

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. G.C.E. Burkhardt, (3)
Regional Structural Planning Eng.,
Central Region,
3501 Dufferin St., Downsview.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: May 14, 1973.

OUR FILE REF

IN REPLY TO MAY 22 1973

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
The Proposed Hwy. 401 E.B. Collector Overpass
Over Revised Heart Lake Road (Bridge #49)
Site #24-316, District #6 (Toronto)
W.O. 72-11157 -- W.P. 127-66-08
CONT. 75-16

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/ao
Attch.

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

c.c. E. J. Orr
B. R. Davis
A. Rutka
R. S. Pillar
H. Greenland
B. J. Giroux
C. Mirza
G. A. Wrong
B. A. Singh

Foundations Files ✓
Documents

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FOUNDATION INVESTIGATION REPORT
For
The Proposed Hwy. 401 E.B. Collector Overpass
Over Revised Heart Lake Road (Bridge #49)
Site #24-316, District #6 (Toronto)
W.O. 72-11157 -- W.P. 127-66-08

1. INTRODUCTION:

The Foundations Office was requested to carry out a subsurface investigation at the above-mentioned structure site. The request was contained in a memorandum from Mr. G.C.E. Burkhardt, Regional Structural Planning Engineer, Central Region, dated February 23, 1973.

Following this request, a foundation investigation was carried out by this Office to determine the subsoil, bedrock and groundwater conditions existing at this site. This report presents the factual data obtained from this investigation together with recommendations pertaining to the foundation design of the structure and stability considerations associated with the approach cuts.

2. DESCRIPTION OF SITE AND GEOLOGY:

The site is located some 400 feet south of the existing intersection of Hwy. 401 and Heart Lake Road, in the Town of Mississauga, County of Peel. The terrain, in the vicinity of the structure site, is flat to gently undulating in relief between elevation 564 and 568, with the exception of the existing roadway (Heart Lake Road) which is up to 20 feet above the terrain. The land was mainly developed for farming purposes.

The site is located in the physiographical region known as "Peel Plain." The characteristic deposit in the vicinity of the area under investigation, is composed of a cohesive glacial till whose thickness is, in general, less than 10 feet. In this region, the Credit River, Oakville Creek and Etobicoke Creek have cut deep valleys into the overburden. There is, therefore, no large undrained depression, swamp or bog in this area, although in many of the interstream areas drainage is still imperfect. The overburden is underlain by shale bedrock of the Meaford-Dundas Formation, Ordovician Period.

3. FIELD INVESTIGATION AND LABORATORY WORK:

Four sampled boreholes, each accompanied with a dynamic cone penetration test, were put down at the site, using a continuous flight auger machine, adapted for soil sampling purposes.

Samples of the overburden were obtained in a 2" O.D. split-spoon sampler at required depths. The sampler was driven into the soil with an energy of 350 ft.-lbs. per blow, in accordance with the specifications for Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Bedrock was proven in all of the boreholes by obtaining BX size rock core samples. Groundwater level observations were carried out, during the period of the field investigation, in the open boreholes.

The soil, bedrock and groundwater conditions, encountered at the boring locations, are presented in the individual Record of Borehole sheets. Field surveying was carried out by the personnel from District #6 (Toronto). The elevations in this report are referenced to a Geodetic Datum. The locations, which were tied into a co-ordinate system, and elevations of the various boreholes are shown on Drawing No. 72-11157A, together with estimated stratigraphical sections.

All the samples were subject to a careful examination in the field and subsequently in the laboratory. Following this examination, laboratory tests were carried out on selected representative samples to determine the physical properties of the overburden encountered; namely,

Grain-Size Distribution
Atterberg Limits
Natural Moisture Contents

The results of the laboratory testing are summarized on Figure Nos. 1 and 2, contained in the Appendix of this report.

The bedrock core samples were inspected by Mr. K. W. Ingham, Geologist.

4. SUBSOIL CONDITIONS:

4.1) General:

The predominant stratum across the site is composed of a heterogeneous mixture of silty clay and traces of sand and gravel. The thickness of this cohesive glacial till stratum is generally less than 10 feet. The overburden is underlain by shale bedrock.

The stratigraphical sequence encountered in the borings is plotted on the Record of Borehole sheets. Stratigraphical sections have been inferred from this data and plotted on Drawing No. 72-11157A. The subsoil and bedrock encountered from ground surface downward, is presented in the subsections to follow.

4.2) Heterogeneous Mixture of Silty Clay and Traces of Sand and Gravel (Glacial Till):

Directly beneath a thin topsoil cover (max. 1 foot) is this predominant stratum across the site. It is composed of a heterogeneous mixture of silty clay and traces of sand and gravel (Glacial Till). The thickness of this deposit varies from 7.5 feet (B.H. #4) to 9 feet (B.H. #2).

Grain size distribution curves, for samples of this cohesive stratum, are shown on Figure #1 in the Appendix. Atterberg Limit tests were also performed on samples of the glacial till. The results, which are shown on the Record of Borehole sheets and on the Plasticity Chart (Figure #2), are also summarized as follows:

	<u>Range</u>	<u>(Average)</u>
Liquid Limit (W_L) %	32 - 43	(40)
Plastic Limit (W_p) %	18 - 26	(20)
Natural Moisture Content (W) %	12 - 20	(16)

Based on the above values, it is estimated that the cohesive deposit has a matrix which is inorganic and of intermediate plasticity.

