIAMETER: 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES — PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE: ELEVN. / DEPTH	DESCRIPTION	SAMPLES: NUMBER	TYPE	BLOWS / FT.
229.2	GROUND LEVEL			
0.0	LOOSE DARK BROWN SAND FILL	1	2" D.O	11
		2	"	9
		3	"	10
221.5 / 7.7	LOOSE GREY ORGANIC SILT TRACE OF CLAY	4	"	11
		5	"	24
218.1 / 11.1	COMPACT GREY SILTY FINE SAND	6	"	37
		7	"	18
		8	"	25
		9	"	21
204.2 / 25.0	VERY DENSE GREY SILTY SAND WITH GRAVEL			
202.2 / 27.0	END OF HOLE			
27.9	END OF PEN. TEST REFUSAL BOULDER OR BEDROCK			



REMARKS: W.L. IN BOREHOLE @ EL. 2[illegible]7 - AFTER COMPLETION

VERTICAL SCALE: 1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN: AT. & J.A.
CHECKED: [illegible]

RECORD OF BOREHOLE B13

LOCATION SEE FIGURE 1 BORING DATE NOV. 30 & DEC. 1, 1961 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

SOIL PROFILE

ELEVN. / DEPTH	DESCRIPTION
224.8	GROUND LEVEL
0.0	COMPACT BLACK CINDER **FILL**
1.0	DENSE TO VERY DENSE GREY - BROWN TO GREY **FINE SAND** TRACE OF SILT
219.7 / 15.1	DENSE TO VERY DENSE **GREY SILTY SAND WITH GRAVEL**
206.9 / 17.9	END OF HOLE REFUSAL **PROBABLY BEDROCK**

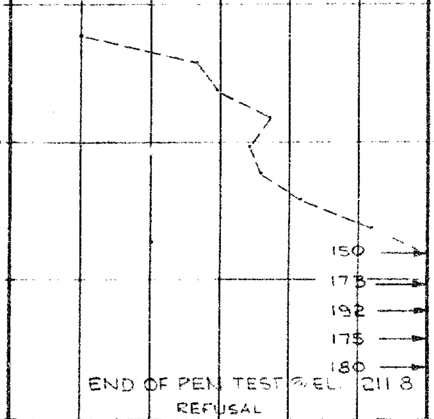
SAMPLES

NUMBER	TYPE	BLOWS / FT.
1	2" D.O.	42
2	"	60
3	"	55
4	"	63
5	"	93
6	"	69
7	"	36

ELEVATION SCALE: 225, 220, 215, 210, 205

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH C, LB./SQ.FT.

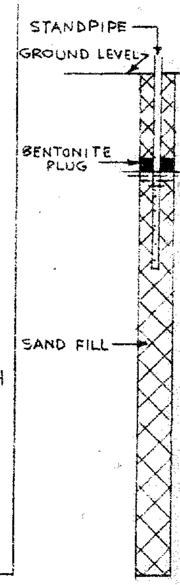


LIQUID LIMIT L_L PLASTIC LIMIT P_L WATER CONTENT W

WATER CONTENT, PER CENT

LAB. TESTING: MH

STANDPIPE INSTALLATION



W.L. IN STANDPIPE @ EL. 221.3 - DEC. 8, 1961

VERTICAL SCALE 1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.

CHECKED JLG

PROJECT No. 6146

RECORD OF BOREHOLE B14

LOCATION SEE FIGURE 1 BORING DATE DEC 1 1961 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	LAB. TESTING
224.4	GROUND LEVEL				
0.0	LOOSE TO COMPACT DARK BROWN CINDER AND SAND FILL	1	2" DO	17	
221.4 / 3.0	SOFT DARK BROWN PEAT	2	"	6	
220.5 / 3.9	LOOSE GREY ORGANIC SANDY SILT				
219.0 / 5.4	DENSE GREY FINE SAND TO SILTY FINE SAND	3	"	38	MH
		4	"	34	
		5	"	43	
		6	"	24	
207.4 / 17.0	DENSE GREY SILTY SAND WITH GRAVEL				
205.7 / 18.7	END OF HOLE				

ELEVATION SCALE: 225, 220, 215, 210, 205

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100

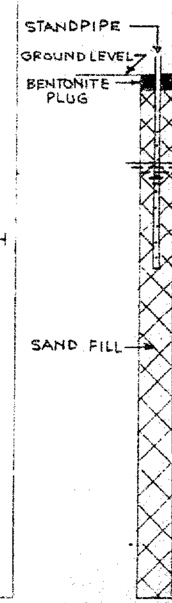
SHEAR STRENGTH C, LB./SQ.FT.

END OF PEN. TEST @ EL. 222.9
REFUSAL ON TIMBER

LIQUID LIMIT L_L
PLASTIC LIMIT P_L
WATER CONTENT W
P_L W L_L

WATER CONTENT, PER CENT

STANDPIPE INSTALLATION



W.L. IN STANDPIPE @ EL. 221.2 - DEC. 16, 1961

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.
CHECKED JM

PROJECT No. 6146

RECORD OF BOREHOLE B15

LOCATION S - FIGURE I BORING DATE DEC 1, 1961 DATUM GEODETIC

BORING TYPE POWER AUGER BORING BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLES	ELEVATION SCALE	REMARKS
224.7	GROUND LEVEL		225	W.L. IN BOREHOLE @ EL.221.7- DEC. 8, 1961
0.0	LOOSE BROWN CINDER AND SAND **FILL**	AUGER HOLE ONLY / NO SAMPLES TAKEN		
221.5 / 3.5	SOFT DARK BROWN **PEAT**		220	
	DENSE GREY **FINE SAND** TRACE OF SILT		215	
211.7 / 13.0	END OF HOLE		210	

Column headings: SOIL PROFILE (ELEVN. DEPTH, DESCRIPTION, STRAT. PLOT); SAMPLES (NUMBER, TYPE, BLOWS / FT.); ELEVATION SCALE; DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT; SHEAR STRENGTH C, LB./SQ.FT.; LIQUID LIMIT L_L, PLASTIC LIMIT P_L, WATER CONTENT W (P_L W L_L); WATER CONTENT, PER CENT; REMARKS

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.
CHECKED

PROJECT No. 6146

RECORD OF BOREHOLE B16

LOCATION SEE FIGURE 1 BORING DATE DEC 4 - 5, 1961 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING BOREHOLE DIAMETER 4.5"

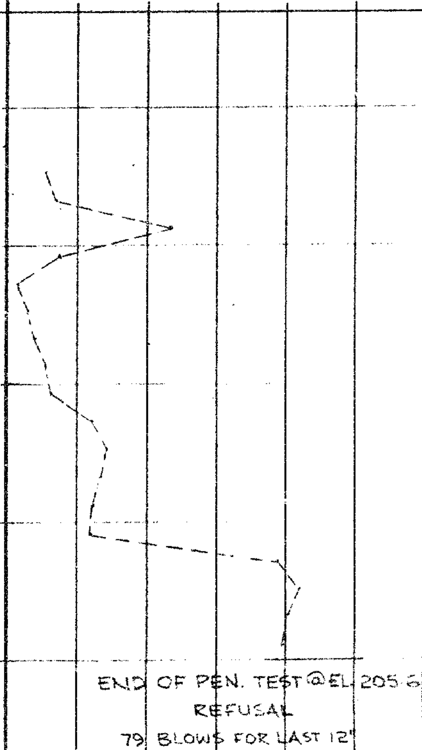
SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
223.6	GROUND LEVEL			
0.0	COMPACT BROWN SAND **FILL**	1	2" DO.	32
		2	"	30
219.3 / 4.3	SOFT DARK BROWN **PEAT**	3	"	2
		4	"	2
212.6 / 11.0	LOOSE GREY **ORGANIC SANDY SILT**	5	"	3
210.3 / 13.3	LOOSE TO COMPACT GREY **SILTY FINE SAND**	6	"	11
		7	"	18
207.6 / 16.0	COMPACT TO DENSE GREY **SILTY SAND WITH GRAVEL**			
202.3 / 21.3	END OF HOLE REFUSAL **PROBABLY BEDROCK**			

ELEVATION SCALE: 225, 220, 215, 210, 205, 200

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20 40 60 80 100

SHEAR STRENGTH C, LB./SQ.FT.



