23-61-01

SOIL INVESTIGATION
UNDERPASS BRIDGE - HIGHWAY NO. 401
TOWNSHIP OF SANDWICH SOUTH
COUNTY OF ESSEX
(SITE NO. 6-233 - PROJECT NO. W.P. 131-64)

DOMINION SOIL INVESTIGATION LIMITED
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May 12, 1965.

OUR REF: 5-3-7

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

Attention: Mr. A. Rutka, [illegible],
Materials & Testing Engineer.

Re: Your W.P. 131-64 - Soil Investigation
for Proposed Intersection Highway #401
Site #6-233, 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.

REGISTERED PROFESSIONAL ENGINEER
CIVIL
K. H. KING
PROVINCE OF ONTARIO

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. 6-233 - PROJECT NO. W.P. 131-64)

SUBMITTED BY

DOMINION SOIL INVESTIGATION LIMITED

77 CROCKFORD BOULEVARD

SCARBOROUGH - ONTARIO

REFERENCE 5-3-7

MAY - 1965

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SUMMARY

The soil investigation at Bridge Site No. 6-233 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 9 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 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 special 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 the road which runs between Concessions Nos. X and XI in the Township of Sandwich South in 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 proposed work 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. 5-3-7/1, 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 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 varying significant amounts of organic matter. The deposits range in thickness between 6 and 10.5 feet and are of stiff consistency. "N" values within the deposit range between 8 and 16 blows per foot while the undrained shear strength determined in situ by the vane method falls between 1770 pounds per square foot and 4420 pounds per square foot. The sensitivity of the soil ranges between 1.9 and 5.0. One unconfined compression on a sample recovered in the split-spoon sampler gave a shear strength value of 2875 pounds per square foot.

Tests on two samples of this material gave Liquid Limits of 41.6 and 54 percent, Plastic Limits of 20.6 and 23.7 percent and Dry Density of 102 pounds per cubic foot at a natural moisture content of 24.1 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 to 7 feet consist of a hard brown silty clay containing traces of sand and gravel. "N" values in this region range between 20 and 58 blows per foot with an average value of 35 blows per foot.

The natural moisture content falls between 14% and 17% and is close to the Plastic Limit of 16.5%. With a Liquid Limit of 29%, the Liquidity Index of this stratum is very small suggesting a heavily overconsolidated material with a high shear strength. Unconfined compression tests on specimens obtained in the split-spoon sampler indicate shear strength values of about 10,000 pounds per square foot. The bulk density was determined at values between 128 and 137 pounds per cubic foot.

Below a depth of about 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 decrease with depth and range between 15 and 33 blows per foot.

At 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 8 and 13 blows per foot compared with the upper hard weathered crust. The natural moisture content in this layer shows a tendency to increase with depth and ranges between 16% and 20%. The Plastic Limit remains very much the same at about 16% but the Liquid Limit

increases slightly to about 30%. The Liquidity Index increases to around 0.35 and indicates that the soil has not been preconsolidated to the same extent as the hard upper crust.

The undrained shear strength measured in situ by the vane ranges between 1180 pounds per square foot and 2950 pounds per square foot with a sensitivity range of 1.5 to 5.0. Unconfined compression tests in the laboratory gave shear strength values between 1063 and 3270 pounds per square foot.

The bulk density of this soil was estimated to be between 124 and 128 pounds per cubic foot.

Consolidation tests were carried out on the stiff grey clay sample recovered from a depth of 20 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 compared with the value of 0.18 obtained from the empir cal 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

The depths to water in the boreholes were determined at various times and the observations are shown on the Geotechnical Data Sheets. The depth to the water surface ranged between 1.3 and 11.2 feet. There is likely to have been some effect from surface water infiltration. The moisture content variation in the samples suggest a water table level at about 10 feet below ground level.

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 contains a significant amount of organic matter and is not considered suitable as a foundation soil for the superstructure. It is advisable that the foundation for the bridge be taken down to the next

layer consisting of the hard brown silty clay till.

At and below Elevation 603.5, normal spread foundations can be used. Between Elevations 603.5 and 602.5 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 595. It is desirable that the foundations be kept as close as possible to the top of the hard brown layer (El. 603.5) in order to take advantage of its higher load bearing capacity and its 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.

