

MEMORANDUM

TO: Mr. B. R. Davis,  
Bridge Engineer,  
Bridge Office,  
Admin. Bldg.

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

ATTENTION: Mr. S. McCombie

DATE: September 18, 1969.

OUR FILE REF.

IN REPLY TO SEP 23 1969

SUBJECT:

FOUNDATION INVESTIGATION REPORT  
For  
Proposed Underpass Structure  
At the Crossing  
of the Q.E.W. and Grand Ave.  
Borough of Etobicoke  
Metropolitan Toronto  
District No. 6 (Toronto)  
W.J. 69-F-61 W.P.314-65-03

Attached, we are forwarding to you, our detailed foundation investigation report on the subsoil conditions existing at the above structure 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/ia  
Attach.

cc: Messrs. B. R. Davis (2)  
H. A. Tregaskes  
D. W. Farren  
G. K. Hunter (2)  
F. G. Allen  
W. S. Malinyshyn

*A.G. Stermac*  
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PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. T. J. Kovich  
B. A. Singh

Foundation Files  
General Files

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FOUNDATION INVESTIGATION REPORT  
For  
Proposed Underpass Structure  
At the Crossing  
of the Q.E.W. and Grand Ave.  
Borough of Etobicoke  
Metropolitan Toronto  
District No.6 (Toronto)  
W.J. 69-F-61 W.P.314-65-03

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1. INTRODUCTION:

It is proposed to reconstruct the Q.E.W. from the Gardiner Expressway easterly. In conjunction with this programme the Foundation Section was requested to carry out a subsoil investigation for the proposed underpass structure, which will replace the existing structure, at the aforementioned location. The request was contained in a memo from the Bridge Location Section (Mr. W.S. Melinyshyn, Regional Bridge Location Engineer), dated July 28, 1969. An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at the site.

1. INTRODUCTION: cont'd...

This report contains the results of the investigation, together with recommendations pertaining to the foundations of the structure, as well as the stability of the approach embankments.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located at the existing intersection of the Q.E.W. Highway and Grand Avenue in the Borough of Etobicoke, Metropolitan Toronto. The existing Eastbound and Westbound lanes of the Q.E.W. each have three paved lanes; the Eastbound and Westbound lanes are divided by a median approximately 36 feet in width. In the vicinity of the existing Grand Avenue structure the Q.E.W. is depressed approximately 4 feet below the surrounding terrain, which is grass covered and flat lying to gently undulating in relief between elevations 304 and 306.

The existing reinforced concrete 2 span (85' - 85') underpass structure, carrying Grand Avenue over the Eastbound and Westbound lanes of the Q.E.W. has a bridge deck approximately 40 feet in width. The associated approach embankments have a maximum height of the order of 18 feet above existing ground surface. In general the structure appears in good condition.

Physiographically, the site is situated in the "Iroquois Plain", which borders the shoreline of Lake Ontario. The "Plain", in the vicinity of the site, is characterized by

2. DESCRIPTION OF THE SITE AND GEOLOGY: cont'd....

a thin veneer of glacial till directly overlying shale bedrock, of the Meaford-Dundas formation, Ordovician Period. The glacial till is generally cohesive in nature.

3. FIELD AND LABORATORY WORK:

Four cased boreholes, each with an accompanying dynamic cone penetration test, were put down at the proposed structure site. The borings were advanced by a conventional diamond drill rig adopted for soil sampling purposes.

Samples of the fill and natural subsoil were recovered at required depths in a 2" O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for carrying out the Standard Penetration Test. The same method was used to advance the dynamic cone penetration test. Bedrock was proven in all of the borings by obtaining BXT size rock core samples. The groundwater level conditions across the site, at the time of the investigation, were determined by recording the water levels in all the open boreholes.

The locations and elevations of the boreholes, which were surveyed by personnel from the Central Region Engineering Surveys Section, are shown on Drawing 69-F-61A, together with an estimated stratigraphical profile along the centre line of Grand Avenue.

3. FIELD AND LABORATORY WORK: cont'd...

All the samples obtained were subjected to a careful visual inspection in the laboratory prior to any testing being carried out. Following this inspection, tests were carried out on certain samples to determine the engineering properties of the various soil types, namely:

Natural Moisture Contents

Grain-Size Distributions

Atterberg Limits

The results of these tests are plotted on the Record of Borelog sheets and summarized on Figures 1 to 3, inclusive, all contained in Appendix 1 of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The parent subsoil stratum across the site is a hard glacial till, some 3.5 to 8.5 feet in thickness, it is composed of clayey silt with sand and a trace of gravel. The glacial till is directly underlain by shale bedrock.

Up to 18 feet of fill material was encountered in the borings put down through the approach embankments. The fill is primarily composed of a compact to dense silt, with some sand and clay.

cont'd./5

#### 4. SUBSOIL AND BEDROCK CONDITIONS:

##### 4.1) General: cont'd.

The boundaries of the various deposits, as determined in the boreholes, are shown on the accompanying borelog sheets. The stratigraphical profile, shown on Drawing 69-F-61 A, is inferred from this boring data.

From ground surface downwards, the various soil types encountered are as follows:

##### 4.2) Existing Embankment Fill:

The borings, put down through the existing approach embankments (BH's #1 and 3), indicated the presence of up to 18 feet of fill. On the edge of the shoulders the upper one foot of this fill is a topsoil. The fill, with the exception of the upper 8 feet at BH #1, is composed of a compact to dense ('N' values between 11 and 50 blows/ft.) silt with some sand and clay. Grain-size distribution curves, for samples obtained from this granular fill, are plotted on Figure #1, in the Appendix of this report.

At the location of BH #1 the upper 8 feet of the fill material is composed of loose sand with some silt followed by a thin layer of very stiff clayey silt.

##### 4.3) Glacial Till:

Underlying the embankment fill, where it exists, and a thin topsoil cover elsewhere, is the predominant overburden stratum across the site, composed of a mottled brown to grey till.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.3) Glacial Till: cont'd.)...

varies from 3.5 feet in BH #4 to 8.5 feet in BH #1.

The glacial till is generally composed of a matrix of clayey silt binding sand and gravel sizes, i.e. it is cohesive in nature. There are granular zones throughout, however, where the deposit is basically composed of silt, sand and gravel. In BH #1 a one foot thick layer of silty sand was encountered at approximately elevation 294. Grain-size distribution curves, for samples of the glacial till obtained using 2" O.D. sampling equipment, are plotted on Figure #2.