LIQUID LIMIT L_L

PLASTIC LIMIT P_L

WATER CONTENT W

WATER CONTENT, PER CENT

LAB. TESTING: MH (at El. 210)

STANDPIPE INSTALLATION

STANDPIPE

GROUND LEVEL

BENTONITE PLUG

SAND FILL

W.L. IN STANDPIPE @ EL. 221.8 - DEC. 12, 1961

VERTICAL SCALE 1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN AT & J.A.

CHECKED JCS

PROJECT No.

RECORD OF BOREHOLE B17

LOCATION SEE FIGURE 1 | BORING DATE DEC. 5 1961 | DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING | BOREHOLE DIAMETER 4.5

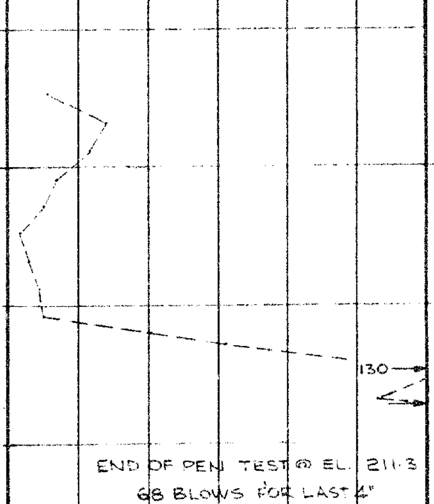
SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES | PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.
223.6	GROUND LEVEL			
0.0	LOOSE TO COMPACT BROWN SAND **FILL**	1	2" D.O.	31
218.1 / 5.5	SOFT DARK BROWN **PEAT**	2	"	11
		3	"	7
213.8 / 9.8	END OF HOLE **PROBABLY** VERY DENSE **SAND AND GRAVEL**			
211.3 / 12.3	END OF PEN. TEST REFUSAL **BOULDER OR BEDROCK**			

ELEVATION SCALE: 225, 220, 215, 210

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20, 40, 60, 80, 100

SHEAR STRENGTH C, LB./SQ.FT.



LIQUID LIMIT L_L

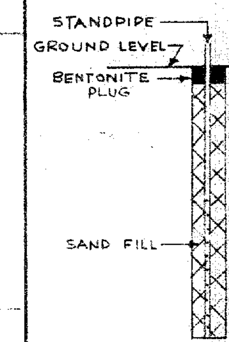
PLASTIC LIMIT P_L

WATER CONTENT W

P_L W L_L

WATER CONTENT, PER CENT

STANDPIPE INSTALLATION



BOREHOLE DRY AFTER COMPLETION

VERTICAL SCALE

1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.

CHECKED JLS

PROJECT No. 61[illegible]

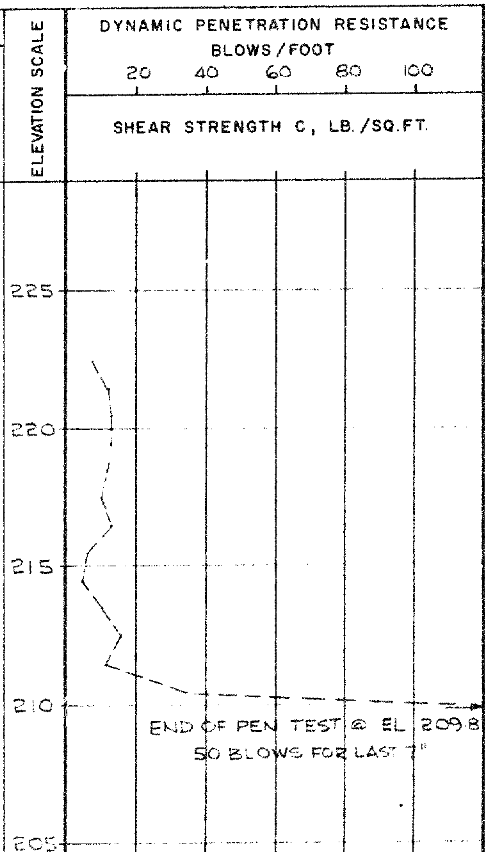
RECORD OF BOREHOLE B18

LOCATION SEE FIGURE 1 BORING DATE DEC. 5, 1961 DATUM GEODETIC

BOREHOLE TYPE POWER AUGER BORING BOREHOLE DIAMETER 4.5"

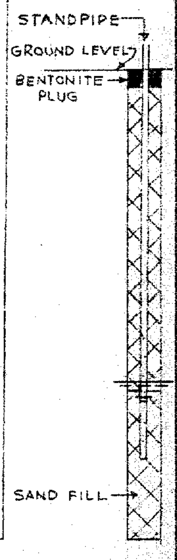
SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS / FT.	LAB. TESTING
223.4	GROUND LEVEL				
0.0	LOOSE TO COMPACT BROWN SAND FILL	1	2" DO	11	
		2	"	14	
214.8		3	"	8	
214.1	SOFT DARK BROWN PEAT				
9.3	LOOSE GREY SILTY SAND TO SANDY SILT	4	"	9	MH
211.2 / 12.2	COMPACT TO DENSE GREY SILTY SAND WITH GRAVEL TRACE OF CLAY	5	"	17	MH
206.5 / 16.9	END OF HOLE REFUSAL BOULDER OR BEDROCK				



LIQUID LIMIT L_L
PLASTIC LIMIT P_L
WATER CONTENT W
WATER CONTENT, PER CENT

STANDPIPE INSTALLATION



W.L. IN STANDPIPE @ EL. 211.9 - AFTER COMPLETION

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.
CHECKED [signature]

PROJECT No. [illegible]

RECORD OF BOREHOLE B19

LOCATION: SEE FIGURE 1 — BORING DATE: DEC. 5-6, 1961 — DATUM: GEODETIC

BOREHOLE TYPE: POWER AUGER BORING — BOREHOLE DIAMETER: 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES — PEN. TEST HAMMER WEIGHT 140 LB. DROP 30 INCHES

ELEVN. / DEPTH	SOIL PROFILE: DESCRIPTION	SAMPLES: NUMBER	TYPE	BLOWS / FT.
223.6 / 0.0	GROUND LEVEL			
	LOOSE BROWN SAND FILL	1	2" D.O.	10
		2	"	9
214.6		3	"	7
213.8	SOFT DARK BROWN PEAT	4	"	3
9.8 / 211.6	LOOSE GREY SANDY SILT			
12.0	COMPACT TO DENSE GREY SILTY SAND WITH GRAVEL	5	"	20
207.7		6	AS.	–
15.9	END OF HOLE REFUSAL BOULDER OR BEDROCK			

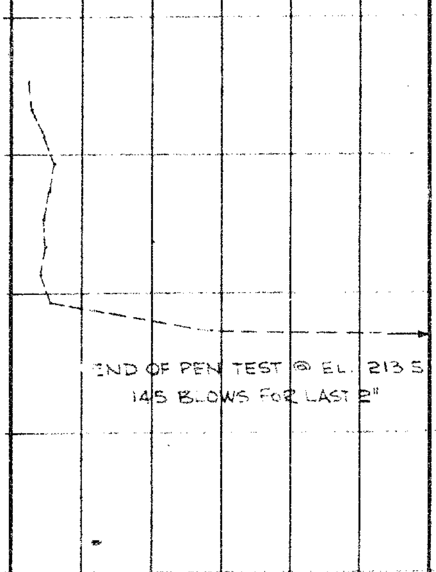
ELEVATION SCALE: 225, 220, 215, 210, 205

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 20, 40, 60, 80, 100

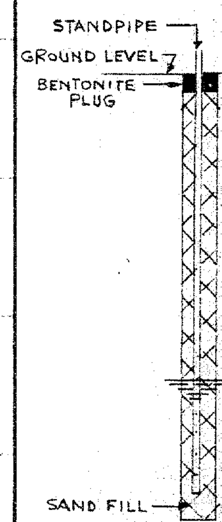
SHEAR STRENGTH C, LB./SQ.FT.

