DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M11-183

DIST. 6 REGION

W.P. No. 33-76-19

CONT. No. 80-70

W. O. No.

STR. SITE No.

HWY. No. NWMA

LOCATION Retaining Wall Between Weston Rd & C.N.R.

No OF PAGES - —

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

CONT
80-70

Ontario

Ministry of
Transportation and
Communications

foundation investigation and design report

cont. 80-70

SAMPLE DISPOSITION NOTICE		
TYPE	TO BE HELD AFTER	RECOMM'D
JARS	79 09 26	M20
TUBES	—	—
ROCK CORES	—	—

ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 33-76-19 DIST 6

HWY NWMA STR SITE N/A

Retaining Wall Between
Weston Road and C.N. Railway

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GEOCRES 30M11-183

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FOUNDATION INVESTIGATION REPORT

For

Retaining Wall Between
Weston Road and C.N. Railway
W.P. 33-76-19, NWMA
District 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation program carried out at the above mentioned location. The field-work was performed during the period of June 11, 1979 to June 14, 1979, utilizing both washboring techniques and an auger machine equipped with hollow stem continuous flight augers. Four boreholes were advanced and sampled to depths ranging from 56.5 to 75.5 feet, corresponding to elevations 324.8 to 285.4.

SITE DESCRIPTION AND GEOLOGY

The site is located 180 feet west of the proposed intersection of NWMA and Weston Road extending for 525 feet along the north side of Weston Road against the C.N.R. embankment in the Borough of York, Metropolitan Toronto.

Presently, fill material for the C.N.R. embankment has been placed on the old Black Creek valley for a maximum height of 30± feet.

Physiographically, the site is located within the upper reaches of Lake Iroquois in the geological past. Under a thin mantle of Lake Iroquois lacustrine deposits and recent alluvial deposits by Black Creek, the underlying subsoils in this area consist of a series of glacial and interglacial deposits of the Pleistocene epoch.

SUBSURFACE CONDITIONS

The site is overlain by an extensive surficial deposit of silty sand fill, composing both the railway embankment and the local

land fill in the area. This granular fill ranged in depths from 21.0 feet to 30.0 feet. Generally, underlying this surficial material is an upper cohesive deposit of clayey silt approximately 12 to 23 feet thick. This cohesive deposit was underlain by a glacial till stratum composed of a heterogeneous mixture of clayey silt, some sand, trace of gravel. In one location the surficial granular deposit is underlain by 13 feet of an alluvial deposit of silt some sand followed by 15 feet of the till deposit which is underlain by a lower cohesive clayey silt deposit.

The boundaries between the various soil types, soil properties and groundwater levels are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with an estimated stratigraphical profile based on borehole data, are shown on attached Drawing 337619.

The various subsoil types encountered are briefly described in the following paragraphs.

Silty Sand (Fill)

Overlying the site, composing both the railway embankment and local fill material, is an extensive surficial stratum of silty sand fill. Individual layers of silt and pockets of clayey silt of varying thicknesses are randomly dispersed within this granular deposit. In two locations a uniform sand of approximately four feet in depth was encountered in the upper portion of the fill. In addition, gradation tended to become finer with depth (i.e. sandy silt gradation) in the two east borehole locations. Total granular fill depths ranged from 21.0 to 30.0 feet.

Typical grain size distribution for this deposit is plotted in envelope form on Figure 1. Standard Penetration Test 'N' values range from 2 to 103 blows per foot indicating the silty sand stratum has a very loose to very dense range of relative density, but generally a loose to compact density.

Upper Clayey Silt

Generally, a cohesive deposit consisting of clayey silt with a trace of sand was found to underly the surficial granular stratum. Thickness of this stratum ranged from 11.3 to 23 feet.

Results of Atterberg Limit testing on representative samples from this deposit are summarized below and plotted on the Plasticity Chart, Figure 4.

			Range	Average
Natural Moisture Content	(W)	%	11-25	20
Plastic Limit	(W_p)	%	9-16	12
Liquid Limit	(W_L)	%	20-36	28
Plasticity Index	(I_p)	%	8-22	14

Results indicate this cohesive deposit to be inorganic of low plasticity (CL).

Two grain size distribution curves for this deposit are shown on Figure 3.

Interpretation of 'N' values which ranged from 6 to 75 blows/foot, but generally averaging 30 blows/foot, in addition to visual classification, indicates this deposit to have a firm to hard consistency, but generally stiff to very stiff in nature. It is considered that this clayey silt stratum is of low compressibility.

Silt

At one boring location, possibly on the river flood plain, an alluvial deposit of silt, some sand, trace of clay was found immediately below the surficial fill deposit. This granular stratum was encountered for a thickness of 13.0 feet. 'N' values for this stratum indicate the silt to have a denseness ranging from compact to dense.

Clayey Silt, Some Sand, Trace of Gravel

In general, the clayey silt deposit is underlain by a glacial till deposit of clayey silt with some sand and a trace of gravel. Thickness of this deposit was explored for depths ranging from 13.5 to 20.2 feet. Gradation for this deposit, as shown on Figure 2, is much coarser than that of the overlying cohesive deposit.

Atterberg Limit Test results as shown on Figure 5 indicate this deposit to be inorganic of low plasticity (CL).

The consistency of this clayey silt deposit is very stiff to hard, based on 'N' values ranging from 30 to 139 blows/foot but generally 46 blows per foot.

Lower Clayey Silt

Underlying the coarse clayey silt deposit as encountered in the deepest boring, is a lower clayey silt with a trace sand deposit. This cohesive deposit was explored for a maximum depth of 22.5 feet. Gradation for this deposit as shown on Figure 3 is very similar to the upper clayey silt deposit. Atterberg Limit Test results as shown on Figure 4, in combination with the upper clayey silt deposit results, indicate this deposit to be inorganic of low plasticity (CL).

'N' values for this cohesive deposit range from 13 to 26 blows per foot, indicating a consistency for this deposit ranging from stiff to very stiff.

Groundwater Conditions

The stabilized groundwater level was found to be at an approximate depth of 12.7 feet corresponding to elevation 344 at the western end of the retaining wall. At the eastern end, the water level is assumed at a depth of 11.4 feet, elevation 372.2, where borehole cave occurred during observation.

No river water level in the Black Creek was obtained during the time of investigation, however, it may be assumed to approximate elevation 339.

DISCUSSION AND RECOMMENDATIONS

General

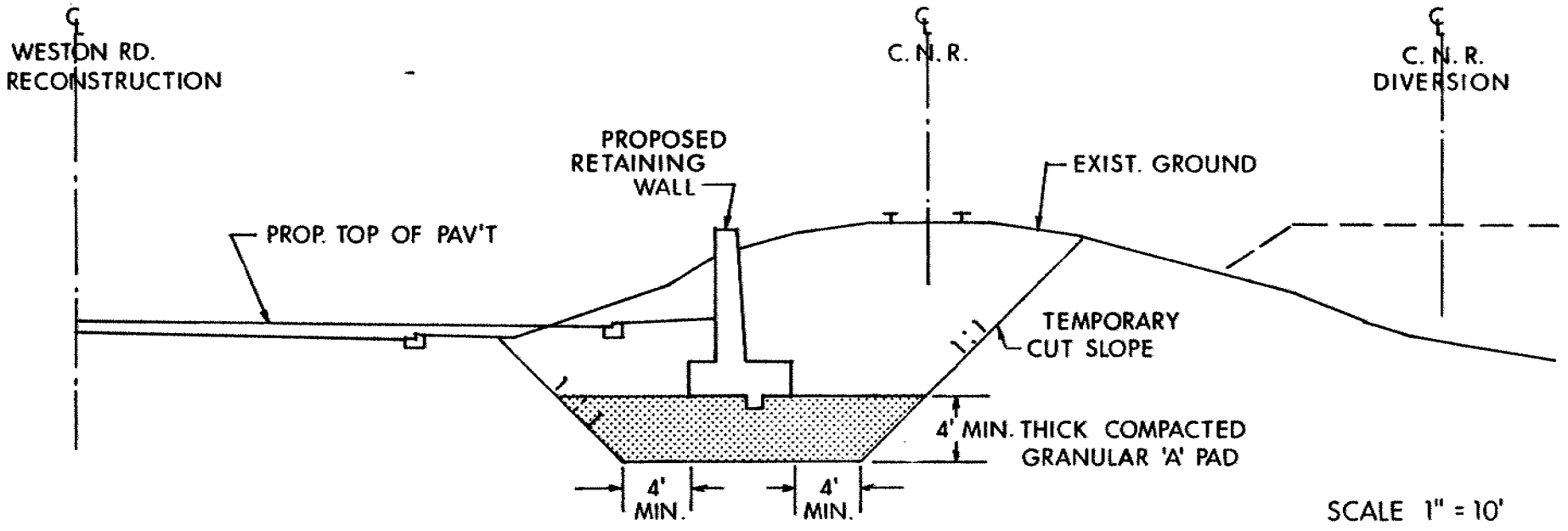
As part of the proposed widening of Weston Road to accommodate increased traffic flow from the N.W.M.A., a 525 foot long retaining wall will be required to retain the existing C.N.R. embankment. The top of the retaining wall will vary to a maximum of 10 feet above profile grade. Construction of the retaining wall is to be carried out during the time the C.N.R. tracks are diverted for construction of the Black Creek structure.

Foundation Considerations

The proposed cantilever retaining wall can be founded on spread footings located on a well compacted granular 'A' pad with a minimum thickness of four feet. In all cases the base of the footing should have a minimal cover of four feet in all directions to prevent any damage due to frost action. In addition, the base of the granular pad should extend for a minimum of four feet beyond the limits of the retaining wall footing to insure proper distribution of the vertical stresses. A typical section for this scheme is shown on Diagram 1. For footings founded as suggested, an allowable bearing pressure up to 2 t.s.f. may be used for design purposes. Net settlement of the spread footings under these recommended loads should not exceed one inch.

Alternatively, in order to cut back on the amount of embankment excavation, it is suggested that an 'L' shaped buttress type retaining wall be considered.

Consideration should also be given to a suitable gravity wall such as a bin wall. A corrugated steel bin wall founded on an 18 inch thick compacted granular pad some four feet below profile grade should provide adequate sliding resistance. For design purposes bin walls with a 1:6 batter should have a base width of 55 percent of the overall height, while vertical bin walls should be designed with a base width of 65 percent. Controlled backfilling inside of these walls is critical since the gravity wall is actually the confined earth mass.



TYPICAL SECTION AT STA. 147+25

SHOWING GRANULAR PAD & TEMPORARY CUT SLOPE DETAILS

DIAGRAM 1

WP 33-76-19

Other Considerations

Backfilling operations and drainage measures should be carried out as per current M.T.C. standards. Free draining granular material should be specified as backfill to the retaining structures.

