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HWY. No. 407/427

LOCATION Hwy 407W-427S Ramp over Steeles Ave

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

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FOUNDATION DESIGN SECTION

WP 368-87-03 DIST 6

HWY 407 STR SITE 37-1337

Ramp 407W-427S Over Steeles Avenue

CONT 93-93

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GEOCRES 30M13-115

DATE OCT 10 1990

FOUNDATION INVESTIGATION REPORT
For
Ramp 407W-427S Over Steeles Avenue
W.P. 368-87-03, Site 37-1337
District 6, Toronto

INTRODUCTION

This report summarizes the results of a foundation investigation conducted at the aforementioned site. A single span steel girder structure is proposed to carry the 407W-427S ramp over Steeles Avenue. The report describes the subsurface conditions at the site and provides detailed recommendations pertaining to the structure foundations and related earthworks.

SITE DESCRIPTION AND GEOLOGY

The site is located immediately west and adjacent to the 407E-427S ramp structure that carries traffic over Steeles Avenue. The 407E-427S ramp ascends in elevation north of Steeles Avenue and contains a multi-span structure immediately north of the site in conjunction with the Hwy. 427/407 interchange complex. Both the aforementioned structures and many other structures associated with the interchange complex were under construction at the time of investigation. The site is located approximately 300 m east of the existing Albion Road/Hwy. 50/Steeles Avenue intersection. The southern half of the site is located within the City of Etobicoke whilst the northern half of the site is located within the Town of Vaughan, Regional Municipality of York. The existing Steeles Avenue is presently a 4 lane roadway.

The natural terrain at the site is generally flat but construction of the aforementioned structures has accentuated the flat terrain with approach fill contours.

Physiographically, the site is located in the geological domain known as the "Peel Plain". The "Peel Plain" is the product of the advance and retreat of the Wisconsinan ice sheet which covered the area during the Pleistocene epoch (over 12,000 years ago). It consists of a bevelled till plain with a gently undulating rolling surface and limited relief. At some locations, the till is overlain by thin deposits of varved clay.

Till sheets of varying composition comprise the "Peel Plain". Generally, the surficial till sheets exhibit a cohesive behaviour whilst the lower till sheets are cohesionless. As characteristic of till material, these deposits contain a wide range of grain sizes ranging from boulders to clay.

The till sheets are usually separated from one another by interbeds of stratified silt or sand of variable thickness. Bedrock in the area has been found at depths ranging from 25 to 30 m below ground surface and consists of interbedded shale and limestone of the Dundas-Meaford Formation, Ordivician period.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in situ and laboratory testing conducted. The procedures employed are discussed below.

Field Investigation

The fieldwork for the investigation was carried out on 90 06 18 and consisted of three (3) sampled boreholes advanced to depths ranging from 9.6 m to 12.6 m below the natural ground surface. Two additional boreholes advanced in conjunction with Ramp 407E-427S over Steeles Ave. have also been included in this report. The boreholes identified as BH 4 and 5 (formerly 1 and 3 respectively were advanced between 82 06 28 and 82 07 01 to depths of 15.2 to 15.3 m respectively. Dynamic Cone Penetration tests advanced to depths of 2.6 m and 2.5 m respectively accompanied these boreholes.

Track mounted CME 55 equipment employing hollow stem augering techniques was used to advance the three (3) current boreholes in the overburden. In general, disturbed subsoil samples were retrieved at 0.7 m intervals for the surficial 6 m and 1.5 m thereafter. Sample retrieval was conducted in accordance with the Standard Penetration Test (ASTM D1586). All samples were identified in the field and then returned to the laboratory for applicable testing.

Groundwater levels were obtained by monitoring the levels in the open boreholes throughout the duration of the field investigation. All open boreholes were backfilled at the completion of the fieldwork.

Survey information related to the location and elevation of boreholes was provided by Central Region Surveys and Plans.

Laboratory Analyses

To identify the behaviour, gradation and pertinent properties and characteristics of the soil, various laboratory tests were performed. These tests included:

1) Atterberg Limit Tests
2) Grain Size Distributions
3) Unit Weights
4) Natural Moisture Contents

Laboratory test results have been summarized in the subsequent section of this report entitled "Subsurface Conditions", and are illustrated on corresponding figures and boreholes included in the attached Appendix.

SUBSURFACE CONDITIONS

In general, reasonably competent and uniform subsurface conditions were encountered across the site. The soil stratigraphy consists of a surficial deposit that contains a heterogeneous mixture of clayey silt, sand and gravel that extends to a maximum depth of 3.7 m. This cohesive deposit has a very stiff to hard consistency.

Underlying the surficial deposit and explored for a maximum thickness of 9.9 m exists a cohesionless deposit consisting of a sandy silt to silty sand with interbedded silt layers to a gravelly sand that also contains occasional boulders and cobbles. This deposit is generally in a dense to very dense state of denseness.

A second lower glacial till consisting of a heterogeneous mixture of clayey silt, sand and gravel underlies the cohesionless deposit. The extent of the deposit was not determined during the investigation. The deposit has a hard consistency.

The boundaries between the various soil types, in situ and laboratory test results as well as groundwater levels established at the time of investigation, are shown on the attached Record of Borehole sheets in the Appendix. A plan of the site illustrating the locations and elevations of the boreholes and subsoil stratigraphical sections are provided on Dwg. 3688703-A.

A detailed description of the subsurface conditions encountered is given below.

Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till)-Upper

The native surficial deposit at the site consists of a heterogeneous mixture of clayey silt, sand and gravel and extends for depths ranging from 2.6 m to 3.7 m. Occasional boulders and cobbles as inferred during the field investigation from auger grinding are also present within the deposit. A grain size distribution envelope, as determined by mechanical sieve and hydrometer analysis, that illustrates the gradation of this material is provided in Figure 1 in the Appendix. The boulder and cobble sizes are not illustrated on the indicated figure.

The deposit has been oxidized and hence is brown in colour.

Atterberg Limit tests were carried out to define the behaviour and plasticity of the fine grained portion of the soil and the results are plotted in Figure 2 in the Appendix. A summary of the indices is provided in Table 1 below.

Table 1 - Clayey Silt

	Range	# of Tests
Natural Moisture Content (w%)	12-16	3
Liquid Limit (w_L%)	17-33	3
Plasticity Index (Ip%)	7-17	3
Unit Weight (kN/m^3)	20.4-22.6	2

The results reveal that the fine grained portion of the deposit is primarily of low plasticity and hence can be classified as clayey silt.

Standard Penetration Tests carried out in this deposit revealed 'N' values ranging from 12 blows/0.3 m to 107 blows/0.3 m. Based on these 'N' values, the material can be described as having a stiff to hard consistency.

Sandy Silt/Silty Sand to Gravelly Sand

The surficial cohesive deposit is underlain by a granular stratum ranging from a sandy silt to silty sand with interbedded silt layers in the upper portion to a gravelly sand with occasional cobbles and boulders. A grain size distribution envelope as determined by mechanical sieve analysis, that illustrates the finer gradation of the deposit (<75 mm) is shown on Figure 3 in the Appendix. The thickness of the stratum encountered ranges from 9.1 m to 9.9 m.

Interpretation of Standard Penetration Test 'N' values ranging from 18 blows/0.3 m to 120 blows/0.15 m, indicates a denseness ranging from compact to very dense. In general, however, the deposit can be categorized as dense to very dense.

Heterogeneous Mixture of Clayey Silt, Sand and Gravel (Glacial Till) - Lower

Underlying the granular deposit and explored for a maximum thickness of 2.5 m a second lower till deposit consisting of a heterogeneous mixture of clayey silt, sand and gravel exists. Although not encountered during the investigation, boulders and cobbles are characteristic components of these deposits and hence can exist in the deposit.

'N' values determined by the Standard Penetration Test were consistently in excess of 100 blows/0.3 m indicating a hard soil consistency.

Groundwater Conditions

Observation of the groundwater level was carried out by measuring the water level in the open boreholes. Groundwater levels determined at the time of investigation were approximately 6 m below the ground surface (El. 170 to 170.5 m). Soil cave-in was witnessed in the boreholes upon penetration of the cohesionless material below the prevailing groundwater due to unbalanced hydrostatic head.

Groundwater levels in general, are subject to seasonal fluctuations and hence can vary from the values given in this report.

DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a single span steel box girder structure that will carry the proposed two lane ramp 407 W-427 S over the existing Steeles Avenue. The ramp structure is approximately 32 m in length and 8.5 m in width and is a component of the Hwy. 427-407 interchange complex. The ramp is a one lane roadway with adjoining shoulders. Abutments for the single span structure have been proposed immediately north and south of the existing Steeles Avenue, a four (4) lane roadway with a future lane proposed in either direction. A plan illustrating the proposed structure is shown on Dwg. 3688703-A in the Appendix of this report.