LIQUID LIMIT L_L / PLASTIC LIMIT P_L / WATER CONTENT W

WATER CONTENT, PER CENT



STANDPIPE INSTALLATION

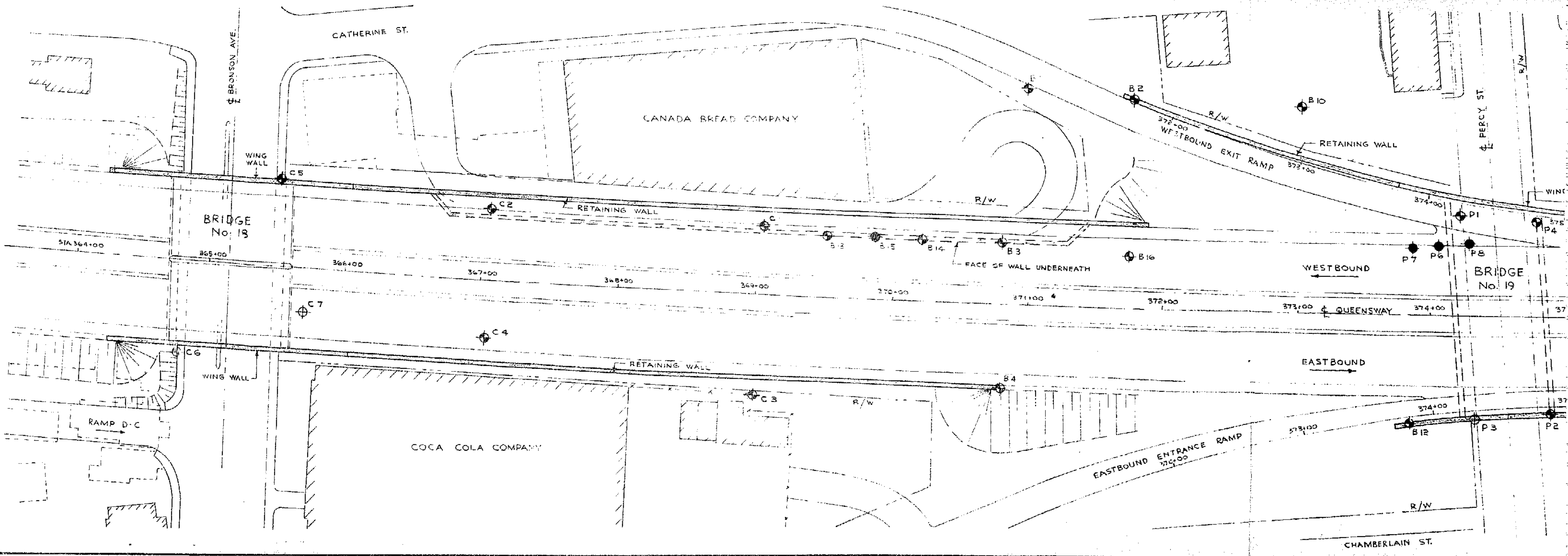


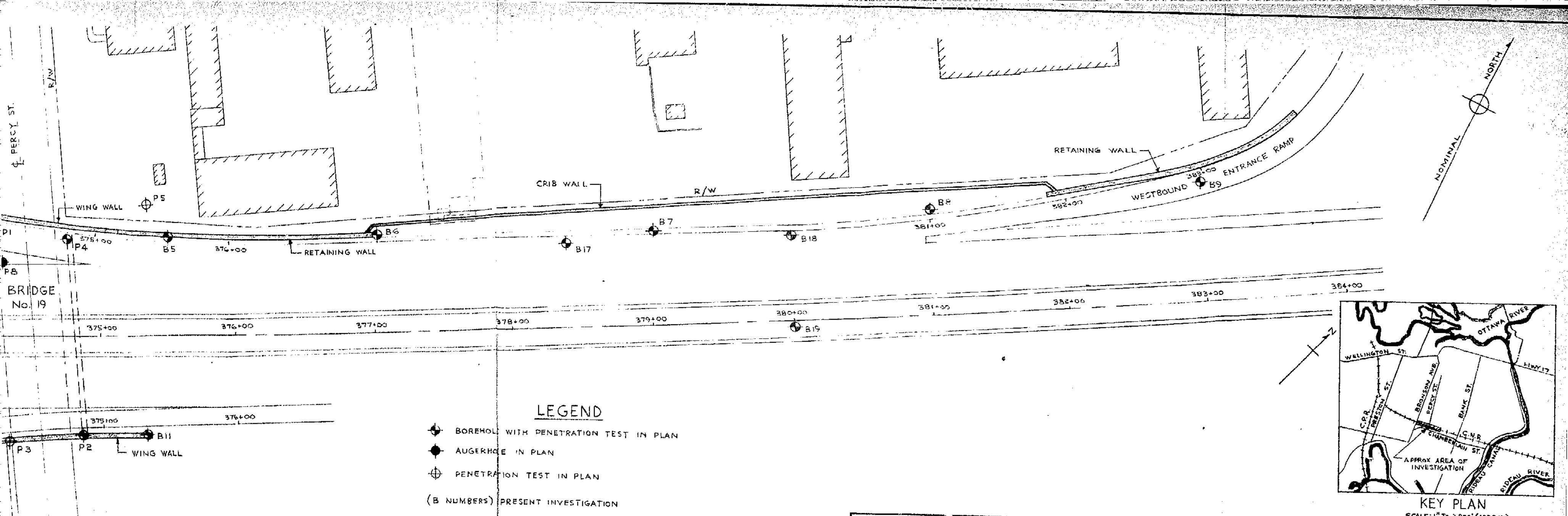
W.L. IN STANDPIPE @ EL. 212.6 - DEC. 22, 1961

VERTICAL SCALE
1 INCH TO 5 FEET

GOLDER & ASSOCIATES

DRAWN A.T. & J.A.
CHECKED [illegible]


CATHERINE ST.
℄ BRONSON AVE.
CANADA BREAD COMPANY
WING WALL
C5
BRIDGE No. 18
C2
RETAINING WALL
R/W
C
B13
B15
B14
B3
FACE OF WALL UNDERNEATH
B2
B10
R/W
372+00
WESTBOUND EXIT RAMP
373+00
RETAINING WALL
℄ PERCY ST.
R/W
374+00
P1
P4
B16
P7
P6
P8
WESTBOUND
BRIDGE No. 19
STA 364+00
365+00
366+00
367+00
368+00
369+00
370+00
371+00
372+00
373+00
℄ QUEENSWAY
374+00
C7
C4
C6
WING WALL
RETAINING WALL
EASTBOUND
B4
C3
R/W
RAMP D-C
COCA COLA COMPANY
EASTBOUND ENTRANCE RAMP
373+00
374+00
B12
P3
P2
R/W
CHAMBERLAIN ST.



KEY PLAN

SCALE: 1" TO 3,800' (APPROX.)

LEGEND

- BOREHOLE WITH PENETRATION TEST IN PLAN
- AUGERHOLE IN PLAN
- PENETRATION TEST IN PLAN

(B NUMBERS) PRESENT INVESTIGATION

(C NUMBERS) PREVIOUS INVESTIGATION, REPORT No G105 - AUG. 1961

(P NUMBERS) PREVIOUS INVESTIGATION, REPORT No G104 - SEPT. 1961

REFERENCE	
DRWG. No.	DESCRIPTION
C 44N-P1	DE LEUW CATHER & COMPANY OF CANADA LIMITED - OTTAWA QUEENSWAY BRIDGE No 18 AT BRONSON AVE., PRELIM. PLAN
D 4966-P1	" " 19 " PERCY ST., SITE PLAN
REPORT G104	GOLDER & ASSOCIATES - PERCY ST. OVERPASS
REPORT G105	GOLDER & ASSOCIATES - BRONSON AVE. OVERPASS