In order to resist lateral forces acting on the retaining wall foundations, frictional forces between the footing base and the granular 'A' pad can be calculated using a coefficient of friction of 0.7. The lateral earth pressure exerted on the retaining wall by the granular backfill can be computed assuming a unit weight of 130 p.c.f. for the backfill and a coefficient of earth pressure of:

K_a = 0.35 for the "active" case where rotation about the base is allowed

K_o = 0.5 for the "at rest" case where no rotation or translation about the base is permitted

In addition, the effects due to the sloping surcharge of the ground behind the retaining structure, railway loading and the use of heavy vibratory compaction equipment should also be taken into account in the computation of earth pressures.

Construction Considerations

Temporary cut slopes in the surficial granular fill material to accommodate footing and granular pad placement should not be steeper than 1:1. This will entail partial removal of the existing railway tracks and substantial excavations into the railway embankment. If steeper slopes are contemplated, an extensive slope protection scheme will have to be incorporated during construction of foundation for the retaining structure. Possible protection schemes may consist of soldier piles and lagging or sheet piling driven by vibratory techniques.
Backfill material should be keyed into the temporary slopes by benching in accordance with M.T.C. Standard DD-414.

Provided groundwater conditions are similar to those at the time of investigation, no major dewatering problems are anticipated. However, if high water level conditions prevail at the time of

construction and excavations are carried out below the water table, a positive dewatering system may be required to prevent 'boiling' of the foundation base due to unbalanced hydrostatic head.

Care should be exercised to prevent loosening of the foundation base during excavation by surface run-off and/or construction activity.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of Mr. R. Jutras and Mr. B. List, Student Technicians. The equipment used was owned and operated by Master Soil Investigation Ltd., Toronto.

This report was written by Mr. T.J. Kazmierowski, Project Engineer and reviewed by Mr. M. Devata, Supervising Engineer.

T.J. Kazmierowski, P. Eng.
Project Engineer

M. Devata, P. Eng.
Supervising Engineer

August, 1979

APPENDIX

Ontario Ministry of Transportation and Communications

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 1

W P 33-76-19 LOCATION Coords. N 15 872 448 E. 1 005 404 ORIGINATED BY R.J.

DIST 6 HWY NWMA BOREHOLE TYPE Continuous Flight Hollow Stem Auger COMPILED BY R.J.

DATUM Geodetic DATE June 11, 1979 CHECKED BY T.K.

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
356.9	Asphalt Surface										
0.0	Silty Sand (Fill) Occasional Clayey Silt Pockets		1	SS	4						0 65 26 9
			2	SS	6		350				
			3	SS	2						2 88 (10)
	Clayey Silt		4	SS	14						
			5	SS	7						0 9 75 16
			6	SS	11		340				
	Very Loose to Compact		7	SS	11						3 72 22 3
335.9			8	SS	11						
21.0	Silt Some Sand Trace of Clay		9	TW	PH		330				
	Compact to Dense		10	SS	46						0 19 72 9
322.9											
34.0	Clayey Silt Some Sand Trace Gravel		11	SS	30		320				
	Very Stiff		12	SS	30						8 31 43 18
			13	SS	30		310				
307.9											
49.0	Clayey Silt Trace Sand Stiff to Very Stiff		14	SS	21						0 2 78 20
			15	SS	26		300				
							290				
285.4			16	SS	13						
71.5	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ontario Ministry of Transportation and Communications

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 2

W P 33-76-19 LOCATION Coords. N 15 872 253; E 1 005 748 ORIGINATED BY RJ

DIST 6 HWY NWMA BOREHOLE TYPE Continuous Flight Hollow Stem Auger COMPILED BY RJ

DATUM Geodetic DATE June 12, 1979 CHECKED BY TK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (400 800 1200 1600 2000)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL / WATER CONTENT (%) (10 20 30)	UNIT WEIGHT γ pcf	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
383.6	Ground Surface										
0.0	Uniform Sand										
379.6			1	SS	20		380				
4.0	Fill		2	SS	25						17 75 (8)
	Silt		3	SS	27						
	Silty Sand to Sandy Silt Occasional Pockets of Clayey Silt		4	SS	69						0 60 34 6
			5	SS	49		370				
			6	SS	35						0 45 46 9
	Compact to Very Dense		7	SS	103						
							360				
			8	SS	42						0 45 50 5
353.6											
30.0	Clayey Silt Trace of Sand Stiff		9	SS	14						
			10	SS	13		350				0 10 63 27
			11	TW	PH			b		130	0 1 62 37
342.3											
41.3	Clayey Silt Some Sand Trace Gravel		12	SS	30						
			13	SS	139		340				
	Hard		14	SS	50.						
							330				
322.1			15	SS	58						
61.5	End of Borehole Borehole Cave From 11.4', Assumed Water Table										

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

Ontario Ministry of Transportation and Communications

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 3

W P 33-76-19 LOCATION Coords. N 15 872 395; E 1 005 533 ORIGINATED BY BL

DIST 6 HWY NWMA BOREHOLE TYPE Diamond Drilling NX Casting COMPILED BY BL

DATUM Geodetic DATE June 12, 1979 CHECKED BY TK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (o UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
373.1	Ground Surface										
0.0	Uniform Sand										
368.6	Fill		1	SS	6		370				
4.5	Silty Sand (Fill) Occasional Pockets of Clayey Silt		2	SS	10						1 52 (47)
			3	SS	10						
			4	SS	9						0 46 44 10
			5	SS	8		360				
	Clayey Silt Loose to Compact		6	SS	9						
	Trace Clay and Gravel		7	SS	11		350				4 49 35 12
348.1											
25.0	Clayey Silt Trace of Sand Very Stiff to Hard		8	SS	26						
			9	SS	20		340				
			10	SS	72						
			11	SS	75		330				7 14 75 4
325.1			12	SS	50						
48.0	Clayey Silt Some Sand Trace of Gravel Hard		13	SS	46		320				
			14	SS	40						
311.6			15	SS	78						
61.5	End of Borehole										

Note: Water Level Not Established

+3, ×5 : Numbers refer to Sensitivity

20 / 15 ⊹ 5 / 10 (%) STRAIN AT FAILURE

Ontario Ministry of Transportation and Communications

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4

W P 33-76-19 LOCATION Coords. N 15 872 312; E 1 005 672 ORIGINATED BY BL

DIST 6 HWY NWMA BOREHOLE TYPE Diamond Drilling NX Casing COMPILED BY BL

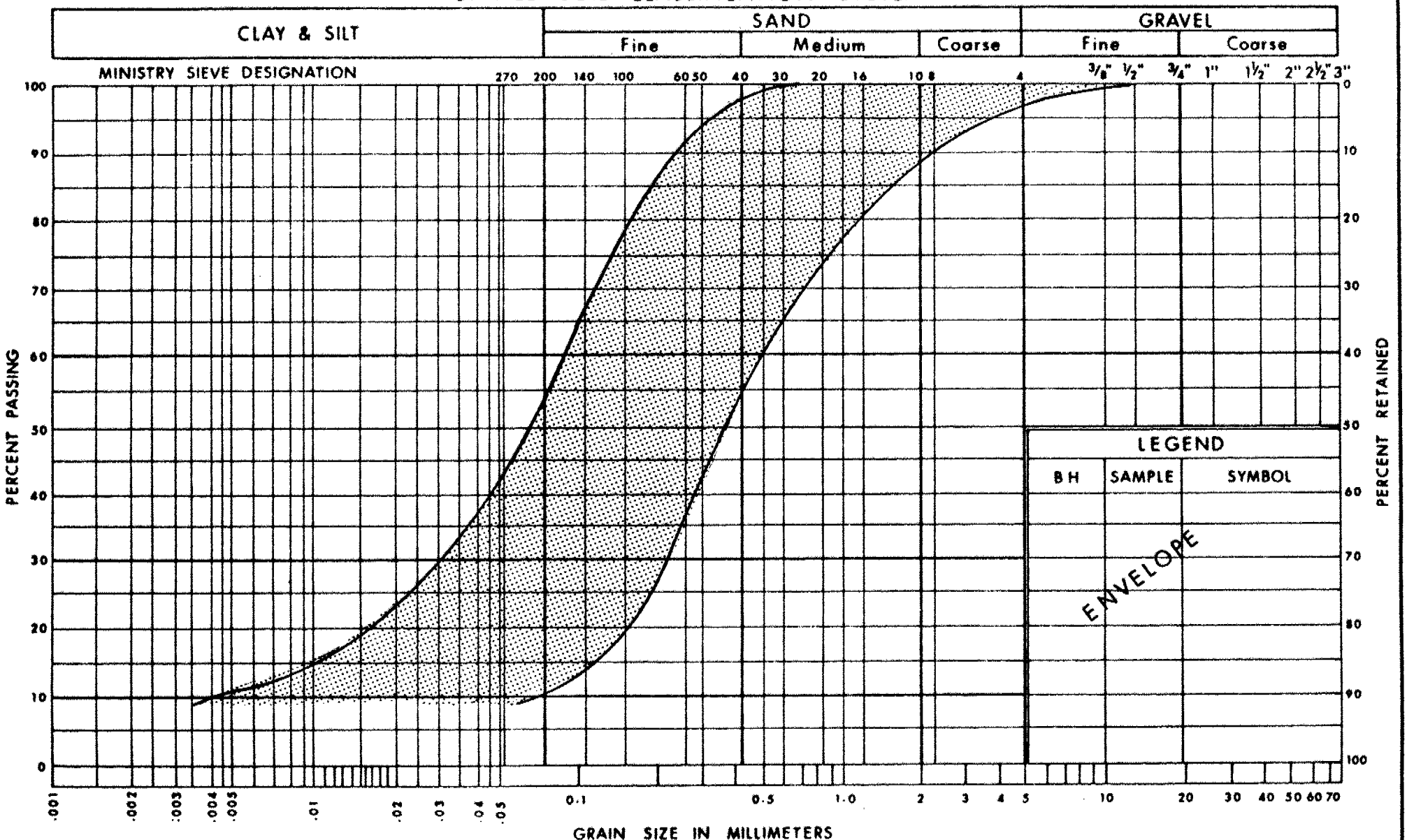
DATUM Geodetic DATE June 14, 1979 CHECKED BY TK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT W_P / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
381.3	Ground Surface										
0.0	Fill Silty Sand to Sandy Silt		1	SS	3		380				
			2	SS	2						0 73 21 6
			3	SS	2						0 78 17 5
			4	SS	6		370				
	Silt		5	SS	9						
	Occasional Pockets of Clayey Silt Compact to Very Dense		6	SS	61		360				0 36 60 4
352.8	Clayey Silt Pockets		7	SS	71						
28.5	Clayey Silt		8	SS	6		350				
			9	SS	9						
341.3	Firm to Stiff										
40.0	Clayey Silt Some Sand Trace Gravel Hard		10	SS	44		340				7 28 50 15
			11	SS	136						
			12	SS	46		330				
324.8			13	SS	42						
56.5	End of Borehole Note: Water Level Not Established										