The existing ground surface at the site is at approximate El. 176 m. However, fills have been placed in conjunction with the neighbouring Hwy. 407 E-427 S structure to an approximate El. of 182 m, adjacent to the proposed structure. At the south abutment, the proposed profile grade of the 427 S-407 W ramp is approximately at El. 184 m and the grade ascends in the northerly direction. Hence, at the north abutment location, the proposed profile grade is at an elevation of 185 m. Consequently, approach fills in the order of magnitude of 8 m to 9 m will be required. The 407 E-427 S ramp structure was under construction at the time of the investigation. This structure (over Steeles Ave.) is founded on conventional spread footings within the native surficial soil.

To facilitate the design and construction of the proposed structure foundations and related earthworks for the 407 W-427 S ramp structure over Steeles Avenue, the following foundation and geotechnical recommendations are provided in the scope of this report.

1) Structure Foundations
2) Approach Embankments
3) Construction Considerations

1) Structure Foundations

In view of the competent nature of the native surficial soils at the site, the abutments can be founded on a shallow foundation. The conventional spread footings can be designed and constructed as discussed below. The design that proves to be most economical and practically feasible shall be selected.

a) Compacted Granular 'A' Pad

Structure foundations can be "perched" on a compacted Granular 'A' pad placed on the existing native soil. For purposes of the O.H.B.D.C., the following bearing capacities are recommended.

Table 2 - Perched Abutment on Granular 'A'

Bearing Capacity at S.L.S. Type II	350 kPa
Factored Bearing Capacity at U.L.S.	900 kPa

The settlements induced as a result of the applied footing pressure will be elastic in nature and consequently is expected to take place during or immediately following the construction period. The magnitude of this settlement is anticipated to be within 25 mm, provided the subsoil/granular material is not softened/loosened by construction or related activities and the granular pad is constructed to the specifications described below.

Figure 4 in the Appendix illustrates the recommended geometry for the design of the perched abutment foundation. The thickness of the pad shall be a minimum 2 m above the existing natural ground surface and a minimum edge distance of 1 m from the edge of the footing to the crest of the granular 'A' pad shall be provided. The figure also illustrates that frost protection is required to protect the founding soil. All footings must have 1.2 m of earth cover.

The Granular 'A' material must be placed and compacted to achieve 100% of the Proctor maximum dry density as outlined in OPSS 501.08.02 (Method A). Quality control in the form of material inspection and field density measurements shall be conducted. Any softened and/or organic material present within the natural subgrade must be subexcavated prior to the placement of the granular pad.

A reduction for inclination of load acting on a shallow foundation must be applied in accordance with Section 6-7.3.3.5 of the O.H.B.D.C. The bearing capacities tabulated in Table 2 must therefore be ajusted accordingly.

The computation of the sliding resistance of the foundation shall be computed in accordance with Section 6-7.3.3.2 of the O.H.B.D.C. An unfactored friction

angle of 35° can be used between the concrete footing and the Granular 'A' material. If additional sliding resistance is required, consideration can be given to employing shear keys beneath the footing. The passive resistance developed by the shear key can be computed using the parameters of the granular material tabulated in Table 4 (see "Lateral Earth Pressures on Structures" in subsequent section of the report).

b) Spread Footings on Native Soil

Alternatively, abutment structure foundations can be founded on the native clayey silt till deposit at or below the elevations summarized in Table 3 below. At the south abutment, some relatively weaker material was identified within the surficial till deposit. Consequently, it is recommended that this material be subexcavated to an elevation of 173.3 m and the footings be placed on the native soil at this elevation or alternatively placed on Granular 'A' material used to replace the subexcavated material. The subexcavation width shall extend a minimum 3 m beyond either edge of the proposed footing elevations. For purposes of the O.H.B.D.C., the bearing capacities tabulated in Table 3 are recommended.

Table 3 - Spread Footings on Native Soil

Structure	Bearing Capacity at S.L.S. Type II (kPa)	Factored Capacity at U.L.S. (kPa)	Founding Elevation (m)
N. Abutment	350	1000	174
S. Abutment	350	1000	173.3

Settlement of the foundation subsoil as a result of the applied footing pressure will be elastic in nature and hence will develop during or immediately following construction. The total and differential settlement is expected to be within 25 mm.

All softened, foreign and/or organic material present at the footing founding elevation shall be removed and replaced with a granular material and/or mass

concrete. In addition, to preserve the founding soil during construction, it is recommended that a concrete working slab be placed in advance of the concrete footing construction.

The influence of the design and construction of a footing adjacent to an existing footing must be considered in view of the close proximity of the proposed 407W-427S ramp structure over Steeles Ave. to the existing 407E-427S ramp structure over Steeles Ave. (W.P. 88-79-24). The existing abutment structure foundations are founded on spread footings within the surficial cohesive till deposit at a founding elevation of 173.8 m whereas the retaining walls are founded on compacted Granular 'A' pads at founding elevations of 179.845 (north) and 178.145 (south). A new foundation placed adjacent to an existing foundation should be located so that a 30° line drawn from the bottom edge of the new foundation does not intersect the underside of the existing foundation as shown in C6-7.2(h)(i) in the Commentary of the O.H.B.D.C. Furthermore, adjacent excavation shall be carefully controlled to avoid potential undermining of the existing foundation. It is recommended that the design and construction scheme of the adjacent foundations be submitted to this office so that on assessment of the foundation impact can be implemented.

An unfactored friction angle of 30° can be used between the concrete footing and the native clayey silt till in the computation of the sliding resistance of the foundation. Additional sliding resistance can be provided by employing shear keys in the native soil. The passive resistance developed by the shear key can be computed using an angle of internal friction of 30° and a natural unit weight of 20 kN/m^3 above the prevailing groundwater table. For footings on Granular 'A' material, an unfactored friction angle of 35° can be used for sliding resistance computation as previously discussed.

All footings must be provided with adequate frost protection. Hence, the foundation must be designed with 1.2 m earth cover or equivalent frost protection.

No dewatering difficulties are anticipated during foundation construction because of the relatively impervious nature of the subsoil. Conventional sump pumping techniques will suffice in discharging any 'perched' or surface runoff

water. Temporary slopes to facilitate the footing construction can be constructed no steeper than 1½H:1V.

2) Approach Embankments

Approach fills in the order of magnitude of 8 to 9 m will be required for the structure approach embankments. Discussion of the lateral earth pressures on the structure, stability, settlement and construction of the approach embankments are provided below.

Lateral Earth Pressure on Structure

Free draining material such as Granular 'A' or Granular 'B' shall be used within a wedge behind the abutments and retaining walls bounded by a plane rising at 60° to the horizontal as shown in Figure 6-9.6.1 in the O.H.B.D.C. The application of granular material combined with weep holes in the abutment walls to drain any accumulation of water in the backfill will prevent hydrostatic pressure build-up. Design parameters of the soil are given in Table 5 below.

Table 4 - Backfill Properties

	Granular 'A'	Granular 'B'
Angle of Internal Friction (0) (unfactored)	35°	30°
Unit Weight (kN/m^3)	22.8	21.2
*Coefficient of Active Earth Pressure (Ka)		
- S.L.S.	0.27	0.33
- U.L.S.	0.33	0.4
*Coefficient of Earth Pressure at Rest (Ko)		
- S.L.S.	0.43	0.5
- U.L.S.	0.5	0.58

*These earth pressure coefficients apply to horizontal backfill surfaces only. The appropriate consideration shall be given to account for sloping backfill.

The earth pressure coefficient at rest is to be used in design if the abutment/ retaining walls are rigid and unyielding.

Stability/Settlement

In view of the competent nature of the subsoil, no deep-seated stability problems are anticipated for the proposed embankment fill heights for slopes constructed at 2H:1V, both in the forward and transverse directions. However to the internal (surficial) stability of the embankment fill, it is recommended that for embankment fill heights exceeding 8 metres, the approach embankment be constructed with a stabilizing midheight berm of 2 m width. The berm should be constructed at a nominal 2% gradient to facilitate surface runoff and 2H:1V slopes are to be maintained. In addition, an effective erosion control protection scheme, such as sodding, should be provided to protect the exposed slopes.

Settlements in the order of magnitude of 50 mm are expected at the approaches due to the elastic recompression of the native subsoil and settlement within the fills under its own weight. It is predicted that the majority of the settlements will be realized during or immediately following the construction of the embankment. To accelerate these anticipated settlements and to minimize post construction maintenance, it is recommended that the approach fills be placed as far in advance of final paving as the construction schedule permits.

Embankment Construction

In the construction of the embankment fills, all softened and/or organic material should be excavated for their full depth within the plan limits prior to fill placement.

Any new fill placement shall be connected to existing fills by "benching" the earth slopes in accordance with MTO Standards (OPSD 208.01).