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 7 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 20 feet in Borehole No. 1 are representative of this layer in which the settlement 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 following are presented the estimated settlements under the foundations:-

TABLE I

Settlement of the Bridge Foundations

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

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/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 visual 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 this 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 I

PROCEDURE

Field Work

The field work was carried out drilling 5 boreholes during the period 7th - 9th April, 1965. The location of the borehole is shown on the plan on Drawing No. 5-3-7/1.

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-inch 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 (El. 610.88) on the south-west corner of the concrete box at Station 65 + 71.

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

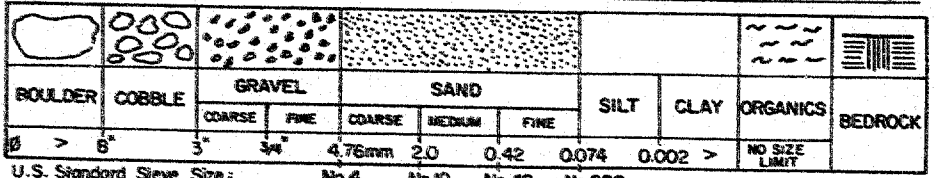
Laboratory Test Results

Borehole No.	Sample No.	Depth Ft.	Shear Strength p.s.f.	L.L. %	P.L. %	Natural Moisture Content %	Liquidity Index %	Density p.c.f. Bulk	Density p.c.f. Dry
1	2	6	11,345	34	17.9	13.0	-	137	121
	4	11	-	-	-	16.2	-	-	
	5	16	-	29.0	15.2	17.5	0.16	-	
	6	20	3,270	27.7	15.2	17.4	0.16	134	114
	7	25	-	-	-	20.2	-	-	
	8	30	1,410	-	-	19.5	-	128	108
	9	35	-	30.4	14.2	19.9	0.35	-	
2	2	6	2,875	54.0	23.7	24.1	0.007	126	102
	3	8	-	-	-	16.9			
	4	11	-	-	-	14.7			
	5	16	-	-	-	17.7			
	6	20	-	-	-	19.2			
3	2	4	-	41.6	20.6	19.8	-	-	
	3	9	-	30.4	16.5	14.4	-	-	
	4	14	-	29.0	16.5	16.6	-	-	
	5	19	-	-	-	18.4		-	
4	4	9	1,920	-	-	11.8		130	
	6	19	-	14.5	10.8	8.2	-	-	
5	3	9	9,785	32	16.2	14.8	-	128	
	4	14	-	32.0	16.4	16.3	-	-	
	6	24	1,150	-	-	19.8	-	129	
	8	34	1,063	27.1	15.3	15.6	-	124	

Enclosures

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.



SAMPLE TYPES.

AS	Auger sample	RC	Rock core	TP	Piston, thin walled tube sample
CS	Sample from casing	%	Recovery	TW	Open, thin walled tube sample
ChS	Chunk sample	SS	Split spoon 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.

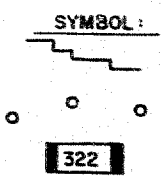
DYNAMIC PENETRATION RESISTANCE : to drive a 2"ø, 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

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 :



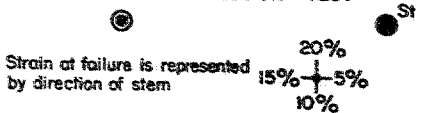
SOIL PROPERTIES.

W %	Water content	γ	Natural bulk density (unit weight)	k	Coeff. of permeability
LL %	Liquid limit	e	Void ratio	C	Shear strength — in terms of total stress
PL %	Plastic limit	RD	Relative density	ϕ	Angle of int. friction — in terms of total stress
PI %	Plasticity index	C_v	Coeff. of consolidation	C'	Cohesion — in terms of effective stress
LI	Liquidity index	m_v	Coeff. of volume compressibility	ϕ'	Angle of int. friction — in terms of effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL COMPRESSION TEST; UNCONFINED TEST; LABORATORY VANE TEST; FIELD VANE TEST; POCKET PENETROMETER TEST



Strain at failure is represented by direction of stem

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

SOIL DESCRIPTION.

COHESIONLESS SOILS :	RD :	COHESIVE SOILS :	C lbs/sq.ft.
Very loose	0 – 15 %	Very soft	less than 250
Loose	15 – 35 %	Soft	250 – 500
Compact	35 – 65 %	Firm	500 – 1000
Dense	65 – 85 %	Stiff	1000 – 2000
Very dense	85 – 100 %	Very stiff	2000 – 4000
		Hard	over 4000

GEOTECHNICAL DATA SHEET FOR BOREHOLE . 1. . . .