$+^3$, $\times^5$: Numbers refer to Sensitivity

20 / 15 ◇ 5 / 10 (%) STRAIN AT FAILURE

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation and Communications
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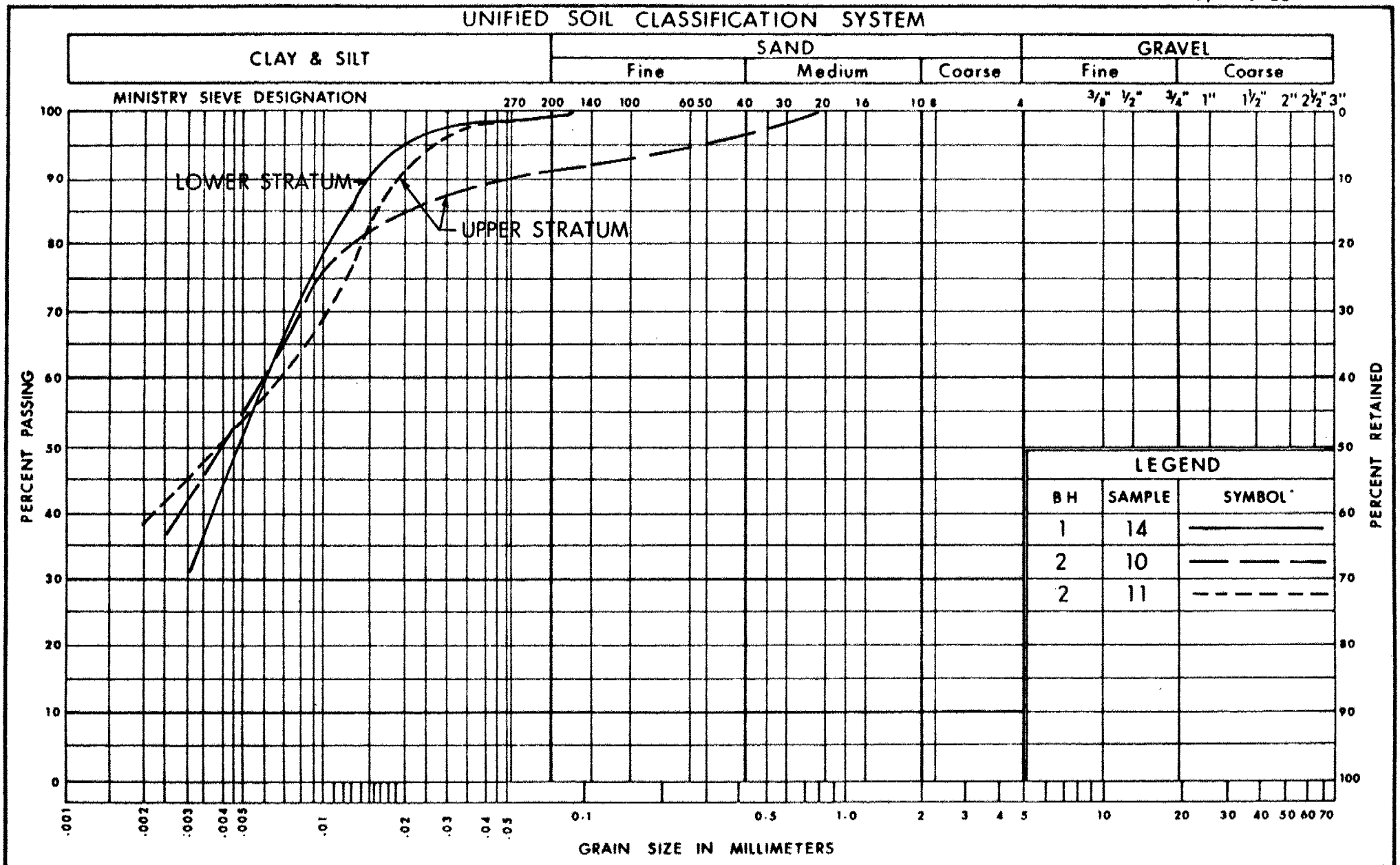
GRAIN SIZE DISTRIBUTION
SILTY SAND

FIG No 1
W P 33-76-19



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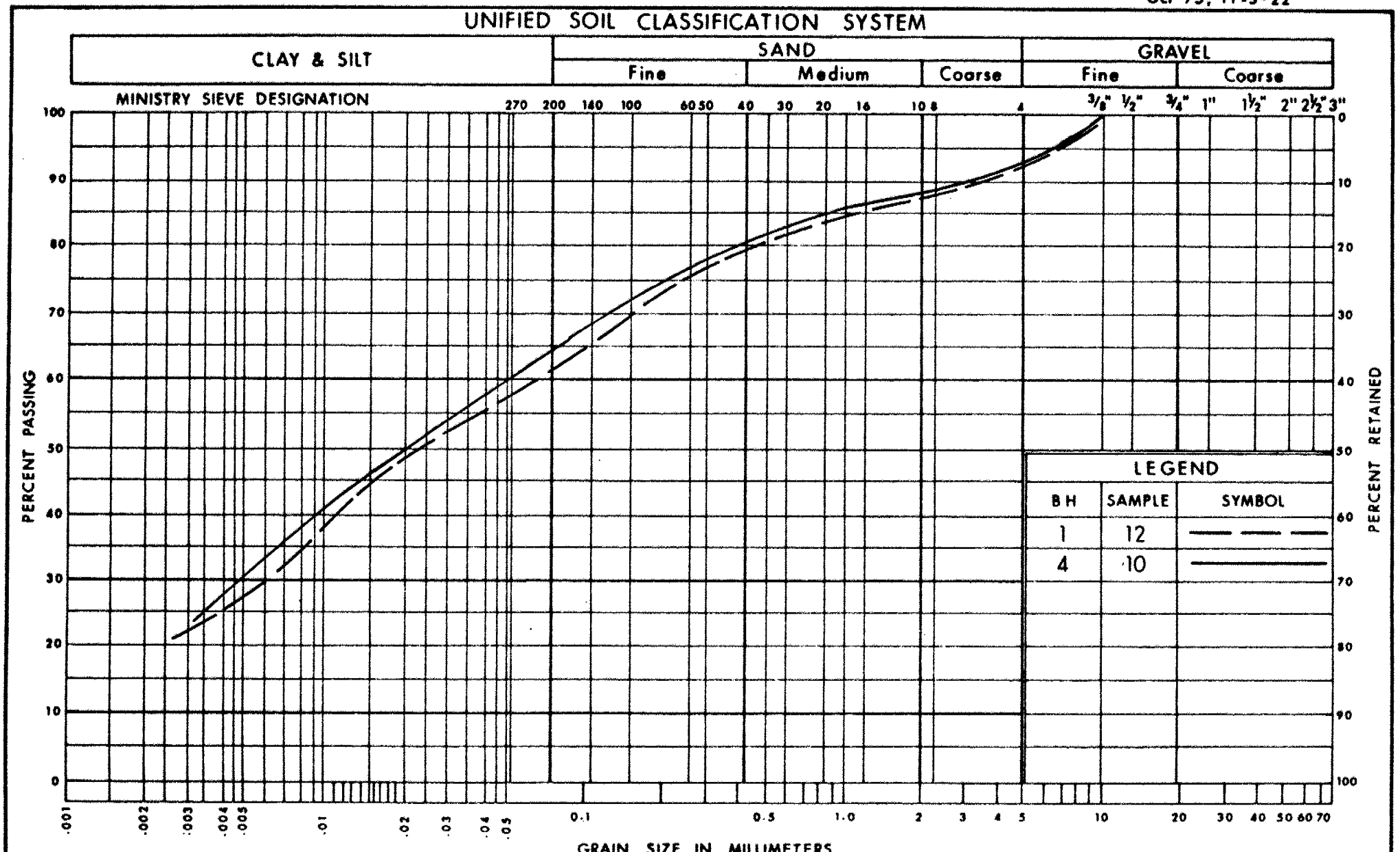
GRAIN SIZE DISTRIBUTION
CLAYEY SILT

FIG No 3
W P 33-76-19



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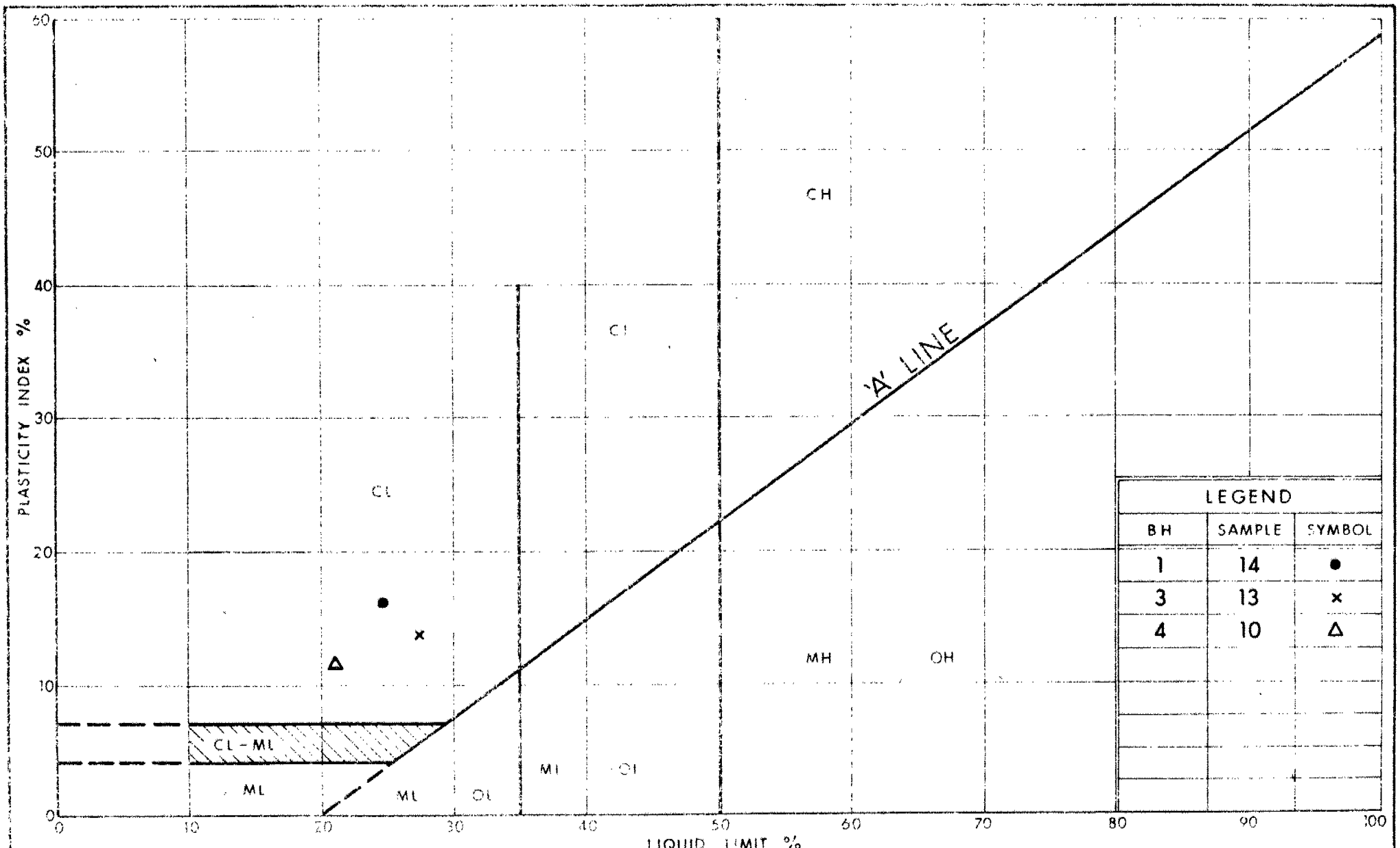
GRAIN SIZE DISTRIBUTION
CLAYEY SILT
SOME SAND TRACE OF GRAVEL