Heavy compaction equipment should not be used behind the abutment/retaining walls within a lateral distance equal to the current height of fill above the wall footing in order to avoid imposing damage or deflection to the wall during the fill placement.

3) Construction Considerations

Temporary Shoring

In the construction of the proposed structure foundations, excavation at the toe of existing embankments and possibly excavation of the embankment toe may be required. In order to facilitate this type of construction, a temporary shoring scheme is recommended to preserve the stability of the embankment. A timber lagging-soldier pile system is one method of shoring recommended. Soil parameters to facilitate the design of the shoring system are summarized in Table 5 below.

Table 5

Soil	Saturated Unit Weight (kN/m^3)	Unfactored Effective Shear Strength Parameters (°)
Fill	22	30
Het. mixt. of clayey silt, sand & gravel (Till-Upper)	21	30
Sandy Silt/Silty Sand to Gravelly Sand	20	35

The design of the shoring system shall include the appropriate earth pressures computed in accordance with Section 6.6.1.2 of the O.H.B.D.C. The loadings induced by any surcharge traffic and adjustment for sloping surfaces shall be incorporated in the design.

The shoring system must be designed to satisfy earth pressure equilibrium. This equilibrium can be achieved by a cantilevered wall or a braced wall. The feasibility of a cantilever wall is contingent on the practicality of the

soldier pile embankment length. If the embankment length is found to be excessive, a more economical design may involve the application of struts or rakers.

Special consideration must be given to the foundation construction (and any associated shoring system that is entailed) and the implications on the existing structure foundations. It is recommended that the excavation and any shoring schemes be submitted to this office for our review and evaluation.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of T. Sangiuliano and M. Michalek, Foundation Engineers, and M. Iampietro, Engineering Student, utilizing equipment owned and operated by Malone's Soil Samples Ltd. and Master Soils Investigation.

The project was carried out by T. Sangiuliano under the general supervision of Dr. B. Iyer, Senior Foundation Engineer. The report was written by T. Sangiuliano reviewed and approved by Dr. B. Iyer.

T. Sangiuliano, P.Eng.
Foundation Engineer

for M.S. Devata, P.Eng.
Chief Foundation Engineer

APPENDIX

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\tilde{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O D 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

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

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

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

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

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 OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), 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	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

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

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

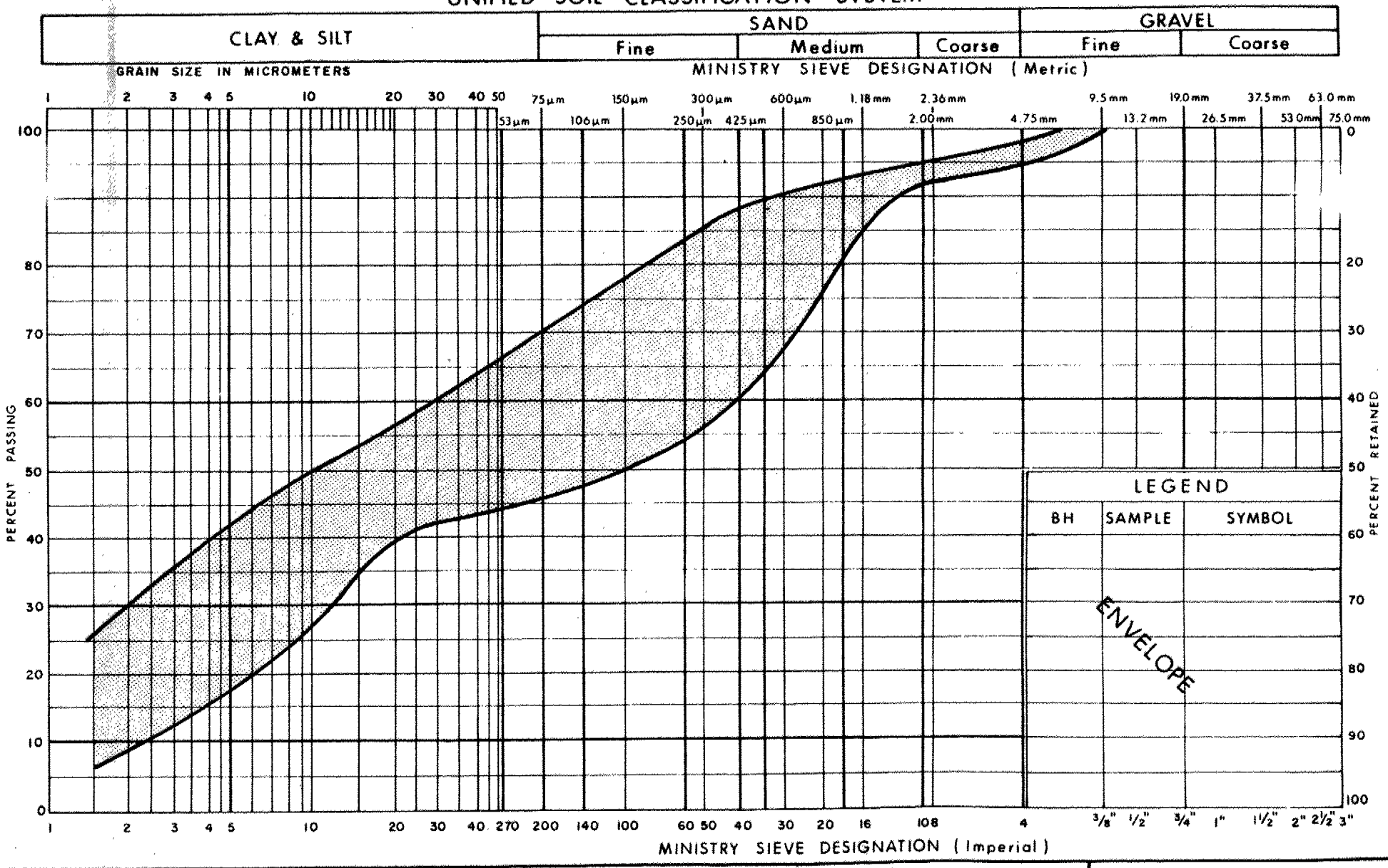
m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

e	1, %	VOID RATIO
n	1, %	POROSITY
w	1, %	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_p	%	PLASTIC LIMIT
w_s	%	SHRINKAGE LIMIT
I_p	%	PLASTICITY INDEX = $w_L - w_p$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	1, %	VOID RATIO IN LOOSEST STATE
e_{min}	1, %	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

UNIFIED SOIL CLASSIFICATION SYSTEM



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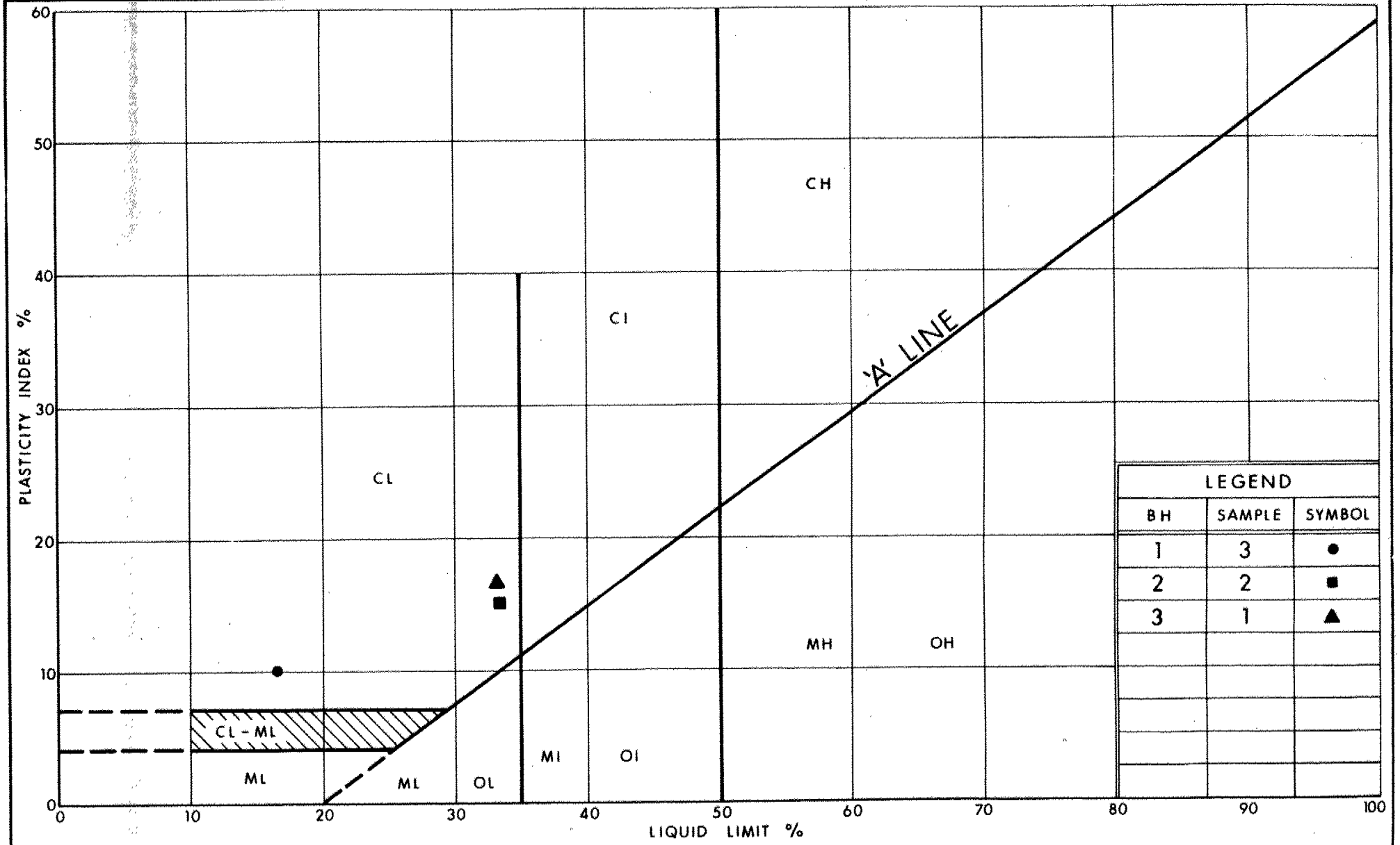
GRAIN SIZE DISTRIBUTION
HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL
(GLACIAL TILL) (UPPER)