Atterberg limit tests were carried out on representative samples of the more cohesive portions of the glacial till. The results of this testing, which are given on the Borelog sheets, are summarized on the Plasticity Chart, Figure #3. This testing gave values for the liquid and plastic limits varying from 21 to 33 and 16 to 21, respectively. From these values it is estimated that the major cohesive portion of the stratum is inorganic with a plasticity in the low range. The natural moisture content is consistently less than the plastic limit.

cont'd./7



4. SUBSOIL AND BEDROCK CONDITIONS:

4.3) Glacial Till: cont'd.)...

Standard penetration resistance testing was carried out within the glacial till; the results are plotted on the Borelog sheets. This testing gave 'N' values which varied from 28 to 133 blows/ft., being typically greater than 50 blows/ft. Based on these results it is estimated that the consistency of the basically cohesive glacial till is hard.

4.4) Shale Bedrock:

Bedrock was proven in all the borings by obtaining between 5 and 14.5 feet of BXT size rock core samples. The surface of the bedrock varies from approximately elevation 287.5 in BH #1 to 295 in BH #4 - i.e. dips in a southerly direction.

The bedrock is composed of a grey shale with random interbeds of limestone. In general, bedrock is sound throughout, however, some signs of fracturing and jointing were observed in the upper 2 to 5 feet at the boring locations.

5. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out, during the period of the investigation, by recording the water levels in the open borcholes. The observations

5. GROUNDWATER CONDITIONS: cont'd.)...

are recorded on the borelog sheets and summarized on Drawing No. 69-F-61A. The results of these measurements indicate that the groundwater level, within the parent subsoil, is about 5.5 to 6 feet, below ground surface - i.e. between elevations 291 and 293.5.

The borings put down through the approach fills indicated that, at these locations, the water level, as recorded in the open boreholes, was at a higher elevation than quoted above.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct a three span structure (70' - 75' - 93') to replace the existing structure, at the crossing of the Q.E.W. and Grand Avenue. The new underpass structure will be about 42 feet wide to accomodate two lanes of traffic. The existing alignment of Grand Avenue will be maintained. The proposed profile grades of the Q.E.W. and Grand Avenue will be approximately at elevations 301 and 321, respectively. This will involve increasing the height of the existing approach fills by between 3 and 5 feet; in addition

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General: cont'd.)...

a nominal widening of the embankment will be required. The maximum height of the reconstructed approaches will be in the order of 19 feet above the Q.E.W. grade.

The Westbound and Eastbound lanes of the Q.E.W. will be relocated slightly to the north; an extra paved lane will be added in either direction, bringing the total number of lanes to four. In addition provision is being made for a future collector lane to be located south of the Eastbound Lane.

The parent material across the site is a hard cohesive glacial till, which varies between 4.5 and 8.5 feet in thickness. The glacial till is directly underlain by shale bedrock. The existing embankment fills, which are as high as 18 feet above existing ground surface, are composed primarily of compact to dense silts and sands.

The piers can be founded within the parent subsoil, while the abutments can be 'perched' within the existing approach fills. The foundation recommendations for these respective elements are discussed in the sections to follow.

6.2) Pier Foundations:

The parent cohesive glacial till is competent. The piers, therefore, can be founded on spread footings, located within this stratum. Four feet of earth cover

6. DISCUSSION AND RECOMMENDATIONS:

6.2) Pier Foundations: cont'd.)

should be provided to the underside of the footings for frost protection purposes. Spread footings, meeting the aforementioned requirements, can be designed using a safe bearing pressure of up to 5.0 t.s.f.

The footings will probably be located above the piezometric groundwater level recorded during the period of the investigation (W.L. between elevation 291 and 293.5) . Therefore, no major dewatering problems are anticipated, during the footing excavation phase. Any groundwater seepage or surface run-off into the excavations could be handled using standard techniques, such as pumping from sumps etc.

Settlement of the foundation subsoil will take place due to the induced footing pressure. For footings, inducing the aforementioned bearing pressure, the settlement will be negligible, since the foundation subsoil is competent. Further, this settlement will be elastic in nature - i.e., take place during or immediately following the construction period.

cont'd./11

6. DISCUSSION AND RECOMMENDATIONS:

6.3) Abutment Foundations:

The proposed abutments may be 'perched' within the existing approach fills; two alternative methods are given for the foundation support of the abutments.

i) The abutments may be supported on spread footings placed within the existing approach fill, at or below elevation 310. It is recommended, however, that the footing excavations i) extend at least 2 feet below the selected footing level and ii) that the perimeter of the excavations extend at least 5 feet from the footing edges in all directions. The sub-excavation so formed should be brought up to the aforementioned footing level with well compacted 'G.B.C.' class 'A' material. An allowable bearing value of 2.0 t.s.f. may be used in footing design.

11) The abutments for the structure may be supported on end-bearing piles driven to bedrock. For estimating purposes, the elevation of the pile tips can be assumed to be as follows:

South Abutment - elevation 287

North Abutment - elevation 293

6. DISCUSSION AND RECOMMENDATIONS:

6.3) Abutment Foundations: cont'd.)

The allowable loads will depend on the pile section chosen (e.g. 12 BP 74 steel H-piles may be designed for 90 tons per pile).

6.4) Approach Embankments:

No stability problems are anticipated for embankments with standard 2:1 slopes, provided the additional fill required is properly compacted.

7. MISCELLANEOUS:

The field work, performed during the period of August 5th to 8th, 1969, was supervised by Mr. K.K. Kwan.

The preparation of this report was undertaken by Mr. B.T. Darch, Senior Foundation Engineer.

The investigation was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who reviewed the report.

Equipment used was owned and operated by Master Soil Investigation Ltd.

September, 1969.

APPENDIX I.

DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-61

LOCATION Co-ords. 182,390 N; 224,265 E.