OUR REFERENCE NO 5-3-7

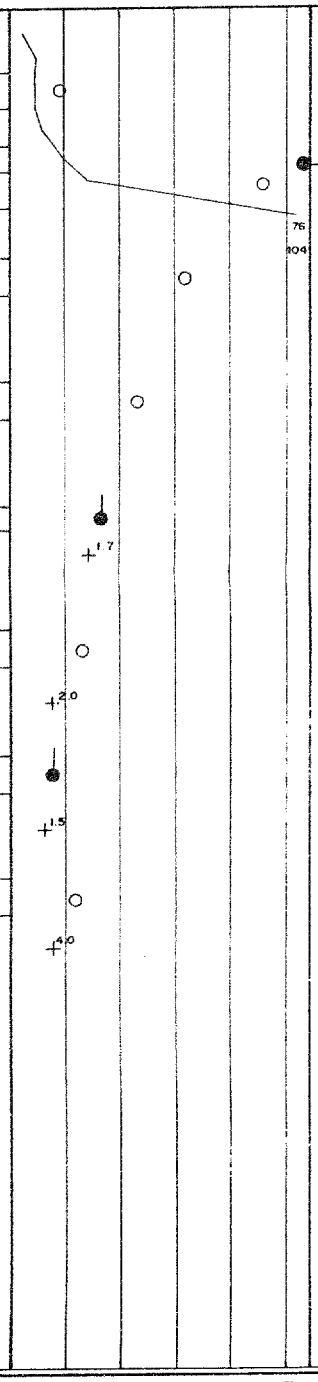
CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS
PROJECT: PROPOSED UNDERPASS
LOCATION: BRIDGE SITE Nº 6-233 HWY. Nº 401
DATUM ELEVATION: GEODETIC

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

ENCLOSURE NO 2

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N — No. of Advancement of Sampler	REMARKS
609.9	0	GROUND SURFACE				
	0.5	TOPSOIL				
		STIFF grey and brown organic SILTY CLAY traces of GRAVEL	1	S.S.	9	
605	5					
	6.0		2	T.W.	W	γ = 137 P.C.F.
		HARD to VERY STIFF brown SILTY CLAYEY TILL traces of SAND and GRAVEL	3	S.S.	46	C_u = 11345 P.S.F.
600	10					
			4	S.S.	32	EL. 598.8 APR. 8, 1965
	12.5					EL. 598.2 APR. 8, 1965
595	15	STIFF	5	S.S.	23	
590	20	grey CLAYEY TILL some SILT traces of SAND and GRAVEL	6	T.W.	W	γ = 134 P.C.F. CONSOLIDATION TEST
585	25		7	S.S.	13	
580	30		8	T.W.	W	γ = 128 P.C.F.
575	35		9	S.S.	12	
		END OF BOREHOLE				
570	40					

PENETRATION RESISTANCE blows per foot 1.0 2.0 3.0 4.0 5.0
SHEAR STRENGTH x 100 lbs/sq ft 20 40 60 80 100
CONSISTENCY water content % PL W LL 10 20 30 40



VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

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

GEOTECHNICAL DATA SHEET FOR BOREHOLE . 2 . . .

OUR REFERENCE NO. 5 - 3 - 7

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS
PROJECT: PROPOSED UNDERPASS
LOCATION: BRIDGE SITE Nº 6-233
DATUM ELEVATION: GEODETIC

METHOD OF BORING: WASHBORING
DIAMETER OF BOREHOLE: 2 3/8"
DATE: APRIL 9, 1965

ENCLOSURE NO. 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N — Number of Advancement of Sampler	PENETRATION RESISTANCE blows per foot (10 20 30 40 50) / SHEAR STRENGTH x 100 lbs sq ft (20 40 60 80 100)	CONSISTENCY water content % (PL W LL; 10 20 30 40)	REMARKS
612.6	0	GROUND SURFACE							
		GRANULAR FILL							
610	2.5	STIFF brown SILTY CLAY with organic matter and traces of SAND		1	S.S.	16	+2.3		
	5			2	T.W.	W			
605				3	S.S.	9	+5.0		
	10								
	10.5	HARD brown SILTY CLAYEY TILL with traces of SAND and GRAVEL		4	S.S.	42	64 100		X = 126 P.C.F. L.L. = 54 %
600	13.5								
	15	VERY STIFF to STIFF grey CLAYEY TILL with some SILT traces of		5	S.S.	20			
595									
	20	SAND and GRAVEL		6	S.S.	15			
		END OF BOREHOLE							
590									

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

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

GEOTECHNICAL DATA SHEET FOR BOREHOLE . 3 . . .