FIG No 1
W P 368-87-03

Oct 75, FF-S-21



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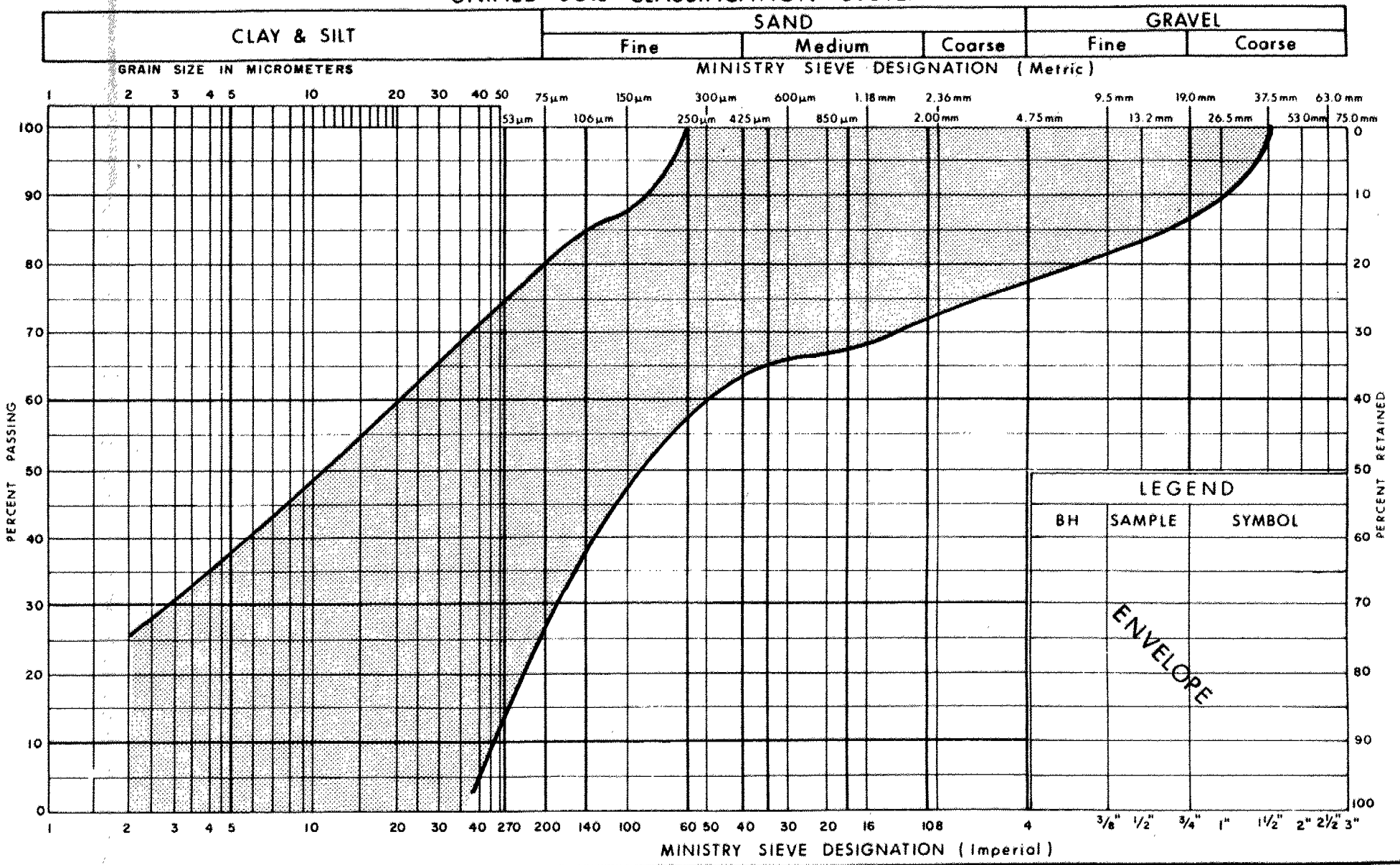
PLASTICITY CHART
HET MIXTURE OF CLAYEY SILT, SAND & GRAVEL
(GLACIAL TILL)

FIG No 2
W P 368-87-03

78 12 M

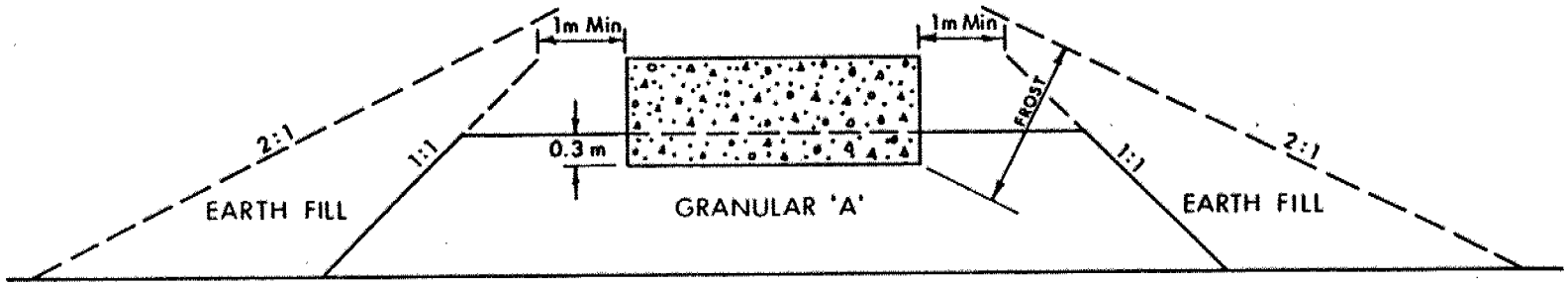
UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation
Ontario

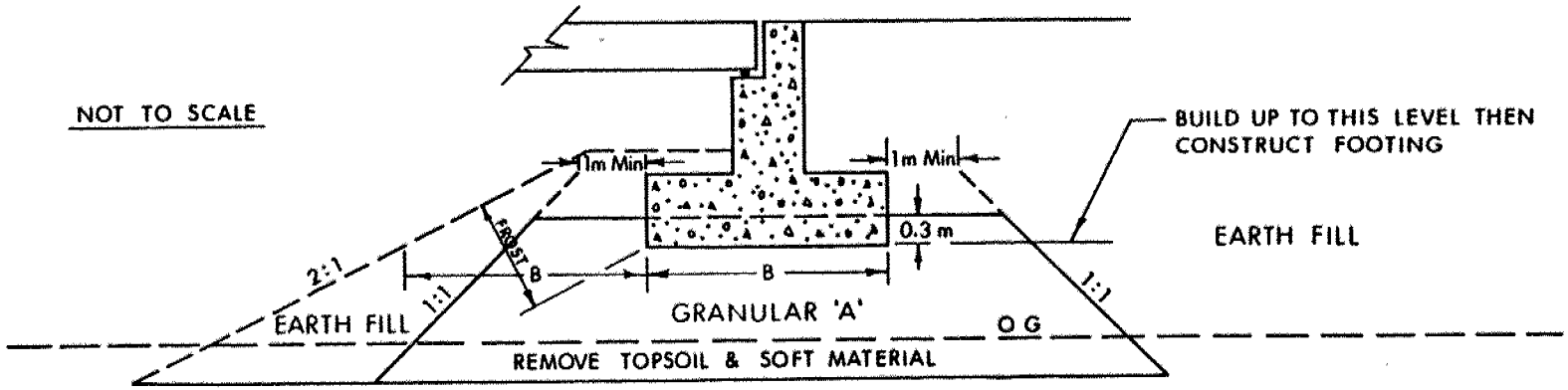
GRAIN SIZE DISTRIBUTION
SANDY SILT / SILTY SAND TO GRAVELLY SAND

FIG No 3
W P 368-87-03



X SECTION

NOT TO SCALE



LONGITUDINAL SECTION

NOTES:

1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.