ORIGINATED BY KK

W.P. 314-65-03

BORING DATE August 5, 6, 7, 1969

COMPILED BY KK

DATUM Geodetic

BOREHOLE TYPE Washboring-NX, BX Casing - BXT BRock Core

CHECKED BY

SOIL PROFILE		STRAT PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY Y P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %		
							20	40	60	80	100	UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE		$w_p$ — $w$ — $w_L$					
313.9	Ground Level																		
311.9	Silty sand (Topsoil)		1	SS	11	310										3 74 16 7 308. WL in open B.H. Aug. 7/69 0 10 79 11 1 21 73 5 1 23 63 13			
2.0	Sand, with some silt, tr. of clay & gravel		2	SS	9														
307.4	(Fill) Loose		3	SS	17														
6.5	Clayey silt with sand & gravel (Fill) Very stiff		4	SS	11	300													
304.9	Silt with some sand & clay. (Fill) (Brown)		5	SS	50														
295.9	Compact to dense		6	SS	15														
18.0	Clayey silt with sand & a trace of gravel (Glacial Till)		7	SS	90	290													
			8	SS	133														
			9	AXT															
287.4	Mottled Brown. Hard		10	SS	102	280													
26.5			11	BXT	65%														
282.4	Fractured																		
31.5	Shale Bedrock (random interbeds of limestone)		12	BXT	91%	270													
272.8	Sound Grey		13	BXT	88%														
41.1	End of Borehole																		

3 74 16 7

308.

WL in open  
B.H.

Aug. 7/69

0 10 79 11

1 21 73 5

1 23 63 13

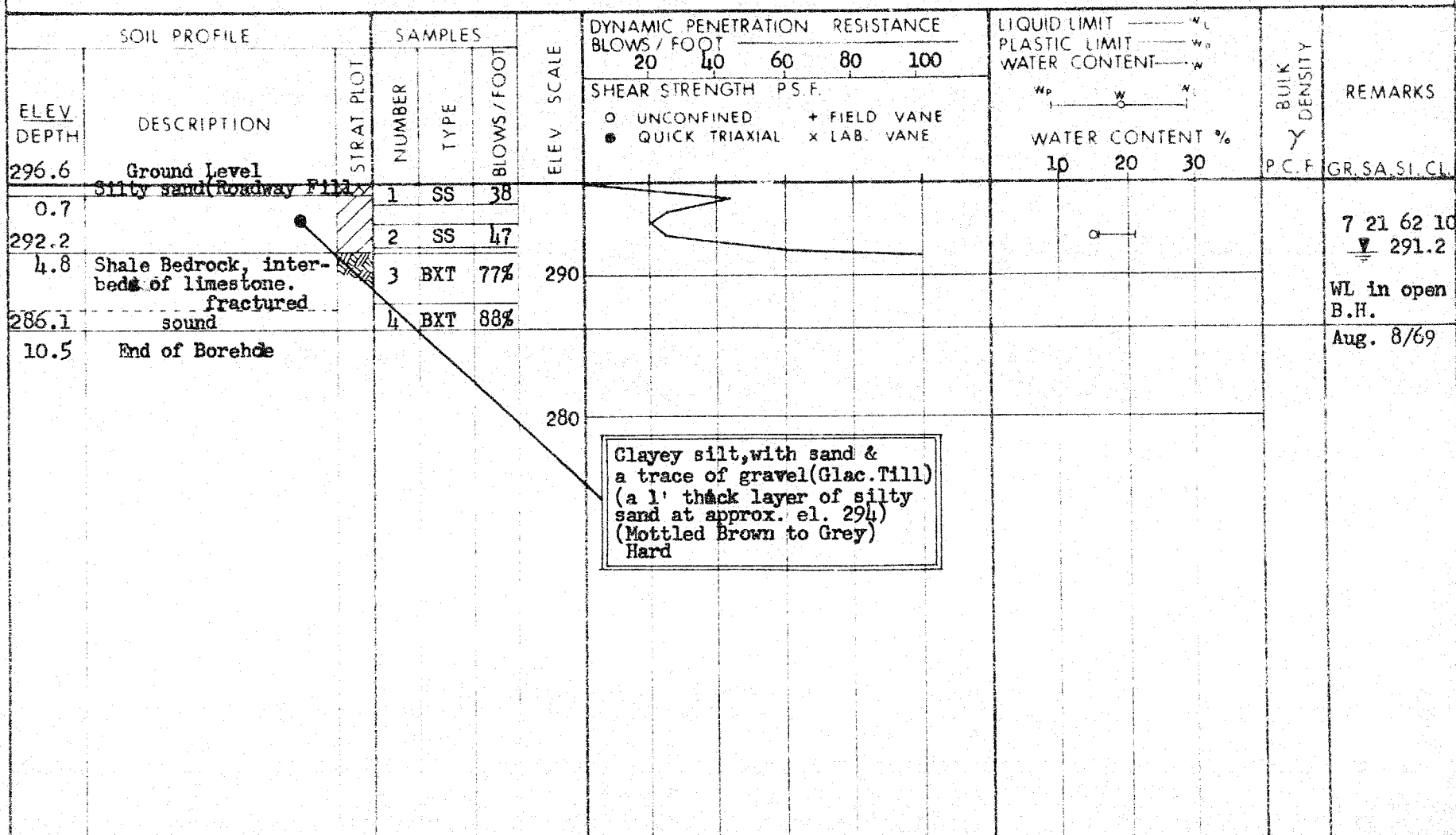


DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-F-61 LOCATION Co-ords. 182,433 N; 224,258 E. ORIGINATED BY KK  
 W.P. 314-65-03 BORING DATE August 6, 1969 COMPILED BY KK  
 DATUM Geodetic BOREHOLE TYPE Washboring - BX Casing - BXT Rock Core CHECKED BY



DEPARTMENT OF HIGHWAYS- ONTARIO  
MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No.3

FOUNDATION SECTION

JOB 69-E-61 69-F-120 LOCATION Co-ords. 182,607 N; 224,216 E. ORIGINATED BY KKK  
 W.P. 314-65-03 BORING DATE August 7, 1969 COMPILED BY KKK  
 DATUM Geodetic BOREHOLE TYPE Washboring - BX Casing - BXT Rock Core CHECKED BY KKK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT ——— $w_L$ PLASTIC LIMIT ——— $w_p$ WATER CONTENT ——— $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %				
							20	40	60	80	100	$w_p$	$w$	$w_L$		
						<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div><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## Note:

