

#62-F-205-C

W.P.# 193-58

HWY.# 401 +

AVENUE RD.

UNDERPASS

62F 205C

cc: Foundations Office (Rm. 110)(2nd copy)

23-62-252

Materials and Research Division

February 23, 1962

Dominion Soil Investigation, Ltd.,  
77 Crockford Blvd.,  
Scarborough, Ontario.

Attention: Mr. A. Bonca.

Re: W.P. 193-58,  
Hwy. 401, Avenue Rd.,  
Toronto, District #6.

Dear Sir:-

Please consider this your authority to carry out a foundation investigation at the above site. Plans and profiles were provided to your representative on February 23, 1962.

It is understood that a qualified Soils Engineer will be in charge of the field work at all times.

Fourteen copies of the completed foundation report should be submitted to the Foundation Section prior to March 12, 1962. Previous requirements as to preliminary borehole information, and laboratory testing program, should be followed.

Charges for the work performed will be in accordance with your Schedule of Rates, dated February 17, 1959, and invoice to be addreseed to the attention of the undersigned.

We would also advise that we now require that borehole locations be confirmed by District personnel. Would you, therefore, advise this office before completion of the drilling, in order that this may be arranged and undertaken while your Engineer is still at the site.

NDS/MdeF

Yours very truly,

cc: Messrs. S. McCombie  
I. C. Campbell  
C. Fraser  
T. J. Kovich  
N. D. Smith (2)  
Foundations Office  
Gen. Files  
Mrs. T. Tate

A. Rutka,  
MATERIALS AND RESEARCH ENGINEER.

Mr. A. H. Toys,  
Bridge Engineer.  
Materials & Research Division,  
(Foundation Section)

March 2, 1962.

FOUNDATION INVESTIGATION REPORT  
By Dominion Soil Investigation,  
Limited.

Attention: Mr. R. McEneaney.

Re: Highway #401 - Avenue Road Underpass  
Toronto, District #6,  
W.P. 193-58

Attached, we are forwarding to you, the above-mentioned report submitted by the Consultant Dominion Soil Investigation, Ltd.

We have reviewed the report and find the factual information well presented, and believe that the recommendations contained in the report will be sufficient for your future design work.

The only change in recommendations that we would suggest is in footing elevation for the North pier (B.M. -2) where a higher elevation (577.0) could be taken. This change is based on the granular character of the soil and also on the results from a previous boring (No. 2) on the West side of the North pier.

If further information is required in connection with this project, please feel free to call on our office.

AGG/McE  
Attach.

cc: Messrs. A. H. Toys (2)  
H. A. Tregaskes  
H. D. McMillan  
I. C. Campbell  
C. Fraser  
J. Roy  
F. J. Kovich  
J. B. Crispier  
B. B. Saint  
C. Norman  
A. Watt

*A. G. Stern*  
A. G. Stern,  
PRINCIPAL FOUNDATION ENGINEER

Foundation Office -- Gen. Files

Mr. A. M. Toye,  
Bridge Engineer.  
Materials & Research Division,  
(Foundation Section)

March 6, 1962.

PRELIMINARY REPORT by  
Dominion Soil Investigation, Ltd.

Attention: Mr. Chester Grebski.

Re: Subsoil Investigation for Highway #401,  
Avenue Road Underpass, Toronto, District #6  
W.P. 193-58 - (Dom. Soil Ref. 2-2-26).

Attached, we are forwarding to you, the Preliminary Report on the above-mentioned subsoil investigation, submitted by Dominion Soil Investigation, Ltd.

We would like to draw your attention to the value of the angle of internal friction to be used in design. The Consultant has quoted the value of  $45^{\circ}$ ; however, after re-considering the problem and discussing it with us, he came to the conclusion that a value of  $38^{\circ}$  would be more realistic and this is the value we would also recommend. In the final report, this value will be suggested by the Consultant.

We believe that the presented information will be sufficient for your future design work. However, should there be any additional information that you would require, please do not hesitate to contact our Office.