2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M T O STANDARDS.

3 - CONSTRUCT CONCRETE FOOTING.

4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.

Ministry of Transportation Ontario	ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE	FIG No 4 W P 368-87-03

RECORD OF BOREHOLE No 1

1 OF 1 METRIC

W.P. 368-87-03 LOCATION Co-ords: N4 845 510 ; E 294 074 ORIGINATED BY MM

DIST 6 HWY 407 BOREHOLE TYPE HS Auger/Washboring COMPILED BY TS

DATUM GEODETIC DATE 90 06 18 CHECKED BY TS

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_p NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
176.3	Ground Surface										
0.0	Heterogeneous mixture of Clayey Silt, sand and gravel (Glacial Till) Brown, V. Stiff to Hard		1	SS	22						
			2	SS	26						
			3	SS	31		174			22.6	2 36 53 9
173.4											
2.9			4	SS	55						2 28 65 5
			5	SS	60						
			6	SS	52		172				
			7	SS	42	▼	170				
	Sandy Silt to Silty Sand Dense to V. Dense		8	SS	18		168				0 66 (34)
			9	SS	41						
	Brown / Grey						166				
			10	SS	66						
163.7			11	SS	105		164				
12.6	End of Borehole										

+3, ×5 : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 2 1 OF 1 METRIC

W.P. 388-87-03 LOCATION Co-ords: N4 845 479.5 ; 294 096 ORIGINATED BY MM

DIST 6 HWY 407 BOREHOLE TYPE HS Auger/Washboring COMPILED BY TS

DATUM GEODETIC DATE 90 06 18 CHECKED BY TS

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 kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
176.0	Ground Surface										
0.0	Heterogeneous mixture of Clayey Silt, sand and gravel (Glacial Till) Brown, Stiff to Hard		1	SS	12						
			2	SS	30		174		○	20.4	2 53 22 23
173.1			3	SS	13						
2.9	Compact		4	SS	24						
			5	SS	93		172				
			6	SS	85						1 18 (81)
	Silty Sand to Gravelly Sand V. Dense		7	SS	84		170				
			8	SS	60	*	168				
	Brown Grey		9	SS	30						
			10	SS	66		166		○		22 50 (28)
163.7			11	SS	110	/15cm	164				
12.3	End of Borehole * Cave-in at 7.6 m depth										

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

$\frac{20}{15}\diamond^5_{10}$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 3 1 OF 1 METRIC

W.P. 368-87-03 LOCATION Co-ords: N4 845 544.5 ; E 294 047.5 ORIGINATED BY MM

DIST 6 HWY 407 BOREHOLE TYPE HS Auger/Washboring COMPILED BY TS

DATUM GEODETIC DATE 90 06 18 CHECKED BY TS

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 kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L / WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
176.4	Ground Surface										
0.0	Heterogeneous mixture of Clayey Silt, sand and gravel (Glacial Till) Brown, Stiff		1	SS	14		174		○		5 23 43 29
173.8											
2.6	Sandy Silt to Silty Sand Dense to V. Dense		2	SS	30						
			3	SS	63		172				
	Brown / Grey		4	SS	47	▼	170				
			5	SS	49		168				
166.8			6	SS	38						
9.6	End of Borehole										

+^{3}, ×^{5} ; Numbers refer to Sensitivity

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

RECORD OF BOREHOLE No 4 (1) 1 OF 1 METRIC

W.P. 368-87-03 (88-78-24) LOCATION Co-ords: N 4 845 511.7 ; E 294 097.8 ORIGINATED BY DW

DIST 6 HWY 407 BOREHOLE TYPE SS Auger & Cone Test COMPILED BY DW

DATUM Geodetic DATE 82 06 28 CHECKED BY JP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
176.3	Ground Surface										
0.0	Heterogeneous mixture of Clayey Silt, sand and gravel (Glacial Till) Brown, V. Stiff to Hard		1	SS	28	*					1 25 38 36
			2	SS	17						
			3	SS	68			50/ 13cm			
172.6			4	SS	97	/25cm					2 22 61 15
3.7			5	SS	80	/15cm					
			6	SS	58	/15cm					4 65 26 5
	Silty Sand with interbedded silt layers		7	SS	96						
	to		8	SS	35						0 26 72 2
	Brown / Grey		9	SS	67						0 54 44 2
	Gravelly sand with occ. boulders and cobbles		10	SS	–						
	Dense to V. Dense		11	SS	90	/13cm					36 62 (2)
163.5											
12.8	Heterogeneous mixture of Clayey Silt, sand and gravel (Glacial Till) Grey, Hard		12	SS	105	/15cm					
161.1			13	AS	–						
15.2	End of Borehole										

* Note: Borehole caved in at a depth of 6.7m.

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

$\frac{20}{15}\diamond\frac{5}{10}$ (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 5 (3) 1 OF 2 METRIC

W.P. 388-87-03 (88-78-24) LOCATION Co-ords: N 4 845 481 ; E 294 111.6 ORIGINATED BY DW
DIST 6 HWY 407 BOREHOLE TYPE SS Auger & Cone Test COMPILED BY DW
DATUM Geodetic DATE 82 07 01 CHECKED BY JP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L	UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
175.9	Ground Surface										
0.0	Heterogeneous mixture of Clayey Silt, sand and gravel (Glacial Till) Brown, V. Stiff to Hard		1	SS	28	*					
			2	SS	27						4 18 30 48
173.0			3	SS	107		174	100/ 25cm			
2.9	Clayey Silt Layers		4	SS	60	/13cm					22 38 33 7
			5	SS	85	/20cm	172				
			6	SS	111	/20cm					6 50 42 2
	Brown / Grey		7	SS	84	/38cm	170				
	Silty Sand with interbedded silt layers to Gravelly Sand with occ. boulders and cobbles Compact to V. Dense		8	SS	44		168				1 7 89 3
			9	SS	16						0 85 (15)
			10	SS	41		166				
163.1			11	SS	120	/15cm	164				
12.8	Heterogeneous mixture of Clayey Silt, sand and gravel (Glacial Till) Grey, Hard		12	SS	50/	/3cm	162				
160.6											
15.3	Continued										Continued

+3, x5 : Numbers refer to Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 5 (3) 2 OF 2 METRIC

W.P. 388-87-03 (88-78-24) LOCATION Co-ords: N 4 845 481 ; E 294 111.6 ORIGINATED BY DW

DIST 6 HWY 407 BOREHOLE TYPE SS Auger & Cone Test COMPILED BY DW

DATUM Geodetic DATE 82 07 01 CHECKED BY JP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa o UNCONFINED + FIELD VANE • QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
160.6	Continued										
15.3	End of Borehole • Water Table not established										

+³, ×⁵ : Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

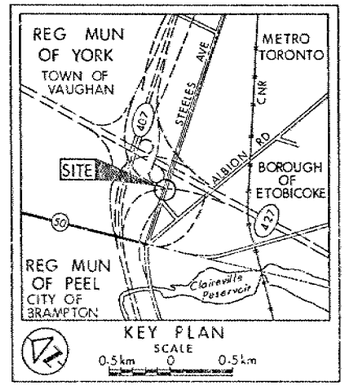
MINISTRY OF TRANSPORTATION, ONTARIO PH-0-207 88 10