BH caved in at approx. el. 304. after removing casing Aug. 7/69

DEPARTMENT OF HIGHWAYS - ONTARIO  
 MATERIALS & TESTING OFFICE

## RECORD OF BOREHOLE No. 4

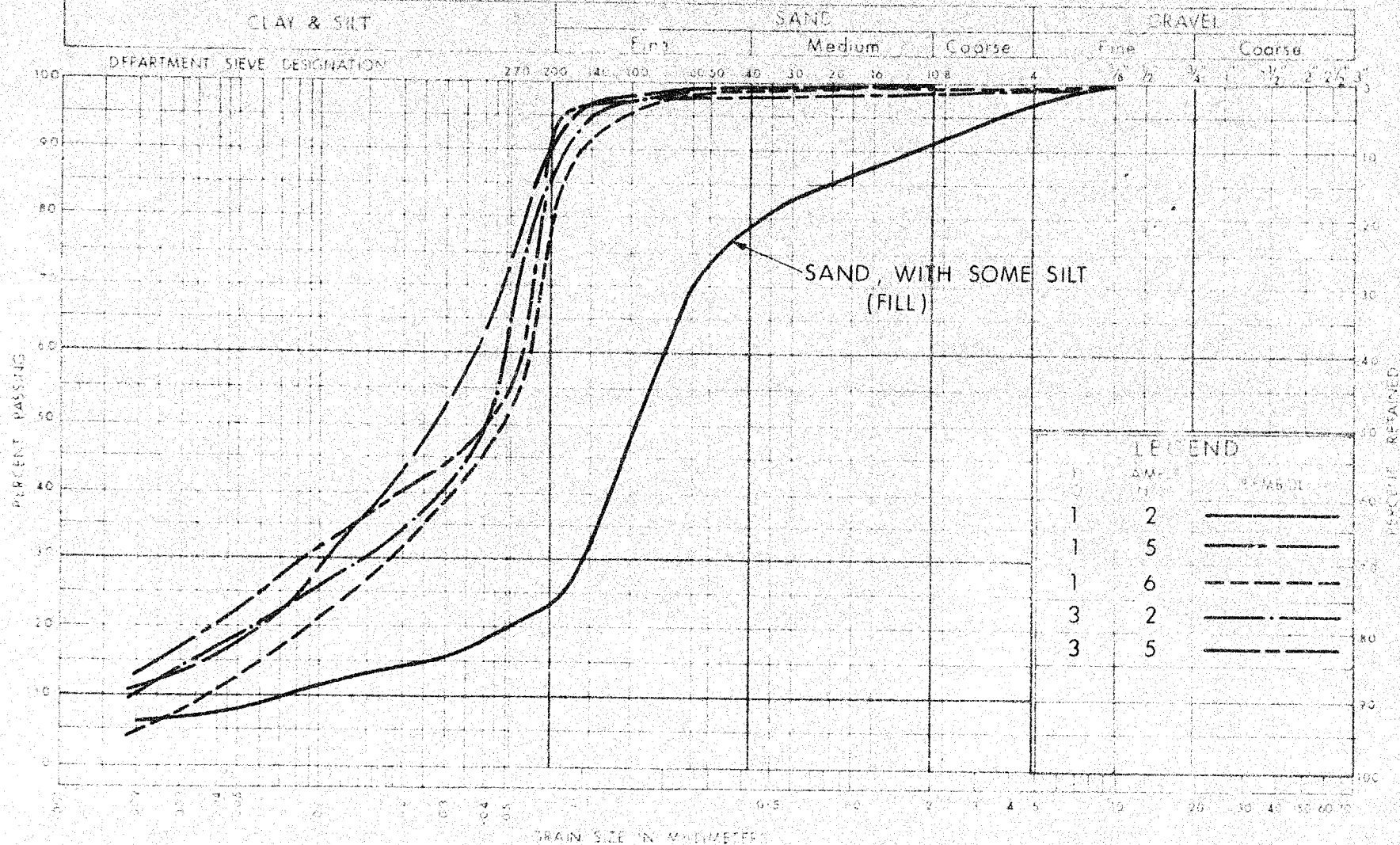
FOUNDATION SECTION

JOB 69-F-61 LOCATION Co-ords. 182,542 N: 224,161 E. ORIGINATED BY KK  
 W.P. 314-65-03 BORING DATE August 7, 8, 1969 COMPILED BY KK  
 DATUM Geodetic BOREHOLE TYPE Washboring - BX Casing - BXT Rock Core CHECKED BY ✓/

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — $w_L$ PLASTIC LIMIT — $w_p$ WATER CONTENT — $w$			BULK DENSITY $\gamma$ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					WATER CONTENT %				
							20	40	60	80	100	$w_p$	$w$	$w_L$		
SHEAR STRENGTH P.S.F.							+ FIELD VANE x LAB. VANE									
299.5	Ground Level															
1.0	Sandy silt (Topsoil)	XX	1	SS	8											
295.2	Clayey silt, with sand & tr. grav. (Giac. Till) Hard		2	SS	66											
4.3	Shale Bedrock with inter-bedded limestone (Grey) fractured		3	BXT	87%											
290.2	sound															
9.3	End of Borehole					290										

