

SOIL INVESTIGATION
UNDERPASS BRIDGE - HIGHWAY NO. 401
TOWNSHIP OF SANDWICH SOUTH
COUNTY OF ESSEX
(SITE NO. 6-231 - PROJECT W.P. 132-64)

68-F-28

DOMINION SOIL INVESTIGATION LIMITED
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May 12, 1965.

OUR REF: 5-3-8

Ontario Department of Highways,
Materials & Testing Division,
Hwy. #401 & Keele
DOWNSVIEW, Ontario.

Attention: Mr. A. Rutka, P.Eng.,
Materials & Testing Engineer.

Re: Your W.P. 132-64 - Soil Investigation
for Proposed Intersection Highway #401
Site #6-231, Township of Sandwich South,
County of Essex.

Dear Sirs:

This letter accompanies our detailed report on the investigation carried out at the above site.

From the point of view of foundation design, the significant soil strata underlying the site consists of hard to stiff clayey tills. Thus it is considered that the site is suitable for the use of normal shallow spread and strip footing foundations for which an allowable bearing value of 9000 pounds per square foot has been given. Computed values of settlement under the foundations and the approach embankments are given in the report. Because these settlements are relatively high, it is suggested that the spans of the bridge be simply supported.

We thank you for this opportunity to be of service to you and trust that our report contains all the information that you require. However, if you should have any questions or wish to discuss the report in any way, please do not hesitate to call on us.

Yours very truly,

DOMINION SOIL INVESTIGATION LTD.


K. H. King, P.Eng.,
Chief Engineer.

KHK/is



ONTARIO DEPARTMENT OF HIGHWAYS
MATERIALS AND TESTING DIVISION
DOWNSVIEW - ONTARIO

REPORT ON
SOIL INVESTIGATION
FOR
UNDERPASS BRIDGE - HIGHWAY NO. 401
TOWNSHIP OF SANDWICH SOUTH
COUNTY OF ESSEX
(SITE NO. 6-231 - PROJECT NO. W.P. 132-64)

SUBMITTED BY
DOMINION SOIL INVESTIGATION LIMITED
77 CROCKFORD BOULEVARD
SCARBOROUGH ONTARIO

REFERENCE 5-3-8
MAY - 1965

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SUMMARY

The soil investigation at Bridge Site No. 6-231 on Highway No. 401 has been completed. A hard to stiff clay till forms the main soil type at the site of the proposed underpass. At depth of approximately 10 feet below ground level, normal spread footings can be used for the foundations and an allowable bearing pressure of 9000 pounds per square foot is suggested.

The settlements which will occur under the foundations will be caused mainly by the loading of the approach embankments. The structure should be designed as simply supported. If the embankments are constructed in advance of the structure, the settlement due to consolidation will be of the order of 2.0 inches at the centre pier and 3.6 inches at the intermediate piers.

No unusual construction problems are envisaged.

INTRODUCTION

The Department of Highways, Ontario, propose to erect a 4-span bridge with approach embankments to provide an underpass at the intersection of Highway No. 401 with road which runs between Concessions VIII and IX in the Township of Sandwich South, Essex.

An exploration of the site was carried out by Dominion Soil Investigation Limited to determine the subsurface condition in order to provide information for the design of the foundations for the proposed works and to assess any problems which are likely to be of importance during construction. This report describes the findings of the investigation with relevant recommendations.

SUBSURFACE CONDITIONS

On Drawing No. 5-3-8/1 two sections of the generalized soil profile are shown. These profiles have been inferred from the soils encountered in the boreholes which were advanced in accordance with the procedures outlined in Appendix I.

The details of the borehole logs are shown on Enclosures No. 2 to No. 6 and the results of Laboratory Tests on representative samples of the soils are tabulated in Appendix II, Table II.

The soil conditions are fairly uniform over the site and the soil profile may be divided into 2 main groups.

- I The superficial deposits of silt and clay mixed with organic matter; sand and gravel fill and topsoil.

- II An underlying clayey till, the upper zone of which has been weathered and heavily preconsolidated.

In more detail, the properties of the soils may be considered as follows:

I The surface deposits consist of thin layers of topsoil or fill material covering a dark brown silty clay in which there are traces of gravel and, in the region covered by Boreholes No. 4 and No. 5, a high organic matter content. These deposits range in thickness between 4 and 8.5 feet and are of firm to stiff consistency. "N" values within the deposits range between 4 and 12 blows per foot, and the undrained shear strength determined in situ by the vane method falls between 2540 pounds per square foot and 4130 pounds per square foot. The sensitivity of the soil as determined by the vane test, ranges between 2 and 3.5. One unconfined compression test was carried out on a sample of the soil recovered in the split-spoon sampler. The shear strength determined from this test gives a value of 2200 pounds per square foot.

Tests on one sample of this material gave a Liquid Limit of 39.0 percent, a Plastic Limit of 16.8 percent and a Dry Density of 102 pounds per cubic foot at a natural moisture content of 17.1 percent. The relatively low dry density and high Liquid Limit suggest a fairly high organic content in this soil and distinguish it from the underlying material.

II The glacial till is encountered as a distinct change in soil type. The uppermost 5 feet consist of a hard brown silty clay containing traces of sand and gravel. "N" values in this region range between 20 and 51 blows per foot with an average value of 36 blows per foot.

The natural moisture content falls between 12% and 16% and is close to the Plastic Limit of 14.5%. With a Liquid Limit of 25%, the Liquidity Index of this stratum is very small suggesting a heavily overconsolidated material with high shear strength. Unconfined compression tests on specimens obtained in the split-spoon sampler indicate shear strength values of 5000 to 7000 pounds per square foot. The bulk density was determined at values between 128 and 134 pounds per cubic foot.

Below a depth of 12 feet, the soil colour changes to grey and the consistency changes from hard to the range of stiff to very stiff. The "N" values tend to decrease with depth and range between 36 and 15 blows per foot.

At a depth of approximately 18 feet, the soil decreases in silt content and can be described as a stiff grey clay with some silt and traces of gravel. The "N" values in this zone range between 10 and 15 blows per foot. The natural moisture content in this layer shows a tendency to increase with depth and ranges between 16% and 20%. The Plastic Limit remains almost constant at about 15% but the Liquid Limit increases slightly to 27%. The Liquidity Index increases to between 0.25 and 0.6 and indicates that the soil has not been preconsolidated to the same extent as the upper crust.

The undrained shear strength measured in situ by the vane ranges between 2060 pounds per square foot and 3740 pounds per square foot with a sensitivity range of 1.4 to 2.0. The unconfined compression tests in the laboratory gave shear strength values between 1000 and 2200 pounds per square foot. The bulk density of this soil was estimated to be between 123 and 127 pounds per cubic foot.