Standard Penetration tests, carried out within this stratum, gave 'N' values ranging from 22 to over 100 blows per foot.

It is estimated that the consistency of the glacial till varies from very stiff to hard.

4.3) Bedrock:

The cohesive glacial till stratum is directly underlain by bedrock which was proven at all of the boring locations, by obtaining up to 28 feet of BX size rock core samples. The rock core samples were examined carefully by Mr. K. W. Ingham, Geologist. A detailed description of the bedrock encountered in the boreholes were presented in a memo from Mr. Ingham, a copy of which is appended to this report.

The bedrock surface was found to vary between elevation 556 (B.H. #2) and elevation 560 (B.H. #4). The bedrock is a dark grey shale with occasional limestone layers. The upper 4 to 8 feet of the bedrock at B.H.'s #2, #3 & #4 is in a weathered condition.

5. GROUNDWATER CONDITIONS:

The groundwater level conditions across the site were observed by taking readings in the open boreholes during and after the field investigation. The results of the readings are shown on the Record of Borehole sheets, as well as on Drawing No. 72-11157A.

The observations indicate that the groundwater level varies between elevations 562 and 567, which corresponds to levels 1 to 3 feet below the existing ground surface.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

In conjunction with the construction program of Hwy. 401 and Hwy. 403, the existing Hwy. 401 from Hwy. 27 westerly to Hwy. 10, is to be developed as a 16-lane basic core-collector. A number of interchanges are proposed for this portion of Hwy. 401, specifically:

- i) Hwy. 401/Hwy. 403/Hwy. 410 complex
- ii) Hwy. 401/Dixie Road Interchange
- iii) Hwy. 4401/Airport Entrance/Little Etobicoke Creek Complex
- iv) Hwy. 401/First Line Interchange

This report will deal with the proposed Bridge No. 49 (Hwy. 401 E.B. Collector over Rev. Heart Lake Road) in the Hwy. 401/Hwy. 403/Hwy. 410 complex. The proposed single-spanned structure will be 74 feet wide. The proposed profile grade of Hwy. 401 E.B. Collector, in the vicinity of the structure will vary from elevations 554 to 555, while that of Heart Lake Road will be at elevation 528. The existing grade of Heart Lake Road is at elevation 581 in the vicinity of the proposed structure while the surrounding terrain is at elevations 564 to 566. Therefore, cuts up to 11 feet high will be necessary for Hwy. 401. An additional cut of up to 27 feet will be required to reach the proposed grades for Heart Lake Road in the vicinity of the structure.

The predominant stratum across the site is composed of a 7 to 9 foot thick cohesive glacial till which is underlain by shale bedrock.

In the subsections to follow the foundation support for the underpass structure will be discussed. In addition, the stability considerations associated with the approach cuts will be presented.

6.2) Closed Type Abutment Foundations:

In the vicinity of the structure, the proposed profile grade of Hwy. 401 is below the bedrock surface. Therefore, it is recommended that closed type abutments be supported on spread footing type of foundation located within the shale bedrock. A minimum of 4 feet earth cover should be provided to the underside of the footings since the shale is considered susceptible to frost action. Taking this into consideration, the footings should be founded at or below elevation 524.

An allowable bearing value of up to 10 t.s.f. may be used in designing the footings, founded as recommended. The horizontal resistance of the footing may be computed using a coefficient of friction of 1.0 between rough concrete surface and shale.

In order to simplify dewatering for the footing excavations, it is recommended that the approach cuts be completed to profile grades prior to the construction of the structure foundations. If this procedure is followed, the resulting depth of excavation for the footings will be in the order of 4 feet below the finished grade. Any minor groundwater seepage or surface runoff into the excavation can be handled by ordinary pumping methods.

The settlement of the footings will be negligible in magnitude, provided that measures are exercised to prevent the shale from being softened by groundwater seepage or uncontrolled surface runoff. It may be advantageous to protect the shale, at the footing foundation level, by covering it with a lean concrete working slab immediately after the completion of the excavation.

If the structure is designed as a rigid frame, then a coefficient of earth pressure at rest (K_o) of 0.5 should be assumed for the granular fill placed behind the wall, when designing the abutments. However, if some movement of the wall is permitted, then a coefficient of active earth pressure (K_a) of 0.33 can be used.

In order to relieve the buildup of excess hydrostatic pressure behind the walls, suitable drainage measures should be provided. This can be accomplished by providing weep holes at the base of the walls. The location and spacing of these weep holes should be determined in accordance with current M.T.C. standards.

6.3) Approach Cuts:

6.3.1) Hwy. 401:

The approach cuts for Hwy. 401, up to 11 feet deep, will be made through the cohesive glacial till and partially into the upper weathered shale bedrock. No stability problems are anticipated for this portion of the cuts provided standard 2:1 slopes are used.