293.4

# UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAY  
MATERIALS and  
TESTING  
DIVISION

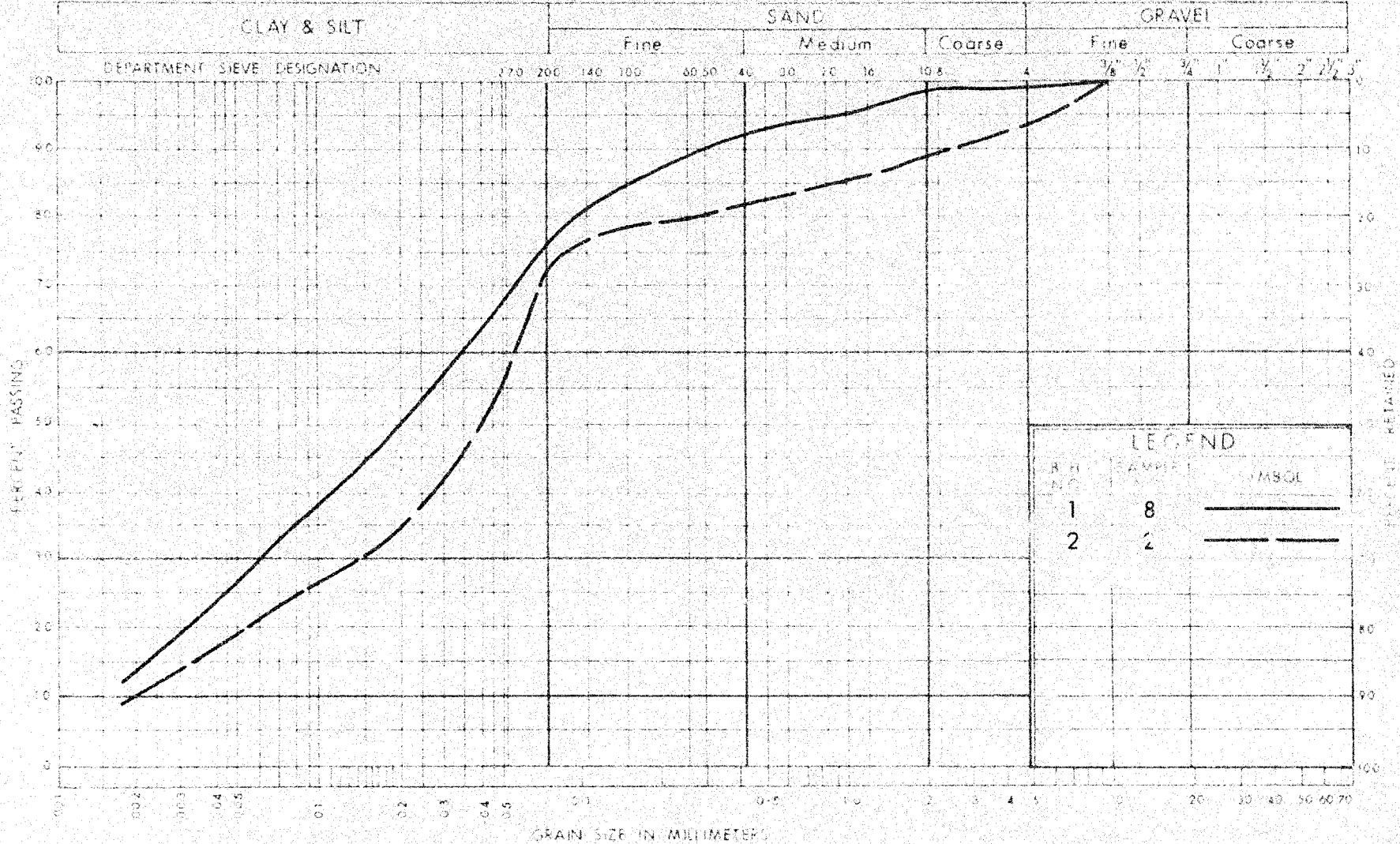
GRAIN SIZE DISTRIBUTION  
FILL  
SILT, WITH SOME SAND & CLAY

W.P. NO. 314-65-03

JOB NO. 69-F-61

FIGURE NO. 1

# UNIFIED SOIL CLASSIFICATION SYSTEM



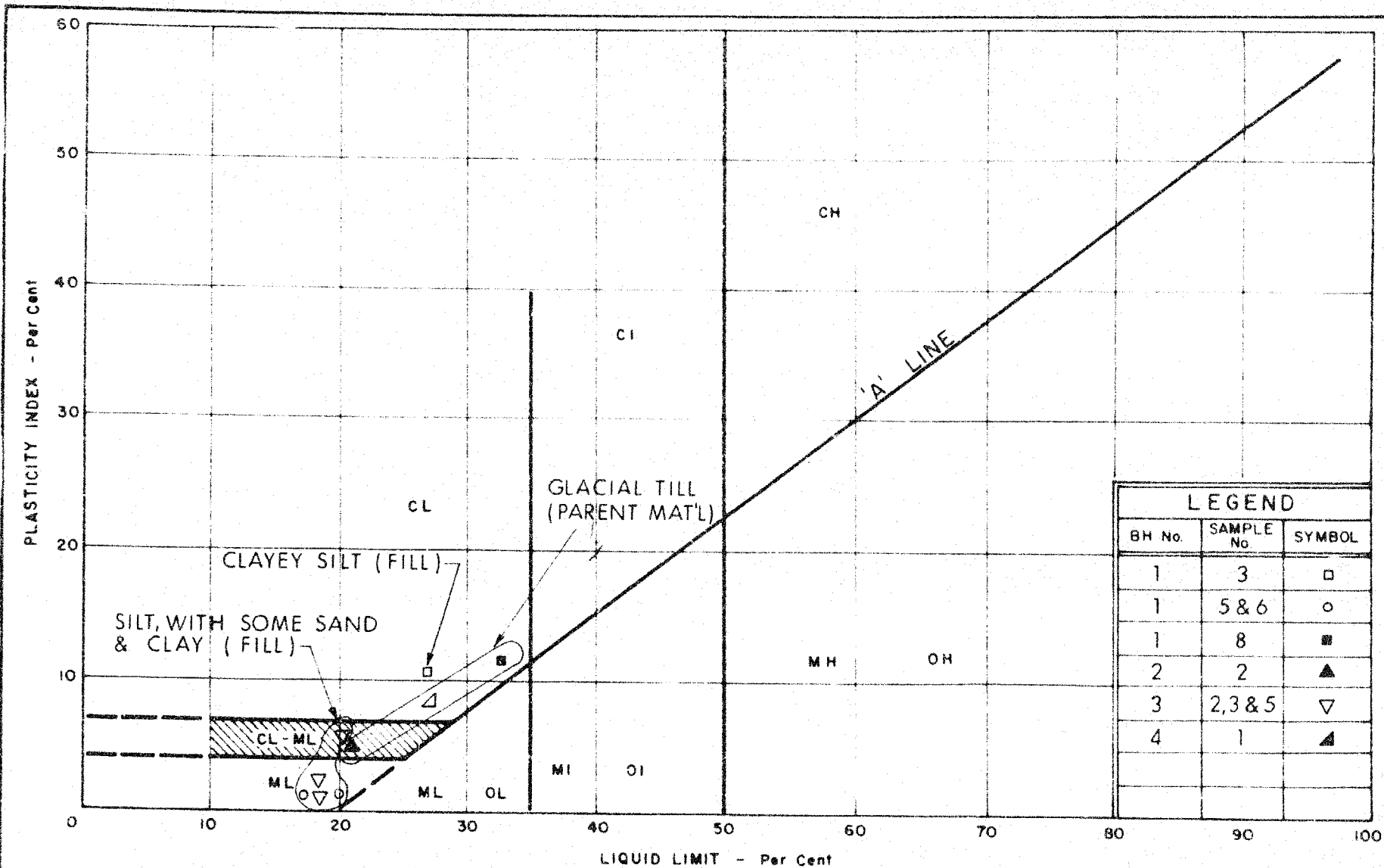
DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