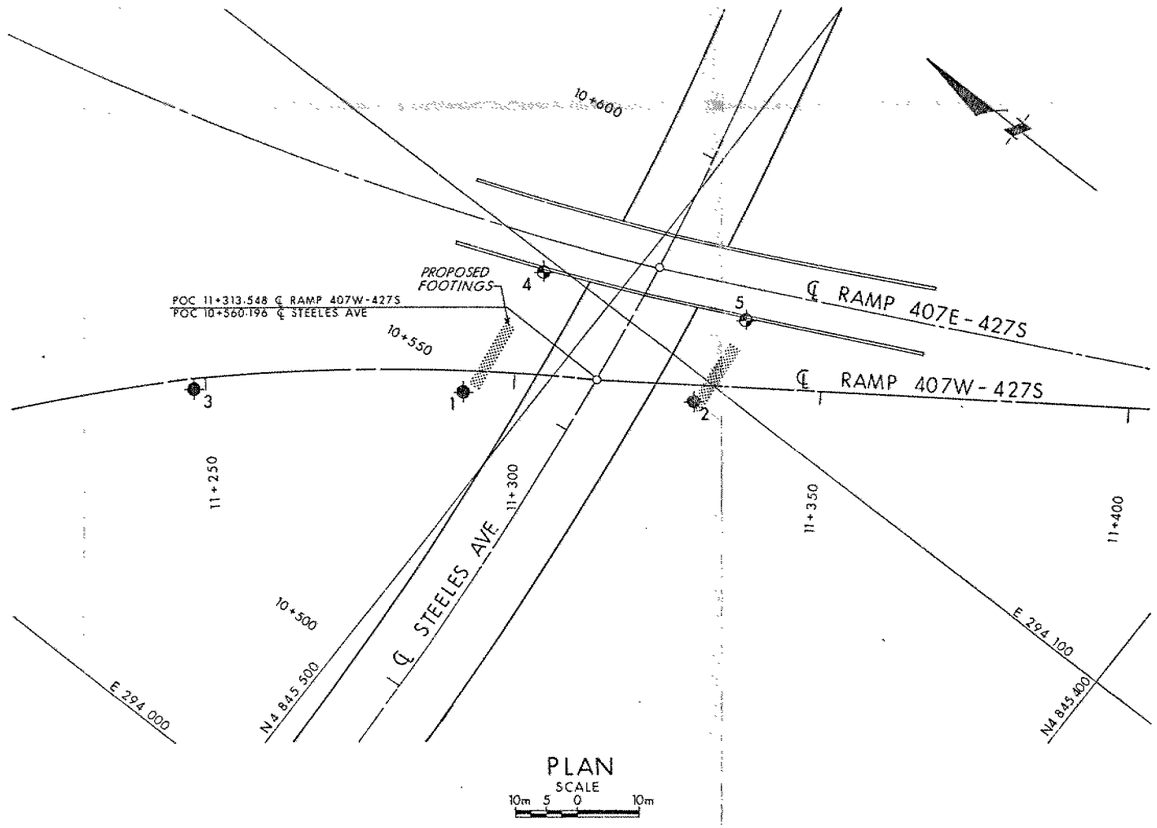
METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES.

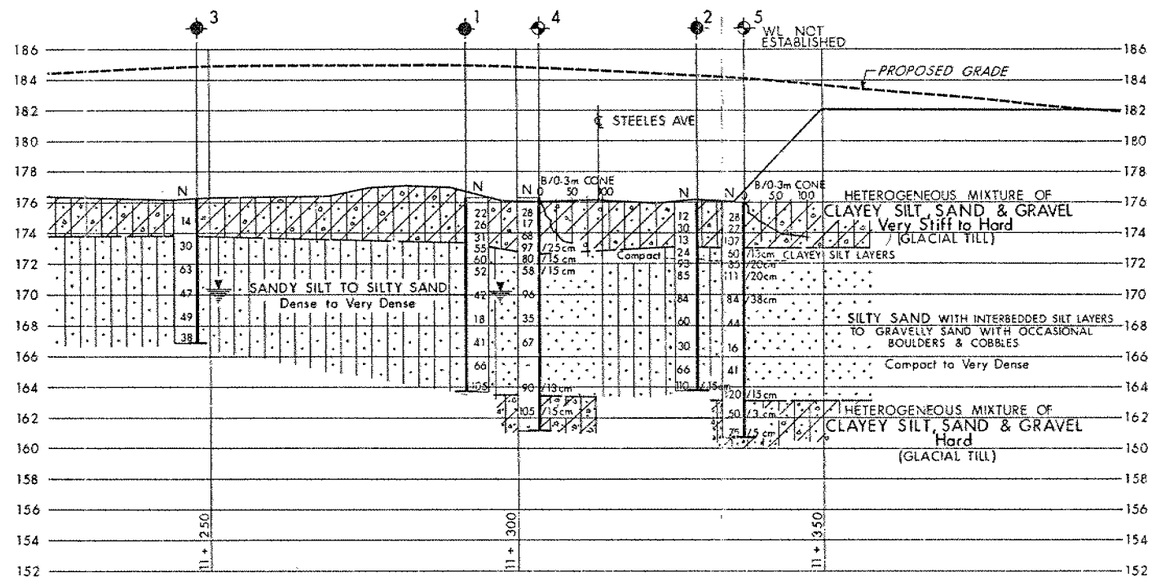
CONT No
WP No 368-87-03

RAMP 407W-427S OVER STEELES AVE
BORE HOLE LOCATIONS & SOIL STRATA

SHEET







LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation 82 06 and 90 06

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	176.3	4 845 510.0	294 074.0
2	176.0	4 845 479.5	294 096.0
3	176.4	4 845 544.5	294 047.5
4	176.3	4 845 511.7	294 097.8
5	175.9	4 845 481.0	294 111.6

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section 102-2 of Form 100.

REV.	DATE	BY	DESCRIPTION

Geocres No 30M13-115

REF No B-73-407-19,20

HWY No 407/427			DIST 6
SUBM'D TS	CHECKED	DATE 90 09 27	SITE 37-1337
DRAWN DT	CHECKED	APPROVED	DWG 2688703-A

memorandum

Ontario

To: V.F. Boehnke
Head, Structural Section
Central Region
4th Floor, Atrium Tower

Date: 1991 08 15

Attn: D. Wong
Sr. Structural Engineer

From: Foundation Design Section
Room 315, Central Bldg.

Re: Final Design Drawing Review
Hwy. 407/427 Interchange Advance Structures
Ramp 427S - 407W Overpass at Steeles Avenue, W.P. 368-87-02
Ramp 407W - 427S Overpass at Steeles Avenue, W.P. 368-87-03
G.W.P. 368-87-00, District 6

The final design drawings and special provisions pertaining to the aforementioned proposed structures have been reviewed for their foundation and geotechnical content. Pertinent comments are provided below.

RAMP 427S - 407W OVERPASS AT STEELES AVENUE, W.P. 368-87-02

The drawings and provisions are in accordance with our previously submitted recommendations and the design is in compliance with foundation and geotechnical standards. Therefore, we have no further comments as far as the design and construction of this structure is concerned.

RAMP 407W - 427S OVERPASS AT STEELES AVENUE, W.P. 368-87-03

Temporary Shoring

a) Reinforced Earth Retaining Wall Between New and Existing Structures

A temporary roadway protection scheme has been designed to facilitate the installation of the reinforced earth module between the existing 407E - 427S ramp structure and the proposed 407W - 427S ramp structure. The shoring scheme and layout in general is deemed acceptable from a geotechnical point of view. However, the following issues should be reviewed to verify and also possibly to enhance the design.

1) It is understood that the retained embankment is to be resisted by the L100x100x10 tie-back anchored into the existing structure concrete wall with a square plate and adhesive epoxy anchors. The additional loads introduced on the existing concrete wall should be taken into consideration to verify that the wall remains stable from an overturning and sliding point of view.

2) Soldier pile embedment lengths range up to 6 metres with the two northerly soldier piles embedded with a toe elevation of approximately 170.0 metres. In view of the fact that a toe elevation of 170.0 m will encroach into the submerged cohesionless sandy silt to silty sand stratum present at the site and hence create soldier pile installation difficulty as a result of unbalanced hydrostatic conditions, it is recommended that the soldier pile embeddments be decreased and terminated at or above elevation 172.0 m.

3) The timber lagging illustrated on the drawings reveals 100 x 100 members spanning the soldier piles. Although, these members may be structurally capable of supporting the applied loads, in practice, 100 x 200 lagging boards are generally employed.

b) North-East Reinforced Earth Retaining Wall

The levelling pad elevations proposed at the north-east reinforced retaining wall are stepped-up and range from El. 174.868 to El. 182.368. The existing contour elevations are not clearly defined on the plan on drawing 1, but it is interpreted that the contours range up to approximately 183 metres. Consequently, it appears that excavation of the existing approach embankment will be required to facilitate the installation of the reinforced earth module and the proprietary facing. In order to ensure the stability of the existing approach embankment, the construction method should be evaluated to determine if a temporary shoring scheme is required.

Reinforced Earth Walls

At the south abutment, section 3 on drawing 5 illustrates the reinforced earth levelling pad unsupported. It is believed that the levelling pad should be positioned on the pier abutment concrete foundation and consequently, the section should be revised to reflect this levelling pad-foundation contact.

Approach Embankments Slope Geometry

The slopes of the proposed approach embankments are not labelled on the drawings. As revealed in the original Foundation report, forward and traverse slopes can be constructed at 2H:1V or flatter for fill heights up to 8 metres. For fill height magnitudes exceeding 8 metres, embankment slopes shall be constructed with 2H:1V slopes and a midheight berm of 2 metres width or alternatively 2.5H:1V or flatter slopes.