FIG No 2
W P 33-76-19



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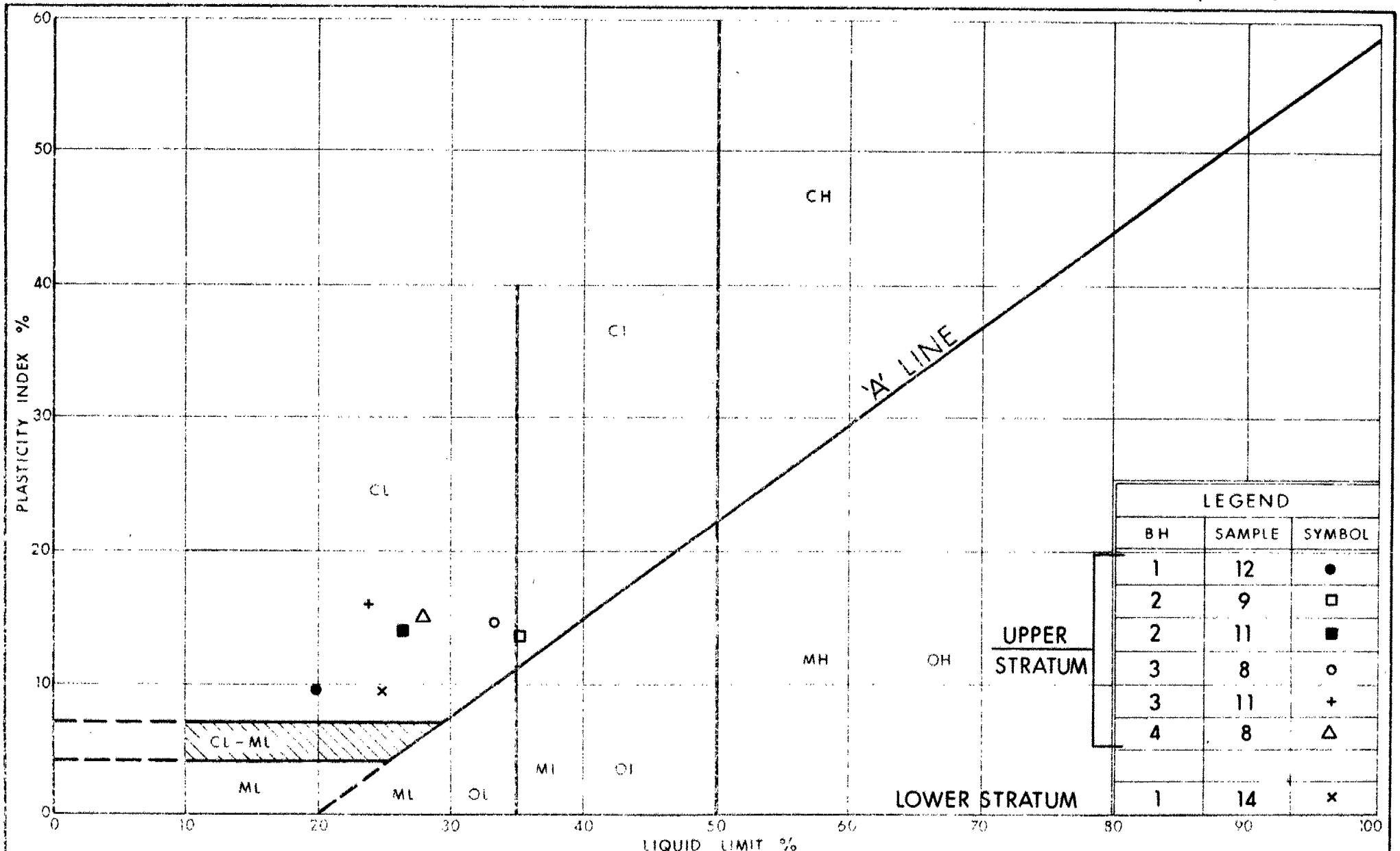
PLASTICITY CHART
CLAYEY SILT
SOME SAND TRACE OF GRAVEL

FIG No 5
W P 33-76-19



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PLASTICITY CHART
CLAYEY SILT

FIG No 4
W P 33-76-19

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH AS FOLLOWS:

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF SPT 'N' VALUES AS FOLLOWS:

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCK QUALITY: ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND/OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4"+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U)
ISOTROPICALLY (I) OR NOT (A)
AND SHEARED DRAINED (D) OR UNDRAINED (U)
WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS)
EG. $\overline{CIU}$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT
UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

S S	SPLIT SPOON
W S	WASH SAMPLE
S T	SLOTTED TUBE SAMPLE
B S	BLOCK SAMPLE
C S	CHUNK SAMPLE
T W	THINWALL OPEN
T P	THINWALL PISTON
O S	OSTERBERG SAMPLE
F S	FOIL SAMPLE
R C	ROCK CORE
P H	T.W. ADVANCED HYDRAULICALLY
P M	T.W. ADVANCED MANUALLY

EARTH PRESSURE TERMS

μ	COEFFICIENT OF FRICTION
δ	ANGLE OF WALL FRICTION
k_o	COEFFICIENT OF EARTH PRESSURE AT REST
k_A	COEFFICIENT OF ACTIVE EARTH PRESSURE
k_p	COEFFICIENT OF PASSIVE EARTH PRESSURE
i	ANGLE OF INCLINATION OF SURCHARGE 
ω	SLOPE ANGLE-BACKFACE OF WALL
β	ANGLE OF SLOPE
N_γ, N_q, N_c	BEARING CAPACITY FACTORS
D_f	DEPTH OF FOOTING
B,L	FOOTING DIMENSIONS

INDEX PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G_s	SPECIFIC GRAVITY OF SOLIDS
e	VOIDS RATIO
e_o	INITIAL VOIDS RATIO
e_{max}	e IN LOOSEST STATE
e_{min}	e IN DENSEST STATE
D_r	RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
n	POROSITY
w	WATER CONTENT
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
w_s	SHRINKAGE LIMIT
I_p	PLASTICITY INDEX = $w_L - w_p$
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_c	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
A_c	ACTIVITY = $\frac{I_p \text{ of soil}}{\% < 2\mu m \text{ Soil Fraction}}$
Om	ORGANIC MATTER CONTENT
S_r	DEGREE OF SATURATION
S	SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

STRENGTH PARAMETERS

ϕ	ANGLE OF SHEARING RESISTANCE
τ_f	PEAK SHEAR STRENGTH
τ_R	RESIDUAL SHEAR STRENGTH
c	COHESION INTERCEPT
$\sigma_1, \sigma_2, \sigma_3$	NORMAL PRINCIPAL STRESSES
u	PORE WATER PRESSURE
u_e	EXCESS u
r_u	PORE PRESSURE RATIO
q_u	UNCONFINED COMPRESSIVE STRENGTH
s_u	UNDRAINED SHEAR STRENGTH
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO
E	MODULUS OF ELASTICITY
G	MODULUS OF SHEAR DEFORMATION
k_s	MODULUS OF SUBGRADE REACTION
m,n	STABILITY COEFFICIENTS
A,B	PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
σ' = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

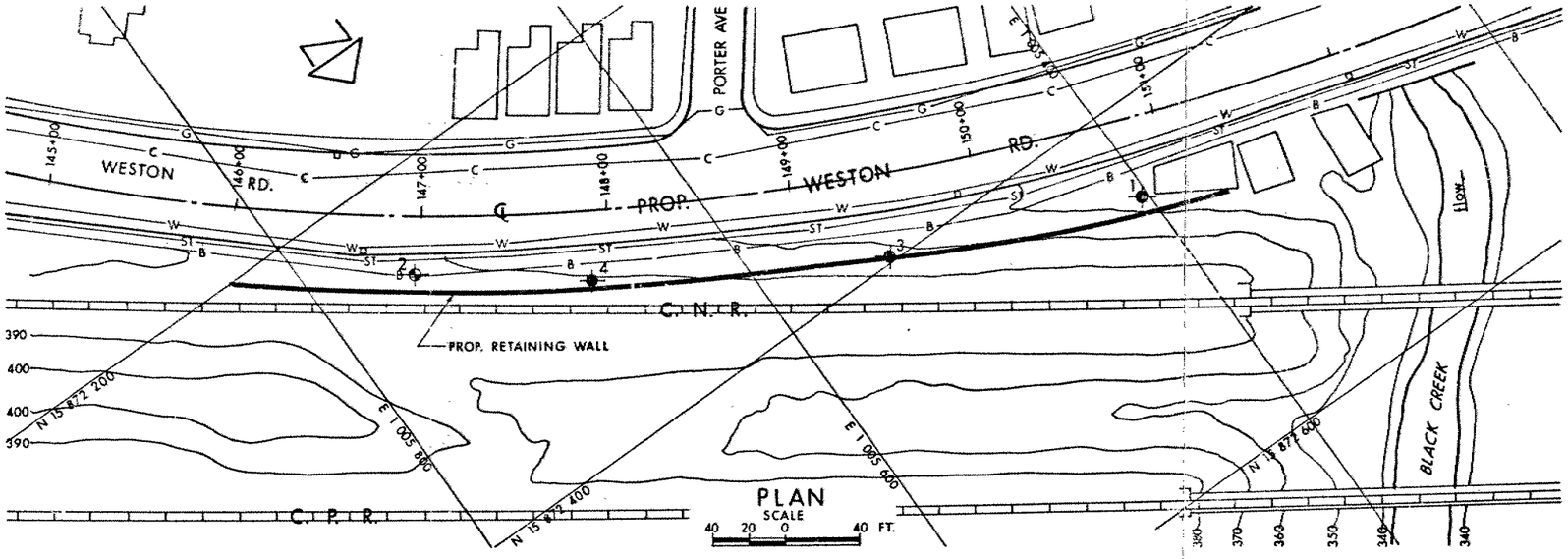
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
j	SEEPAGE FORCE PER UNIT VOLUME
η	COEFFICIENT OF VISCOSITY
k	COEFFICIENT OF HYDRAULIC CONDUCTIVITY
k_h	k IN HORIZONTAL DIRECTION
k_v	k IN VERTICAL DIRECTION
m_v	COEFFICIENT OF VOLUME CHANGE
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX
C_r	RECOMPRESSION INDEX
d	DRAINAGE PATH DISTANCE
T_v	TIME FACTOR
U	DEGREE OF CONSOLIDATION
OCR	OVERCONSOLIDATION RATIO (OCR)