AGS/Mdef  
Attach.

*A. G. Stermac*  
A. G. Stermac,  
PRINCIPAL FOUNDATION ENGINEER

cc: Foundations Office  
Gen. Files.

March 5th, 1962.

Ontario Department of Highways,  
Materials and Research Division,  
Parliament Buildings,  
Toronto, Ontario.

Att'n: Mr. A. Stermac,  
Principal Foundations Engineer

Re: Subsoil Investigation for Highway #401,  
Avenue Road Underpass, Toronto - District #6  
Your ref: W.P. No. 193-58 - Our ref: 2-2-26.

Dear Sir:

This letter is a preliminary report on the findings and contains recommendations on the foundations for the above project.

Four (4) boreholes were drilled at the site to reveal the subsurface stratigraphy. The table below lists the essential data:

<u>Borehole No.</u>	<u>Location of Hole</u>	<u>Ground Level</u>	<u>Depth of Hole</u>
One	North Abutment - West Side	604.10	29'-4"
Two	North Pier - East Side	582.55	14'-4"
Three	South Pier - West Side	605.28	29'-0"
Four	South Abutment - East Side	590.55	14'-5"

Fill was encountered mainly in those holes which were located above the original ground level. The material is similar to the original subsoil and only the higher moisture content, smaller density and weathered appearance together with traces of organics, indicate the artificial origin of the substrata.

.....2

March 5th, 1962.

The natural ground below the zone of weathering has an ultimate bearing capacity much above that required. Hence, the four tons per square foot allowable bearing pressure provides for an ample margin of safety and no appreciable settlement will occur.

The following elevations are suggested as base levels for the proposed underpass:

Around Borehole No. One - Elevation 586 or lower

" " " Two - " 575 " "

" " " Three - " 583 " "

" " " Four - " 583 " "

For design purposes (safety against slipping), an internal angle of friction equal to 45 degrees may be assumed. The cohesion is to be neglected.

We trust that this preliminary information will be of help to you. Enclosed please also find one print of the geotechnical data sheet for the four boreholes. The final, complete report will follow shortly.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED,

*L. R. Szalatnay*

L. R. Szalatnay, P. Eng.,  
Senior Soils Engineer.

LRS/oed

Encl.

DEPARTMENT OF HIGHWAYS  
O N T A R I O  
MATERIALS AND RESEARCH DIVISION

REPORT ON  
FOUNDATION INVESTIGATION  
F O R  
HIGHWAY 401 - AVENUE ROAD UNDERPASS  
TORONTO, DISTRICT #6  
W. P. #193-58

Submitted by  
DOMINION SOIL INVESTIGATION LIMITED  
77 Crockford Boulevard  
SCARBOROUGH - ONTARIO

OUR REFERENCE: 2-2-26

MARCH 1962.

## C O N T E N T S

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## E N C L O S U R E S

LOCATION OF BOREHOLES AND SUBSURFACE PROFILE	Encl. #1
GEOTECHNICAL DATA SHEETS .....	Encls. #2-5 inclusive



## I N T R O D U C T I O N

A letter of authorization dated February 23rd, 1962 was received from the Department of Highways of Ontario, Materials and Research Division, to conduct a subsoil investigation at the site of the proposed Highway 401-Avenue Road Underpass.

The proposed project will be a three-span reinforced concrete rigid frame as indicated on a Drawing (D-5034-P1) supplied to us.

Number, location and depth of the boreholes were as directed.

The purpose of the exploration was to confirm the findings of a subsoil investigation previously performed not too far away from the present one. Regarding this fact, our report is intended to be brief and is confined to the essential design data only.

## I. FIELD WORK

Field work was carried out on the 27th and 28th of February, 1962 and comprised four boreholes at the locations shown on Enclosure No. 1. The positions of the test holes were set out on the site with the assistance of the drawing provided to us and as agreed upon. Elevations were measured relative to the top of asphalt on the centre line of Highway 1401 at station 327+10.00 (=el. 584.00) as indicated on the Drawing previously referred to.