Slope Benching

The plan or drawing 1 clearly depicts that new approach fills will be superimposed on existing approach fills. It is hereby reiterated that any new fill placement shall be connected to existing fills by 'benching' the earth slopes in accordance with M.T.O standards (see Pg. 11 of foundation report 'Embankment Construction') The applicable standard drawing (OPSD - 208.01) should therefore be included or referenced on the contact drawings

If you have any queries regarding the above comments or require additional information, please do not hesitate to contact this office.

T. Sangiuliano P. Eng.
Foundation Engineer

for

M. Devata, P. Eng.
Chief Foundation Engineer

MD/TS/me

CONSTRUCTION NORTH

EXIST. BRIDGE
W.P. 88-78-24
SITE 37-1117

℄ STEELES AVE.

3300 3600 3600 3600 1500 3600 3600 3600 3300 1500

R = 600m

℄ CONTROL RAMP 407E-427S

C.S. 11+246.401

25206 REINFORCED EARTH RETAINING WALL

S.C. 11+312.229

SKEW ANGLE 27°18'21.50"

4080 WINGWALL

4000±(FIELD VERIFY) REINFORCED EARTH RETAINING WALL

ROADWAY PROTECTION (SEE DWG. No. 3)

W.P.1 STA. 11+295.129 EL. 184.84

POC STA.11+313.548 PROFILE CONTROL RAMP 407W - 427S
POC STA.10+560.196 C.L. STEELES AVE.
N. 4845494.659 E. 294089.323

6000 APPROACH SLAB WITH 80mm ASPHALT (TYP.)

A = 160

TANGENT AT P.O.C. AZ. 024° 32' 53.2"

MIN. CLEARANCE LOCATION

R=1000m

CONTROL LINE RAMP 407W-427S

W.P.2 STA.11+331.629 EL. 184.23

TANGENT AT P.O.C. AZ. 81° 51' 14.7"

25161 REINFORCED EARTH RETAINING WALL

36500 ALONG PROFILE CONTROL OF RAMP

22181 REINFORCED EARTH RETAINING WALL

AZ. 81° 51' 14.7"

℄ N. ABUT. BRGS.

FUTURE LANE

FUTURE LANE

℄ S. ABUT. BRGS.

AZ. 81° 51' 14.7"

HIGH LEVEL HYDRO LINES

EXISTING CONTOURS

NEW CONTOURS

PLAN
1:200

NOTES :
1. APPROACH SLABS, ASPHALT AND WATERPROOFING ARE NOT IN THIS CONTRACT.
2. EXTERIOR FACES OF RETAINING WALLS, WINGWALL AND EDGES OF THE DECK ARE PARALLEL TO CONTROL LINE RAMP 407W-427S.

66865 EAST - (MEASURED ALONG OUTSIDE FACE OF BARRIER WALL)
86263 WEST - (MEASURED ALONG OUTSIDE FACE OF BARRIER WALL)

REINFORCED EARTH RETAINING WALL
CONCRETE BARRIER WALL
℄ STEELES AVE.
REINFORCED EARTH RETAINING WALL
INSERTS (OPSD 918.01) TYPICAL

185
180
175
170

EXIST. GRADE PROFILE AT WEST FACE
EXP.
MIN. FALSEWORK CLEARANCES DURING CONSTRUCTION
FIX
T/FTG. EL. 174.77
4500 MIN. TO FALSEWORK
MIN. VERTICAL CLEARANCE : 5000 (REQ'D.) 6690 (PROVIDED)
T/FTG. EL.174.30
EXIST. GRADE PROFILE AT WEST FACE
1600
EXISTING TRAFFIC LANES
1600
150mm PERFORATED SUBDRAIN (TYP.)

1
1:200

CONTROL LINE RAMP 407W-427S

9460*
480* 1250* 4750* 2500* 480*

EAST WEST

ASPHALT AND WATERPROOFING SYSTEM (90mm TOTAL)
225 mm CONC. DECK
PROFILE CONTROL T/PAVEMENT
VARIES (SEE TABLE)
1-75mm RIGID PVC DUCT(TYP.)
1-50mm RIGID PVC DUCT(TYP.)
WELDED STEEL BOX GIRDERS
1400 (TYP.)
325 (TYP.)
2400 2400 2400
VARIES FROM 1291 AT MID-SPAN TO 1178 AT ABUTMENT (EAST)
VARIES FROM 962 AT MID-SPAN TO 1178 AT ABUTMENT (WEST)

2
1:50

* DENOTES DIMENSION NORMAL TO CONTROL LINE

WEST
STA. 10+500 EL. 176.315
184.84 176.32 8.52
PROFILE CONTROL TOP OF PAVEMENT
-0.45%
P.O.C. STA. 10+560.196 ℄ STEELES AVE.
P.O.C. STA. 11+313.548 CONTROL LINE RAMP 407W-427S
184.23 176.35 7.88
STA. 10+625 EL. 175.750
EAST

NORTH ABUTMENT

PROFILE STEELES AVE.
NTS

V.P.I. STA. 11+267.110
EL. 186.770
H.O.T. 10+560.196 ℄ STEELES AVE.
P.O.C. STA. 11+313.548 CONTROL LINE RAMP 407W-427S
B.V.C. STA. 11+171.610
EL. 182.950
E.V.C. STA. 11+362.610
EL. 183.294
+4.0%
K=-25
L=191.00
-3.64%
PROFILE CONTROL TOP OF PAVEMENT
LIMITS OF STRUCTURE
NORTH
SOUTH

PROFILE RAMP 407W - 427S
NTS

℄ STEELES AVE.

6900 3600 3600 3000 3600 3600 6900
3300 3600 FUTURE LANE
3600 3300 FUTURE LANE
PROFILE CONTROL TOP OF PAVEMENT
2% 2% 2% 2%

SOUTH ABUTMENT

SECTION SHOWING STEELES AVE. UNDER RAMP 407W - 427S
NTS

B.M. ELEVATION 173.207
TABLET IN CENTRE AT NORTH END OF WEST CONCRETE PIER OF BRIDGE OVER CNR TRACKS ON ALBION ROAD 1.18m ABOVE GROUND LEVEL APPROX. 200m EAST OF STRUCTURE SITE.

METRIC
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CROSSFALL TABLE ALONG ℄ CONTROL RAMP 407W-427S

LOCATION	STATION	SUPERELEVATION
C.S.	11+246.401	6.50%
N. ABUT.	11+295.129	3.17%
	11+300.000	2.84%
	11+305.000	2.49%
	11+310.000	2.15%
S.C.	11+312.229	2.00%
	↓	↓
S. ABUT.	11+331.629	2.00%

LOCATION OF WORKING POINTS

W.P.#	STATION	CO-ORDINATES	
		NORTHING	EASTING
1	11+295.129	484 5509.559	29 4078.495
2	11+331.629	484 5479.823	29 4099.657

DIST No 6
CONT No
WP No 368-87-03

RAMP 407W/427S OVERPASS AT STEELES AVE.
GENERAL ARRANGEMENT

SHEET

DS-Lea Associates Ltd.

GENERAL NOTES

CLASS OF CONCRETE
- All concrete 30 MPa

CLEAR COVER TO REINFORCING STEEL
- Footings 100 ± 25
- Abutments, Wingwalls & Retaining Walls
  Front Face 80 ± 20
  Back Face 70 ± 20
- Deck
  Top 70 ± 20
  Bottom 40 ± 10
- Remainder unless noted otherwise 70 ± 20

REINFORCING STEEL
- Reinforcing steel shall be Grade 400 unless specified otherwise. Bar marks with Suffix "C" denote coated bars.

CONSTRUCTION NOTES
- Concrete barrier walls on retaining walls shall not be cast until the retaining wall backfill has been completed.
- The contractor shall finish the bearing seats level to the specified elevations.
- Concrete in barrier walls shall not be placed until deck concrete has reached 25 MPa strength.

LIST OF DRAWINGS :

APPLICABLE STANDARD DRAWINGS:
M.T.O. DD-4603 FALSEWORK CLEARANCES
O.P.S.D. 918.01 CONNECTION TO NEW STRUCTURES

REGISTERED PROFESSIONAL ENGINEER P. C. OJALA PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER CIVIL S. M. MILES PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	PO	CHK	SAM	CODE	OHBDC-83	LOAD	CLASS 'A'
DRAWN	SML	CHK	BD	SITE	37-1337	STRUCT	SCHEME

DATE JAN. 1991
DWG 1

CAD FILE - 13395001.DWG

METRIC

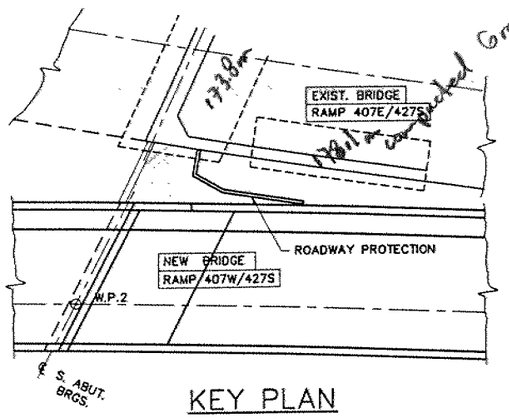
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

DIST No
CONT No
WP No 368-87-03

RAMP 407W/427S OVERPASS AT STEELES AVENUE
ROADWAY PROTECTION

SHEET

DS-Lea Associates Ltd.