6.3.2) Heart Lake Road:

As mentioned previously (Section 6.1), an additional cut of up to 27 feet deep will be required in the vicinity of the structure in order to reach the proposed grades of Heart Lake Road. This cut will be made through the shale bedrock.

According to experience gained by District Construction personnel from the construction of the 427-Q.E.W. interchange, the shale, once it was exposed to the atmosphere, appeared to be susceptible to weathering and erosion. The shale bedrock encountered at the proposed structure site is of the same formation as that of the shale existing at the 427-Q.E.W. interchange. Therefore, it is recommended that the cuts through the shale bedrock be treated as earth cuts and be constructed with 2:1

slopes. It is further recommended that the cut slopes be protected with an adequate cover of topsoil and sodded.

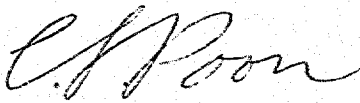
The groundwater level established during the period of field investigation, is up to 39 feet above the bottom of the proposed approach cut. Some seepage through, and consequently local sloughing of the shale can, therefore, be expected. However, this problem will be temporary in duration and minor in nature, since the excavation will result in a general lowering of the groundwater level across the site.

7. MISCELLANEOUS:

The field work was carried out between March 1 and March 7, 1973, under the supervision of Mr. V. Korlu, Project Foundations Engineer.

Drilling equipment was owned and operated by Johnston Drilling Company Ltd., Toronto.

This report was prepared by Mr. C. S. Poon, Project Foundations Engineer, and reviewed by Mr. M. Devata, Supervising Foundations Engineer.


C. S. Poon, P. Eng.


M. Devata, P. Eng.



CSP/ao
May 11, 1973.

APPENDIX I

MEMORANDUM

TO: Mr. M. Devata,
Sup. Foundation Engineer.

FROM: K. W. Ingham

ATTENTION:

DATE: May 1, 1973

OUR FILE REF.

IN REPLY TO

SUBJECT: Foundation Investigation 72-11157;
Hwy. 401 and Hwy. 410 Overpass

A brief description is given below for 4 boreholes drilled to bedrock at this site, together with the appropriate bedrock elevation.

<u>Hole No. 1</u>	Bedrock at 556.6
7.8 - 9.6	Limestone; medium grey, fine grained, thin to medium bedded, occasional thin layers of silty shale.
9.6 - 10.4	Limestone; dark grey, fine grained, thin to medium bedded, shaly, occasional thin shale seams.
10.4 - 23.0	Shale; dark grey, thin to platy bedded, occasional limestone layers 0.05 to 0.1 ft. in thickness, slightly weathered.
23.0 - 23.2	Limestone; light greenish grey, fine grained.
23.2 - 31.6	Shale; dark grey, thin to medium bedded, occasional thin layers of limestone and silty limestone, evidence of weathering 26.3 - 26.5 ft.
31.6 - 32.1	Limestone; light grey, fine grained, frequent thin shale layers.
32.1 - 34.0	Shale; dark grey, thin to medium bedded.

Hole No. 2

Bedrock at 556.1

- 9.0 - 9.8 Interbedded limestone and badly weathered shale.
- 9.8 - 12.6 Limestone; light grey, fine grained, thin to medium bedded, silty, occasional thin shale seams and layers, generally moderately weathered and fractured.
- 12.6 - 13.1 Shale; dark grey, thin bedded, badly weathered.
- 13.1 - 25.4 Shale; dark grey, thin to medium bedded, slightly weathered
13.7 - 14.0 ft., occasional thin lenses of silty limestone, occasional layers of limestone 0.1 to 0.2 ft. in thickness.

Hole No. 3

Bedrock at 560.2

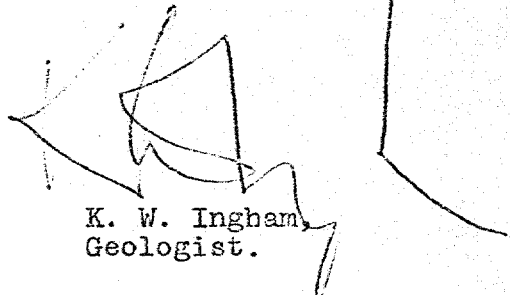
- 8.0 - 11.9 Shale; medium grey, thin to platy bedded, badly weathered, occasional limestone layers 0.1 to 0.2 ft. in thickness.
- 11.9 - 14.8 Limestone; light grey, fine grained, thin to medium bedded, occasional thin layers of shale.
- 14.8 - 15.8 Shale; dark grey, thin bedded, slightly silty, moderately weathered.
- 15.8 - 16.2 Limestone; medium grey, fine grained.
- 16.2 - 27.3 Shale; dark grey, thin to medium bedded, slightly weathered in the upper 0.5 ft., minor thin layers of silty limestone.
- 27.3 - 27.5 Limestone; medium grey, fine grained.
- 27.5 - 28.9 Shale; dark grey, medium bedded.