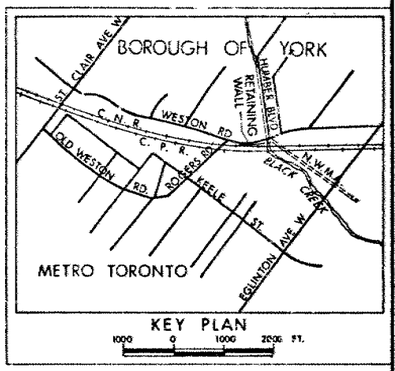
CONT No
WP No 33-76-19

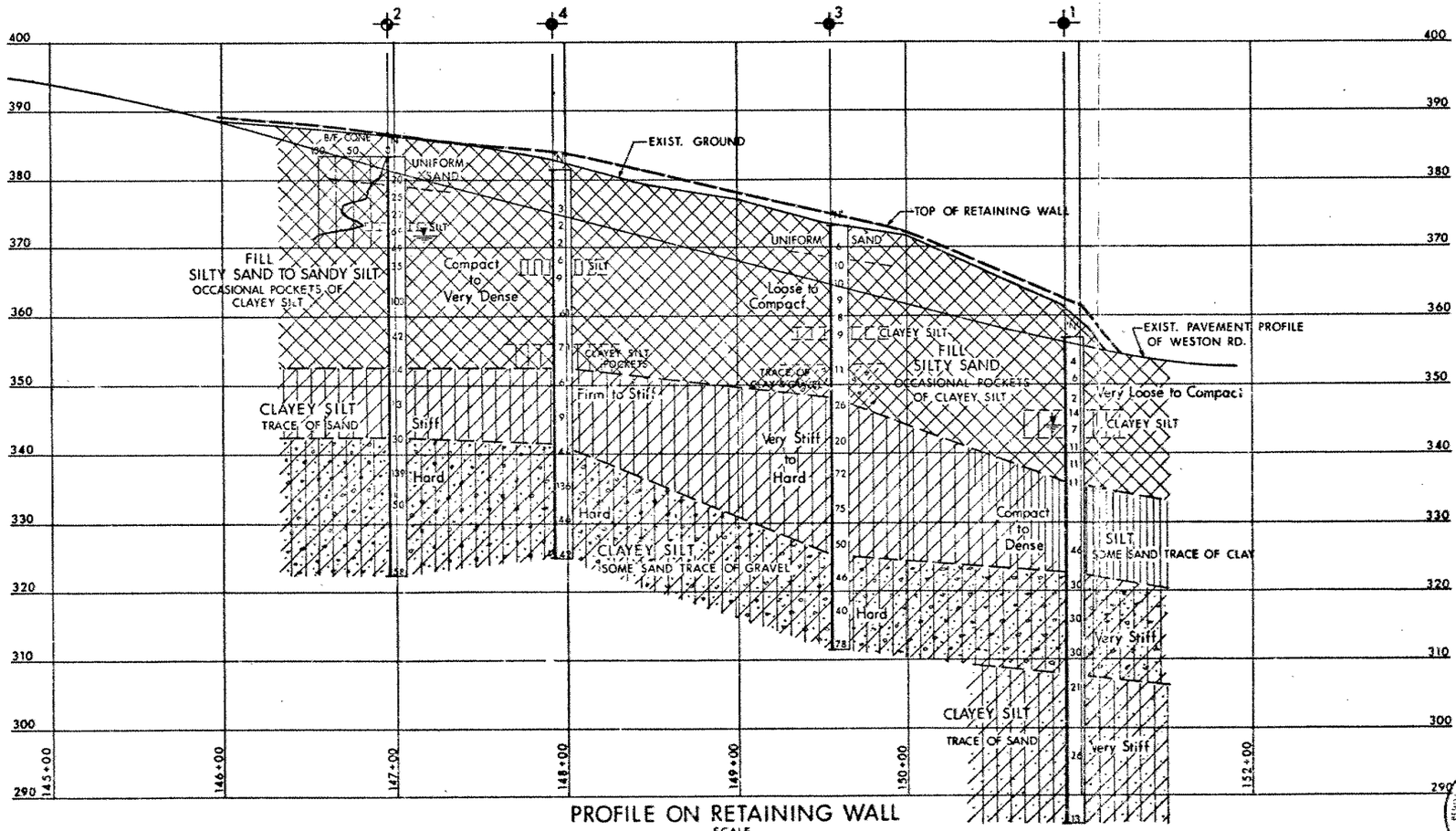
WESTON RD RETAINING WALL

BORE HOLE LOCATIONS & SOIL STRATA

SHEET







LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- 'N' Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- W.L at time of investigation JUNE 1979 NO W.L established B/H No 3 & 4

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	256·9	15 872 448	1 005 404
2	383·6	15 872 253	1 005 748
3	373·1	15 872 395	1 005 533
4	381·3	15 872 312	1 005 672