DE LEUW CATHER & COMPANY OF CANADA LIMITED

OTTAWA ONTARIO

PROPOSED RETAINING WALLS

OTTAWA QUEENSWAY - STA. 366+00 - 384+00

OTTAWA ONTARIO

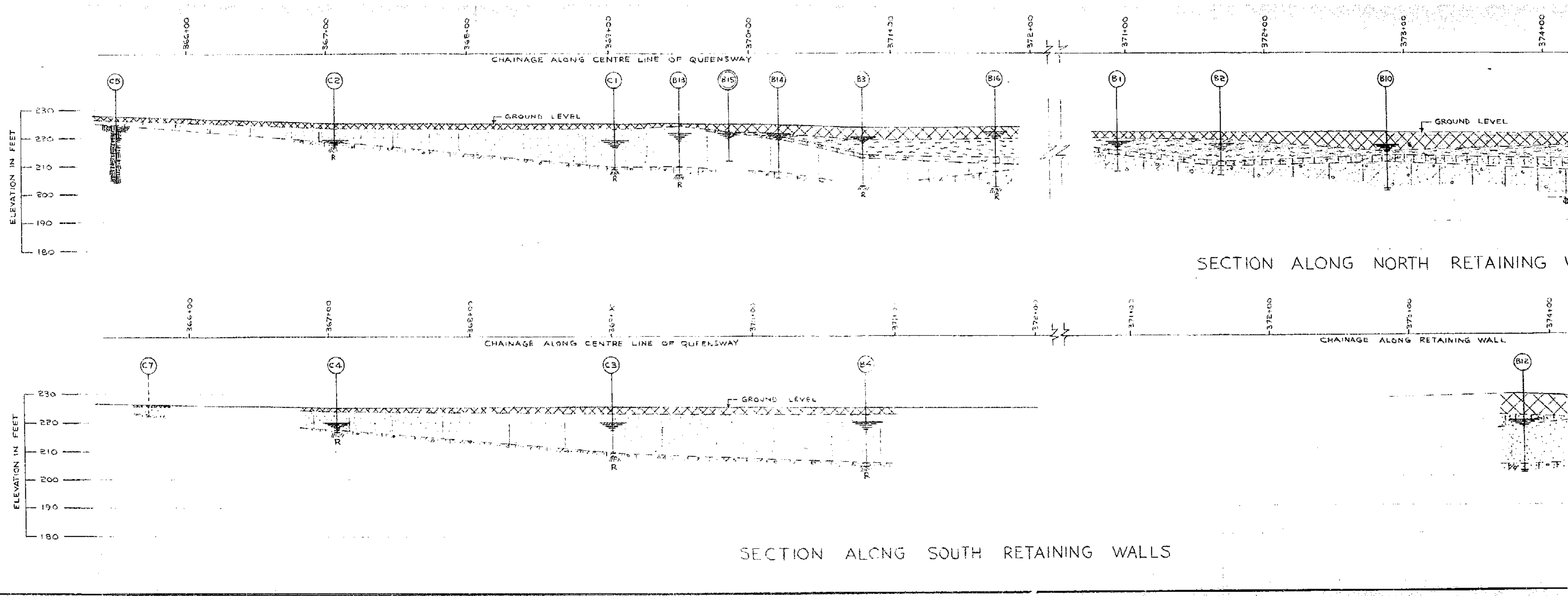
BORING PLAN

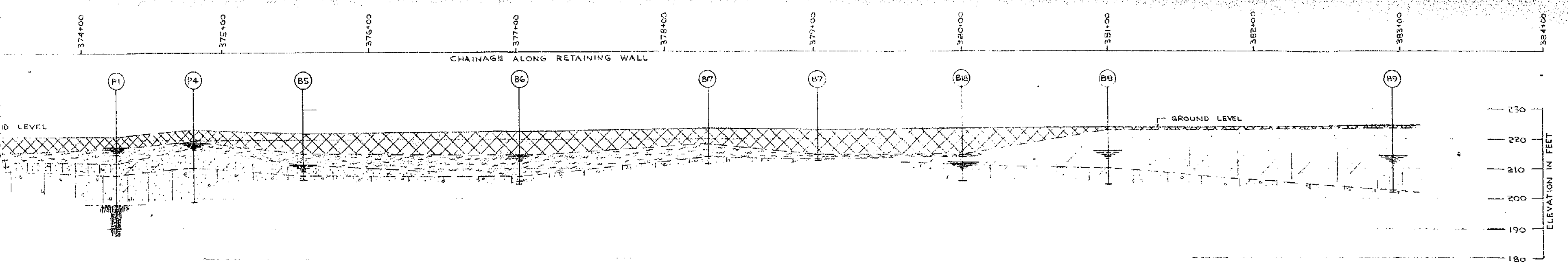
GOLDER & ASSOCIATES

CONSULTING CIVIL ENGINEERS

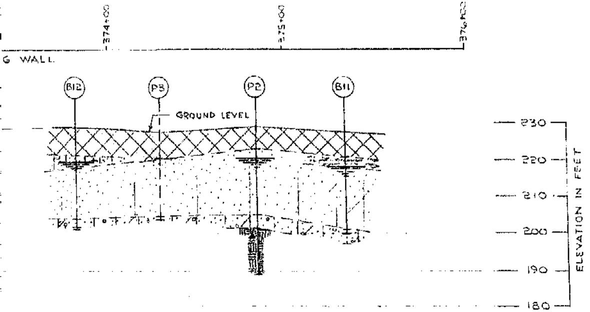
DATE: JAN. 3, 1962 SCALE: 1" TO 40'-0"

MADE	CHKD.	APPD.	FIGURE
J.A.	JLS	V.H.	1


CHAINAGE ALONG CENTRE LINE OF QUEENSWAY
GROUND LEVEL
ELEVATION IN FEET
CHAINAGE ALONG RETAINING WALL
SECTION ALONG NORTH RETAINING
SECTION ALONG SOUTH RETAINING WALLS



ETAINING WALLS



LEGEND

(P1) BOREHOLE IN ELEVATION

(B15) AUGERHOLE IN ELEVATION

(P3) PENETRATION TEST IN ELEVATION

(B NUMBERS) - PRESENT INVESTIGATION, DEC. 1961

(C NUMBERS) - PREVIOUS INVESTIGATION, APRIL 1961, REPORT No. G105

(P NUMBERS) - PREVIOUS INVESTIGATION, APRIL 1961, REPORT No. G104

W.L. IN HOLE DURING INVESTIGATION

STRATIGRAPHY

- LOOSE TO COMPACT DARK BROWN HETEROGENEOUS GRANULAR FILL
- SOFT DARK BROWN PEAT
- LOOSE GREY ORGANIC SANDY SILT
- LOOSE BROWN TO GREY FINE SAND TO SANDY SILT, TRACE OF CLAY
- COMPACT TO DENSE BROWN TO GREY MEDIUM TO SILTY FINE SAND
- COMPACT TO VERY DENSE GREY SILTY SAND WITH GRAVEL (TILL)
- DARK GREY LIMESTONE BEDROCK
- REFUSAL - ASSUMED BEDROCK

NOTE: DESCRIBED IN REPORT UNDER "SAND TO SANDY SILT"

REFERENCE	
DRWG. No.	DESCRIPTION
1	GOLDER & ASSOCIATES - BORING PLAN.
REPORT G104	GOLDER & ASSOCIATES - PROPOSED PERCY ST. OVERPASS.
REPORT G105	GOLDER & ASSOCIATES - PROPOSED BRONSON AVE. OVERPASS.