Hole No. 4

Bedrock at 560.4

- 7.4 - 11.2 Shale; medium greenish grey, thin to platy bedded, badly weathered, occasional thin layers of limestone.
- 11.2 - 11.8 Limestone; medium grey, fine grained, thin to medium bedded, moderately weathered.
- 11.8 - 12.3 Limestone; dark grey, fine grained, shaly, moderately weathered.
- 12.3 - 14.1 Limestone; medium grey, fine grained, thin to medium bedded, occasional thin shale seams.
- 14.1 - 16.0 Interbedded shale and shaly limestone; dark grey thin bedded.
- 16.0 - 26.6 Shale; dark grey, thin to medium bedded, occasional thin layers of limestone 0.1 to 0.2 ft. in thickness.
- 26.6 - 26.9 Limestone; medium grey, fine grained, slightly silty.
- 26.9 - 35.2 Shale; dark grey, thin to medium bedded, occasional thin limestone layers, evidence of weathering 30.6 - 30.7 ft. and 33.2 - 33.5 ft.
- 35.2 - 35.7 Limestone; medium grey, fine grained, thin bedded, frequent thin shale seams throughout.

KWI:mv



K. W. Ingham
Geologist.

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1

JOB 72-11157

LOCATION Co-ords. 857,273 N; 959,673 E.

ORIGINATED BY VK

W.P. 127-66-08

BORING DATE March 1, 1973

COMPILED BY CSP

DATUM Geodetic

BOREHOLE TYPE Power Auger, Cone Test & BX Rock Core

 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT — w_L	BULK DENSITY	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	PLASTIC LIMIT — w_p			WATER CONTENT — w
564.4	Ground Level						SHEAR STRENGTH P.S.F.	w_p — w — w_L			
							○ UNCONFINED + FIELD VANE	WATER CONTENT %	γ		
							● QUICK TRIAXIAL x LAB VANE	15 30 45	P.C.F.	GR.SA.SI.CL	
0.0	Het.mix.of silty clay traces of sand and gravel (Glacial Till) Grey		1	SS	22	560		○ —		1 3 54 42	
556.6	Very Stiff to Hard		2	SS	96		100/8"	○ —		8 4 58 30	
7.8	Bedrock Shale with occasional limestone layers up to 0.8' thick. Dark Grey Sound		3	RC BX	60%	555					
			4	BX	54%						
			5	BX	54%						
			6	BX	93%	550					
			7	BX	100%	545					
			8	BX	100%	540					
			9	BX	93%	535					
529.9			10	BX	100%	530					
34.5		End of Borehole									
NOTE: for detailed description of the bedrock, refer to Geologist's Report.											
						525					

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2

JOB 72-11157

LOCATION Co-ords. 857,207 N; 959,721 E

ORIGINATED BY VK

W.P. 127-66-08

BORING DATE March 7, 1973

COMPILED BY CSP

DATUM Geodetic

BOREHOLE TYPE Power Auger, Cone Test & BX Rock Core

CHECKED BY JJK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L	
565.1	Ground Level														
0.0	Het. mix. of silty clay traces of sand and gravel (Glacial Till) Grey-brown Very Stiff to Hard		1	SS	22	565									
			2	SS	61	560									
556.1			3	BC BX	28	555									
9.0			4	BX	47	550									
552.0	Weathered														
13.1	Bedrock		5	BX	96	545									
	Shale with occasional limestone layers.		6	BX	100	540									
	Dark Grey														
539.6	Sound		7	BX	100	535									
25.5	End of Borehole														
NOTE: for detailed description of the bedrock, refer to Geologist's Report.															

OFFICE REPORT ON SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 3

JOB 72-11157

LOCATION Co-ords. 857,191 N; 959,566 E.

ORIGINATED BY WK

W.P. 127-66-08

BORING DATE March 5, 1973

COMPILED BY CSP

DATUM Geodetic

BOREHOLE TYPE Power Auger, Cone Test & BX Rock Core

CHECKED BY *C.L.*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L		
568.2	Ground Level															
0.0	Het. mix. of silty clay trace of sand and gravel (Glacial Till) Grey-brown Very Stiff to Hard		1	SS	30	565										567.2
560.2			2	SS	136											2 17 48 33
8.0			3	RC BX	38%	560										
			4	EX	41%											
			5	EX	45%	555										
652.4	Weathered		6	EX	63%											
15.8	Bedrock Shale with occasional limestone layers Dark grey		7	EX	95%	550										
			8	EX	82%											
			9	EX	100%	545										
539.2	Sound					540										
29.0	End of Borehole															
	NOTE: for detailed description of the bedrock, refer to Geologist's Report.					535										

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 4

JOB 72-11157

LOCATION Co-ords. 857,142 N; 959,630 E.