OUR REFERENCE NO. 5-3-7

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS
PROJECT: PROPOSED UNDERPASS
LOCATION: BRIDGE SITE Nº 6-233
DATUM ELEVATION: GEODETIC

METHOD OF BORING: WASHBORING
DIAMETER OF BOREHOLE: 2 3/8
DATE: APRIL 8 & 9, 1965

ENCLOSURE NO. 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N — or Advancement of Sampler	PENETRATION RESISTANCE blows per foot 10 20 30 40 50 / SHEAR STRENGTH x 100 lbs/sq ft 20 40 60 80 100	CONSISTENCY water content % PL W LL 10 20 30 40	REMARKS
612.6	0	GROUND SURFACE							
	1.5	GRANULAR FILL							
610	5.5	STIFF grey and brown organic SILTY CLAY with traces of SAND		1	T.W.	W			W.L. 611.3 APR. 9 3 P.M.
	5			2	S.S.	13	5.0		W.L. 608.4 APR. 9 11 A.M.
605	7.5	VERY STIFF brown SILTY CLAYEY TILL traces of SAND and GRAVEL		3	S.S.	27	58 103		
	10								
600	12.5	HARD to VERY STIFF grey CLAYEY TILL some SILT traces of SAND and GRAVEL		4	S.S.	32			
	15								
595	20			5	S.S.	17			
		END OF BOREHOLE							
590									

VERTICAL SCALE: 1 IN TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

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

GEOTECHNICAL DATA SHEET FOR BOREHOLE . 4 . . .

OUR REFERENCE NO 5 - 3 - 7

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS
PROJECT: PROPOSED UNDERPASS
LOCATION BRIDGE SITE Nº 6-233 HWY. Nº 401
DATUM ELEVATION GEODETIC

METHOD OF BORING: WASHBORING
DIAMETER OF BOREHOLE 2 3/8"
DATE APRIL 7, 1965.

ENCLOSURE NO 5

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N — or Advancement of Sampler	PENETRATION RESISTANCE blows per foot 1.0 2.0 3.0 4.0 5.0	SHEAR STRENGTH x 100 lbs. sq ft 2.0 4.0 6.0 8.0 10.0	CONSISTENCY water content % PL W LL 1.0 2.0 3.0 4.0	REMARKS
612.3	0	GROUND SURFACE								
610		GRANULAR FILL		1	S.S.	11				
	4.3 5	STIFF brown SILTY CLAY with organic matter traces of SAND and GRAVEL		2	S.S.	8				
605				3	S.S.	11				
	8.5 10	HARD brown SILTY CLAYEY TILL traces of SAND and GRAVEL		4	S.S.	42				
600	13.0									
	15	VERY STIFF to HARD grey CLAYEY TILL some SILT traces of		5	S.S.	24				
595	20	SAND and GRAVEL		6	S.S.	33				
		END OF BOREHOLE								
590										

+1.9

71
114

W.L. 608.2 APR.8, 1965

W.L. 598.0 APR. 7, 1965

γ = 130 P.C.F.

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: J.B.E. CHD.

GEOTECHNICAL DATA SHEET FOR BOREHOLE . .5 . . .