-NOTE-

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

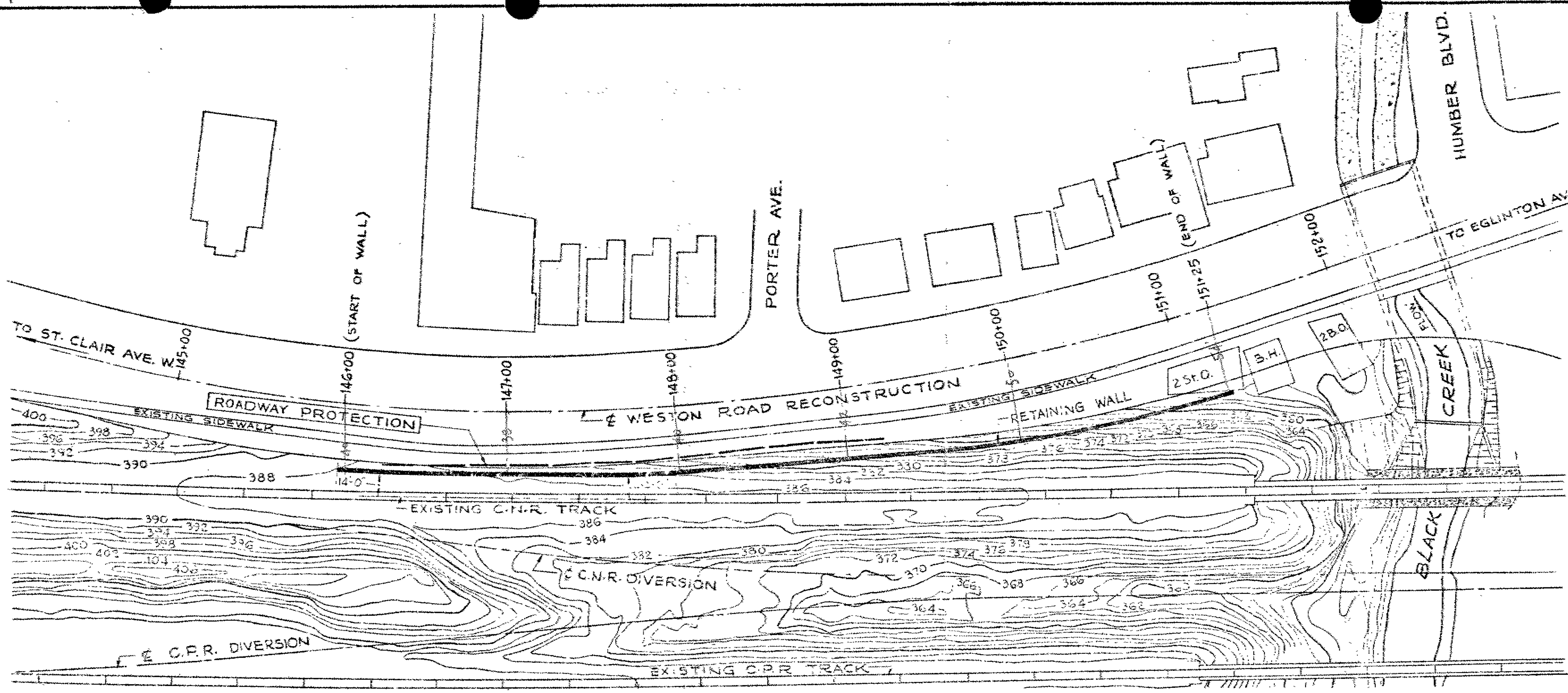
REVISIONS		
DATE	BY	DESCRIPTION

HWY No N.W.M.A.			DIST 6
SUBM'D T. K.	CHECKED	DATE 79 08 08	SITE
DRAWN O. J.	CHECKED	APPROVED	DWG 337619-A

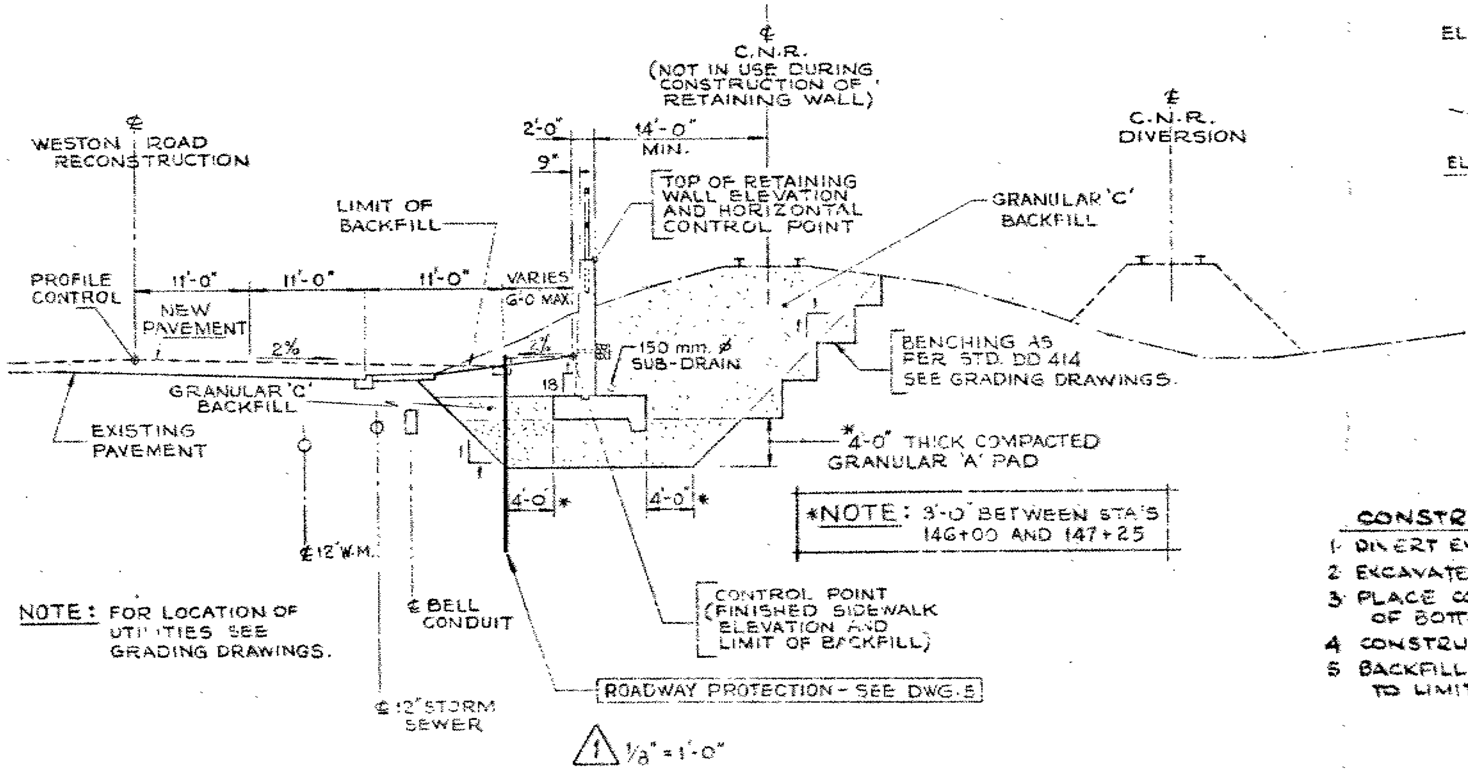
DIST. 5
CONT No
WP No 33-75-19

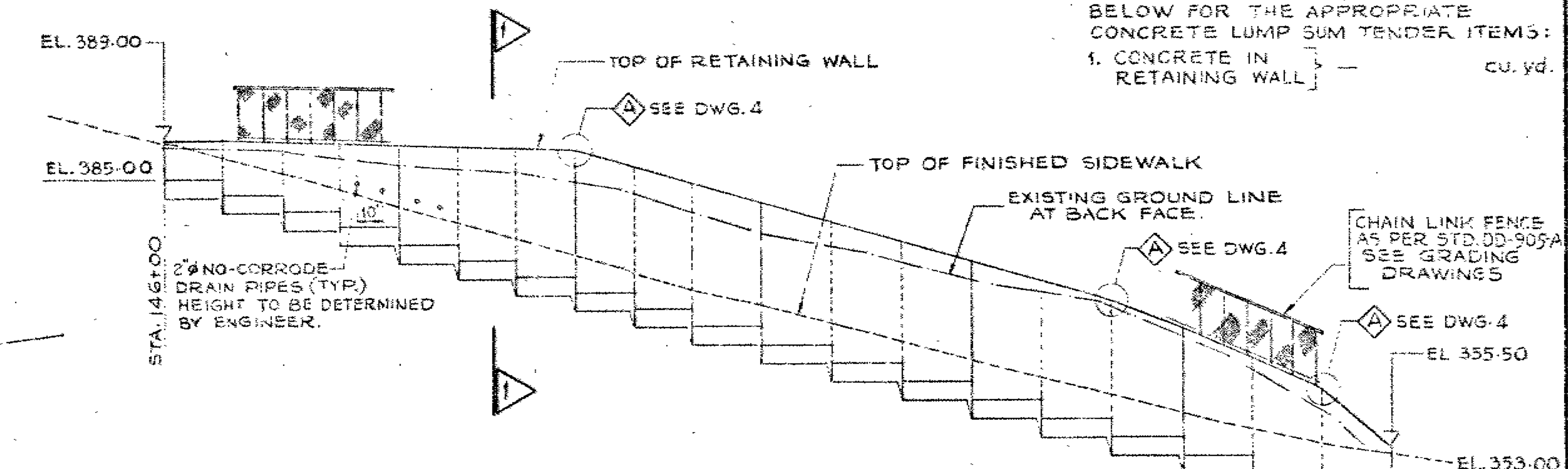
RETAINING WALL
AT WESTON ROAD
NORTHWEST METRO ARTERIAL
GENERAL PLAN

SHEET



PLAN
SCALE: 1" = 40'-0"





NORTH ELEVATION
SCALE: HOR. 1" = 40'; VER. 1" = 10'

STA. 151+25

GENERAL NOTES

CLASS OF CONCRETE

30 MPa

REINFORCING STEEL GRADE

GRADE 400

CLEAR COVER ON REINFORCING STEEL

3" IN FOOTINGS AND WALL

LIST OF DRAWINGS

1. GENERAL PLAN
2. BORE HOLE LOCATIONS & SOIL STRATA
3. ALIGNMENT DETAILS
4. CONSTRUCTION TABLE
5. STANDARD DETAILS

CONCRETE QUANTITIES:

CONCRETE QUANTITIES IS LISTED BELOW FOR THE APPROPRIATE CONCRETE LUMP SUM TENDER ITEMS:

1. CONCRETE IN RETAINING WALL } — cu. yd.

CONSTRUCTION SEQUENCE

1. DIVERT EXISTING C.N.R. TRAINS.
2. EXCAVATE FOR CONSTRUCTION OF THE GRANULAR PAD.
3. PLACE COMPACTED GRANULAR PAD TO ELEV. OF BOTTOM OF FOOTING.
4. CONSTRUCT THE RETAINING WALL.
5. BACKFILL WITH COMPACTED GRANULAR 'A' & C TO LIMITS SHOWN ON DRAWING.

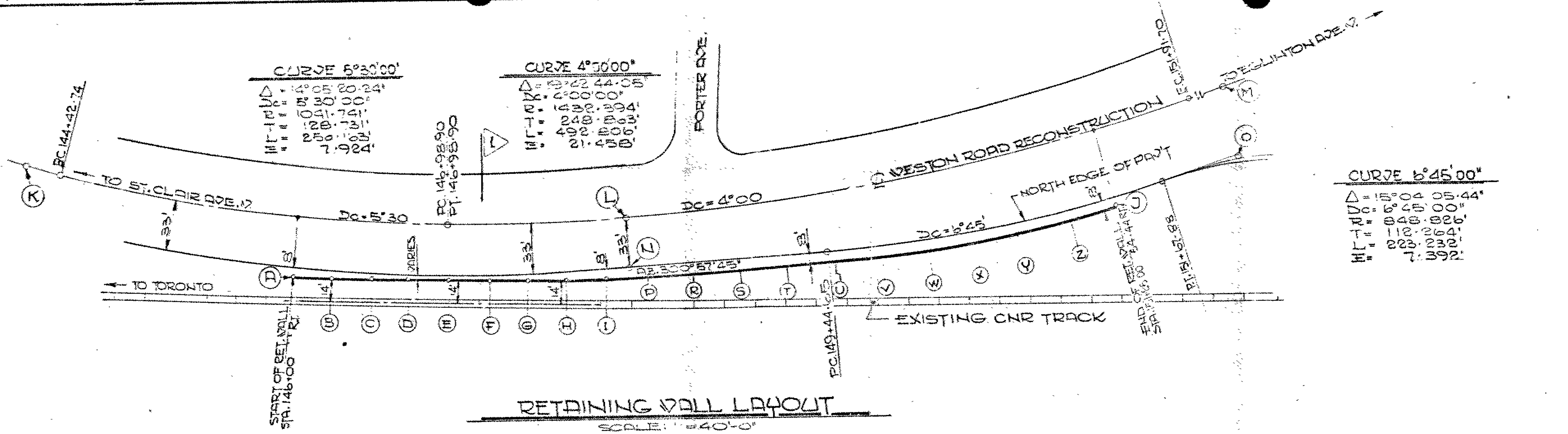
FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

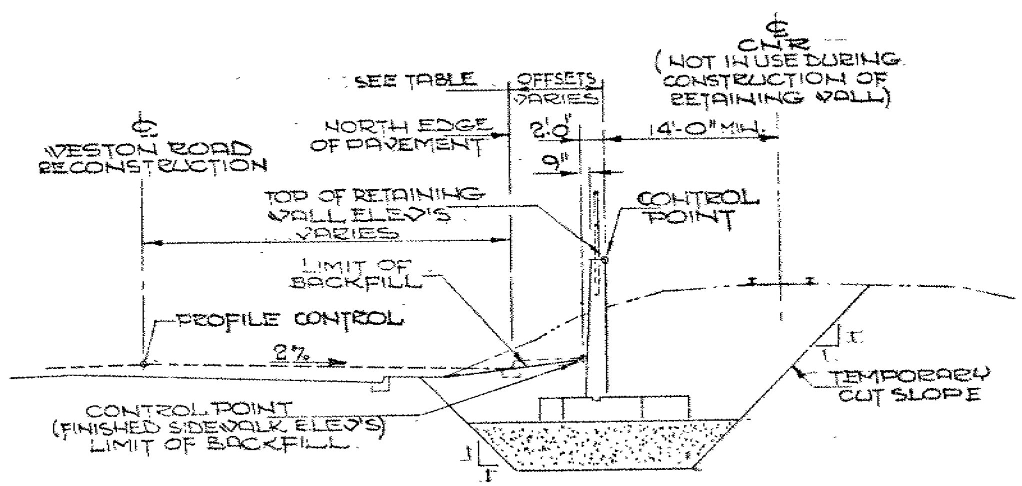
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	CHECK	LOADING	DATE
DRAWING	CHECK	SITE No	DWG

CONT No	
WP No	33-76-19

RETAINING WALL AT WESTON ROAD
NORTHWEST METRO ARTERIAL
ALIGMENT DETAILS

SHEET





℄ WESTON ROAD

POINT	STATION	PROVINCIAL CO-ORDINATES NORTH	EAST
(K)	144+9.81	15872 039.022	1005930.216
E.C.	144+42.74	15872 056.507	1005915.385
PT & PC	146+98.90	15872 229.019	1005127.458
E.C.	151+91.70	15872 442.676	1005 285.782
(M)	152+69.79	15872 469.535	1005 191.438

WESTON ROAD - NORTH EDGE OF PAVEMENT

POINT	STATION	OFFSET	PROVINCIAL CO-ORDINATES NORTH	EAST
(L)	148+15.00	NIL	15872 293.328	1005 080.424
(N)	148+15.00	33' RT.	15872 321.655	1005 047.402
PC	149+41.40	38.72' RT.	15872 386.326	1005 336.282
PT	151+57.69	45.92' RT.	15872 476.627	1005 331.993
(O)	151+09.79	45.50' RT.	15872 491.393	1005 280.840