Consolidation tests were carried out on the stiff grey clay sample recovered at a depth of 26 feet, in a thin-walled sample tube in Borehole No. 1. The relationship between pressure and void ratio is shown on Enclosure No. 7. Also presented on Enclosure No. 7 is the curve showing the variation of the coefficient of consolidation with the consolidating pressure.

The compression index of the clay measured on the normal consolidation part of the curve is 0.140 and compares favourably with the value of 0.15 obtained from the empirical relationship between the Liquid Limit and compression index of clays of medium sensitivity.

From the shape of the consolidation curve, it is estimated that at this site the clay has been precompressed by consolidation pressures of about 3 tons per square foot in excess of the existing overburden pressures.

WATER CONDITIONS

During the period covered by the exploration there was appreciable surface water runoff and infiltration. The depths to water in the boreholes were determined at various times and the observations are recorded on the Geo-technical Data Sheets.

The most reliable observation was taken in Borehole No. 5 in which the elevation of the water table was at 607.20 at the time of the exploration.

DISCUSSION

A bridge approximately 194 feet long and 34 feet wide together with approach embankments will provide the underpass for the main highway. The bridge will consist of two approach spans each 35 feet long and two intermediate spans each 62 feet long. To provide adequate headroom, approach fills will be approximately 20 feet high with side

slopes assumed at 1 (Vertically) on 2 (Horizontally) from a top width of 40 feet.

The loading on the centre pier is estimated at 18 tons per lineal foot, on the intermediate bents at 15 tons per lineal foot and on the abutments at 6 tons per lineal foot.

The surface deposit of silty clay varies considerably in organic matter content and consistency. It is advisable therefore that the foundations for the bridge be taken down to the next layer consisting of the hard brown silty clay till.

At and below Elevation 609, normal spread footings can be used. Between Elevations 609 and 606, the safe bearing pressure is estimated at 9000 pounds per square foot. This value allows for a Factor of Safety of 3 against shear failure and takes into consideration the decrease in soil strength below Elevation 600. It is desirable that the foundations be kept as close as possible to the top of the hard brown layer (El. 609) in order to take advantage of its higher load bearing capacity and the load distributing effect.

The stability of the approach embankments has been examined by the slip circle method and the Factor of Safety against sliding found to be greater than 2.5. In the exploration of Borehole No. 1 a thin layer of loose saturated sandy silt was described but similar layers were not encountered

in the other boreholes. It is concluded that the saturated sandy silt occurs in an isolated pocket; as such it is enclosed by the stronger clay layers and its presence is not therefore considered as significant.

The bearing capacity of the subsoil is therefore considered very suitable for the construction of normal spread footings to support the structure and the settlement characteristics will be examined next.

It was not practicable to obtain undisturbed samples of the hard crust forming the uppermost 5 feet of the glacial till for laboratory tests. It is, however, inferred from the consistency of this layer that the soil has been heavily preconsolidated and for practical purposes this layer may be considered as incompressible within the range of loading which will be induced by the structure.

The thickness of the underlying grey clayey till was not measured, but it is known from published information that the stratum extends down to Elevation 460 approximately (Ref.1).

It is considered that the results of tests carried out on the sample of the stiff grey clayey till recovered from depth 26 feet in Borehole No. 1 are representative of this layer in which the settlement which will be caused by consolidation will be significant. These results which are illustrated on Enclosure No. 7 have been used in the calculation of the settlements.

In the computation of the settlements, the width of footings was assumed to be 5 feet and the trapezoidal embankment section was considered as an equivalent rectangular load. The loading of the approach embankments has a considerable influence on the settlement of the abutments and the intermediate piers but has no significant effect on the centre pier.

In Table I below are presented the estimated settlements under the foundations:-

TABLE I
Settlement of the Bridge Foundations

| <u>Location</u> | <u>Load</u> | <u>Estimated Settlement in Inches</u> | |
|-------------------|-------------|---------------------------------------|------------|
| Abutment | Embankment | Elastic | 2.7 |
| | " | Consolidation | 2.6 |
| | Structure | | <u>0.6</u> |
| | | Total | <u>5.9</u> |
| | | | |
| Intermediate Pier | Embankment | Elastic | 1.6 |
| | " | Consolidation | 1.7 |
| | Structure | | <u>1.9</u> |
| | | Total | <u>5.2</u> |
| | | | |
| Centre Pier | Structure | Total | <u>2.0</u> |

If the embankments are constructed in advance of the footings, the total settlements will be reduced to:

| | |
|--------------------|-------------|
| Abutments | 3.2 inches |
| Intermediate Piers | 3.6 inches |
| Centre Piers | 2.0 inches. |

The settlements given above have been corrected for lateral deformation as proposed by Skempton and Bjerrum (Ref. 2). The Modulus of Elasticity of the soil was assumed to be 200 tons per square foot for the purpose of estimating the elastic settlement.

Due to the fact that the upper desiccated crust of the till layer has been neglected in the settlement calculation, it can be safely predicted that the given settlement values represent a conservative estimate. However, it is believed that, irrespective of the amount of settlement, the difference in settlements between the various bridge supports will remain and could possibly be even slightly larger. Because of this possibility, it is recommended that:

1. The bridge superstructure be designed with simply supported spans, and
2. The approach embankments be built in advance of the structure. This does not mean that stage construction is suggested but rather the proper construction sequence is outlined. This sequence will take care of the elastic settlements and thus reduce the total settlements to be expected after the superstructure is built.

An examination of the coefficient of consolidation and the range of applied pressures has indicated that no significant benefit would be derived from the application of

some surcharge. It is also estimated that it will take at least about 30 years for the greatest part of the aforementioned settlements to take place.

For the foundation of the abutments one of the following alternatives is recommended.

(a) Spread footings using 2.0 tons per square foot placed on compacted fill. The use of granular material for the portion of the compacted fill under the abutment footings is suggested because good compaction is easier achieved.

(b) Footings on piles driven through the embankment and the surface deposit 2 feet into the hard till crust. Steel tube, timber or concrete piles with an allowable load of 30 tons/pile are recommended. It should be emphasized that no benefit would be derived by driving the piles any deeper.

CONSTRUCTION

There are no construction problems which are considered to be worthy of note. The excavation for the proposed foundations will be carried out within the surface deposit of firm to stiff silty clay which may be braced or sloped.

In view of the low permeability of the soil, the quantity of water seeping into the excavation will be relatively small and together with any surface runoff can be readily removed by pumping from sumps.