OUR REFERENCE NO. 5 - 3 - 7

CLIENT: ONTARIO DEPARTMENT OF HIGHWAYS
PROJECT: PROPOSED UNDERPASS
LOCATION: BRIDGE SITE Nº 6-233 HWY. Nº 401
DATUM ELEVATION: GEODETIC

METHOD OF BORING: WASHBORING
DIAMETER OF BOREHOLE 2 3/8"
DATE: APRIL 7, 1965

ENCLOSURE NO. 6

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	NUMBER	TYPE	N — or Advancement of Sampler
611.2	0	GROUND SURFACE			
610	1.2	TOPSOIL			
	5	STIFF brown SILTY CLAY with organic matter traces of SAND and GRAVEL	1	S.S.	12
605	7.5		2	S.S.	31
	10	HARD brown SILTY CLAYEY TILL traces of SAND and GRAVEL	3	S.S.	58
600	13.0				
	15	VERY STIFF to STIFF grey CLAYEY TILL some SILT traces of SAND and GRAVEL	4	S.S.	26
595					
	20		5	S.S.	12
590					
	25		6	T.W.	W
585					
	30		7	S.S.	9
580					
	35		8	T.W.	W
575					
	40		9	S.S.	8
570		END OF BOREHOLE			

PENETRATION RESISTANCE
blows per foot
10 20 30 40 50

SHEAR STRENGTH x 100 lbs / sq ft
20 40 60 80 100

CONSISTENCY
water content %
PL W LL
10 20 30 40

REMARKS

3.0
56
91
143
2.0
1.8
1.7
1.7

γ = 128 P.C.F.
W.L. 598.0 APR. 8, 1965
W.L. 600.0 APR. 7, 1965
γ = 129 P.C.F.
γ = 124 P.C.F.

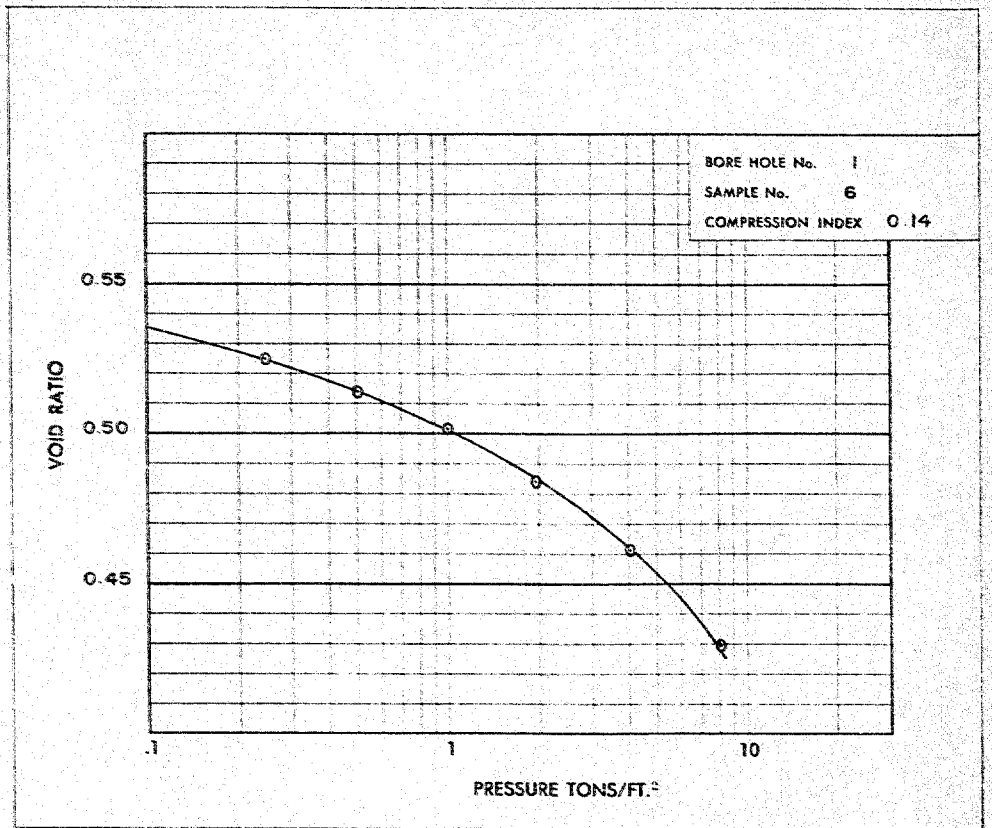
VERTICAL SCALE: 1 IN. TO 5 FT.