OFFSETS FROM ℄ PROFILE CONTROL TO NORTH EDGE OF PAVEMENT

STA. ON PROF. CONTROL	OFFSET TO NORTH E/P
148+00 BEGINNING OF RET. WALL	33.000'
148+5.00	33.000'
148+25	33.036'
148+50	33.438'
148+75	34.287'
149+00	35.584'
149+25	37.332'
149+41.40 = PC	38.724'
149+50	39.486'
149+75	41.478'
150+00	43.138'
150+25	44.465'
150+50	45.459'
150+75	46.119'
151+00	46.445'
151+25 END OF RET. WALL	46.437'
[illegible]	46.094
[illegible]	45.921
[illegible]	45.605

RETAINING WALL

POINTS	STATIONS-NORTH EDGE OF PAV'T	OFFSETS FROM NORTH EDGE OF PAV'T	CO-ORDINATES @ CONTROL POINT NORTH	EAST	PANEL LENGTHS @ CONTROL POINT	PANEL No	ELEV'S TOP OF RETAINING WALL	ELEV'S TOP OF BACKFILL
(A)	145+94.19	7.995'	15872 199.242	1005 831.932	26.19'	1	389.00	386.81
(B)	146+20.19	7.307'	15872 215.671	1005 811.534	25.91'	2	389.00	387.23
(C)	146+45.90	6.134'	15872 231.034	1005 790.676	25.90'	3	388.83	385.53
(D)	146+71.67	5.535'	15872 246.371	1005 769.[illegible]	25.[illegible]	4	388.67	383.[illegible]
(E)	146+97.48	5.479'	15872 261.651	1005 748.869	25.69'	5	388.50	381.95
(F)	147+23.07	5.508'	15872 276.719	1005 723.025	25.69'	6	388.33	380.18
(G)	147+48.64	6.613'	15872 291.[illegible]	1005 707.168	25.68'	7	388.17	378.40
(H)	147+74.17	7.148'	15872 306.610	1005 686.264	25.62'	8	388.00	376.64
(I)	147+99.65	7.997'	15872 320.481	1005 664.[illegible]	25.71'	9	386.36	374.86
(P)	148+25.23	8.00'	15872 333.[illegible]	1005 642.[illegible]	30.67'	10	384.51	373.[illegible]
(R)	148+55.93	↑	15872 349.[illegible]	1005 616.23	30.20'	11	382.42	371.18
(S)	148+86.67		15872 365.50	1005 [illegible]	30.97'	12	380.30	369.25
(T)	149+7.47		15872 381.49	1005 [illegible]	31.06	13	378.23	367.3[illegible]
(U)	149+48.36		15872 397.46	1005 536.54	31.23'	14	376.14	365.36
(V)	149+79.30		15872 412.84	1005 509.50	[illegible]	[illegible]	374.04	363.41
(W)	150+10.26		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(X)	150+41.21		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(Y)	150+72.19		15872 452.[illegible]	1005 [illegible]	31.25'	[illegible]	[illegible]	[illegible]
(Z)	151+03.15	↓	15872 464.25	1005 [illegible]	[illegible]	19	[illegible]	[illegible]
(J)	151+24.15	8.00'	15872 474.55	1005 366.81	31.27'		355.50	354.99

CHORD LENGTH / ARC LENGTH

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
2 INCHES ON ORIGINAL PLAN

REVISIONS		
DATE	BY	DESCRIPTION
DESIGN	CHECK	LOADING
DRAWING	CHECK	SITE No

CONT No	
WP No	33-76-19

RETAINING WALL AT WESTON ROAD NORTHWEST METRO ARTERIAL CONSTRUCTION TABLE

SHEET

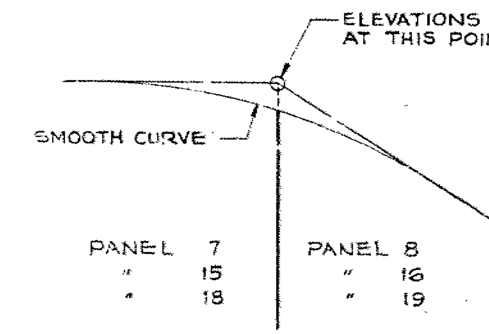
STATIONS ALONG N. EDGE OF PAVEMENT.

PANEL No	LENGTH / EL. TOP FTG.	TYPE OF JOINT (DWG.5)	STATION	EL. TOP WALL	WALL HEIGHT	"E"
			√145+94.19	384.00	4.00	1.47
1.	26.19 / 385.00	CONSTR	√146+20.19	389.00	4.00 / 5.75	1.47 / 1.57
2.	25.91 / 383.25	CONSTR	√146+45.90	388.83	5.58 / 7.33	1.56 / 1.66
3.	25.92 / 381.50	EXP	√146+71.67	388.67	7.17 / 8.92	1.65 / 1.75
4	25.93 / 379.75	CONSTR	√146+97.48	388.50	8.75 / 10.50	1.74 / 1.83
5	25.69 / 378.00	CONSTR	√147+23.07	388.33	10.33 / 12.08	1.82 / 1.92
6	25.69 / 376.25	EXP	√147+48.64	388.17	11.92 / 13.67	1.91 / 2.01
7	25.68 / 374.50	CONSTR	√147+74.17	388.00	13.50 / 14.75	2.00 / 2.07
8	25.62 / 373.25	CONSTR	√147+99.65	386.26	13.01 / 14.76	1.97 / 2.07
9.	25.71 / 371.50	EXP	√148+25.23	384.51	13.01 / 15.01	1.97 / 2.08
10.	30.87 / 369.50	CONSTR	√148+55.93	382.42	12.92 / 14.92	1.97 / 2.08
11.	30.90 / 367.50	CONSTR	√148+86.67	380.32	12.82 / 14.82	1.96 / 2.07
12.	30.97 / 365.50	EXP	√149+17.47	378.23	12.73 / 14.73	1.96 / 2.07
13.	31.06 / 363.50	CONSTR	√149+48.36	376.14	12.64 / 14.64	1.95 / 2.06
14.	31.23 / 361.50	CONSTR	√149+79.30	374.04	12.54 / 14.54	1.95 / 2.06
15.	31.24 / 359.50	EXP	√150+10.25	371.95	12.45 / 14.45	1.94 / 2.05
16.	31.25 / 357.50	CONSTR	√150+41.21	368.65	11.15 / 13.65	1.87 / 2.01
17.	31.26 / 355.00	CONSTR	√150+72.18	365.35	10.35 / 12.35	1.83 / 1.94
18.	31.26 / 353.00	CONSTR	√151+03.15	362.05	9.05 / 9.05	1.75 / 1.75
19.	31.27 / 353.00		√151+34.13	355.50	2.50	1.39

PANEL No	"A"	"D"	"H"	YG / YF	G / F (SPACED @ 12")	Z / L (SPACED @ 12")	M	N	R	S	P WALL	P FTG	V	K	"B"	"C"	"J"
							QTY. OF #15 SPACED @ 12"										
1.	2'-3"	5'-2"	2'-0"	3'-9"	#15	—	27	27	27	—	10	15	27	4	1'-6"	2'-0"	1'-9"
				—	—	#15											
2.	3'-0"	6'-0	2'-0"	5'-5"	#15	—	26	26	26	—	12	17	26	5	1'-6"	2'-0"	1'-9"
				—	—	#15											
3.	4'-0"	7'-1"	2'-0"	7'-1"	#20	—	26	26	26	—	16	19	26	6	1'-6"	2'-0"	1'-9"
				—	—	#20											
4.	5'-0"	8'-2"	2'-0"	5'-8"	#15	#20	26	26	26	—	18	21	26	7	1'-6"	2'-0"	1'-9"
				4'-6"	#20	#15											
5.	5'-6"	9'-0"	2'-0"	7'-0"	#20	#25	26	26	26	26	22	23	26	8	1'-6"	2'-0"	2'-3"
				5'-0"	#20	#15											
6.	8'-0"	11'-9"	2'-6"	9'-0"	#20	#25	26	26	26	26	26	27	26	10	1'-9"	3'-0"	1'-9"
				7'-0"	#25	#15											
7.	8'-0"	12'-6"	2'-6"	9'-0"	#25	#25	26	26	26	26	28	29	26	11	1'-9"	3'-0"	1'-3"
				5'-6"	#25	#20											
8.	8'-0"	13'-6"	2'-6"	11'-0"	#30	#25	26	26	26	26	28	31	26	12	1'-9"	3'-0"	1'-9"
				5'-6"	#30	#20											
9.	9'-0"	15'-3"	2'-6"	11'-0"	#30	#30	26	26	26	26	30	35	26	14	1'-9"	3'-0"	2'-0"
				5'-6"	#30	#20											
10.	9'-0"	16'-1"	2'-6"	10'-6"	#30	#30	31	31	31	31	30	37	3	15	1'-9"	3'-0"	2'-0"
				6'-0"	#30	#25											
11.	10'-0"	18'-4"	2'-6"	10'-6"	#30	#35	31	31	31	31	30	41	3	17	2'-0"	4'-0"	2'-0"
				6'-0"	#30	#30											
12.	10'-0"	18'-4"	2'-6"	10'-6"	#30	#35	31	31	31	31	30	41	3	17	2'-0"	4'-0"	2'-0"
				6'-0"	#30	#30											
13.	9'-0"	16'-9"	2'-6"	10'-6"	#25	#30	31	31	31	31	30	37	31	15	2'-0"	4'-0"	2'-0"
				6'-6"	#30	#30											
14.	9'-0"	16'-9"	2'-6"	10'-6"	#25	#30	32	32	32	32	30	37	32	15	2'-0"	4'-0"	2'-0"
				6'-6"	#30	#30											
15.	9'-0"	16'-9"	2'-6"	10'-6"	#25	#30	32	32	32	32	30	37	32	15	2'-0"	4'-0"	2'-0"
				6'-6"	#30	#30											
16.	8'-0"	15'-0"	2'-6"	9'-0"	#20	#30	32	32	32	32	28	35	32	14	2'-0"	4'-0"	2'-0"
				7'-0"	#25	#20											
17.	7'-0"	12'-6"	2'-0"	6'-0"	#25	#25	32	32	32	32	26	29	32	11	2'-0"	4'-0"	2'-0"
				—	—	#20											
18.	6'-0"	10'-11"	2'-0"	5'-0"	#25	#20	32	32	32	32	22	25	32	—	2'-0"	4'-0"	—
				—	—	#20											
19.	4'-6"	9'-3"	2'-0"	VARIES	#15	—	32	32	32	—	18	23	32	—	2'-0"	4'-0"	—
				—	—	#20											