KEY PLAN
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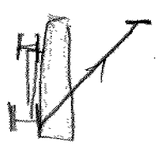

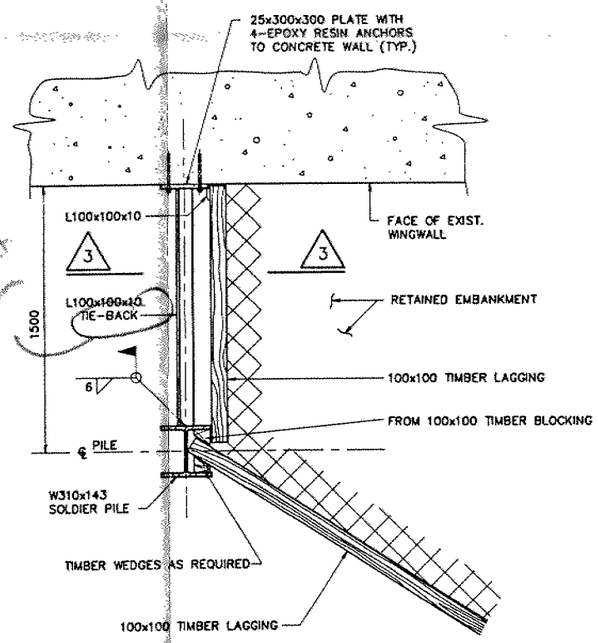

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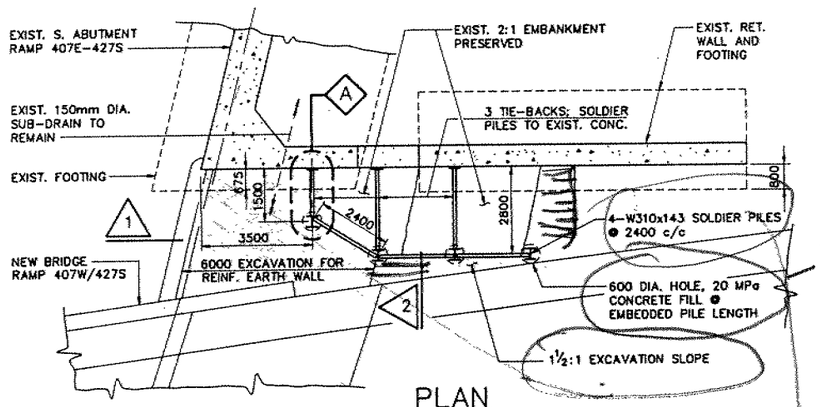

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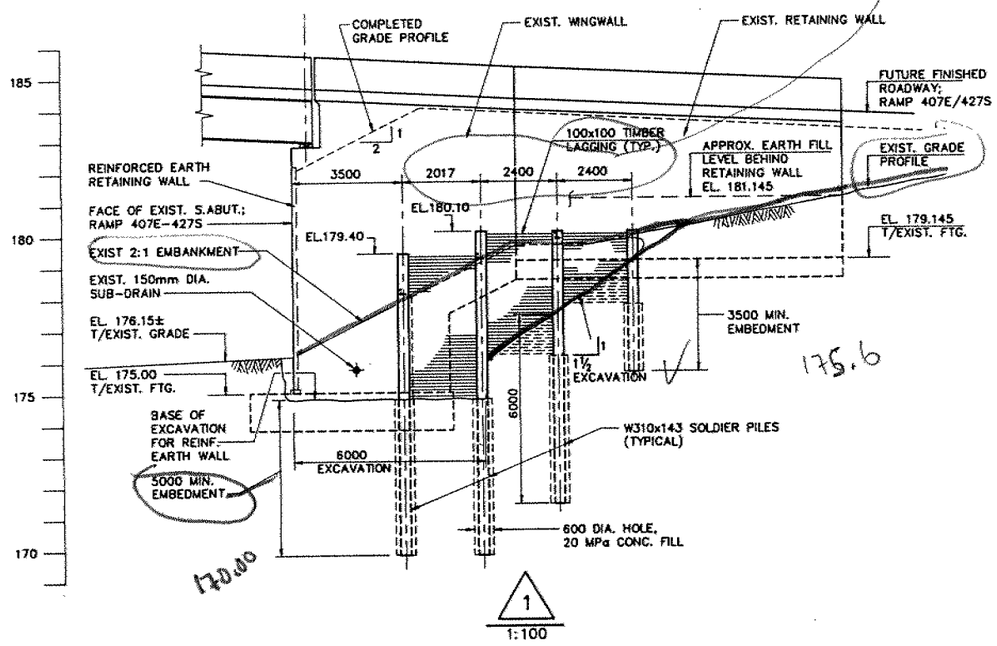

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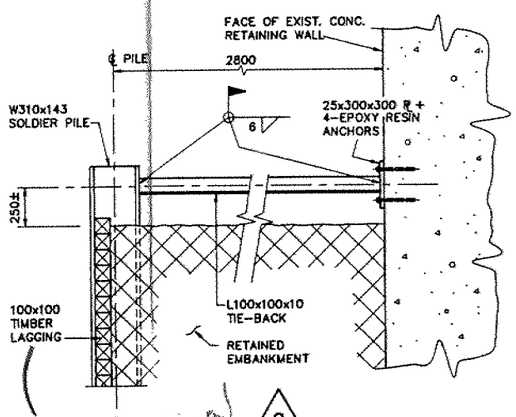

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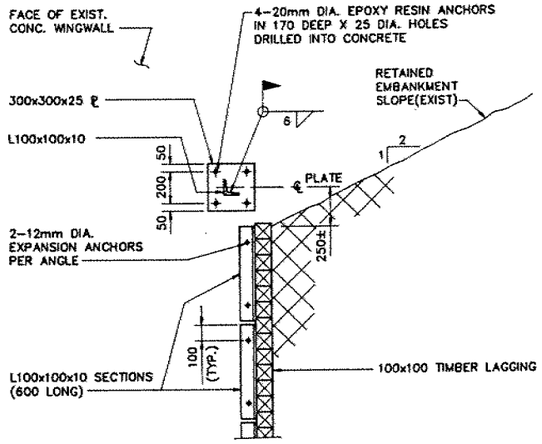

3
1:20

GENERAL NOTES

- All steel shall be in accordance with C.S.A. CAN3-G40.21-M81, GR 300W.
- Erectors and fabricators for shoring steelwork shall be qualified in accordance with CSA W47.1-83, Division 2 minimum. Welding design and practice shall conform to CSA Standard W59-M84.
- Lagging shall be of timber of species SPF, Grade 1, Strength Group "D", thickness as indicated on drawings.
- Piles shall be placed into predrilled holes and holes shall be filled with 20 MPa concrete below base of excavation and with sand up to grade level.
- Lagging to be installed in lifts not exceeding 1.0 m as excavation or backfill proceeds.
- Contractor to verify all dimensions prior to start of any work. Fabrication to suit field measurements for soldier pile location.
- Contractor to submit shop drawings for shoring scheme.

REGISTERED PROFESSIONAL ENGINEER P. C. OJALA PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER CIVIL B. A. MILES PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION

DESIGN	P.O.	CHK	S.A.M.	CODE	OHBDC-83	LOAD	CLASS 'A'
DRAWN	J.Y.J.	CHK	B.O.	SITE	37-1337	STRUCT	
DATE	MAY 1991						
SCHEME				DWG	3		

CAD FILE - 1339S002.DWG

memorandum

Ontario

To: V. Boehnke
Head, Structural Section
Central Region

Date: 1990 12 17

Atten: D. Wong
Structural Engineer

From: Foundation Design Section
Room 315, Central Building

Re: Highway 427/407 Interchange Advanced Structure
Ramp 407W-427S Overpass at Steeles Avenue
Site #37-1337, W.P. 368-87-03
District 6, Toronto

The General Arrangement Drawing for the afore-mentioned project has been reviewed by this office from a foundation and related earthworks point of view. The retaining walls supported on compacted granular 'A' pad are situated above the abutment spread footings and consequently the influence of the additional loading on the lower abutment foundation should be considered in the design.

All other geotechnical aspects of the drawing are in accordance with previously submitted recommendations.

Dr. B. Iyer, P. Eng.
Sr. Foundation Engineer

BI/TS/mmj