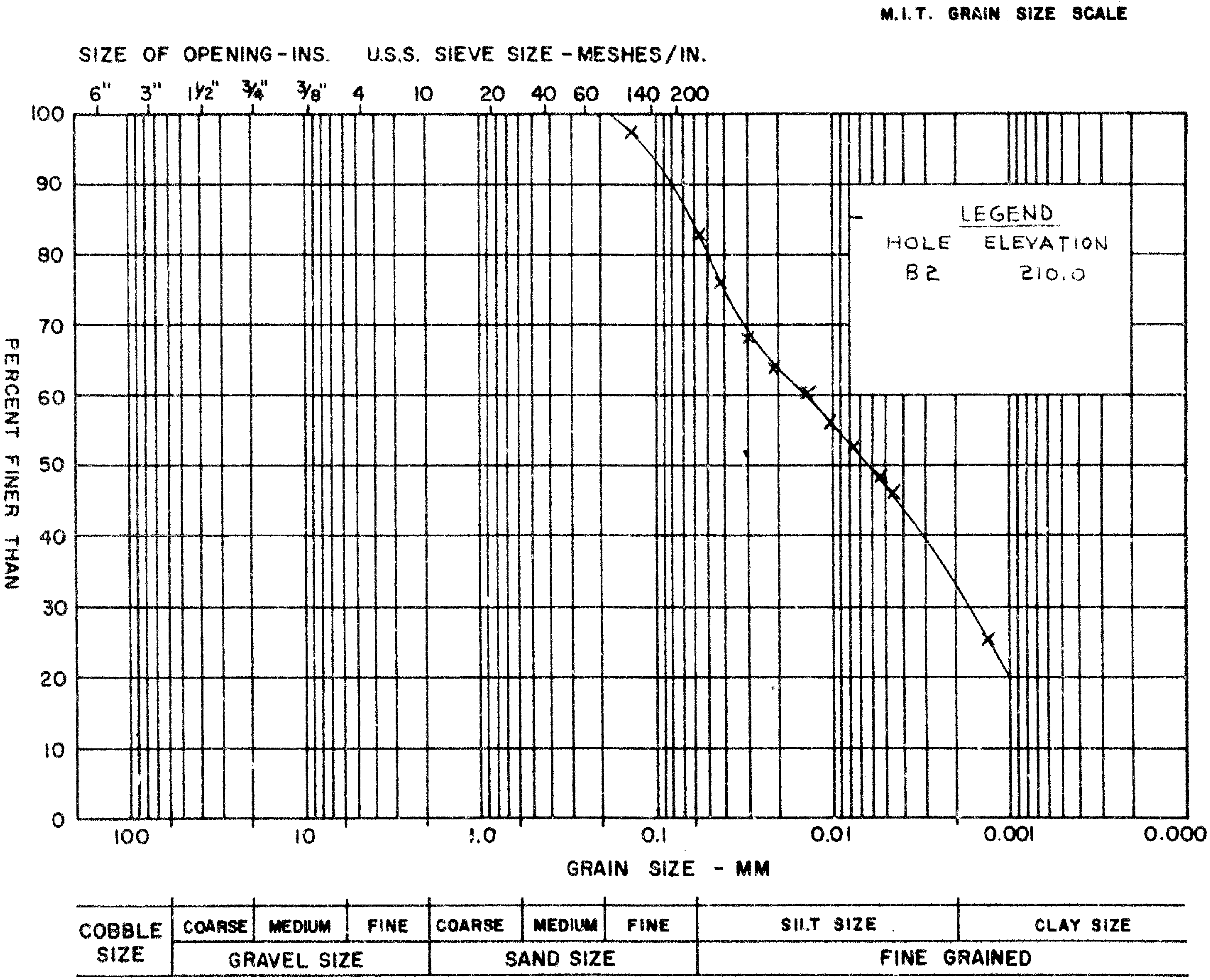
DE LEUW CATHER & COMPANY OF CANADA LIMITED
OTTAWA ONTARIO

PROPOSED RETAINING WALLS
OTTAWA QUEENSWAY - STA. 366+00 - 384+00
OTTAWA ONTARIO
SOIL STRATIGRAPHY

GOLDER & ASSOCIATES
CONSULTING CIVIL ENGINEERS

DATE: JAN. 4, 1962 SCALE: HORIZ. 1" TO 40' VERT. 1" TO 20'