ORIGINATED BY VK

W.P. 127-66-08

BORING DATE March 2, 1973

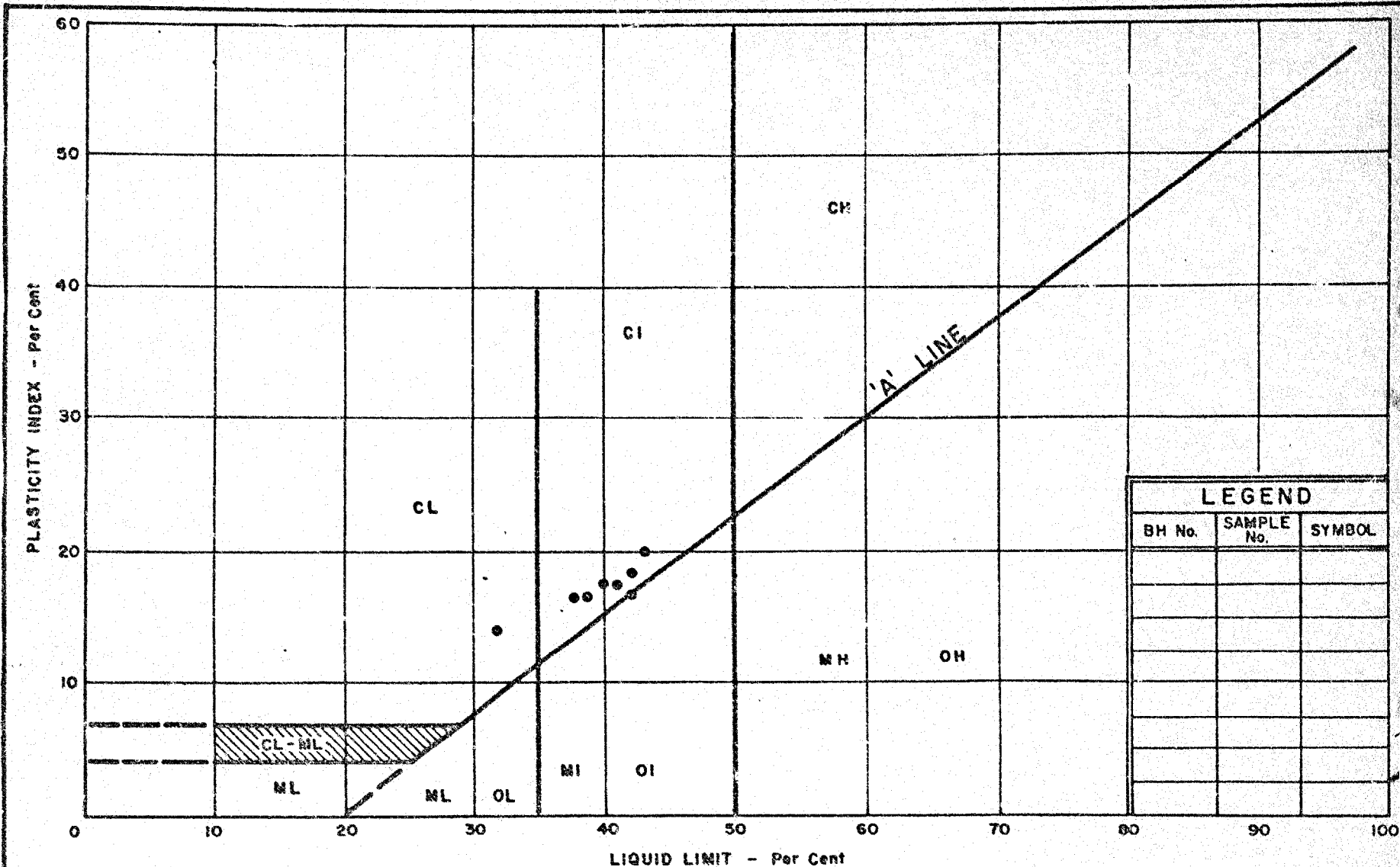
COMPILED BY CSP

DATUM Geodetic

BOREHOLE TYPE Power Auger, Cone Test and BX Rock Core

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					PLASTIC LIMIT — w_p				
							20	40	60	80	100	WATER CONTENT — w				
							SHEAR STRENGTH P.S.F.					w_p	w	w_L		
						○ UNCONFINED + FIELD VANE								γ		
						● QUICK TRIAXIAL x LAB VANE										
											15 30 45			P.C.F.	GR.SA.SI.CL	
567.8	Ground Level														567.3	
0.0	Het. mix. of silty clay traces of sand and gravel (Glacial Till) Brown-grey		1	SS	43	565									7 10 49 34	
560.4	Very Stiff to Hard		2	SS	132										12 9 54 25	
7.4			3	BX	26%	560										
			4	BX	35%											
555.5	weathered		5	BX	63%											
12.3			6	BX	36%	555										
			7	BX	83%											
	Bedrock		8	BX	75%											
			9	BX	67%	550										
	Shale with occasional limestone layers.		10	BX	100%											
			11	BX	97%	545										
	Dark grey		12	BX	94%	540										
	Sound		13	BX	97%	535										
532.0			14	BX	100%											
35.8	End of Borehole					530										
NOTE: for detailed description of the bedrock, refer to Geologist's Report																