GRAIN SIZE DISTRIBUTION  
GLACIAL TILL  
CLAYEY SILT, WITH SAND & TRACE OF GRAVEL

WP No. 314-65-03

JOB No. 69-F-61

FIGURE NO. 2



DEPARTMENT OF HIGHWAYS  
MATERIALS and  
TESTING  
DIVISION

## PLASTICITY CHART

WP No. 314 - 65 - 03

JOB No. 69 - F - 61

FIGURE NO. 3

## ABBREVIATIONS USED IN THIS REPORT

### PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' - 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>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

### TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W	THINWALL OPEN
WS	WASHED SAMPLE	T.P	THINWALL PISTON
S.B	SCRAPER BUCKET SAMPLE	O.S	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C	ROCK CORE
S.T	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

### SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

$\gamma$	UNIT WEIGHT OF SOIL (BULK DENSITY)
$\gamma_s$	UNIT WEIGHT OF SOLID PARTICLES
$\gamma_w$	UNIT WEIGHT OF WATER
$\gamma_d$	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
$\gamma'$	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
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
$\tau$	SHEAR STRENGTH
c	EFFECTIVE COHESION
$\phi'$	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
$c_u$	APPARENT COHESION
$\phi_u$	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
$\mu$	COEFFICIENT OF FRICTION
$S_i$	SENSITIVITY

## GENERAL

$\pi$	= 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
$\sigma$	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ( $\bar{\sigma}$ IS ALSO USED)
$\tau$	SHEAR STRESS
$\epsilon$	LINEAR STRAIN
$\gamma$	SHEAR STRAIN
$\nu$	POISSON'S RATIO ( $\mu$ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
$\eta$	COEFFICIENT OF VISCOSITY

## EARTH PRESSURE

d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
$\delta$	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

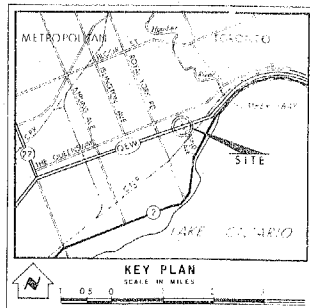
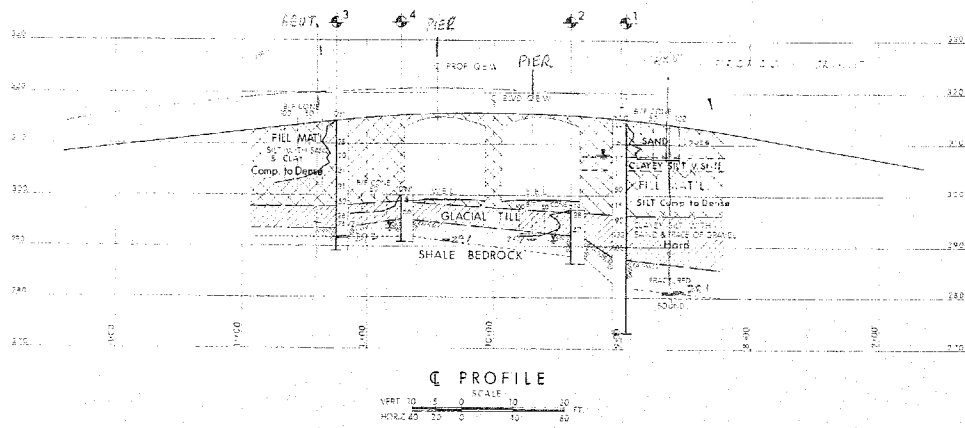
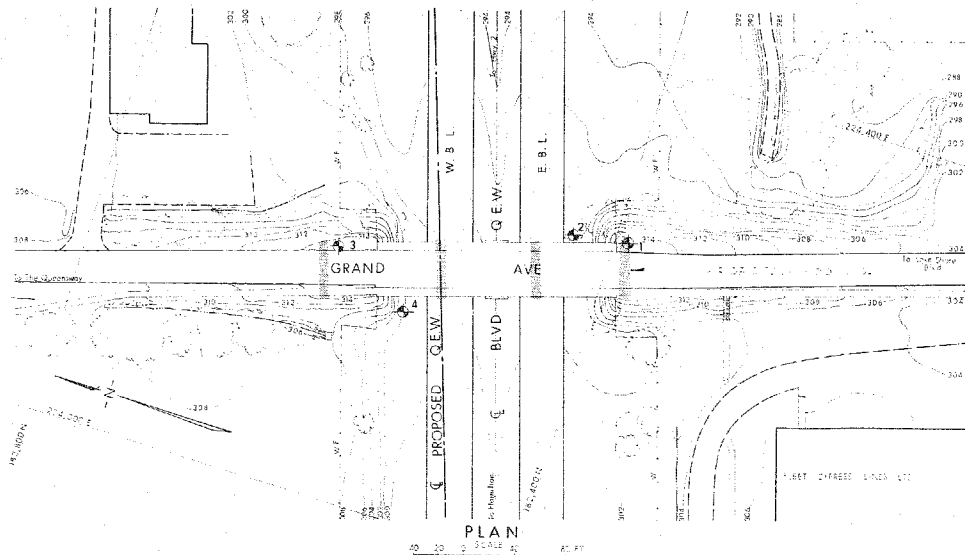
## FOUNDATIONS

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
$\beta$	ANGLE OF SLOPE TO HORIZONTAL





LEGEND			
	Bore Hole		
	Cone Penetration Hole		
	Bore & Cone Penetration Hole		
	Water Levels established at time of field investigation. Aug. 1964		
NO.	ELEVATION	PO. HOLE LOCUS	DATE
1	313.4	182.950	722.245
2	298.6	182.453	724.759
3	314.4	182.607	722.846
4	298.5	182.542	722.101

**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.

DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

**GRAND AVE**

KIND'S HIGHWAY NO. Q.E.W. DIST NO. 6  
CO. YORK METRO. TORONTO  
TWP. ETOBICOKE LOT        CON.       

**BORE HOLE LOCATIONS & SOIL STRATA**

SURV. V.K.	CHECKED	S.P. NO. 214.05.03	DATE
DRAWN E.O.	CHECKED	JOB NO. 54-1-1-1	DATE
DATE	2 SEP 1964	SITE NO.	
APPROVED		DATE	

69-F-61A

## MEMORANDUM

TO: Mr. A. Stermac,  
Principal Foundation Engineer,  
Room 107, Lab. Bldg.

FROM: C.S. Grebski,  
Bridge Office

ATTENTION:

DATE: March 31, 1971

OUR FILE REF.