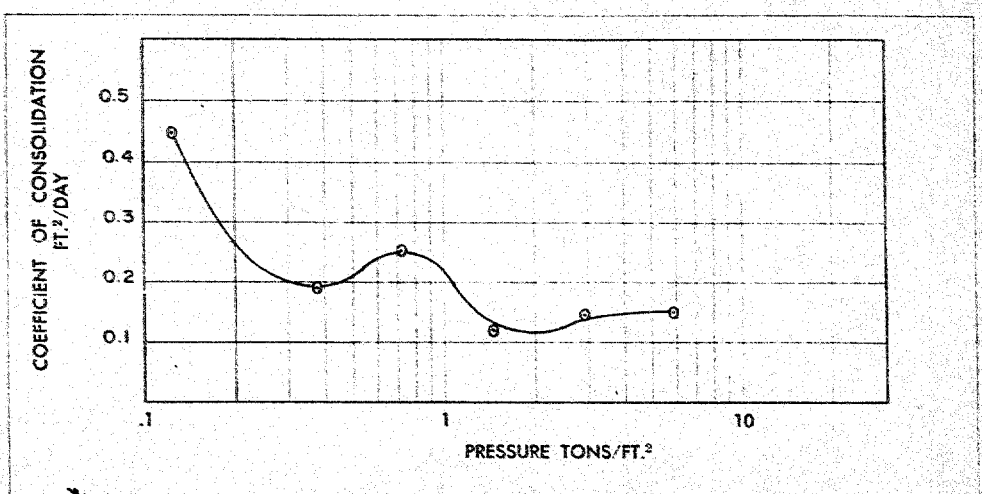
DOMINION SOIL INVESTIGATION LIMITED

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

Dominion Soil Investigation Ltd.

CONSOLIDATION TEST





cc: Gen. Files

Mr. A. M. Toye,
Bridge Engineer,
Bridge Division.

Attention: Mr. S. McCombie

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

May 17, 1965

FOUNDATION INVESTIGATION REPORT BY:
Dominion Soil Investigation, Limited.
Underpass Bridge - Highway No. 401,
Township of Sandwich South, County of
Essex, District #1 (Chatham, Ontario)
Site No. 6-233 -- W.P. 131-64

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.

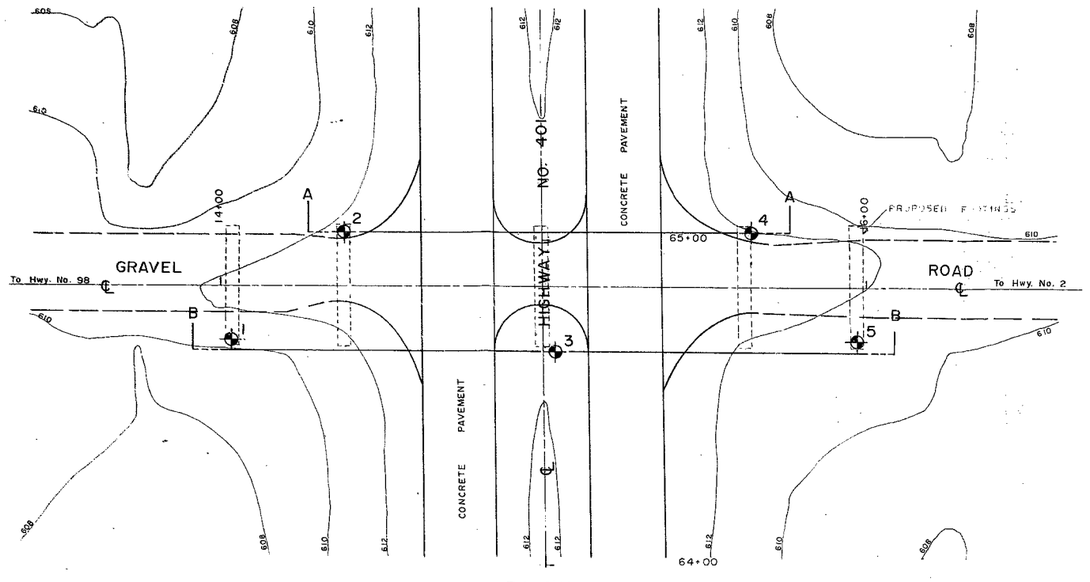
K. J. Lo,
SUPERVISING FOUNDATION ENGINEER

KYL/MdeP
Attach.
cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
H. D. McMillan
A. Cater
F. C. Brown
J. Foy
A. Watt

Foundations Office
Gen. Files

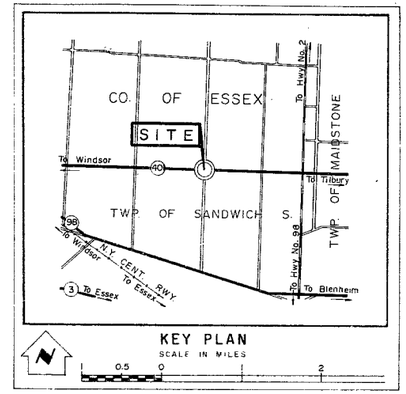
#65-F-212
W.P. #131-64
Hwy. #401
UNDERPASS
BRIDGE SITE
#6-233
SANDWICH S. TWP.