The boreholes were of  $3\frac{1}{2}$  in. diameter. They were advanced to the required sampling depths by a mounted, continuous flight power auger.

Standard penetration tests were made at frequent intervals using a 2 in. outside diameter split spoon driven into the bottom of the clean borehole by a constant driving energy (140 pound hammer dropping 30 inches). This test provided disturbed samples of the substrata indicating their relative density or consistency.

The samples were shipped to our laboratory where they were thoroughly examined and classified. The results of this analysis together with the findings obtained in the field comprise the basis on which the geotechnical properties of the subsoil are being evaluated.

The stratification of the subsoil, sampling depths and the results of the penetration tests are recorded on geotechnical data sheets comprising Enclosures 2 to 5 inclusive.

Deep snow covered the site at the time of field work. A bulldozer was hired to clear passageways for the drilling equipment.

## II. SUBSURFACE CONDITIONS

The subsurface materials found at the site may be classified into two groups from the point of view of origin :

- (i) An artificial, man-made fill - and
- (ii) A glacial till.

(i) Two boreholes (Nos. 1 and 3) were drilled through the approach embankments of the existing bridge. Therefore, the material encountered first was naturally a fill. It originates from the site, hence its characteristics are similar to that of the original subsoil. It consists mainly of silt (around 50%), sand (around 25%) and the balance being clay and gravel. It is brown coloured, the moisture content is estimated to be around 15%. The consistency is firm to stiff.

(ii) The subsoil proper at the site is a glacial till, its surface elevation varying between 575 and 585 ft. The till may be described as a "ground-up rock debris which was carried by the glacier and deposited into a compact, unstratified mass of angular fragments of all sizes: clay, silt, sand, stones and boulders. Its outstanding characteristic is that it is nonsorted. It may consist of 99% clay particles or 99% large boulders, or any combination of these and intermediate sizes". (Goldthwaite and Flint, Reference 3).

The present till is mostly silt (about 60%) with sand (about 40) (= sandy silt with fine gravel). The deposit changes to sand (mostly fine) at greater depths. The surface of the sand stratum appears to be sloping to the north at a fall of roughly  $2\frac{1}{2}$  per cent.

Both types of till (the "silt till" and "sand till" ) are very dense and have a low moisture content. Higher water content was found in the sandy silt at the location of borehole No. 3.

No groundwater has been encountered in any of the boreholes. Piezometers should be installed at greater depths to be able to locate the phreatic level.

### III. DISCUSSION AND RECOMMENDATIONS

The new structure will be of a statically indeterminate design, a reinforced concrete rigid frame consisting of three spans. The bridge design office requested elevations at which the subsoil is capable of supporting four tons per square foot. The following levels are suggested:

Around Borehole No. 1	-	Elevation 586 ft. or lower
" No. 2	-	" 575 " "
" No. 3	-	" 583 " "
" No. 4	-	" 583 " "

No appreciable settlement is expected, the subsoil being incompressible.

The shear strength characteristics of the subsurface material are assumed to be as follows:

Internal angle of friction ..... 38 degrees

Cohesion ..... negligibly small

(The above values are suggested on the basis of the field tests and obtained in consolidated drained direct shear tests which were performed on glacial tills - See Reference 3).

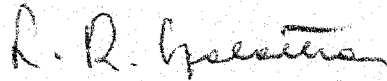
No construction problems are anticipated.