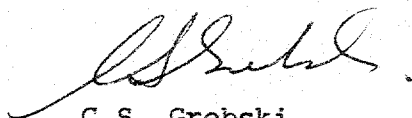
IN REPLY TO

SUBJECT: Grand Avenue Underpass  
over Q.E.W. & Future South Collector Road  
W.P. 314-65-03, Site No. 37-242  
Q.E.W., District No. 6

69-F-61

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

Kindly give us your comments at your earliest  
convenience.



C.S. Grebski,  
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Office

no comment  
BTD April 5/71

Handwritten signature and date: 7/1

no comments  
M. Devotta  
April 8th 1971

## MEMORANDUM

To: Mr. A.G. Stermac,  
Principal Foundation Engineer,  
Room 107,  
Lab. Building.

FROM: W.S. Melinyshyn,  
Bridge Office.

ATTENTION:

DATE: July 28th, 1969.

OUR FILE REF.

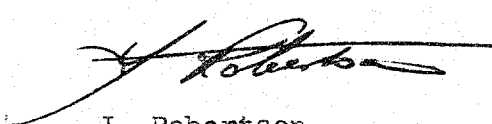
IN REPLY TO

SUBJECT: Grand Avenue Underpass,  
W.P. 314-65-03, Site 37-242,  
District 6, Hwy. Q.E.W.

The attached marked up partial print, B-80-68, details the approximate location of the proposed footing for the above detailed structure. Also enclosed are prints taken from the Functional Planning Report showing the proposed grade. Field Reconnaissance Report will be forwarded in the near future covering this site.

Would you kindly arrange to have a foundation investigation of sufficient magnitude to allow the Bridge Office to proceed with the structure design.

JR/cew  
Encl.  
cc E. Cross

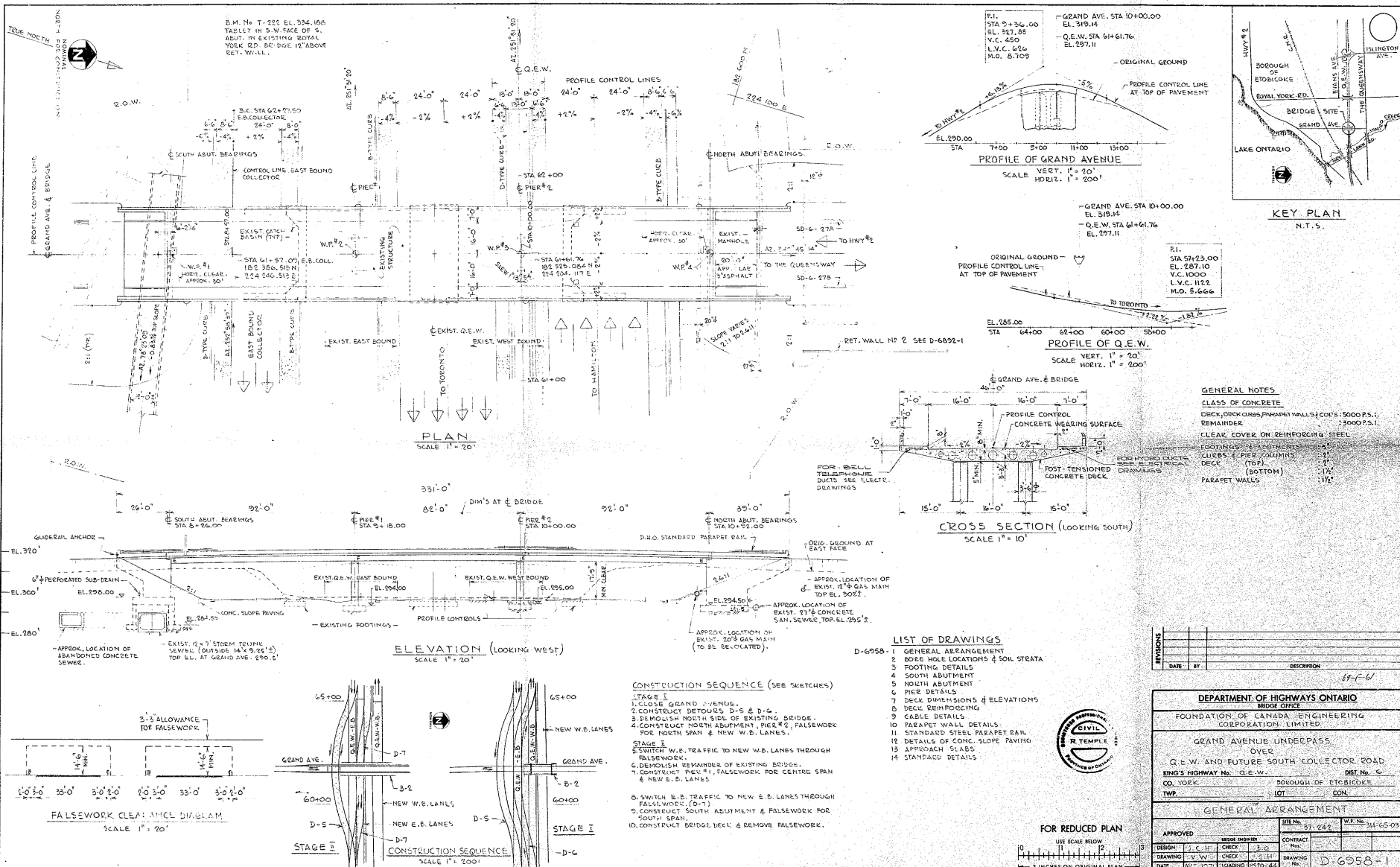
  
J. Robertson,  
BRIDGE LOCATION SUPERVISOR,  
for:  
W.S. Melinyshyn,  
REGIONAL BRIDGE LOCATION ENGINEER.

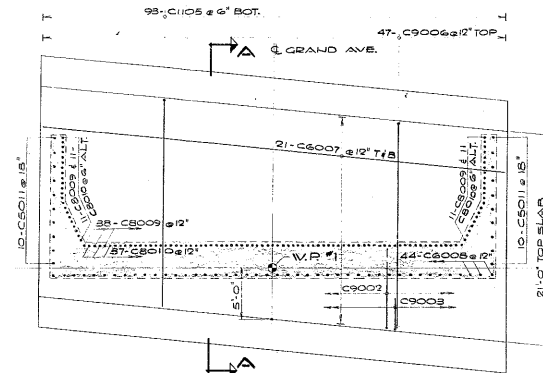
#69-F-61

W.P. 314-65-03

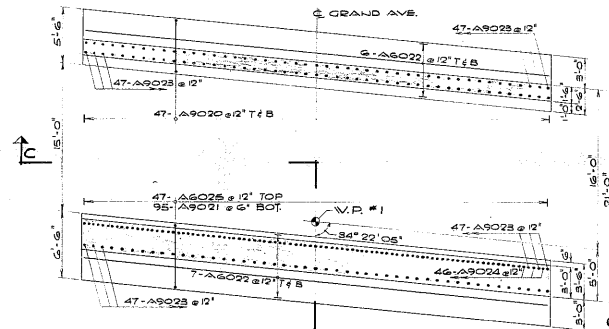
Q.E.W.