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART GLACIAL TILL

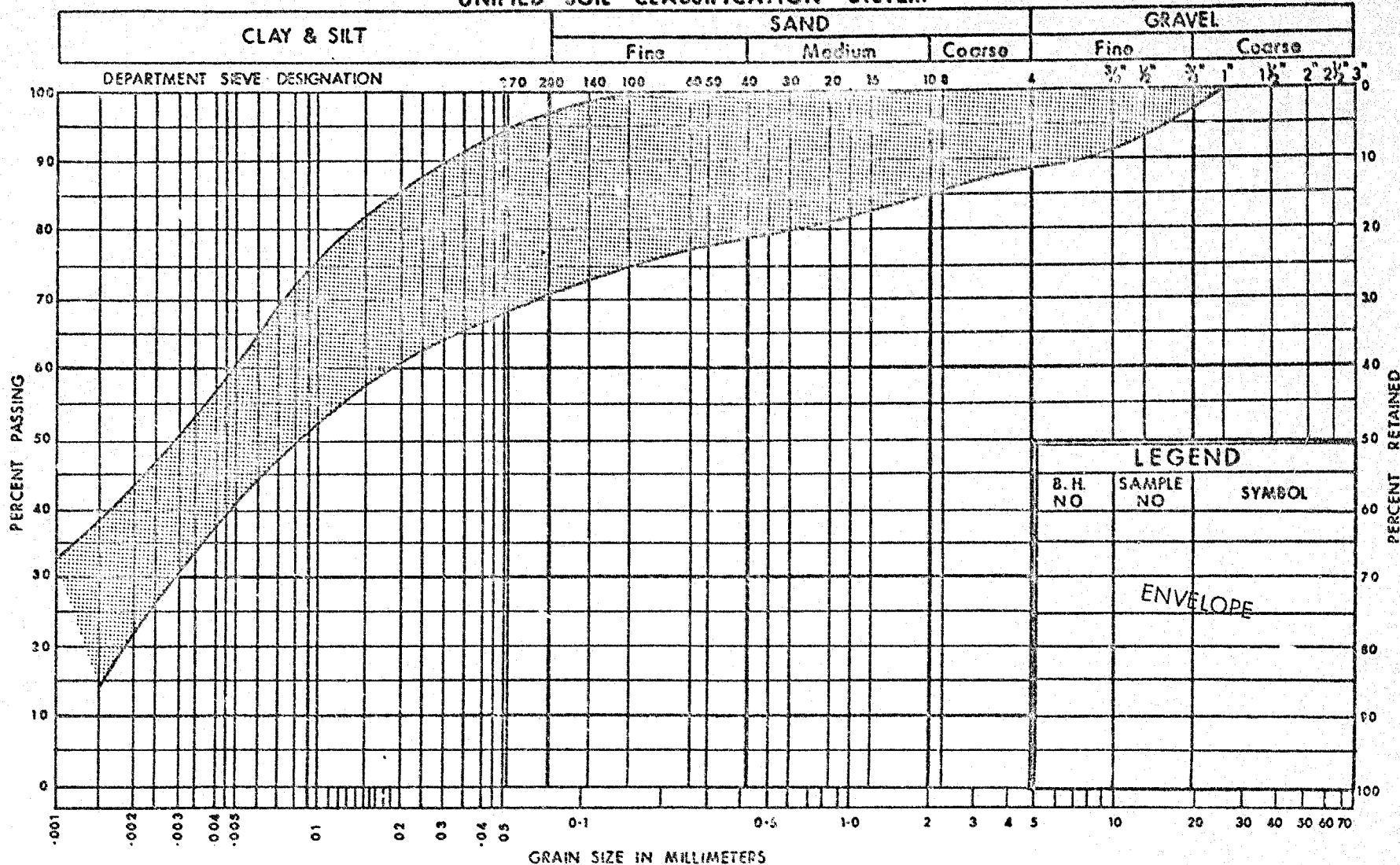
HET. MIX. OF SILTY CLAY, SOME SAND AND TRACES OF GRAVEL

WP. No. 127-66-08

JOB No. 72-11157

FIG.1

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS



DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION GLACIAL TILL

HET. MIX. OF SILTY CLAY, SOME SAND AND TRACES OF GRAVEL

W.P. No. 127-66-08

JOB No. 72-11157

FIG. 2

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION RESISTANCE

'N'-STANDARD PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL. THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>c LB./SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
w_s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_c	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

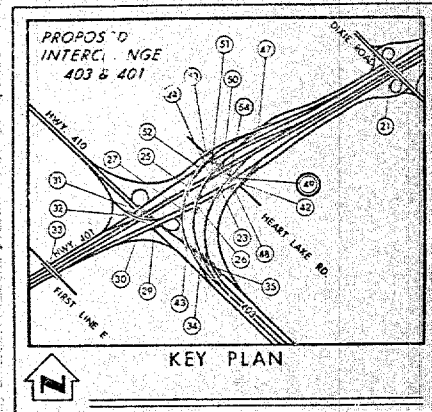
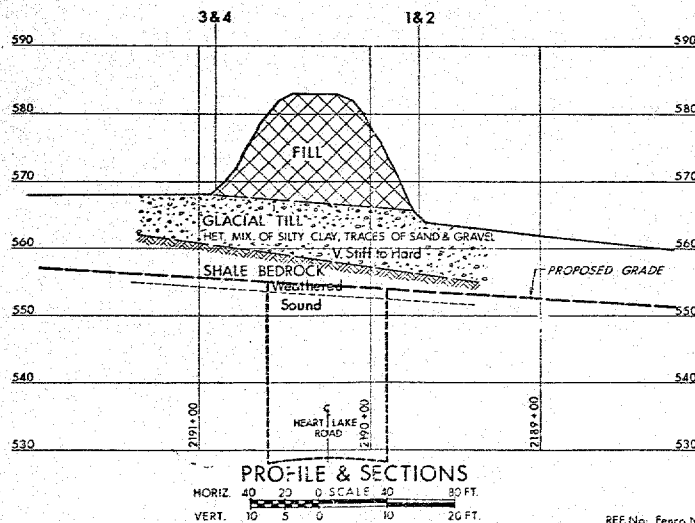
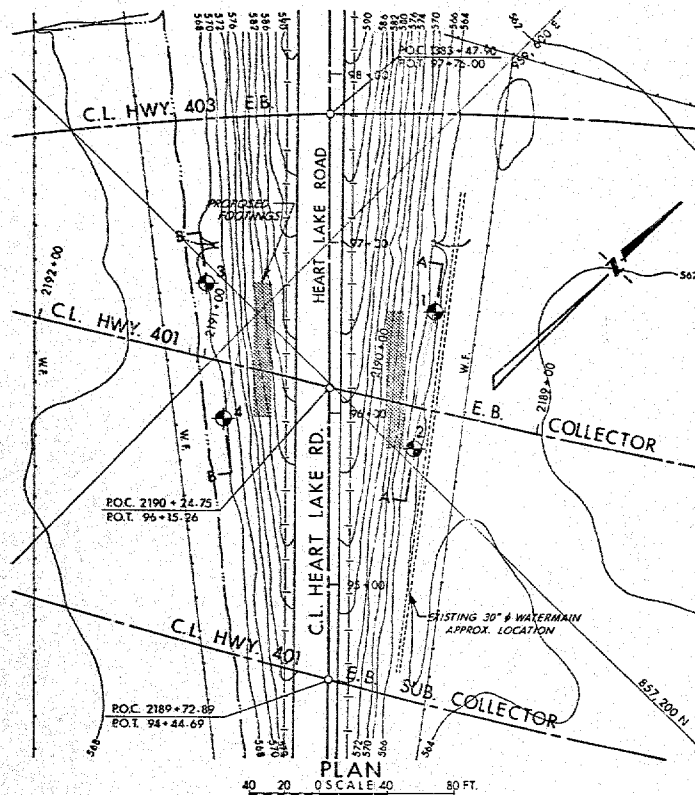
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



LEGEND

- ◆ Bore Hole
- ⊕ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- ⊕ Water Levels established at time of field investigation March 1973.

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	564.4	857,273	959,673
2	565.1	857,207	959,721
3	568.2	857,191	959,566
4	567.8	857,142	959,630

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO
DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

BRIDGE No. 49

HWY. 401 E.B. COLLECTOR OVER HEART LAKE ROAD

HIGHWAY NO. 401 & 403 DIST. NO. 6

CO. PEEL

TOWN OF MISSISSAUGA LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUMMD. V.K.	CHECKED <input checked="" type="checkbox"/>	W.P. NO. 127-66-08	DRAWING NO.
DRAWN S.R.	CHECKED <input checked="" type="checkbox"/>	W.O. NO. 72-11157	72-11157 A
DATE MAY 8, 1973	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO.		
PRINCIPAL FOUNDATION ENGINEER			



MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

72-11157

TO: Mr. A. G. Stermac,
Principal Foundation Engineer,
West Building.

FROM: G. C. E. Burkhardt,
Structural Planning Office,
3501 Dufferin Street.

ATTENTION: M. Devata

DATE: Febraury 23, 1973.

OUR FILE REF.

IN REPLY TO

SUBJECT: Hwy. 401 E.B. Collector Overpass
over Heart Lake Road - Bridge #49,
Site 24-316; W.P. 127-66-080,
District 6, Toronto.

The above structure is a part of the Hwy. 401/403/410 interchange as covered by W.P. 127-66-01. The location is shown on the attached "Scheme of the Interchange".

You are kindly requested to prepare the Foundation Report for this structure (due date May 9, 1973).

Attached are also two copies of "Fenco Drawing No. 3983-3K-1 on which the following information is shown:

- a) Proposed structure type and footing locations (marked in red).
- b) Profiles of all intersecting roads
- c) Co-ordinates of control point and alignments.

Point 1, as marked in red on the drawing, has been staked out by Fenco.

Co-ordination of boreholes will be carried out on your request by District Forces under the supervision of Mr. I. Tremain.

The approximate location of the existing 30" diameter watermain is shown in red on the attached drawing. This is the only underground utility in this area according to the information available.

MAA:lc
Attach.

M. A. Almer, *M. A. Almer*
STRUCTURAL PLANNING ENGINEER,
for:
G. C. E. Burkhardt,
REG. STRUCTURAL PLANNING ENG.

c.c. W. Roters
J. D. Barclay
R. Fitzgibbon
J. Anderson

Design Services Branch,
Downsview, Ontario.
M3M 1J8

Telephone: 248-3282.

March 8, 1973.

F. E. Johnston Drilling Co. Ltd.,
377 Munster Ave.,
Toronto, Ontario.

Dear Sirs:

This letter confirms our request of March 1, 1973,
for the supply of a C.M.E. auger machine together with all
necessary equipment, as specified under the terms of our
Contract Agreement, at Hwy. 401 & Heart Lake Rd. on March 1,
1973.

Mobilization will be from our Project W.O. 72-11167.

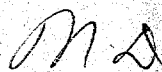
Our Project Number is W.O. 72-11159. ✓

Yours truly,

MD/ao

cc: W. W. Fry
(Attn: Mrs. M. Andrews,

For:


M. Devata,
Supervising Foundations Engineer,
A. G. Stermac,
Principal Foundations Engineer.

Foundations Files
Documents

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. G. Burkhardt
3501 Dufferin Street,
Downsview, Ontario.

FROM: Structural Office,
West Building,
Downsview, Ontario.

ATTENTION:

DATE: August 28, 1973.

OUR FILE REF.

IN REPLY TO

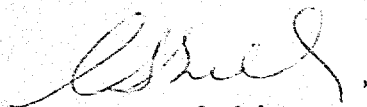
SUBJECT: Hwy. 401 E.B. Coll. Over Heart Lake Road,
Bridge 49,
W.P. 127-66-08, Site 24-316,
Hwy 401, District 6.

72-11-157

Attached herewith are prints of the Preliminary Bridge Plan
Drawing D 24-316-P1 the above mentioned structure.

The estimated cost of the proposed structure is \$200,000
which includes tender, materials, engineering and sundry
construction.

Any comments or revisions you may have should be submitted
within four weeks.



C. S. Grebski,
Structural Design Engineer.

/cls

Attach.

No comments.

M.D.

OK to file Oct 11/73

c.c. B. R. Davis
W. D. Birch
A. E. McKim
W. McFarlane
M. Stoyanoff
A. Stermac / 2 memos plus plan
J. Anderson - memo only
R. Fitzgibbon

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. A. Stermac,
Principal Foundation Engineer,
Foundations Office,
West Building.

FROM: Structural Office,
West Building.

ATTENTION:

DATE: December 28, 1973.

OUR FILE REF.

IN REPLY TO

SUBJECT:

Hwy. 401 E.B.C. over Heart Lake Rd.,
Bridge #49,
W.P. 127-66-08, Site 24-316,
Hwy. 401, District #6.

72-11-157

Attached herewith are the final bridge
drawings which show the foundation design for this
structure.

Kindly give us your comments at your
earliest convenience.

CSG/jh
Attach.

c.c. Foundation Office

for A. Radkowski
C. S. Grebski
Structural Design Engineer

See letter of Jan. 4/73

C. Poor

Mr. C. S. Grebski,
Structural Design Engineer,
Structural Office,
West Bldg., Downsview.

Geotechnical Office,
Engineering Services Branch,
West Bldg., Downsview.

January 4, 1974.

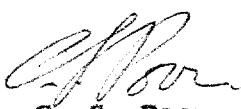
Hwy. 401 E.B. Collector Over Heart Lake Rd.
(Bridge #49) District #6 (Toronto), Site 24-316
W.O. 72-11157 W.P. 127-66-08

We have reviewed the final structural Drawings 24-316-1 & -3 for the above-mentioned project and submit the following comments.

The foundation investigation was carried out for a single-span close-abutment structure. Since the submission of our Foundation Report (W.O. 72-11157), an alternate scheme incorporating a three-span structure was adopted. As a result of this, no boreholes were put down at the west and east pier locations. However, the founding elevations of the pier footings, as shown in the structural drawings, are from 24 to 26 feet (8 to 9 m) below the established sound bedrock surface in this general area. In view of this, it is our opinion that the recommendations pertaining to spread footing founded on sound shale bedrock given in our Foundation Report W.O. 72-11157 will still be applicable.

Should you have any queries regarding this project, please feel free to contact this Office.

CSP/ao


C. S. Poon,
Project Foundations Eng.,
For: M. Devata,
Supervising Foundations Eng.

WP 127-66-08

Mr. O. Hopper
Manager
Contract Control Office

Soil Mechanics Section
Geotechnical Office

April 4, 1975

INFORMATION TO CONTRACTOR DURING PERIOD OF TENDER CALLING

This is to confirm the information given to you by telephone on March 26, 1975 that the following foundation reports were examined by Mr. Henry Shelagy, P. Eng., Division Manager of Kilmer Van Nostrand Co. Limited, at our office on March 25, 1974:

- 1) Bridge #51; Structure Site 24-314, W.P. 127-66-06, Dist. #6
- 2) Bridge #48; Structure Site 24-316, W.P. 127-66-03, Dist. #6
- 3) Bridge #31; Structure Site 24-323, W.P. 127-66-20, Dist. #6
- 4) Bridge #29; Structure Site 24-324, W.P. 127-66-22, Dist. #6.

H. DEVATA
Supervising Engineer.

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30412-23

DIST. 6 REGION CENTRAL

W.P. No. 127-66-08

CONT. No. 75-16

W. O. No. 72-11157

STR. SITE No. 24-31E

HWY. No. 401

LOCATION COLLECTOR OVERPASS

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 2

REMARKS: Drawings to be unfolded
before microfilmed