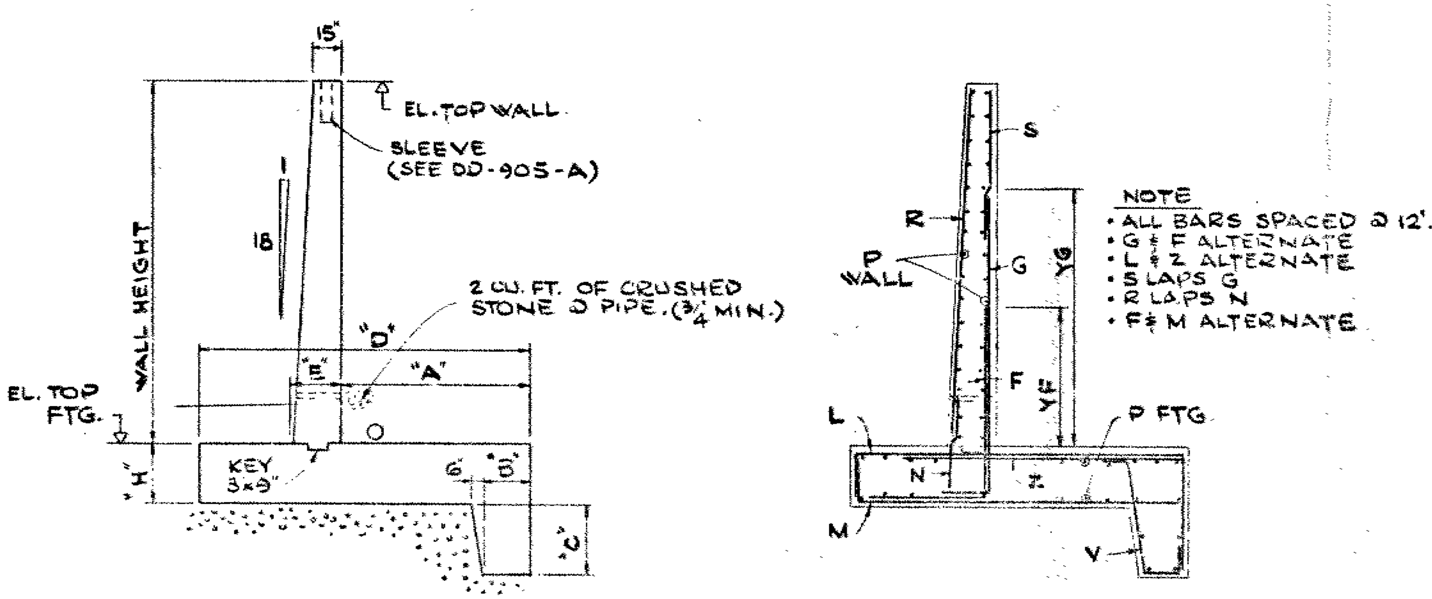
NOTES

- BARS TO START AND END 3" FROM END OF WALL OR JOINTS.
- HORIZONTAL STEEL IS NOT CONTINUOUS THRU JOINTS.
- BARS R & S TO HAVE 2'-0" LAP (MIN) WITH N & G.

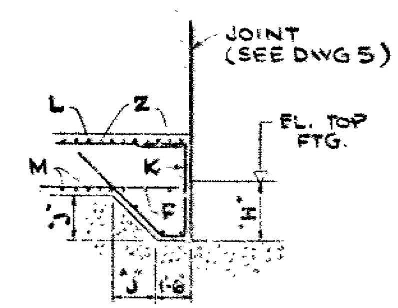


TOP OF WALL PROFILE

SEE DRAWING 1 - (A)



TYPICAL SECTIONS



STEP DETAIL

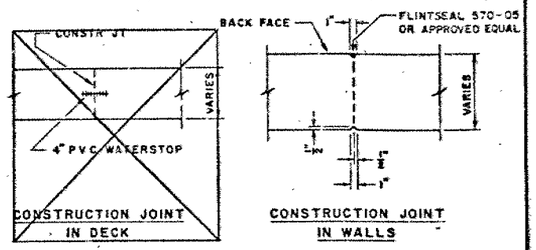
FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	CHECK	LOADING	DATE
DRAWING	CHECK	SITE No	DWG 4

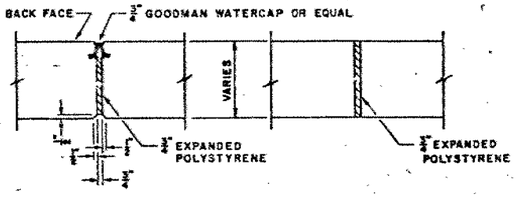
TYPICAL JOINT DETAILS

SS16-70
MAY 1977



CONSTRUCTION JOINT IN DECK

CONSTRUCTION JOINT IN WALLS



EXPANSION JOINT IN WALLS

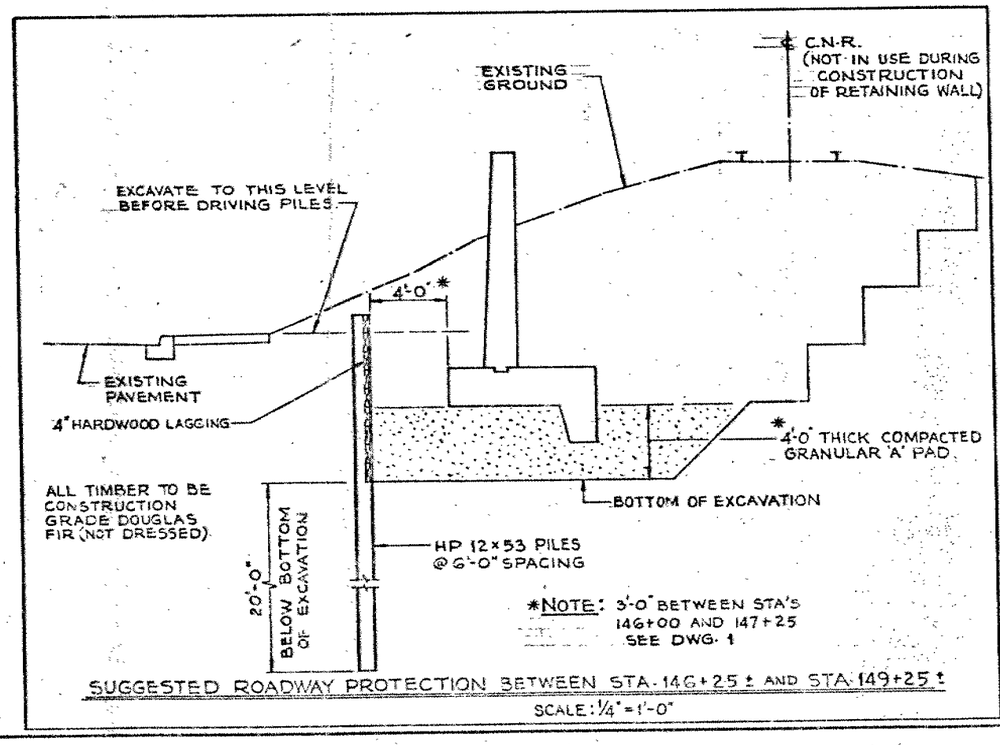
EXPANSION JOINT IN FOOTINGS

NOTES:
EXPANDED POLYSTYRENE HELD IN PLACE WITH LIGHT GALV NAILS.

CONT No
WP No 33-75-15

RETAINING WALL
AT WESTON ROAD
NORTHWEST METRO ARTERIAL
STANDARD DETAILS

SHEET



SUGGESTED ROADWAY PROTECTION BETWEEN STA. 146+25 ± AND STA. 149+25 ±

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

FOR REDUCED PLAN
USE SCALE BELOW
10 11 12 13
3 INCHES ON ORIGINAL PLAN

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN		CHECK	LOADING ESC DATE JAN 5
DRAWING J.E.		CHECK	SITE No N-37 DWG 5

memorandum

Ontario

To: Mr. M. Devata,
Pavement Design & Foundations Section,
Central Building, Downsview.

Date: 80 02 08

Subject: Retaining Wall at Weston Road,
W.P. 33-76-19, Site 37RW
NWMA, District #6.

Structures in the same contract as the above retaining wall have been designed for Granular "C" backfill. Could you please confirm that this material is suitable for the Weston Road retaining wall and that the following design parameters are satisfactory:

Unit weight of backfill 130 p.c.f.

Angle of internal friction $\phi = 30°$

In addition as agreed with Mr. T. J. Kazmierowski would you corroborate that the compacted granular"A" pad under the wall footing may be reduced to 3' between Station 146+00 and 147+25.

R. E. Haynes

REH/cf

R. E. Haynes,
Senior Project Engineer,
Central Section.

RECEIVED
FEB 12 1980
Pavement and Foundation Design Section

memorandum

Ontario

To: Mr. W. Lin
Design Engineer
Central Section
Structural Office Att: R.E. Haynes

Date: 1980-02-14

From: Pavement & Foundation Design Section
Room 313, Central Building
Downsview

Re: Retaining Wall at Weston Road
W.P. 33-76-19, Site 37RW
NWMA, District #6

As per discussions between Messrs. T.J. Kazmierowski and R.E. Haynes Granular 'C' backfill for the above mentioned project with the following properties:

Unit weight - 130 pcf
Internal Angle of Friction $\phi = 30^{0}$

is suitable for design purposes.

In addition, due to the proximity of utilities to the temporary forward cut slopes it was agreed to reduce the thickness of the compacted Granular 'A' to 3' between Stations 146+00 and 147+25.

T.J. Kazmierowski
Project Foundations Engineer

TJK:ea

Mr. W.L. Lin
A/Head, Central Section
Structural Office
West Building

1980-03-07

From: Pavement & Foundation Design Section
Room 313, Central Building

Re: Retaining Wall at Weston Road
W.P. 33-76-19, Site R37
N.W.M.A., District 6

We have received the final drawings, associated D4 and Special Provisions for the above mentioned project. It has been noted that the minimum horizontal clearance between the retaining wall and railway tracks have been increased to 14 feet and we will adjust the foundation drawing accordingly. We have no further comments on the foundations and related earthworks for this structure at the present time.

T. Kazmierowski
Project Foundations Engineer

TK:ea

WP33-76-19

Ministry of Transportation and Communications
Ontario

Memorandum

To: Mr. C. S. Grebski,
Head/Central Section,
Structural Office,
2nd Floor, West Building.

Attention:

From: Pav't. & Foundation Design Section,
Engineering Materials Office,
Room 315, Central Building.

Date: 79 11 14

Our File Ref.

In Reply to

Subject: Re: Retaining Wall at Weston Road,
W.P. 33-76-19, Site R-37,
NWMA, District 6, Toronto.

We have reviewed the Preliminary Bridge Plan Drawing R-37-PI for the above mentioned structure. Our comments are as follows.

1) Backfill material placed to restore the C.N.R. embankment after construction should be keyed into the temporary cut slopes by benching in accordance with M.T.C. Standard DD-414.

2) Insure free-draining granular backfill is used immediately behind the retaining wall.

TK/MD/cy

T. Kazmierowski,
Project Foundations Engineer.
For: M. Devata,
Senior Foundations Engineer.

c.c. Files