The field work was carried out under the supervision of Mr. V. Chan, B.Sc., and the report which was reviewed by Mr. A. G. Stermac, P.Eng., M.Sc., was prepared by Mr. F. Debidin, Soils Engineer.

DOMINION SOIL INVESTIGATION LIMITED,



F. Debidin,
Soils Engineer.

FD/is

REFERENCES

1. L. G. Soderman, T. C. Kenney and A. K. Loh,
Geotechnical Properties of Glacial Clays in Lake
St. Clair Region of Ontario, Proceedings of the
Fourteenth Canadian Soil Mechanics Conference,
Technical Memorandum No. 69, page 55.
2. G. A. Leonards, Foundation Engineers,
McGraw-Hill Book Company, Inc., page 573.

APPENDIX IPROCEDUREField Work

The field work was carried out by drilling 5 boreholes during the period 2nd - 7th April, 1965. The location of the boreholes is shown on the plan of Drawing No. 5-3-8/1.

Drilling was carried out by the washboring method. Bx size casing was driven to depths of 10 feet beyond which the hole was advanced without casing. Samples were recovered in a 2" O.D. split-spoon sampler used in the Standard Penetration Resistance Test. Where the consistency of the soil permitted, shear vane tests were carried out with a 4-blade 2" diameter vane, 4 inches long. Both the undisturbed and remolded shear strengths were determined.

Cone penetration tests were carried out adjacent to each borehole by driving a 2" diameter 60 degree apex cone into the soils. Samples of soil were also recovered in thin walled sample tubes, sealed and shipped to the laboratory for further testing.

The water levels in the boreholes were observed at convenient intervals and the elevation of the ground surface at each borehole determined using as a reference the bench mark on the concrete culvert for which a value of El. 613.97 was given.

The maximum depth explored was approximately 40 feet.

Laboratory Tests

On selected representative samples, tests were carried out in the laboratory to determine the unconfined compressive strength, natural moisture contents, Liquid and Plastic Limits and bulk density of the soils. Consolidation tests were carried out on one sample to obtain the relevant factors for determining the settlement characteristics of the soil strata.

APPENDIX II - TABLE II

LABORATORY TEST RESULTS

| Borehole No. | Sample No. | Depth Ft. | Shear Strength p.s.f. | L.L. % | P.L. % | Natural Moisture Content % | Liquidity Index | Density Bulk | p.c.f. Dry |
|--------------|------------|-----------|-----------------------|--------|--------|----------------------------|-----------------|--------------|------------|
| 1 | 2 | 6 | 2220 | 39.0 | 16.8 | 17.1 | 0.01 | 119 | 102 |
| | 3 | 8 | 3600 | 25.3 | 15.4 | 14.6 | - | 128 | 112 |
| | 4 | 11 | 5530 | - | - | 12.4 | - | 131 | 117 |
| | 5 | 13 | 6105 | - | - | 13.3 | - | 128 | 114 |
| | 6 | 15 | - | 24.9 | 14.7 | 14.7 | - | - | - |
| | 9 | 26 | 2380 | 26.6 | 14.8 | 15.8 | 0.09 | 123 | 107 |
| | 12 | 36 | - | 25.0 | 13.8 | 20.3 | 0.58 | - | - |
| 2 | 3 | 7.5 | 3520 | - | - | 18.7 | - | 134 | 113 |
| 3 | 1 | 3 | - | - | - | 21.5 | - | - | - |
| | 2 | 6 | - | - | - | 22.3 | - | - | - |
| | 3 | 9 | 4820 | - | - | 16.8 | - | 123 | 110 |
| 4 | 2 | 6 | 2530 | - | - | 20.3 | - | 132 | 110 |
| | 3 | 9 | 7280 | - | - | 15.6 | - | 125 | - |
| 5 | 2 | 6 | 7070 | - | - | 17.7 | - | 123 | - |
| | 5 | 16 | 3730 | 28.4 | 14.7 | 13.4 | - | - | - |
| | 7 | 22 | 2195 | - | - | 15.7 | 0.07 | 127 | 111 |
| | 8 | 26 | - | 28.9 | 15.4 | 16.5 | - | 127 | - |
| | 9 | 31 | - | 28.9 | 15.4 | 18.0 | 0.25 | - | - |
| | 9 | 31 | - | 25.9 | 13.8 | 19.7 | 0.49 | - | - |
| | 11 | 36 | 1085 | - | - | 17.3 | - | 123 | - |
| | 12 | 39 | - | 27.5 | 14.1 | 18.1 | 0.30 | - | - |

Enclosures

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.

| | | | | | | | | | | | | |
|---------------------------|--------|--------|------|--------|--------|--------|---------|-------|----------|---------------|--------------------|------------------|
| | | | | | | | | | | | | |
| BOULDER | COBBLE | GRAVEL | | SAND | | | SILT | CLAY | ORGANICS | BEDROCK | GROUND WATER LEVEL | DEPTH OF CAVE-IN |
| | | COARSE | FINE | COARSE | MEDIUM | FINE | | | | | | |
| 10 | > 8" | 3" | 3/4" | 4.75mm | 2.0 | 0.42 | 0.074 | 0.002 | > | NO SIZE LIMIT | | |
| U.S. Standard Sieve Size: | | | | No. 4 | No. 10 | No. 40 | No. 200 | | | | | |

SAMPLE TYPES.

AS Auger sample

CS Sample from casing

CHS Chunk sample

RC Rock core

% Recovery

SS Split spoon sample

TP Piston, thin walled tube sample

TW Open, thin walled tube sample

WS Wash sample

SAMPLER ADVANCED BY static weight : w
 " pressure : p
 " tapping : t

OBSERVATIONS
 MADE WHILE
 CORING

Steady pressure
 No pressure
 Intermittent pressure

Washwater returns
 Washwater lost

PENETRATION RESISTANCES.

DYNAMIC PENETRATION RESISTANCE : to drive a 2" dia, 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

STANDARD PENETRATION RESISTANCE, -N- : to drive a 2" outside dia, split spoon sampler 1 foot into the ground, expressed in blows per foot.

EXTRAPOLATED -N- VALUE

The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

SYMBOL :



322

SOIL PROPERTIES.

W % Water content
 LL % Liquid limit
 PL % Plastic limit
 PI % Plasticity index
 LI Liquidity index

γ Natural bulk density (unit weight)
 e Void ratio
 RD Relative density
 C_v Coeff. of consolidation
 m_v Coeff. of volume compressibility

k Coeff. of permeability
 C Shear strength in terms of total stress
 ϕ Angle of int. friction
 C' Cohesion in terms of effective stress
 ϕ' Angle of int. friction

UNDRAINED SHEAR STRENGTH.