IV. SUMMARY

- (1) FOUR BOREHOLES WERE DRILLED TO LOCATE THE HIGHEST STRATUM CAPABLE OF SUPPORTING THE NEW BRIDGE - (SEE PARAGRAPH III).
- (2) THE GLACIAL DEPOSIT AT THE SITE IS A VERY DENSE, COHESIONLESS SANDY SILT AND SAND. THE SHEAR STRENGTH PARAMETERS OF THE TILL ARE STATED - (SEE PARAGRAPHS II AND III).
- (3) NO GROUNDWATER WAS ENCOUNTERED.
- (4) NO CONSTRUCTION PROBLEMS ARE ENVISAGED.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED



L. R. Szalatnay, P. Eng.,  
Senior Soils Engineer.

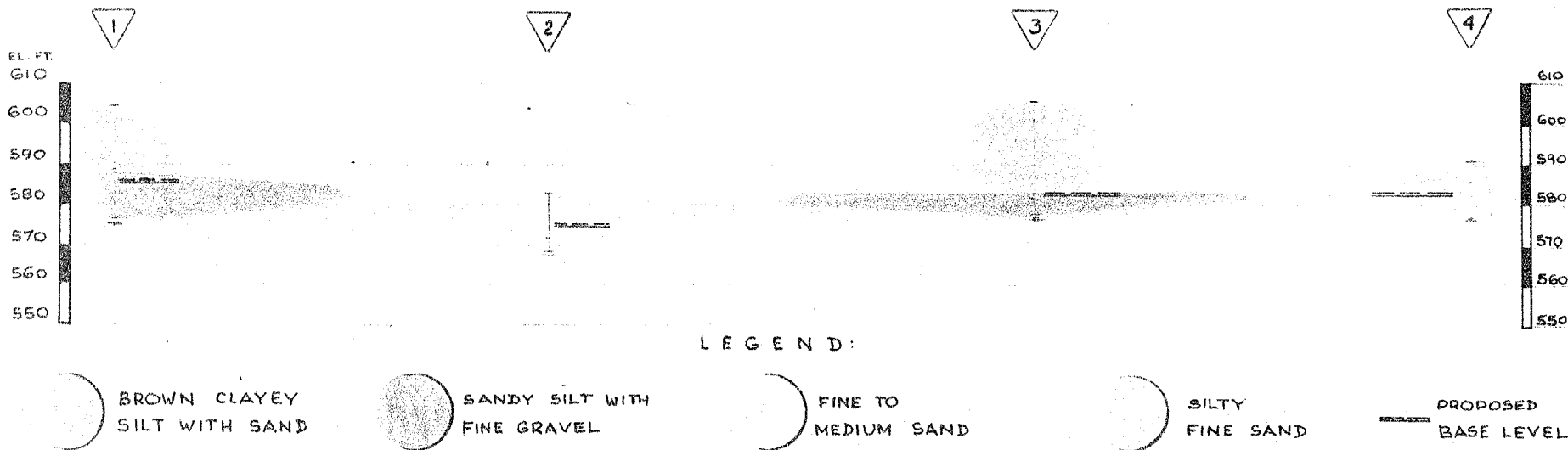
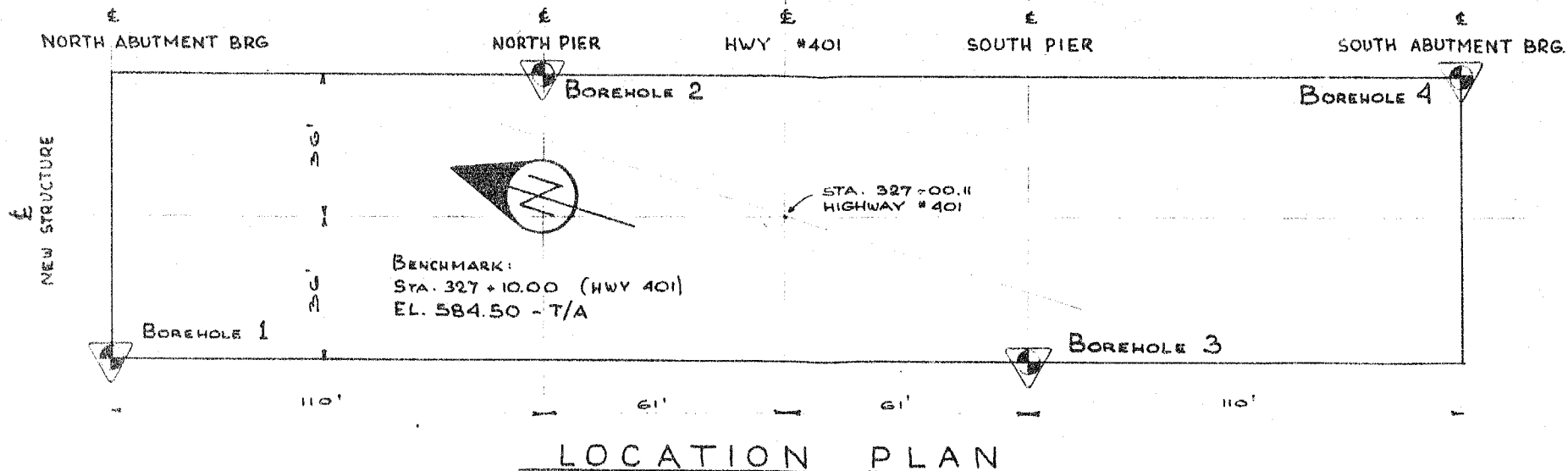
LRS/oed