GRAND AVENUE  
UNDERPASS STRUCTURE

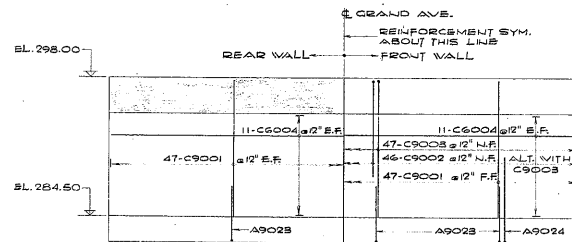




PLAN OF SOUTH ABUTMENT FOOTING  
SCALE: 3/8" = 1'-0"

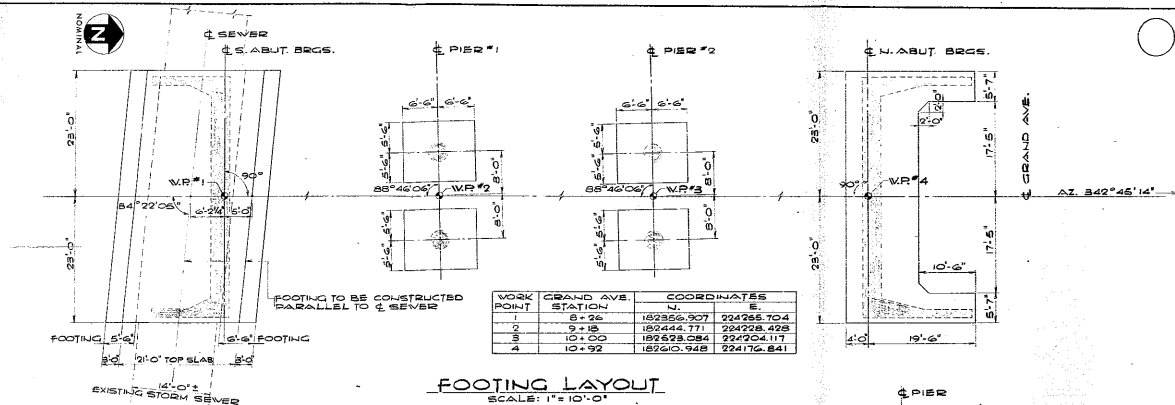


SECTION B-B  
SCALE: 3/8" = 1'-0"

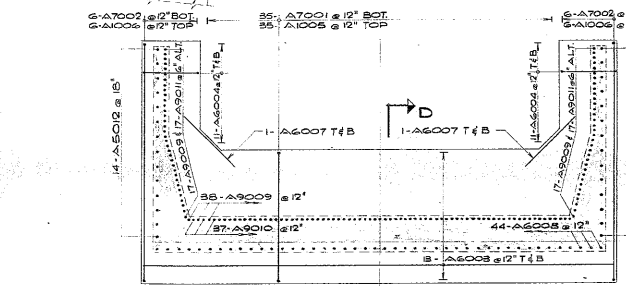


SECTION C-C  
SCALE: 3/8" = 1'-0"

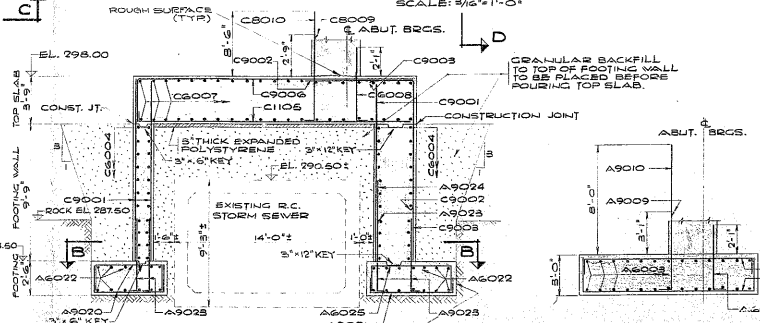
INSIDE FACES OF FOOTING WALLS UP TO TOP OF CURB MAY BE FORMED WITH EXPANDED POLYSTYRENE LEFT IN PLACE. ALTERNATIVELY FORMWORK SHALL BE REMOVED AND GAP SHALL BE FILLED WITH GRANULAR BACKFILL.



FOOTING LAYOUT  
SCALE: 1" = 10'-0"

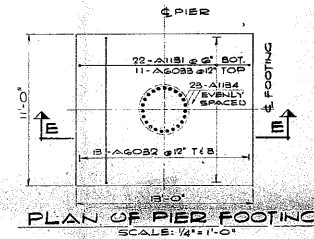


PLAN OF NORTH ABUTMENT FOOTING  
SCALE: 3/8" = 1'-0"

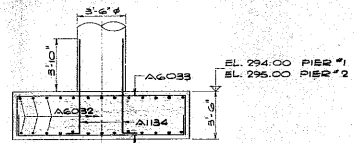


SECTION A-A  
SCALE: 1/4" = 1'-0"

SECTION D-D  
SCALE: 1/4" = 1'-0"



PLAN OF PIER FOOTING  
SCALE: 1/4" = 1'-0"



SECTION E-E  
SCALE: 1/4" = 1'-0"



REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS, ONTARIO  
BRIDGE OFFICE  
FOUNDATION OF CANADIAN ENGINEERING CORPORATION LIMITED

GRAND AVE. UNDERPASS  
OVER  
G.E.V. AND FUTURE SOUTH COLLECTOR RD.  
ENG'S HIGHWAY No. 2 E.V. DIST. No. 6  
CO. YORK BOROUGH OF STONICKE  
TWP. LOT CON.

FOOTING DETAILS	
APPROVED	37-242
DESIGN	J.C.H./R.C.
DRAWING	K.E.P. CHECK
DATE	MAY 71