- DERIVED FROM -

TRIAXIAL COMPRESSION TEST



UNCONFINED TEST



LABORATORY

VANE TEST



FIELD



POCKET PENETROMETER TEST



Strain at failure is represented by direction of stem

20%
 15% + 5%
 10%

St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

SOIL DESCRIPTION.

COHESIONLESS SOILS :

RD :

Very loose 0 - 15 %
 Loose 15 - 35 %
 Compact 35 - 65 %
 Dense 65 - 85 %
 Very dense 85 - 100 %

COHESIVE SOILS :

C lbs/sq ft

Very soft less than 250
 Soft 250 - 500
 Firm 500 - 1000
 Stiff 1000 - 2000
 Very stiff 2000 - 4000
 Hard over 4000

GEOTECHNICAL DATA SHEET FOR BOREHOLE I. I. I.

OUR REFERENCE NO. 5-3-8

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS
PROJECT: PROPOSED UNDERPASS
LOCATION: BRIDGE SITE NO. 6-231 HWY. NO. 401
DATUM ELEVATION: GEODETIC

METHOD OF BORING: WASH-BORING
DIAMETER OF BOREHOLE: 2 3/8"
DATE: APRIL 2, 1965

ENCLOSURE NO. 2

| ELEVATION ft. | DEPTH ft. | STRATIFICATION DESCRIPTION | SYMBOL | SAMPLES | | | PENETRATION RESISTANCE Blows per foot | | | | | CONSISTENCY water content % | | | | REMARKS |
|------------------|--------------|-------------------------------------|--------|---------|------|-----------------|--|----|----|----|----|--------------------------------|----|----|----|---------|
| | | | | NUMBER | TYPE | WATER CONTENT % | 10 | 20 | 30 | 40 | 50 | 10 | 20 | 30 | 40 | |
| 616.0 | 0 | GROUND SURFACE | | | | | | | | | | | | | | |
| 615 | | FIRM to STIFF dark brown organic | | | | | | | | | | | | | | |
| | | SILTY CLAY | | 1 | S.S. | 7 | | | | | | | | | | |
| | | traces of FINE | | | | | | | | | | | | | | |
| | | SAND and GRAVEL | | 2 | S.S. | 9 | | | | | | | | | | |
| 610 | 6.0 | HARD brown | | 3 | S.S. | 38 | | | | | | | | | | |
| | | SILTY CLAYEY TILL | | | | | | | | | | | | | | |
| | | traces of | | 4 | S.S. | 51 | | | | | | | | | | |
| 605 | | SAND and GRAVEL | | | | | | | | | | | | | | |
| | | | | 5 | S.S. | 36 | | | | | | | | | | |
| | | | | 6 | S.S. | 15 | | | | | | | | | | |
| 600 | | GREY | | 7 | S.S. | 17 | | | | | | | | | | |
| | | | | 8 | S.S. | 11 | | | | | | | | | | |
| 595 | | CLAYEY TILL | | | | | | | | | | | | | | |
| | | | | 9 | T.W. | W | | | | | | | | | | |
| 590 | | some SILT | | 10 | S.S. | 15 | | | | | | | | | | |
| | | | | 11 | S.S. | 13 | | | | | | | | | | |
| 585 | | traces of | | | | | | | | | | | | | | |
| | | | | 12 | T.W. | W | | | | | | | | | | |
| 580 | | SAND and GRAVEL | | 13 | S.S. | 15 | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 575 | 40 | END OF BOREHOLE | | | | | | | | | | | | | | |

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE J.B.E. CHD

GEOTECHNICAL DATA SHEET FOR BOREHOLE . 2 . .

OUR REFERENCE NO. 5-3-8

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS
 PROJECT: PROPOSED UNDERPASS
 LOCATION: BRIDGE SITE N° 6-231
 DATUM ELEVATION: GEODETIC

METHOD OF BORING: WASH BORING
 DIAMETER OF BOREHOLE: 2 3/8"
 DATE: APRIL 2, 1965

ENCLOSURE NO. 3

| ELEVATION ft. | DEPTH ft. | STRATIFICATION DESCRIPTION | STRATIFICATION SYMBOL | SAMPLES | | | PENETRATION RESISTANCE blows per foot | | | | | CONSISTENCY water content % | | | | REMARKS |
|------------------|--------------|--|--------------------------|-------------|------|-----------------------------------|--|----|----|----|----|--------------------------------|---|----|--|----------------------------|
| | | | | NUMBER | TYPE | N - Adj. content of sampler | 10 | 20 | 30 | 40 | 50 | PL | W | LI | | |
| 617.0 | 0 | GROUND SURFACE | | | | | | | | | | | | | | |
| 615 | 3.5 | GRANULAR FILL | | 1 | S.S. | 11 | | | | | | | | | | EL. 616.4 APR. 6, 1965. |
| | 5 | STIFF brown SILTY CLAY | | 2 A B | S.S. | 9 | | | | | | | | | | EL. 612.6 APR. 5, 1965. |
| 610 | 7.5 | HARD brown SILTY CLAYEY TILL traces of | | 3 | T.W. | W | | | | | | | | | | X = 134 P.C.F. |
| | 10 | SAND and GRAVEL | | 4 | S.S. | 50 | | | | | | | | | | |
| 605 | 12.5 | GREY HARD STIFF CLAYEY TILL some SILT traces of | | 5 | S.S. | 33 | | | | | | | | | | |
| | 15 | SAND and GRAVEL | | 6 | S.S. | 24 | | | | | | | | | | |
| 600 | 20 | END OF BOREHOLE | | | | | | | | | | | | | | |
| 595 | | | | | | | | | | | | | | | | |