Encls.

V. REFERENCES

- (1) Procedures for Testing Soils, ASTM, April 1958, pp. 186 to 198. (Unified Soil Classification System - by A. A. Wagner).
- (2) Terzaghi and Peck: Soil Mechanics in Engineering Practice - John Wiley and Sons, New York - 1948.
- (3) Research Conference on Shear Strength of Cohesive Soils - Strength and Deformation Characteristics of Various Glacial Till in New England - K. A. Linell and H. F. Shea - University of Colorado, Boulder, Colorado.

E n c l o s u r e s



LEGEND:



SUBSURFACE PROFILE

SCALE: 1" TO 30'



OUR REFERENCE NO. 2-2-26

## GEOTECHNICAL DATA SHEET FOR BOREHOLE ONE.

CLIENT: DEPARTMENT OF HIGHWAYS, ONTARIO  
 PROJECT: AVENUE ROAD, HWY 401 UNDERPASS  
 LOCATION: TORONTO, DISTRICT #6  
 DATUM ELEVATION: 604.10

METHOD OF BORING: AUGER  
 DIAMETER OF BOREHOLE: 3 1/2"  
 DATE: FEB. 27, 1962.

ENCLOSURE NO. TWO

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot		CONSISTENCY water content %		REMARKS	
				NUMBER	TYPE	N <sub>60</sub> or Adj. value of sampler	0	20	40	60		80
604.10	0											
600	5	BROWN MOIST TO WET CLAYEY SILT WITH SAND FILL <b>ML</b>		1	SS	13	0					
595	10			2	SS	5	0					
590	15	BROWN DAMP STIFF CLAYEY SILT WITH SAND <b>ML</b>		3	SS	13	0					
585	20	BROWN DAMP VERY DENSE SANDY SILT WITH EMBEDDED FINE ANGULAR GRAVEL <b>SM-ML</b>		4	SS	83						
580	25			5	SS	>100						
575	30	DAMP FINE SAND <b>SP</b>		6	SS	>100						

SS DENOTES  
SPLIT SPOON  
SAMPLE

# GEOTECHNICAL DATA SHEET FOR BOREHOLE TWO

OUR REFERENCE NO. 2-2-26

CLIENT: DEPARTMENT OF HIGHWAYS, ONTARIO  
 PROJECT: AVENUE ROAD, HWY 401 UNDERPASS  
 LOCATION: TORONTO, DISTRICT #6  
 DATUM ELEVATION: 582.55

METHOD OF BORING: AUGER  
 DIAMETER OF BOREHOLE: 3 1/2"  
 DATE: FEB. 28, 1962.