MADE J.A. CHKD. APPD. FIGURE 2



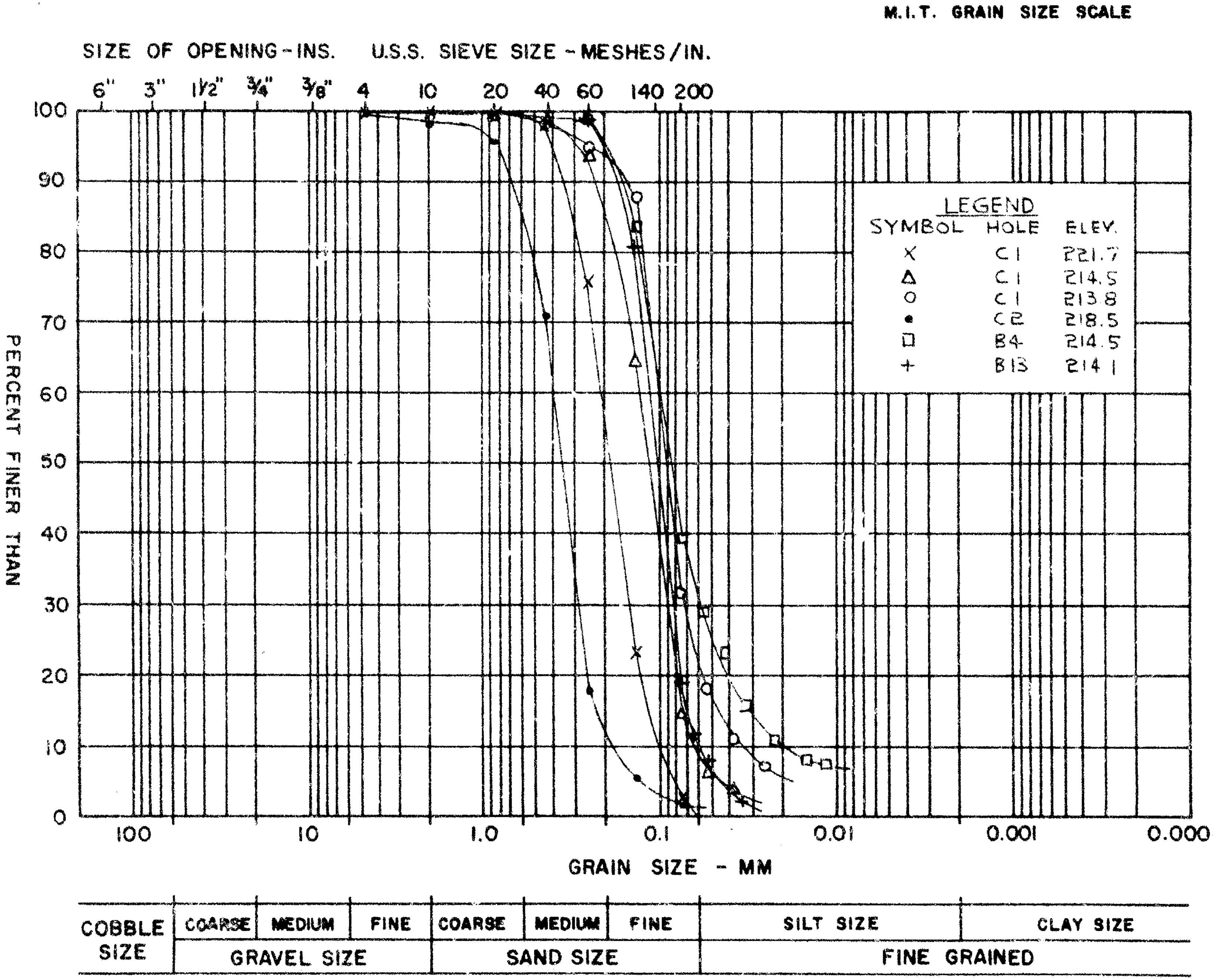
GOLDER & ASSOCIATES

GRAIN SIZE DISTRIBUTION

ORGANIC CLAYEY SILT

FIGURE 3

GOLDER & ASSOCIATES

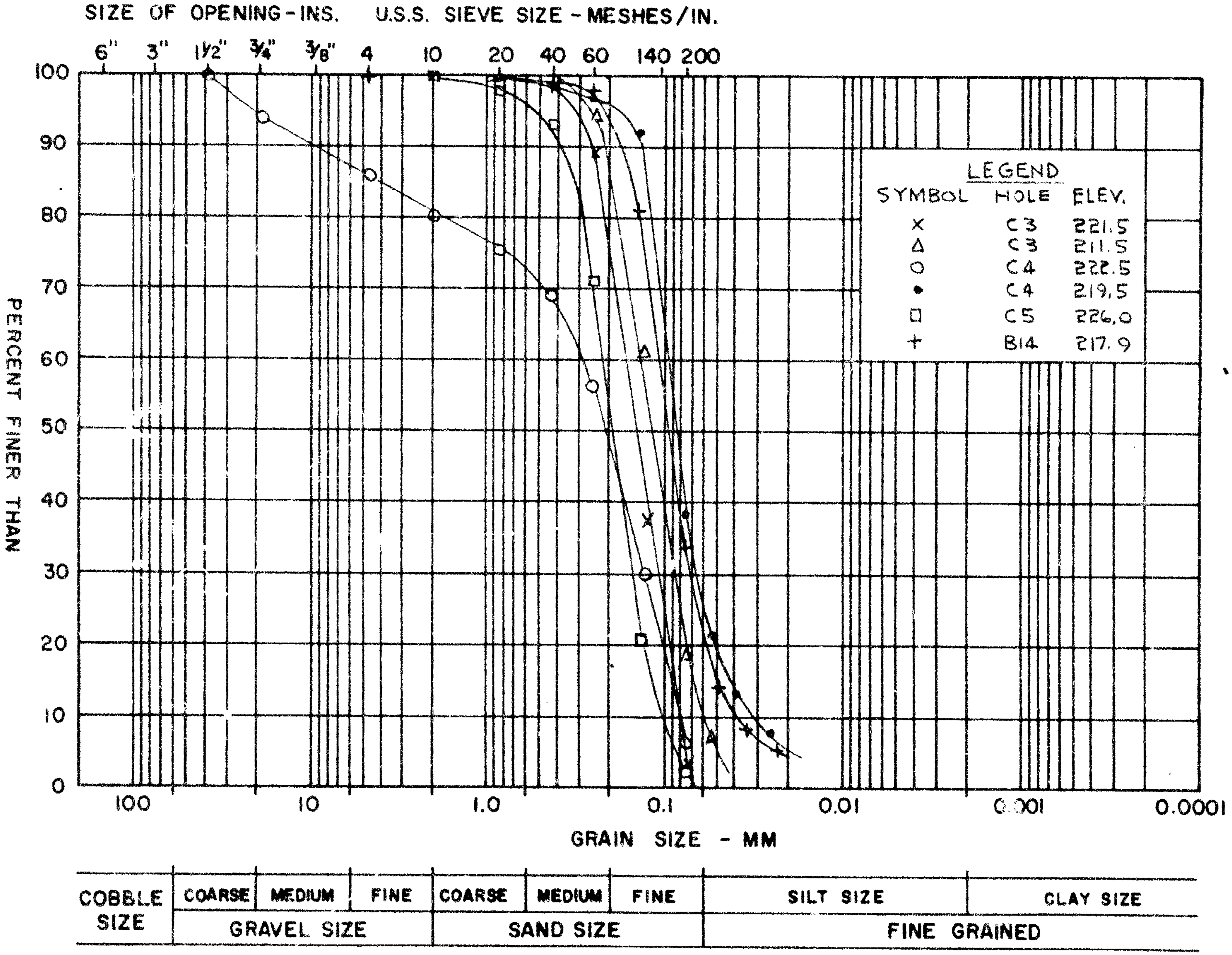


GRAIN SIZE DISTRIBUTION

MEDIUM TO SILTY FINE SAND

FIGURE 4

M.I.T. GRAIN SIZE SCALE



GOLDER & ASSOCIATES

GRAIN SIZE DISTRIBUTION

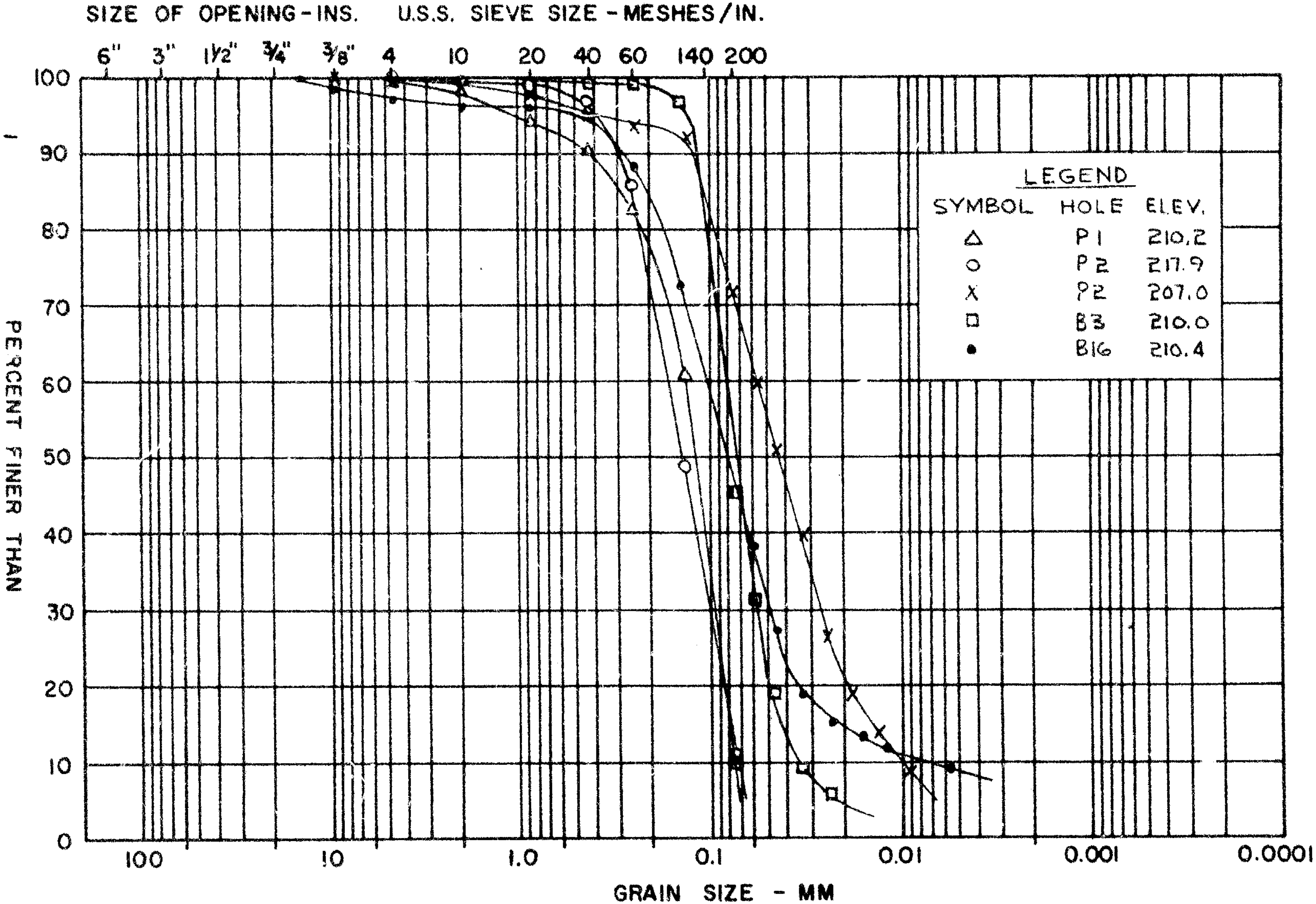
MEDIUM TO SILTY FINE SAND

FIGURE 5

GRAIN SIZE DISTRIBUTION

FINE SAND TO SANDY SILT

M.I.T. GRAIN SIZE SCALE

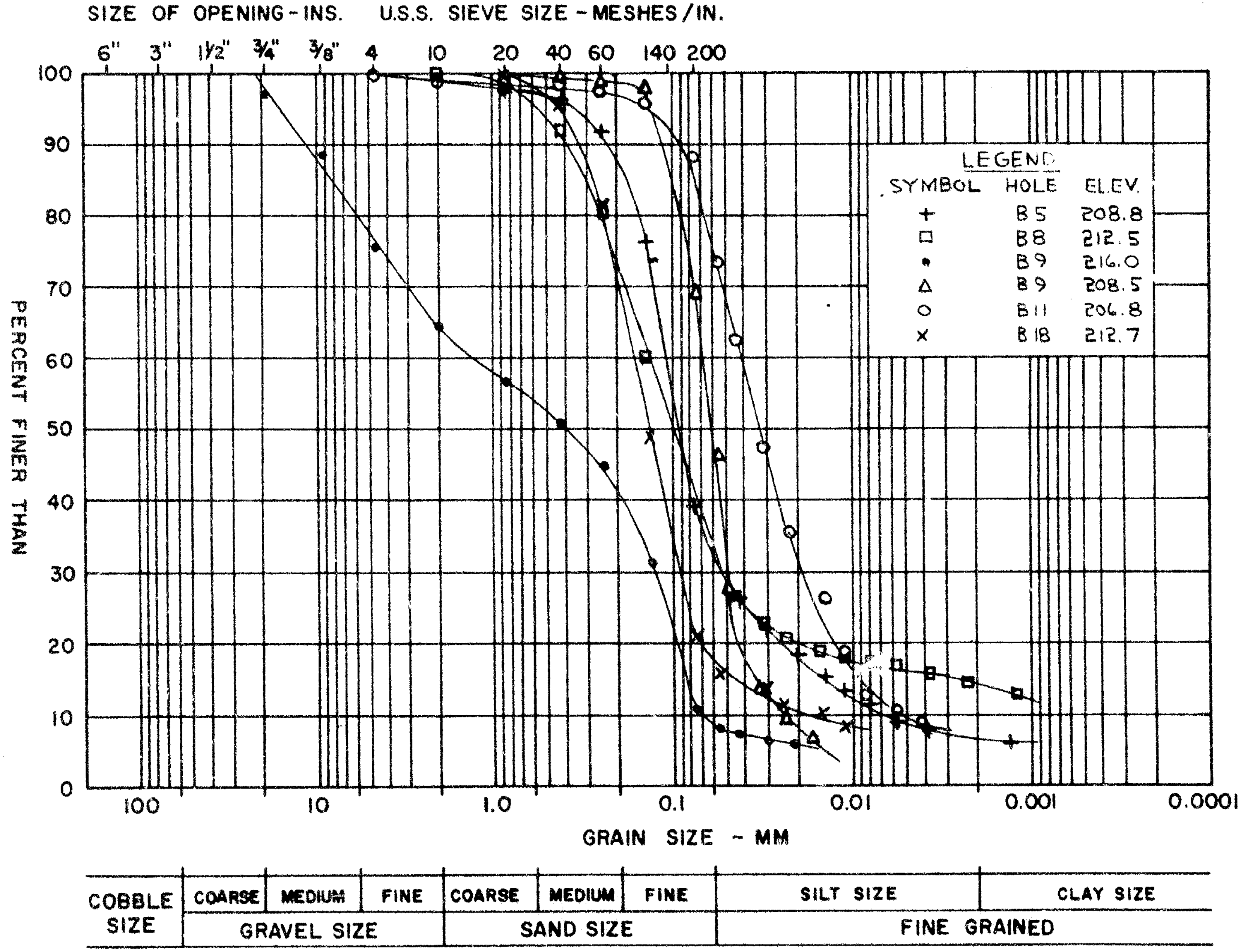


COBBLE SIZE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE
	GRAVEL SIZE			SAND SIZE			FINE GRAINED	

GOLDER & ASSOCIATES

FIGURE 6

M.I.T. GRAIN SIZE SCALE



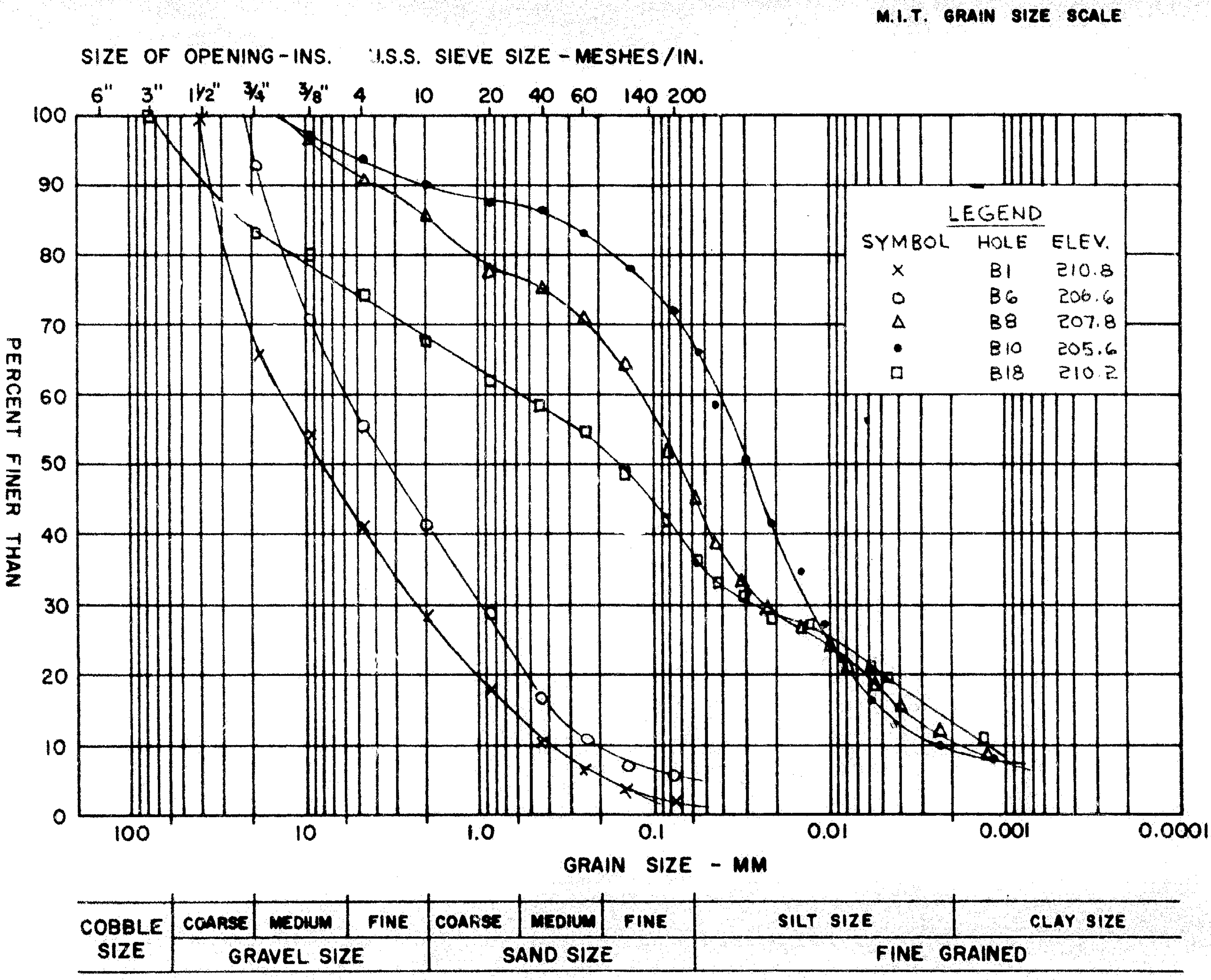
GOLDER & ASSOCIATES

GRAIN SIZE DISTRIBUTION

FINE SAND TO SANDY SILT

FIGURE 7

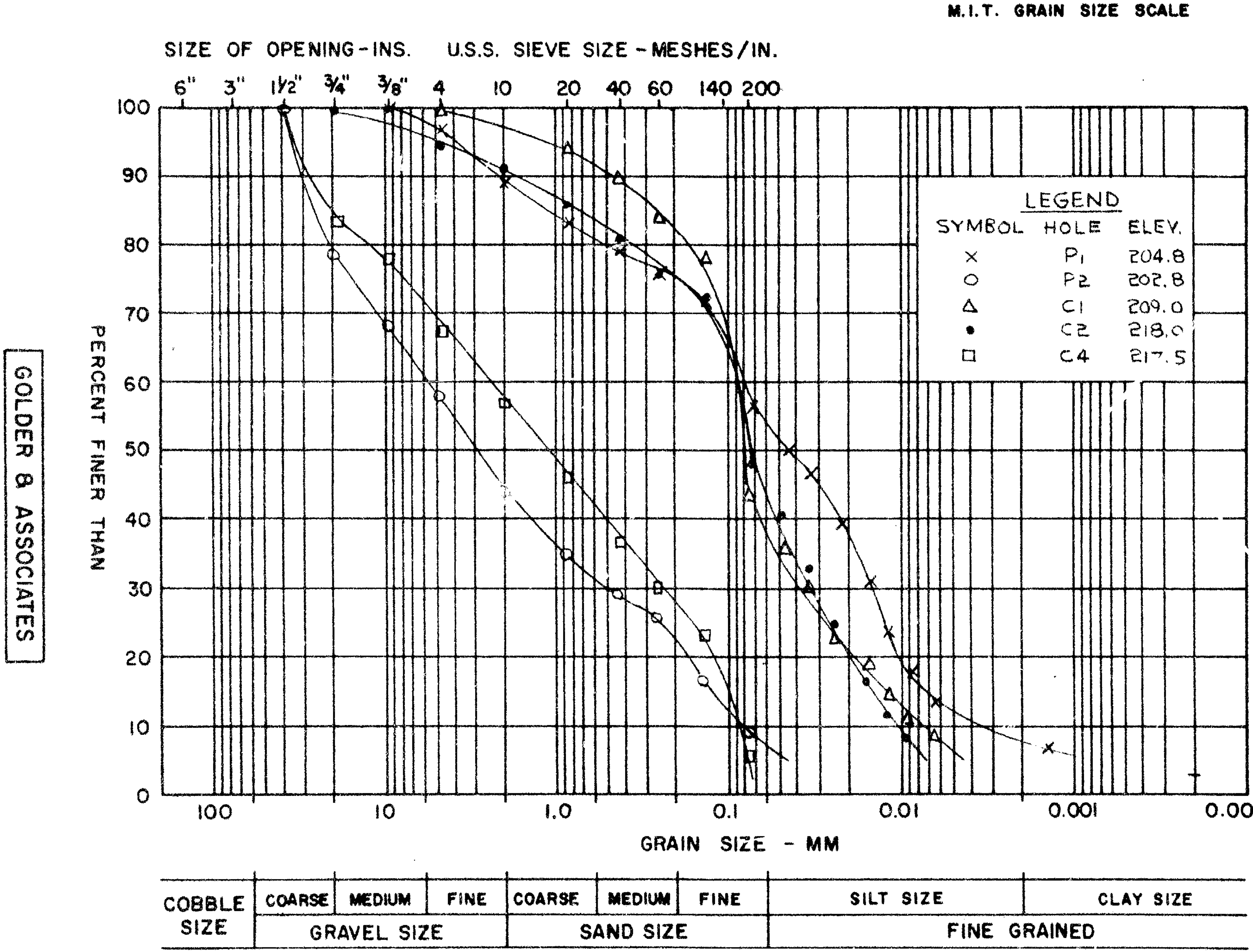
GOLDER & ASSOCIATES



GRAIN SIZE DISTRIBUTION

TILL

FIGURE 8



GRAIN SIZE DISTRIBUTION

TILL

FIGURE 9

62-F-223C

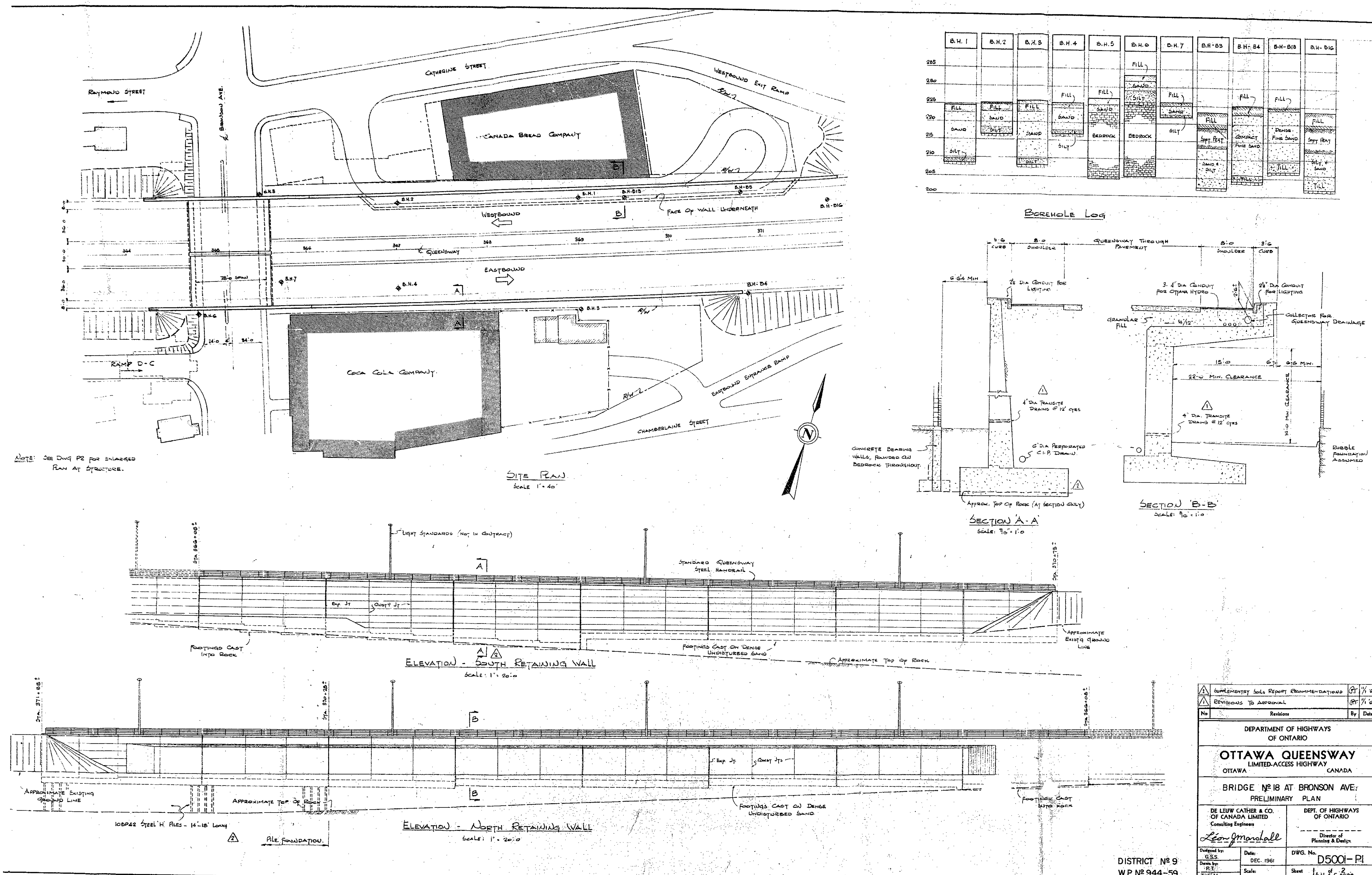
W.P. 944-59 &

W.P. 945-59

O.Q.W., RET. WALLS,

PERCY ST.

VICINITY.



No	Revisions	By	Date
2	SUPPLEMENTARY SOILS REPORT RECOMMENDATIONS	PT	11/62
1	REVISIONS TO APPROVAL	PT	1/62

DEPARTMENT OF HIGHWAYS OF ONTARIO

OTTAWA QUEENSWAY
LIMITED-ACCESS HIGHWAY
OTTAWA CANADA

BRIDGE Nº 18 AT BRONSON AVE.
PRELIMINARY PLAN

DE LEUW CATHER & CO. OF CANADA LIMITED
Consulting Engineers
Léon J. Marshall

DEPT. OF HIGHWAYS OF ONTARIO
Director of Planning & Design

Designed by: G.S.S.
Drawn by: P.T.
Checked by: G.G.S.
Date: DEC. 1961
Scale: AS SHOWN
DWG. No. D5001-P1
Sheet 1 of 2
JAN 15 1962