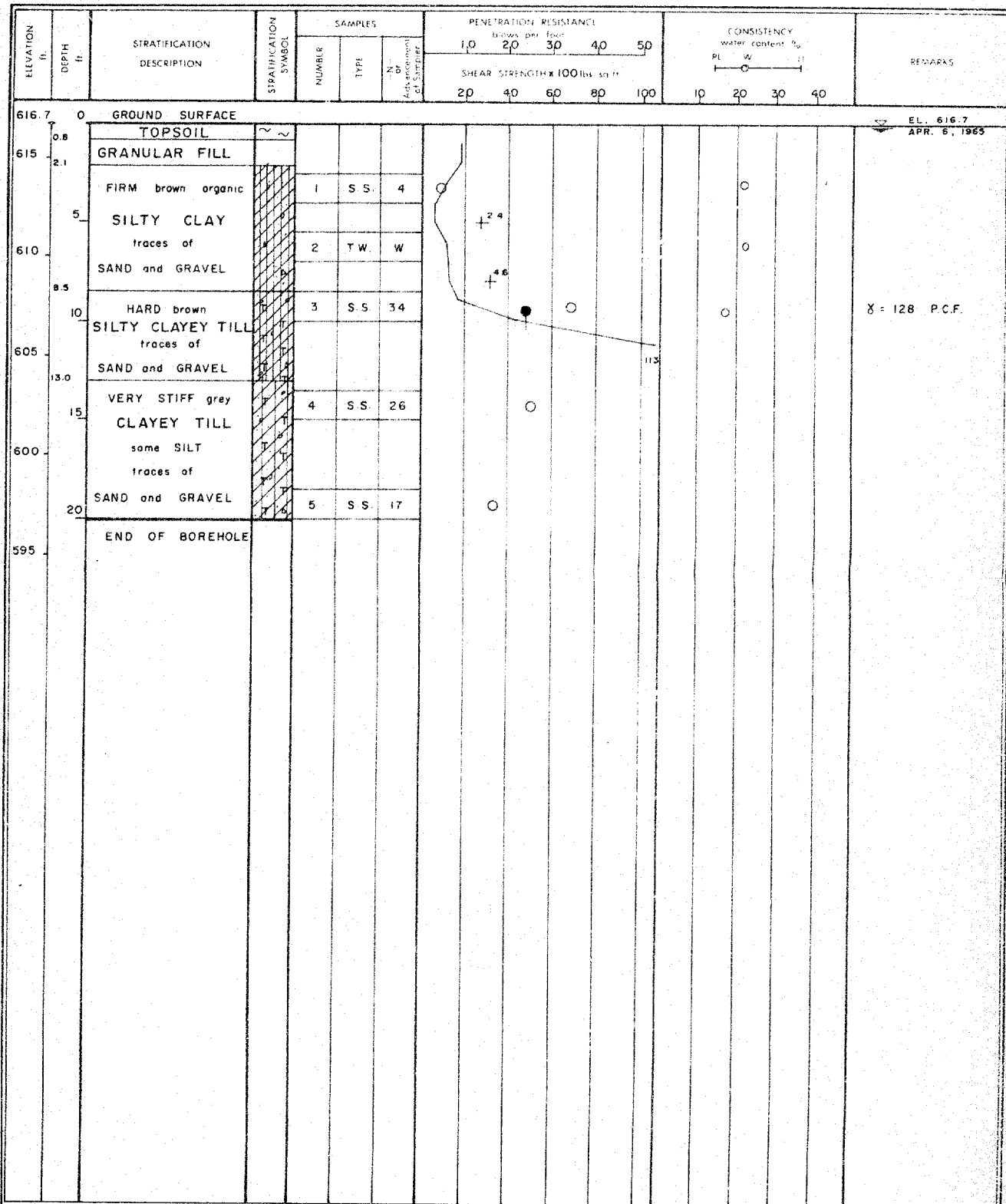
GEOTECHNICAL DATA SHEET FOR BOREHOLE 3

OUR REFERENCE NO 5-3-8

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS
PROJECT: PROPOSED UNDERPASS
LOCATION: BRIDGE SITE N° 6-231 HWY. N° 401
DATUM: ELEVATION GEODETIC

METHOD OF BORING: WASH-BORING
DIAMETER OF BOREHOLE: 2 3/8"
DATE: APRIL 5, 1965

ENCLOSURE NO. 4



VERTICAL SCALE: 1 IN TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: J.B.E. CHD

OUR REFERENCE NO. 5 - 3 - 8

FACULTY: 40 5

DIAMETER OF BOREHOLE 2 3/8"
DATE APRIL 5, 1965

[illegible]

VERTICAL SCALE: 1 IN TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE J.B.E. CHD

OUR REFERENCE NO. 5-3-8

GEOTECHNICAL DATA SHEET FOR BOREHOLE . 5 . . .

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS

METHOD OF BORING: WASH BORING

PROJECT: PROPOSED UNDERPASS

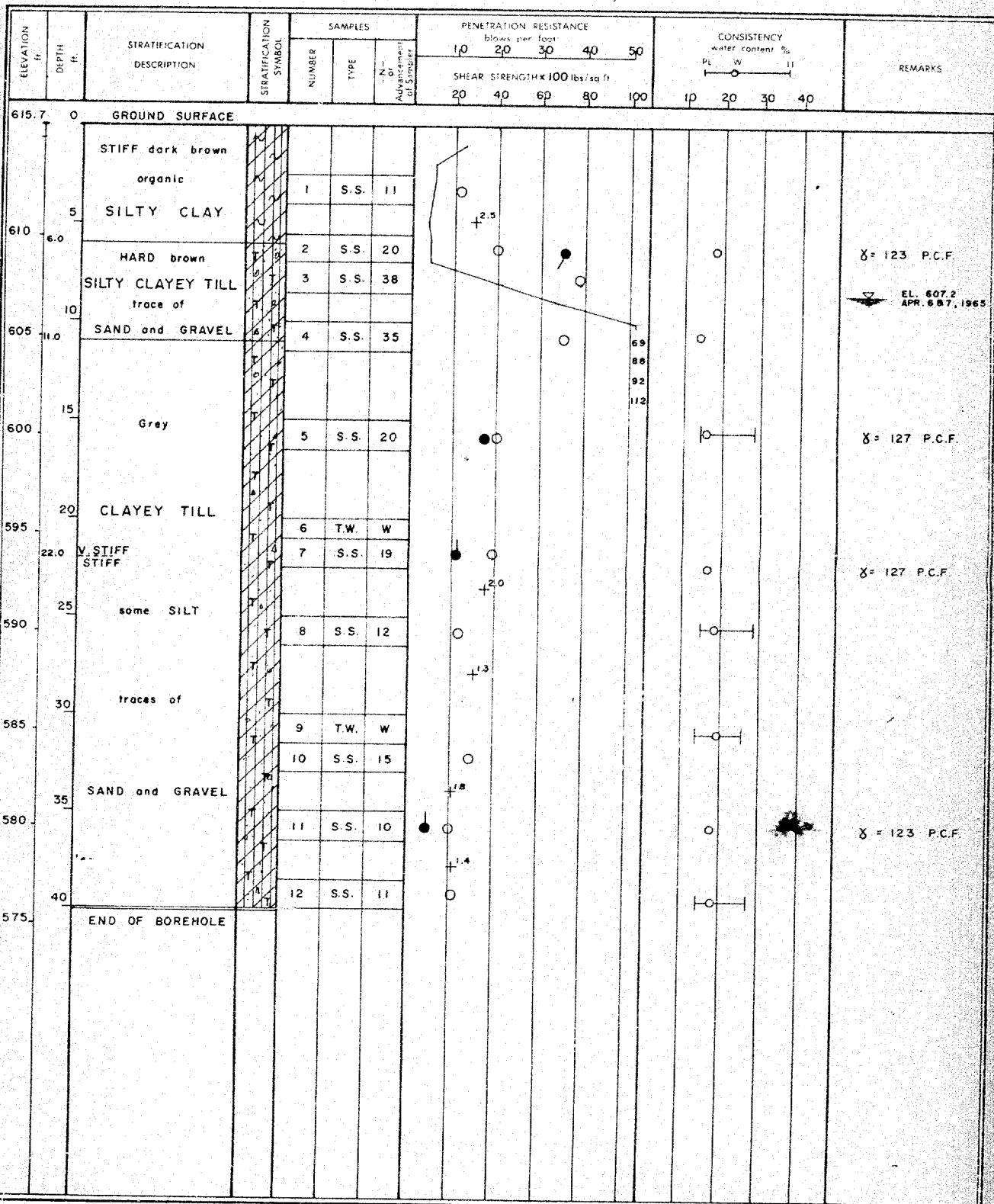
DIAMETER OF BOREHOLE: 2 3/8"