ENCLOSURE NO. THREE

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %			REMARKS		
				NUMBER	TYPE	N- or Advancement of Sampler	0	20	40	60	80	100	PL	W		LI	
582.55	0	<div style="text-align: center;">fill</div> <hr style="border-top: 1px dashed black;"/> MOIST PALE BROWN VERY DENSE FINE SAND TRACES OF FINE ANGULAR GRAVEL <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-top: 10px;">SP</div>		1	SS	13	0										
580																	
575	5			2	SS	>100											
570	10			3	SS	>100											
	15																

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE L

CHKD: *f*

# GEOTECHNICAL DATA SHEET FOR BOREHOLE THREE

OUR REFERENCE NO. 2-2-26

CLIENT: DEPARTMENT OF HIGHWAYS, ONTARIO

METHOD OF BORING: AUGER

ENCLOSURE NO. FOUR

PROJECT: AVENUE RD, HWY 401 UNDERPASS

DIAMETER OF BOREHOLE 3 1/2"

LOCATION: TORONTO, DISTRICT # 6

DATE: FEB. 28, 1962.

DATUM ELEVATION: 605.28

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot						CONSISTENCY water content %			REMARKS
				NUMBER	TYPE	N <sub>60</sub> or Adjusted Value	0	20	40	60	80	100	PL	W	LI	
605.28	0															
	5	BROWN MOIST CLAYEY SILT AND SAND FILL		1	SS	16										
600																
	10		ML	2	SS	6										
595																
	15	traces of roots probably original topsoil		3	SS	11										
590																
	20	BROWN, DAMP HARD CLAYEY SILT WITH SAND	ML	4	SS	28										
585																
	25	BROWN SATURATED SANDY SILT VERY DENSE	SM-ML	5	SS	86										
580																
	30	BROWN FINE TO MED. SAND		6	SS	>100										
575																

# GEOTECHNICAL DATA SHEET FOR BOREHOLE FOUR

OUR REFERENCE NO. 2-2-26

CLIENT: DEPARTMENT OF HIGHWAYS, ONTARIO  
PROJECT: AVENUE RD, HWY 401 OVERPASS  
LOCATION: TORONTO, DISTRICT #6  
DATUM ELEVATION: 590.55

METHOD OF BORING: AUGER  
DIAMETER OF BOREHOLE: 3 1/2"  
DATE: FEB. 28, 1962.

ENCLOSURE NO. FIVE

ELEVATION ft	DEPTH ft	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %			REMARKS				
				NUMBER	TYPE	Advancement of Sampler	0	20	40	60	80	100	PL	W		LI			
590.55	0	BROWN MOIST SILTY FINE SAND TRACES OF ORG.	SP-ML	1	SS	23													
585	5																		
580	10			BROWN DAMP VERY DENSE FINE TO MEDIUM SAND	2	SS	>100												
	15	3	SS		>100														

OUR REFERENCE NO. 2-2-26

## GEOTECHNICAL DATA SHEET FOR BOREHOLE ONE.

CLIENT: DEPARTMENT OF HIGHWAYS, ONTARIO  
 PROJECT: AVENUE ROAD, HWY 401 UNDERPASS  
 LOCATION: TORONTO, DISTRICT #6  
 DATUM ELEVATION: 604.10

METHOD OF BORING: AUGER  
 DIAMETER OF BOREHOLE: 3 1/2"  
 DATE: FEB. 27, 1962.

ENCLOSURE NO. TWO

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE		CONSISTENCY		REMARKS
				NUMBER	TYPE	N or Advancement of Sampler	blows per foot	SHEAR STRENGTH	water content %		
604.10	0						0		PL	W	LI
600	5	BROWN MOIST TO WET CLAYEY SILT WITH SAND (FILL) ML		1	SS	13	0				
595	10			2	SS	5	0				
590	15	BROWN DAMP STIFF CLAYEY SILT WITH SAND ML		3	SS	13	0				
585	20	BROWN DAMP VERY DENSE SANDY SILT WITH EMBEDDED FINE ANGULAR GRAVEL SM-ML		4	SS	83					
580	25			5	SS	>100					
575	30	DAMP FINE SAND SP		6	SS	>100					