3454 50E
4678 450N 17 46 J 2W



PLAN

SCALE 20 10 0 20 40 FT

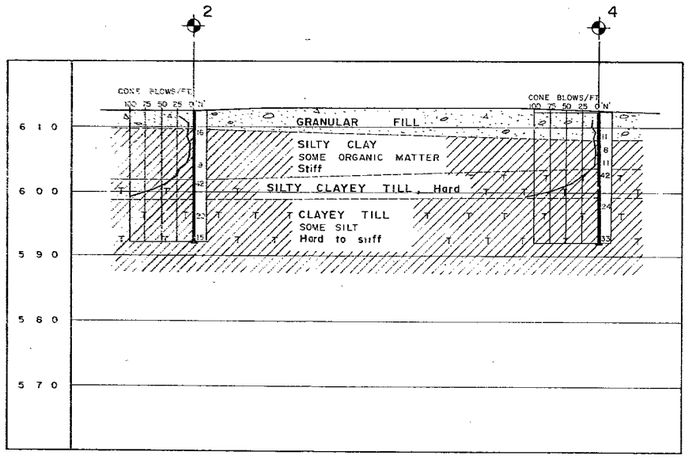


KEY PLAN
SCALE IN MILES 0.5 0 2

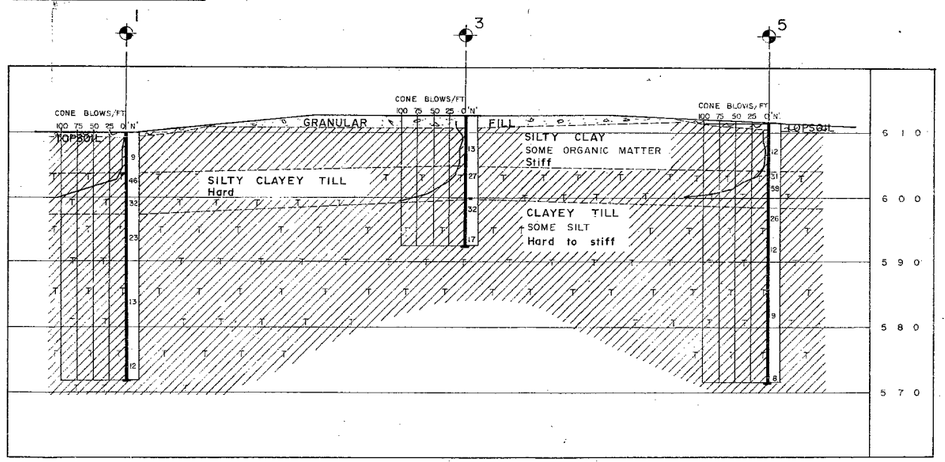
LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation.

NO.	ELEVATION	STATION	OFFSET
1	609.92	14+04	17' R
2	612.56	14+38	17' L
3	612.56	15+04	20' R
4	612.26	15+64	17' L
5	611.23	15+97	17' R



A — A



B — B

SECTIONS

SCALE 20 10 0 20 40 FT.

— NOTE —

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS

DATE	BY	DESCRIPTION

DOMINION SOIL INVESTIGATION LTD.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION - FOUNDATION SECTION

PROPOSED UNDERPASS BRIDGE NO. 6-233

KING'S HIGHWAY NO. 401 DIST. NO. 1
CO. ESSEX
TWP. SANDWICH SOUTH LOT 12 CON. X & XI

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. D.S.I.	CHECKED	W.P. NO. 131-64	DRAWING NO. 5-3-7/1
DRAWN J.B.E.	CHECKED	JOB NO.	
DATE MAY 3, 1965		SITE NO.	BRIDGE DRAWING NO.
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT NO.	

PRINT RECORD

NO.	FOR	DATE