ENCLOSURE NO. 6

LOCATION: BRIDGE SITE NO 6-231 HWY. NO 401

DATE: APRIL 6, 1965

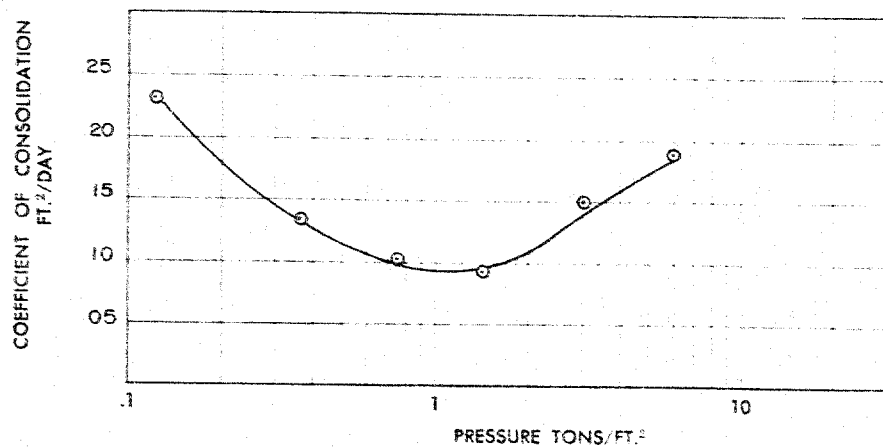
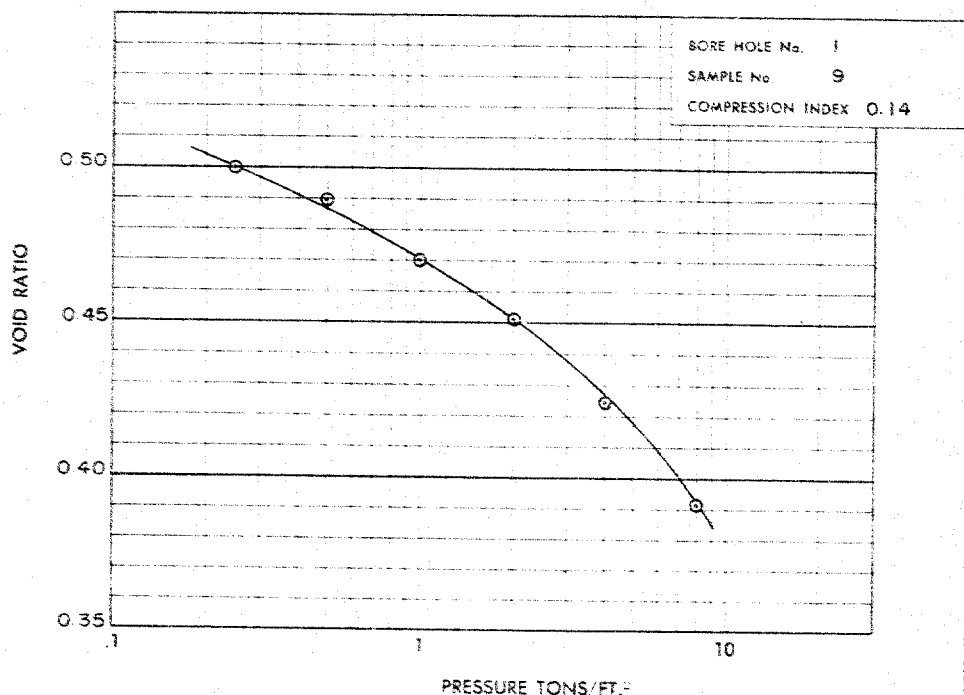
DATUM ELEVATION: GEODETIC



VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: J. B. E. CH'D:

Dominion Soil Investigation Ltd.**CONSOLIDATION TEST**

MEMORANDUM

To: Mr. F. C. Brown,
District Engineer,
District #1 (Chatham).

FROM: Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attn: Mr. P. H. Peacock,
Construction Engr.

DATE: June 6, 1968

OUR FILE REF.

IN REPLY TO

SUBJECT:

INSTALLATION OF SETTLEMENT MONITORING DEVICES
Hwy. #401 Structures - County of Essex
District No. 1 (Chatham)
Contract 67-01 -- W.P. 132-64 -- W.J. 68-F-28

Settlement observations are being carried out at three underpass structure locations presently being constructed along Hwy. 401; the sites are located immediately east of Windsor, Ontario. This memo will describe the type of installations and the frequency and number of readings required to provide the necessary settlement data.

INSTRUMENTS INSTALLED:

1. Settlement Plates:

Five settlement plates were installed beneath existing ground surface at each structure location. These plates are located some 40 to 50 feet behind the proposed location of the south abutment.

Following placement of the approach fills, the plates will be buried. It will be necessary to locate the plates and install extensions in order to determine the elevations of the plates at various periods following construction. With this in mind, we have requested that your construction personnel notify us as soon as the fill, in the vicinity of the plates, is brought up to final grade. At this time we will make arrangements to have a drill rig proceed to the site and drill through the fill to locate the plates and install extensions.

Elevations can be taken on top of the extensions; by doing this, the settlement of the foundation subsoil, due to the surcharge loading of the embankment, can be determined.

2. Cut-crosses and Brass Plugs:

The settlement observation of the piers and abutments on the clayey silt subsoil, is also required. This is accomplished in the following way:

cont'd. /2 ...

Mr. F. C. Brown,
District Engineer,
District #1 (Chatham).

Attn: Mr. F. H. Peacock,
Construction Engr.

2.

June 6, 1968

INSTRUMENTS INSTALLED: (cont'd.) ...

2. Cut-crosses and Brass Plugs: (cont'd.) ...

Once the pier footings are poured, crosses are cut at either end of the footings; elevations are periodically taken on these crosses. Following the pouring of the columns, and prior to backfilling of the footing excavations, brass plugs are installed on the outer face of each of the end columns at the pier footing location. These plugs are placed about 1 foot above finished grade. At this stage the reference elevation is transferred from the cut-crosses to the plugs. In a similar manner, brass plugs are installed on either side of the abutments following installation of the same.

3. Benchmark:

A benchmark was installed at each structure location. This benchmark is located outside the sphere of influence of the proposed construction.

The location and elevation of the settlement plates, brace plugs and benchmarks, are given in Table I attached to this memo.

LOADING HISTORY:

In order to co-relate the settlements recorded under various load influences, it is imperative that we be supplied with the complete loading history and sequence of construction. In this regard, your construction personnel have agreed to periodically provide the following information:

- i) the dates and locations of all concrete pours.
- ii) the dates of approach fill construction including the elevations of fill; and
- iii) all other pertinent loading information.

cont'd. /3 ...

Mr. F. C. Brown,
District Engineer,
District #1 (Chatham).

3.

Attn: Mr. P. H. Peacock,
Construction Engr.

June 6, 1968

SEQUENCE OF SETTLEMENT OBSERVATIONS:

Survey elevations will be required periodically to allow the determination of the time rate of settlement performance of the various structure components. As the period immediately following construction is critical, as far as the time rate is concerned, we would request that a weekly set of elevations be taken on all the plugs and settlement plates. Periodically, a record of these readings should be forwarded to this office.

Your construction personnel have agreed to forward the above information as soon as it becomes available. We are most appreciative of the cooperation you and your staff have given us in this matter. If there are any questions with regard to the installation and subsequent readings required, please do not hesitate to contact this office.

MD/MdeF

cc: Foundations Files
Gen. Files

Devata
M. Devata,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Sternac,
PRINCIPAL FOUNDATION ENGR.

TABLE I

INSTALLATION OF SETTLEMENT DEVICES

Contract #67-01 -- W.P. 132-64 -- W.J. 68-F-28

SETTLEMENT PLATES

BENCHMARK

| <u>Install. Date</u> | <u>No.</u> | <u>Location</u> | <u>Initial Elevation</u> | <u>Install. Date</u> | <u>No.</u> | <u>Location</u> | <u>Elevation</u> |
|--------------------------|------------|-------------------------|------------------------------|--------------------------|------------|--------------------------|------------------|
| Apr. 5/68 | 1 | Sta. 13+60, Q | 615.82 | May 13/68 | - | Sta. 13+55, O/S 215' Rt. | 615.5 |
| " | 2 | Sta. 13+60, O/S 17' Lt. | 615.17 | | | | (top of 1" |
| " | 3 | Sta. 13+60, O/S 17' Rt. | 614.58 | | | | Dia. |
| " | 4 | Sta. 13+60, O/S 57' Lt. | 613.58 | | | | Black |
| May 1/68 | 5 | Sta. 13+60, O/S 57' Lt. | 613.57 | | | | Pipe) |

CUT-CROSSES

BRASS PLUGS

| <u>No.</u> | <u>Location</u> | <u>Install. Date</u> | <u>Elevation</u> | <u>Install. Date</u> | <u>Elevation</u> |
|------------|--------------------|--------------------------|------------------|--------------------------|------------------|
| 1 | E. Side - S. Abut. | - | - | - | - |
| 2 | E. Side - Pier #1 | Apr. 5/68 | 611.99 | Apr. 23/68 | 619.04 |
| 3 | E. Side - Pier #2 | " | 612.06 | " | 618.89 |
| 4 | E. Side - Pier #3 | " | 612.02 | " | 618.83 |
| 5 | E. Side - N. Abut. | - | - | - | - |
| 6 | W. Side - S. Abut. | - | - | - | - |
| 7 | W. Side - Pier #1 | Apr. 5/68 | 612.06 | Apr. 23/68 | 619.07 |
| 8 | W. Side - Pier #2 | " | 612.00 | " | 618.90 |
| 9 | W. Side - Pier #3 | " | 612.00 | " | 618.86 |
| 10 | W. Side - N. Abut. | - | - | - | - |

Note: Reference Elevation Transferred from
Cut-crosses to Brass Plugs.

Bridge Division,
Barnesville, Ontario,
November 1, 1965.

MEMORANDUM:

To File

RE: Proposed structures on Hwy. 401,
located 0.6 miles to 0.9 miles
East of Hwy. 98.
District NO. 1, Chatham,
H.P. 127-64, 128-64, 129-64,
131-64, 132-64, 133-64, 310-64,
659-64 and 679-64.

At a meeting between Mr. H. Devata of Foundations Branch
and H. Inesi of Bridge Division, concerning the above structures
held on October 28, 1965 at the Bridge Office, it was
agreed that:

1. The spread footings for all the piers can be designed for
a bearing capacity of $2\frac{1}{2}$ tons/sq. ft.
2. The abutment piles for all the structures if driven in
accordance with the recommendations given in the indi-
vidual Foundation Reports, can be designed to carry
30 tons/pile.
3. The structures should be designed to tolerate a minimum
differential settlement between the abutments and shoulder
piers in the order of 1 to $1\frac{1}{2}$ inches.

KED/CS

c.c. R. C. Starnes ✓
G. Scott

H. C. Inesi,
Bridge Project Engineer.

Mr. S. McCombie,
Bridge Planning Engr.,
Bridge Division.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attn: Mr. N. Soltay,
Bridge Location Engr.

August 5, 1965

- W.P. 18-62 - C.P.R. Overhead, Hwy. #9, Harriston.
W.P. 131-64 - Sandwich S. Twp. Rd. Concession XI U'Pass.
✓ W.P. 132-64 - Essex County Rd. No. 27 U'Pass.

We have reviewed the Preliminary Plans D-5646-P1,
D-5722-P1, and D-5723-P1 for the above-mentioned proposed
structures with respect to the foundation design.

In all cases, the designer appears to have followed
the recommendations contained in our foundation reports.

KSS/MaeF

cc: Foundations Office
Gen. Files

J. G. Selby
J. G. Selby,
SENIOR FOUNDATION ENGINEER
For:
J. G. Sternac,
PRINCIPAL FOUNDATION ENGINEER

MEMORANDUM

To: Mr. K. Selby,
Foundation Section,
Lab. Building.

From: Bridge Division,
Downsview, Ontario.

DATE: July 16, 1965.

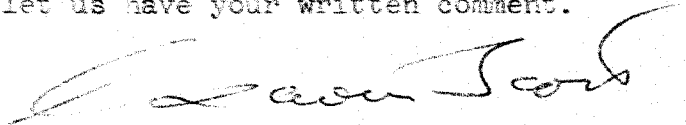
OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 132-64,
Site 6-231,
Essex County Road No. 27 U'pass,
Hwy. 401, District 1.

We are sending to you herewith one print of our preliminary plan D 5723-P2 for the subject structure.

Would you please let us have your written comment.



GS/ds
c.c. N.D. Smith

G. Scott,
Regional Bridge Location Engineer.

Mr. A. J. Foye,
Bridge Engineer,
Bridge Division.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

Attention: Mr. S. McMillan

May 17, 1967

FOUNDATION INVESTIGATION REPORT #1:
Dominion Soil Investigation, Limited.
Underpass Bridge - Highway No. 401,
Township of Sandwich South, County of
Essex, District #1 (Chatham, Ontario)
Site No. 6-231 -- W.P. 132-64

Attached, please find the above-mentioned report
submitted by the Consultant, Dominion Soil Investigation,
Ltd. We have reviewed the report and found the factual
information both adequate and well presented. We are in
agreement with the recommendations contained therein, and
since we find these self-explanatory, no comment is needed.

Should there be any queries in connection with this
project, please do not hesitate to contact our office.

WFL/MSMF
Attach.

cc: Messrs. A. J. Foye (2)
R. A. Tragaske
R. S. McMillan
A. Cater
R. C. Brown
J. Roy
A. Watt

Foundations Office ✓
Gen. Files

K. J. Ho
K. J. Ho,
SUPERVISING FOUNDATION ENGINEER

Hwy. 401 & Seale St.,
Downsview, Ontario.

March 15, 1965

Materials and Testing Division

Reinforced Soil Investigation, Ltd.,
77 Crookford Blvd.,
Scarborough, Ontario.

Attention: Mr. E. Sims

Re: M.T. 131-64, Sr. Site #6-233, Sandwich South Township
Ed. Interchange, 24.3 Miles S. of West Junction, Hwy. #2,
Hwy. 401, District 1, Chatham, Ont.

M.T. 132-64, Sr. Site #6-231, Sandwich South Township
Ed. Interchange, 26.3 Miles S. of West Junction, Hwy. #2,
Hwy. 401, District 1, Chatham, Ont.

Dear Sir:

Please consider this your authority to carry out foundation investigations at the above-mentioned sites. The necessary plans are attached to this letter.

The sites are readily accessible and no problems are anticipated regarding the setting up of drill rigs.

The proposed size and outlay of the structures are sketched in red on the respective drawings, and we feel that you should have no difficulty in laying out the necessary borings.

Both structures are in District No. 1 - the District Engineer is Mr. E. C. Brown, Maintenance Engineer is Mr. G. W. Langlands, both in Chatham, while the Regional Materials Engineer, Mr. J. Roy, is with the Regional Office in London. Would you please advise the two latter persons of the time your crew will move to the site.

It is understood that the investigations will be carried out by the personnel of your London Office and all the mobilization costs will be charged accordingly. It is also understood that a qualified Soils Engineer will be in charge of the field work at all times.

Two copies of the completed foundation reports, with one additional copy of each subsoil profile, should be submitted to the

cont'd. /2 ...

March 15, 1965

Foundation Section prior to May 15, 1965. Previous requirements as to preliminary borehole information and laboratory testing program, should be followed.

Because the drawings accompanying the foundation reports, showing the location of borings, the inferred subsoil conditions, etc., are to become contract drawings, you are requested to prepare them in accordance with the D.M.C. standards. To enable you to do this, we are supplying you with sample drawings with all the necessary explanations, together with linen sheets for your drawings. You are also requested to provide the D.M.C. with Cronaflex copies of the drawings.

Charges for the work performed will be in accordance with your Schedule of Rates, dated July 6, 1964, and invoices to be addressed to the attention of the undersigned.

We are attaching Purchase orders J 34782 and J 34783, covering the purchase of any new material required for these projects, in order that you may use these as a basis for exemption from the Federal Tax for such purposes. The Exemption Certificate is printed thereon.

AGS/MSF

Encls. -

Plan 2-4331-1 (Two copies)

Plan 2-4332-1 (Two copies)

Yours very truly,

A. Lutka

A. Lutka,

MATERIALS & TESTING ENGINEER

cc: Messrs. C. McCombie

A. Gater

F. C. Brown

J. Roy

H. Konings

R. D. Smith (2)

Foundations Office ✓

Gen. Files (2)

Mr. P. C. Brown,
District Engineer,
Chatham, Ontario.

Materials & Testing Division.

Attn: Mr. P. Peacock.

April 5, 1966.

Installation of Settlement Plates at the
Approach fill locations on Hwy. #01, Dist. #1.

Purther to our telephone conversation, we are enclosing the list of various structure which are scheduled to be built in your District. We may wish to instrument some of these projects and request you to advise us at least two weeks prior to the commencement of approach fill construction of each project.

- *P127-64 County Rd. to Pace Interchange No. 4 8.9 Miles East of Hwy. 95.
- *P131-64 Sandwich S. Twp. Rd., Concession XI, Underpass 5.2 Miles East of Hwy. 95.
- *P132-64 Essex County Rd. 27 Underpass 1.5 Miles East of Hwy. 95. *Item 120*
- *P134-64 Mallistone Twp. Rd. Concession VII Underpass 7.1 Miles East of Hwy. 95.
- *P135-64 Mallistone Twp. Rd. Concession IX Underpass 1.4 Miles East of Hwy. 95.
- *P136-64 Mallistone Twp. Rd. Concession VI Underpass 1.3 Miles East of Hwy. 95.
- *P137-64 Mallistone Twp. Rd. Concession XII Underpass 6.3 Miles East of Hwy. 95.
- *P138-64 Sandwich S. Twp. Rd. Concession X Underpass 2.3 Miles East of Hwy. 95.
- *P139-64 Sandwich S. Twp. Rd. Concession XII Underpass 3.6 Miles East of Hwy. 95.

ML/lt
cc: Foundations Office
Gen. Files

M. Devata
SENIOR FOUNDATION ENGINEER

For: A. G. Sternac
PRINCIPAL FOUNDATION ENGINEER

68-F-28
#

W.P. 132-64

HWY # 401

UNDERPASS

BRIDGE #6-231

SANDWICH S

TWP.