SS DENOTES  
SPLIT SPOON  
SAMPLE

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: L CHD: 7

OUR REFERENCE NO 2-2-26

## GEOTECHNICAL DATA SHEET FOR BOREHOLE T.W.O

CLIENT: DEPARTMENT OF HIGHWAYS, ONTARIO  
 PROJECT: AVENUE ROAD, HWY 401 UNDERPASS  
 LOCATION: TORONTO, DISTRICT #6  
 DATUM ELEVATION: 582.55

METHOD OF BORING: AUGER  
 DIAMETER OF BOREHOLE: 3 1/2"  
 DATE: FEB. 28, 1962.

ENCLOSURE NO. THREE

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot 0 20 40 60 80 100	CONSISTENCY water content % PL W LI	REMARKS
				NUMBER	TYPE	N or Advancement of Sampler			
582.55	0								
580									
575	5	MOIST PALE BROWN VERY DENSE FINE SAND TRACES OF FINE ANGULAR GRAVEL		1	SS	13	0		
570	10			2	SS	>100	0		
	15			3	SS	>100	0		

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: L

CH'D: F

OUR REFERENCE NO. 2-2-26

## GEOTECHNICAL DATA SHEET FOR BOREHOLE THREE

CLIENT: DEPARTMENT OF HIGHWAYS, ONTARIO

METHOD OF BORING: AUGER

ENCLOSURE NO. FOUR

PROJECT: AVENUE RD, HWY 401 UNDERPASS

DIAMETER OF BOREHOLE: 3 1/4"

LOCATION: TORONTO, DISTRICT # 6

DATE: FEB. 28, 1962.

DATUM ELEVATION: 605.28

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE		CONSISTENCY		REMARKS
				NUMBER	TYPE	N or Advance of Sampler	blows per foot	SHEAR STRENGTH lbs/sq ft	water content % PL W LI		
605.28	0										
	5	BROWN MOIST CLAYEY SILT AND SAND FILL		1	SS	16					
	10	ML		2	SS	6					
595	15	traces of roots probably original topsoil		3	SS	11					
	20	BROWN, DAMP HARD CLAYEY SILT WITH SAND	ML	4	SS	28					
585	25	BROWN SATURATED SANDY SILT VERY DENSE	SM-ML	5	SS	86					
580	30	BROWN FINE TO MED. SAND		6	SS	>100					
575											

VERTICAL SCALE: 1 IN. TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE: L CH D. 6

# GEOTECHNICAL DATA SHEET FOR BOREHOLE . FOUR

OUR REFERENCE NO. **2-2-26**

CLIENT: **DEPARTMENT OF HIGHWAYS, ONTARIO**  
 PROJECT: **AVENUE RD, HWY 401 OVERPASS**  
 LOCATION: **TORONTO, DISTRICT #6**  
 DATUM ELEVATION: **590.55**

METHOD OF BORING: **AUGER**  
 DIAMETER OF BOREHOLE: **3 1/2"**  
 DATE: **FEB. 20, 1962.**

ENCLOSURE NO. **FIVE**

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot		CONSISTENCY water content %		REMARKS		
				NUMBER	TYPE	IN- or Advancement of Sampler	0	20	40	60		80	100
590.55	0	<div style="border: 1px solid black; padding: 2px; display: inline-block;">SP-ML</div> BROWN MOIST SILTY FINE SAND TRACES OF ORG.											
			1	SS	23								
585	5												
		BROWN DAMP VERY DENSE FINE TO MEDIUM SAND <div style="border: 1px solid black; padding: 2px; display: inline-block; float: right;">SP</div>											
			2	SS	>100								
580	10												
				3	SS	>100							
	15												

VERTICAL SCALE: 1 IN. TO **5** FT.

**DOMINION SOIL INVESTIGATION LIMITED**

MADE: CHD: