MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. G. C. E. Burkhardt, (2)
Regional Structural Planning Eng.,
Central Region,
90 Floral Pkwy.,
ATTENTION: Downsview.

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

DATE: November 20, 1972.

OUR FILE REF.

IN REPLY TO DEC - 8 1972

SUBJECT:

*FOUNDATION INVESTIGATION REPORT*
*For*
*Proposed Overpass Structure at the Crossing of*
*Hwy. #409 (Belfield Expressway) and Shaft Rd.*
*Borough of Etobicoke, County of York*
*District 6 (Toronto)*
*W.O. 72-11116 -- W.P. 218-65-16*

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

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

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attach.
cc: E. J. Orr
B. R. Davis
A. Rutka
R. S. Pillar
H. Greenland
B. J. Giroux
C. Mirza
G. A. Wrong
B. A. Singh

Foundations Files ✓
Documents

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1. *INTRODUCTION:*

The Foundations Office was requested to carry out a subsurface investigation for the proposed overpass structure at the crossing of Hwy. #409 (Belfield Expressway) and Shaft Road, in the Borough of Etobicoke, York County. The request was contained in a memo from Mr. G. C. E. Burkhardt, Regional Structural Planning Engineer, Central Region, dated October 16, 1972. Subsequently, an investigation was carried out by this Office to determine the subsoil and groundwater conditions at the site.

The factual data obtained from this investigation is presented in this report, together with our recommendations for the design of the structure foundations as well as the stability and settlement considerations associated with the approach fills.

2. *SITE AND GEOLOGY:*

The site under investigation is located on Shaft Road, specifically at a point about 700 feet west of Kipling Avenue and 500 feet south of existing Belfield Road, in the Borough of Etobicoke, Metropolitan Toronto. The terrain is gently undulating in relief between about elevations 510 and 515.

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The area has been commercially developed; numerous one and two storey office buildings are located on either side of Shaft Road. Shaft Road is a two-lane paved roadway whose grade is at existing ground surface.

The area is within the physiographic region known as the "Peel Plain." The characteristic deposit in this region is a ground moraine laid down during the Wisconsin Glacial Age. In the vicinity of the area under investigation, the moraine is primarily composed of a basically cohesive, stoney glacial till extending to a depth of greater than 50 feet below the existing ground surface. The glacial till is underlain by grey shale bedrock of the Meaford-Dundas formation, Ordovician Period.

## 3. *FIELD AND LABORATORY WORK:*

Two boreholes, each accompanied by a dynamic cone penetration test, were put down at the site during the course of the recent field investigation. The boreholes and the cone penetration tests were advanced by means of a diamond drill rig adapted for soil sampling purposes. In addition, two boreholes put down during previous investigations in this area (refer to B.H.'s #2 and 5, Report No. W.O. 71-11112, dated January 31, 1972) were incorporated into this report because of their close proximity to this site.

Samples of the overburden were obtained at specified depths using a 2 inch O.D. split-spoon sampler. The energy used to drive the sampler into the soil conformed to the specifications for the Standard Penetration Test. The same method was used to advance the cone penetration tests.

During sampling operations detailed logs of the borings were made. These logs, which are located in Appendix I of this report, contain a record of the drilling and sampling techniques used, together with the soil types encountered.

The location and elevation of all the boreholes are shown on Drawing No. W.O. 72-1116A, together with estimated

stratigraphical sections across the site.

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this examination, laboratory tests were carried out on selected samples to determine the following engineering properties of the soil.

Natural Moisture Content
Atterberg Limits
Grain-Size Distribution

The results of field and laboratory tests are plotted on the Record of Borelog sheets as well as on Figures 1 and 2, all contained in Appendix I of this report.

## 4. *SUBSOIL CONDITIONS:*

### 4.1) *General:*

The predominant stratum across the site is composed of a competent glacial till. This deposit was proven to extend to depths in excess of 50 feet below existing ground surface. The upper portion of the till is cohesive in nature; at depth, however, the matrix of the till is granular. At those boring locations put down along the shoulder of Shaft Road up to 4 feet of fill was encountered.

The gradational variations within the glacial till, as determined at the borehole locations, are shown on the accompanying borelog sheets. The stratigraphical sections shown on Drawing No. W.O. No. 72-11116A have been inferred from this information.

A brief description of the fill and overburden encountered is presented in the subsections to follow.

### 4.2) *Fill (Clayey Silt):*

At B.H.'s #1 and 2 put down on the shoulder of Shaft Road, 4 and 2 feet of fill respectively were encountered. The fill is composed of a clayey silt with some sand. It is estimated that the fill has been subjected to a moderate compactive energy.

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*4.3) Glacial Till:*

The glacial till stratum is present immediately beneath a thin topsoil cover (1 foot or less), or the roadway fill where it exists. The glacial till was not fully penetrated at any of the boring locations; it was, however, proven to extend to a maximum depth of 51 feet below existing ground surface (refer to B.H. #2). The major portion of the glacial till is cohesive in nature being composed of a matrix of clayey silt binding sand and gravel. At B.H.'s #2 and 3 a lower zone within the glacial till is granular, being composed of a heterogeneous mixture of silt, sand and gravel with a trace of clay. At B.H.'s #2 and 4 a 4 to 4.5 feet thick granular layer, composed of a sandy silt with a trace of clay and gravel is present. Grain-size distribution tests for samples from the till and granular layer, obtained with 2 inch I.D. sampling equipment, are plotted on Figure #1.

Atterberg limit tests were carried out on samples from the till stratum the results are plotted on the borelog sheets and summarized on the Plasticity Chart, Figure #2. The testing indicates that the cohesive portion of the glacial till are inorganic with a plasticity in the low range. The nature moisture contents are typically 2 to 4 percent below the plastic limit. The granular zones were, however, found to be basically, non-plastic (plasticity indices between 1 and 3).

Standard penetration tests were performed within the stratum. The values are plotted on the borelog sheets. In the upper cohesive portion of the glacial till the "N" value range is from 11 blows/ft. to over 100 blows per foot indicating that the consistency of this zone varies from stiff to hard. The "N" value range in the granular zone of the glacial till is 33 blows/ft. to over 100 blows per foot indicating that the relative density ranges from dense to very dense.

*5. GROUNDWATER CONDITIONS:*

Groundwater level observations have been carried out during the period of this investigation by recording the levels in the boreholes. The results are shown on the Record of Borelog

sheets and summarized on Drawings No. 72-11116A. These observations indicate that the groundwater level, during boring operations, varied between elevations 507 and 510, corresponding to depths of from 2 to 5 feet below existing ground surface.

## 6. *DISCUSSIONS AND RECOMMENDATIONS:*

### 6.1) *General:*

It is proposed to construct an east-west expressway in the vicinity of Belfield Road which will connect Hwy. 401 in the Islington-Kipling area with the Toronto International Airport; this project will be in the Borough of Etobicoke, Metropolitan Toronto. The new Belfield Expressway, which will be known as Hwy. #409, will be 3.3 miles long.

This project will necessitate the construction of a number of structures and retaining walls. Foundation reports have been submitted for the majority of the structures and retaining walls. This report will be concerned with one of the proposed structures, namely, the overpass structure at the crossing of Hwy. #409 (the Belfield Expressway) and Shaft Road.

The Shaft Rd. - Hwy. #409 structure is to be a single span (44 feet), 118 feet wide structure incorporating closed-type abutments. The profile grade of Shaft Rd., in the vicinity of the crossing, will be at about elevation 511, which is approximately 1 to 2 feet below existing ground surface. The profile grade of Hwy. #409 will range between elevations 531 and 533. The corresponding maximum height of the approaches, in the longitudinal and transverse directions, will be 22 feet and 20 feet, respectively.

Due to space restrictions the approach fills, in the vicinity of the structure, will be retained by retaining walls, specifically Wall #R.W. 1A and 1B (north side) and R.W. 11A and 11B (south side). An exception to this pattern occurs:

i) west of Station 569+45 along the north side of the west approach (R.W. #1B ends at this station), and

ii) east of Station 566+10 along the south side of the east approach (R.W. #11A ends at this station).

Beyond these limits the fill will not be retained by retaining walls instead the fill will spill through with a slope of 3:1. Recommendations pertaining to the foundation design of these retaining walls were presented in Report No. W.O. 71-11122A, dated January 31, 1972. This report should be read in conjunction with the previous report.

The predominant stratum across the site is composed of a competent glacial till which extends to depths greater than 50 feet below existing ground surface. The upper portion of the till is cohesive in nature; at depth, however, the matrix of the till is granular.

*6.2) Foundations:*

*6.2.1) Closed-Type Abutments:*

The closed-type abutments can be founded on spread footings located in the upper portion of the competent cohesive glacial till stratum. A minimum of 4 feet of earth cover should be provided above the base of the footings for frost protection purposes; this will place them at or below elevation 507. Footings meeting the aforementioned requirements can be designed using an allowable bearing value of 3.5 t.s.f.

The abutment footing excavations will extend anywhere from 1 to 3 feet below the groundwater level prevailing during the period of the investigation (October, 1972). Since the excavations will be carried out in a relatively impervious subsoil no major dewatering problems are anticipated. Any minor seepage could be handled using conventional techniques such as pumping from sumps.

Settlement will be induced in the cohesive glacial till by the imposed footing pressure. The cohesive till is highly preconsolidated, therefore, the settlement will be of a recompression nature; i.e., take place during or immediately following the construction period. Computations carried out indicate that this settlement should not exceed 1/2 inch, provided the foundation subsoil is not softened by uncontrolled surface runoff or construction operations. In this regard it would be advantageous

to place a lean concrete working slab at the footing formation level as soon as it is reached.

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

The granular backfill behind the walls should be allowed to drain in order to prevent the build up of excess hydrostatic groundwater pressures in this area. This can be accomplished by providing weep holes at the base of the walls. The location and spacing of these weep holes should be determined in accordance with current M.T.C. practices.

It is recommended that a value of 3,000 p.s.f. be used in the computations to determine the sliding resistance between the rough concrete base of the footing and the underlying cohesive stratum.

The closed-type vertical wall section will be inherently stable with respect to a deep-seated rotational type of failure in the cohesive subsoil located beneath the spread footings.

*6.2.2) Retaining Walls (R.W. 1A, 1B, 11A and 11B):*

Recommendations pertaining to the foundation design of these walls was discussed in detail in Subsection 6.2.1) of Report No. W.O. 71-11122.

*6.3) Approach Fills - Stability and Settlement Considerations:*

The approach fills, in the vicinity of the structure will be retained by retaining walls. Outside the retaining wall sections the fills will be placed on a slope of 3:1. The maximum height of fill will be of the order of 20 feet. Both the retaining wall sections and the spill through sections will be inherently stable with respect to a deep-seated failure within the cohesive foundation subsoil. The spill through sections should be protected against surficial erosion due to uncontrolled surface runoff.

This can be accomplished by sodding or alternatively seeding and mulching them.

The glacial till will settle due to the induced fill loading. This settlement, which will be of a recompression nature, will be of the order of 1/2 to 3/4 of an inch.

7. *MISCELLANEOUS:*

The recent field work was performed on October 25 and 26, 1972, under the supervision of Mr. V. Korlu, Project Foundations Engineer, who also prepared this report.

The equipment used was owned and operated by Dominion Soil Investigation Ltd., Toronto.

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

V. Korlu, P. Eng.

REGISTERED PROFESSIONAL ENGINEER
CIVIL
V. KORLU
PROVINCE OF ONTARIO

M. Devata, P. Eng.

VK/ao
Nov. 17, 1972.

# APPENDIX I

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

# RECORD OF BOREHOLE Nº 1

JOB 72-11116 — LOCATION Co-ords. 879,615 N; 982,643 — ORIGINATED BY V.K.

W.P. 218-65-16 — BORING DATE Oct. 15, 1972 — COMPILED BY V.K.

DATUM Geodetic — BOREHOLE TYPE Wash & bore with BX Casing — CHECKED BY

| ELEV. / DEPTH | DESCRIPTION | STRAT. PLOT | SAMPLES NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE |
|---|---|---|---|---|---|---|
| 513.2 | Ground Level | | | | | |
| 0.0 | Clayey silt, some sand (Fill) | | | | | |
| 509.2 | Brown Very Stiff | | 1 | SS | 17 | 510 |
| 4.0 | Het.mix.of clayey silt, sand & gravel (Glacial Till) Brown changing to Grey below El. 503. | | 2 | SS | 53 | |
| | | | 3 | SS | 38 | |
| | | | 4 | SS | 37 | 500 |
| | | | 5 | SS | 83 | |
| | | | 6 | SS | 41 | |
| | | | 7 | SS | 100/6" | 490 |
| | | | 8 | SS | 95 | |
| | | | 9 | SS | 114 | 480 |
| | Hard | | | | | |
| 471.7 | | | 10 | SS | 129 | |
| 41.5 | End of Borehole | | | | | 470 |

DYNAMIC PENETRATION RESISTANCE — BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F. — ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT $w_L$ — PLASTIC LIMIT $w_P$ — WATER CONTENT $w$ — $w_P$ $w$ $w_L$

WATER CONTENT % — 10 20 30

BULK DENSITY $\gamma$ P.C.F.

REMARKS — GR SA SI C

▼ 507.5

31 49 2

0 36 49 1

0 36 45 1

20 / 15 ◇ 5 / 10 % STRAIN AT FAILURE

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

# RECORD OF BOREHOLE No 2

JOB 72-11116 — LOCATION Co-ords. 879,497 N; 982,675 E. — ORIGINATED BY VK

W.P. 218-65-16 — BORING DATE Oct. 26, 1972 — COMPILED BY VK

DATUM Geodetic — BOREHOLE TYPE Wash & bore with BX Casing — CHECKED BY

| ELEV. / DEPTH | DESCRIPTION | STRAT. PLOT | SAMPLES NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE |
|---|---|---|---|---|---|---|
| 512.0 | Ground Level | | | | | |
| 0.0 / 510.0 | Clayey silt with sand Fill) Very Stiff | | | | | 510 |
| 2.0 | Het.mix.of clayey silt sand & gravel (Glacial Till) | | 1 | SS | 34 | |
| | | | 2 | SS | 63 | |
| | | | 3 | SS | 149 | |
| | Very Stiff to Hard | | 4 | SS | 65 | 500 |
| | Brown changing to Grey below El.502. | | 5 | SS | 36 | |
| | | | 6 | SS | 25 | |
| | Sandy silt, trace of clay. Very Dense | | 7 | SS | 100/6" | 490 |
| | | | 8 | SS | 80 | |
| | Het.mix.of silt,sand and gravel, trace of clay | | 9 | SS | 100/6" | 480 |
| | | | 10 | SS | 94 | |
| | (Glacial Till) Grey | | 11 | SS | 149 | 470 |
| 461.0 | Very Dense | | 12 | SS | 59 | |
| 51.0 | End of Borehole | | | | | 460 |

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT $w_L$
PLASTIC LIMIT $w_p$
WATER CONTENT $w$
$w_p$ $w$ $w_L$
WATER CONTENT % 10 20 30

BULK DENSITY $\gamma$ P.C.F.

REMARKS

▼ 507.0
GR SA SI CL
0 29 50 21
0 25 67 8
0 8 90 2

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS–ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

# RECORD OF BOREHOLE Nº 3 (#5, 71-11122)

JOB 72-11116 — LOCATION Co-ords. 879,639 N; 982,685 E. — ORIGINATED BY HS

W.P. 218-65-16 — BORING DATE Nov. 23, 1971 — COMPILED BY HS

DATUM Geodetic — BOREHOLE TYPE Pendrill — CHECKED BY

| ELEV. / DEPTH | DESCRIPTION | STRAT. PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES BLOWS/FOOT | ELEV. SCALE |
|---|---|---|---|---|---|---|
| 513.6 | Ground Level | | | | | |
| | Het.mix. of clayey silt, sand & gravel | | 1 | SS | 11 | 510 |
| | | | 2 | SS | 59 | |
| | Stiff to Hard | | 3 | SS | 27 | |
| | Brown changing to Grey below El.504.5 | | 4 | SS | 70 | 500 |
| | | | 5 | SS | 56 | |
| 492.6 | Glacial Till | | | | | |
| 21.0 | Het.mix.of silt,sand & gravel, with trace of clay. (Glacial Till) | | 6 | SS | 132 | 490 |
| | | | 7 | SS | 33 | |
| 483.1 | Dense to Very Dense | | 8 | SS | 123/6" | |
| 30.5 | End of Borehole | | | | | 480 |

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F.
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT —— $W_L$
PLASTIC LIMIT —— $W_P$
WATER CONTENT —— W
$W_P$ W $W_L$
WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

REMARKS GR.SA.SI.C

▼508.9
in open B

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

# RECORD OF BOREHOLE No 4 (#2, 71-11122)

JOB 72-11116 — LOCATION Co-ords. 879,540 N; 982,718 E. — ORIGINATED BY HS

W.P. 218-65-16 — BORING DATE November 23, 1971 — COMPILED BY HS

DATUM Geodetic — BOREHOLE TYPE Pendrill — CHECKED BY

| ELEV / DEPTH | DESCRIPTION | STRAT. PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES BLOWS/FOOT | ELEV. SCALE |
|---|---|---|---|---|---|---|
| 512.2 | Ground Level | | | | | 510 |
| | Topsoil | | | | | |
| | Het.mix.of clayey silt, sand & gravel | | 1 | SS | 39 | |
| | | | 2 | SS | 76 | |
| | Hard Brown changing to Grey below El. 503. | | 3 | SS | 54 | |
| | | | 4 | SS | 97 | 500 |
| | Glacial Till | | 5 | SS | 64 | |
| | Sandy silt with traces of gravel & clay. Very Dense | | 6 | SS | 117/6" | 490 |
| | | | 7 | SS | 61 | |
| 480.7 | | | 8 | SS | 124 | |
| 31.5 | End of Borehole | | | | | 480 |

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

LIQUID LIMIT $w_L$
PLASTIC LIMIT $w_P$
WATER CONTENT $w$
$w_P$ — $w$ — $w_L$
WATER CONTENT %
10 20 30

BULK DENSITY $\gamma$ P.C.F.

REMARKS

GR.SA.SI.C

510.0 ▼

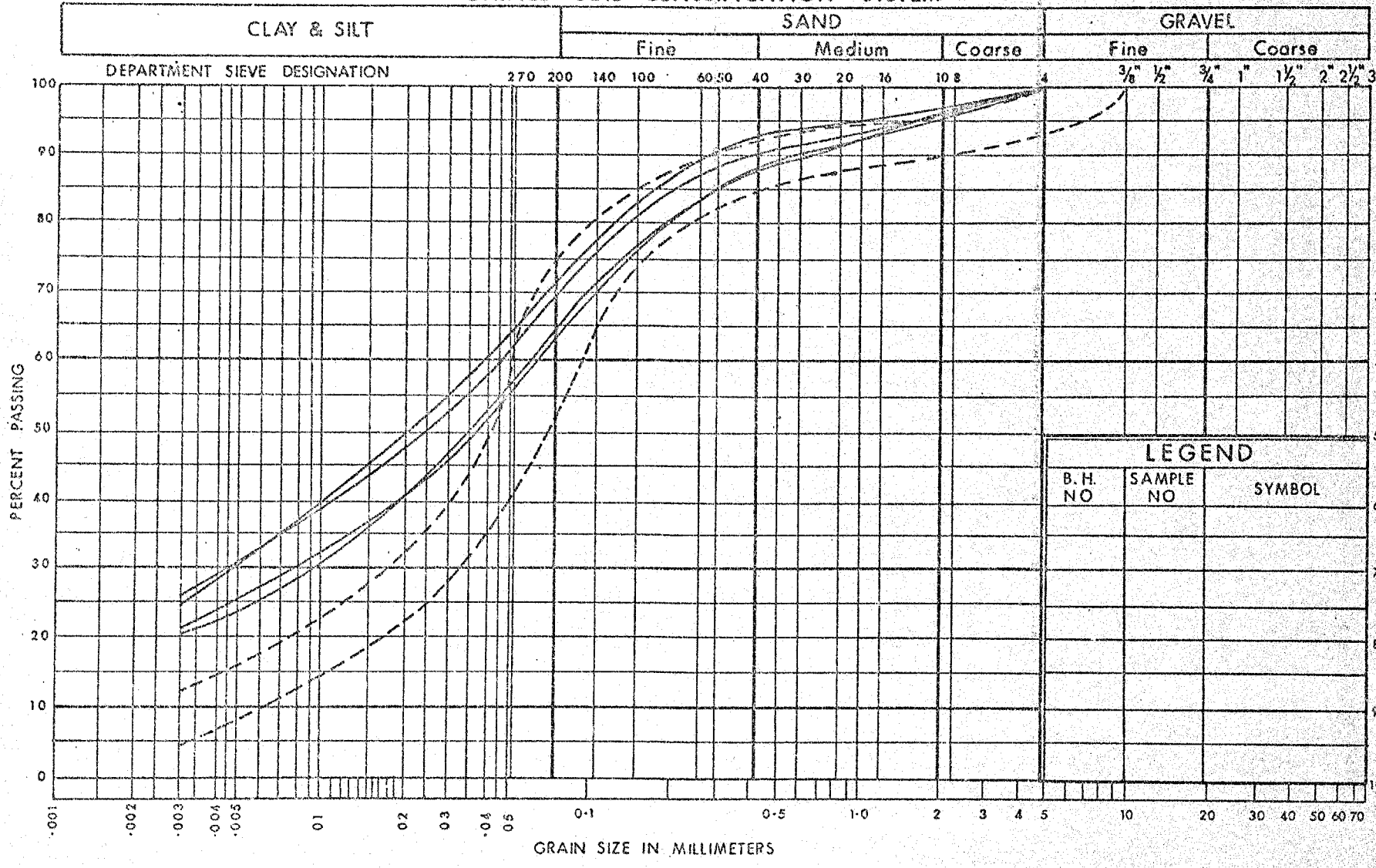
7.30 60

OFFICE REPORT ON SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

FORM OD-MT-17
REV. AUG. 1971

# UNIFIED SOIL CLASSIFICATION SYSTEM




DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

DESIGN SERVICES BRANCH

ONTARIO

## GRAIN SIZE DISTRIBUTION

———HET. MIX. CLAYEY SILT SAND & GRAVEL (GLAC. TILL)

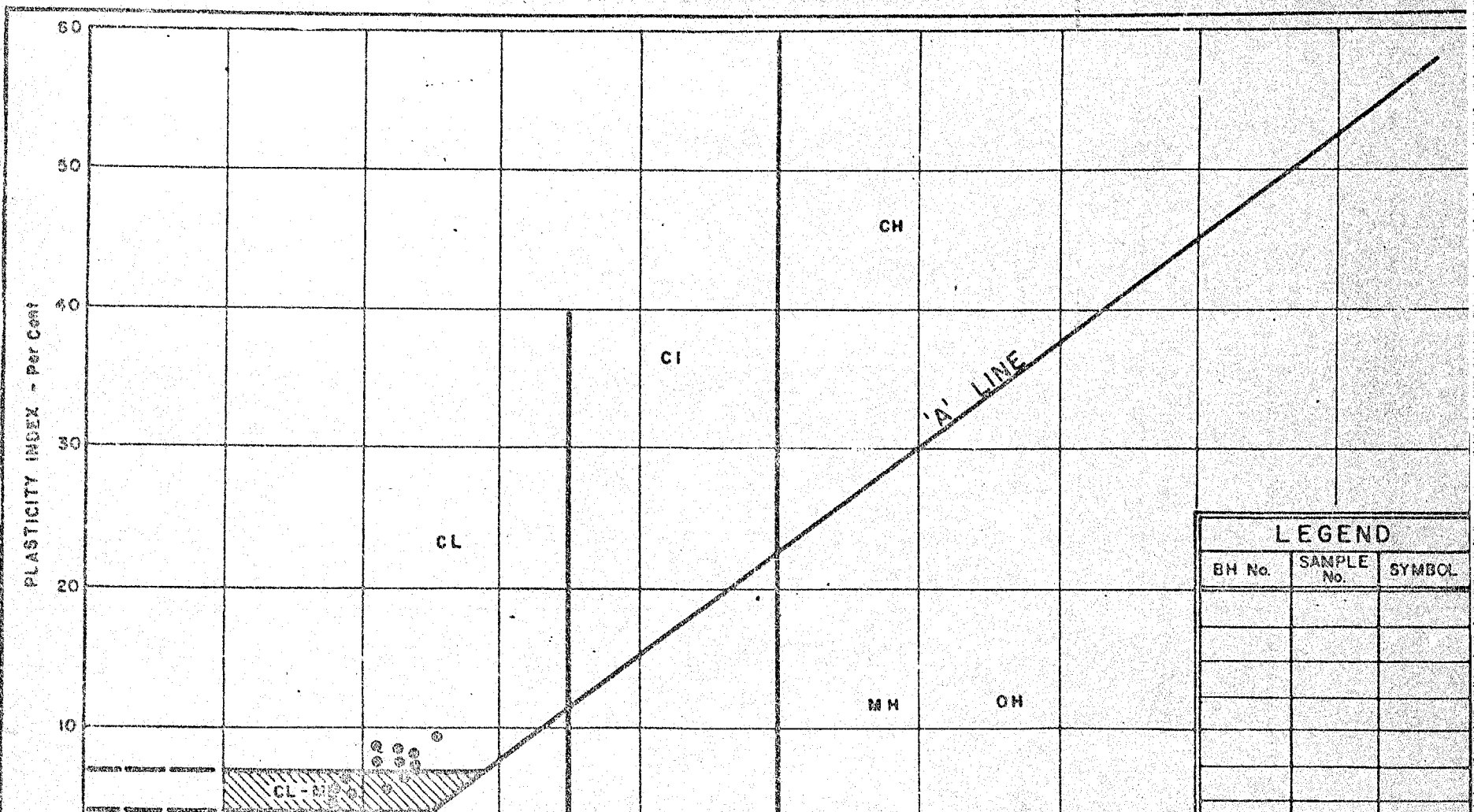
— — —SILTY SAND, LAYER IN COHESIVE GLACIAL TILL

W.P No. 218-65-16

JOB No. 72-11116

FIG. 1

REVISED JUL[illegible]966




DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

# PLASTICITY CHART

● HET. MIX. CLAYEY SILT, SAND & GRAVEL (GLACIAL TILL) COHESIVE

▲ HET. MIX. SILT, SAND & GRAVEL (GLACIAL TILL) NON COHESIVE

W.P. No. 218-65-16

JOB No. 72-11116

FIG. 2

# ABBREVIATIONS USED IN THIS REPORT

## PENETRATION RESISTANCE

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

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

## DESCRIPTION OF SOIL

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

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

## TYPE OF SAMPLE

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

## SOIL TESTS

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

# ABBREVIATIONS USED IN THIS REPORT

## SOIL PROPERTIES

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

## GENERAL

| | |
|---|---|
| $\pi$ | = 3·1416 |
| e | BASE OF NATURAL LOGARITHMS 2·7183 |
| $\log_e a$ OR $\ln a$ | NATURAL LOGARITHM OF $a$ |
| $\log_{10} a$ OR $\log a$ | LOGARITHM OF $a$ TO BASE 10 |
| t | TIME |
| g | ACCELERATION DUE TO GRAVITY |
| V | VOLUME |
| W | WEIGHT |
| M | MOMENT |
| F | FACTOR OF SAFETY |

## STRESS AND STRAIN

| | |
|---|---|
| u | PORE PRESSURE |
| $\sigma$ | NORMAL STRESS |
| $\sigma'$ | NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED) |
| $\tau$ | SHEAR STRESS |
| $\varepsilon$ | LINEAR STRAIN |
| $\gamma$ | SHEAR STRAIN |
| $\nu$ | POISSON'S RATIO ($\mu$ IS ALSO USED) |
| E | MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS) |
| G | MODULUS OF SHEAR DEFORMATION |
| K | MODULUS OF COMPRESSIBILITY |
| $\eta$ | COEFFICIENT OF VISCOSITY |

## EARTH PRESSURE

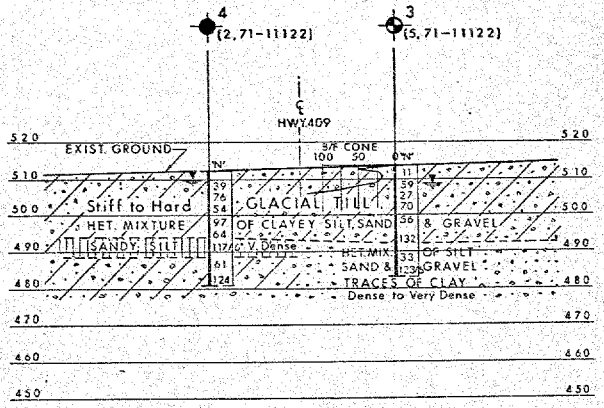
| | |
|---|---|
| d | DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE |
| $\delta$ | ANGLE OF WALL FRICTION |
| K | DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS |
| $K_o$ | COEFFICIENT OF EARTH PRESSURE AT REST |

## FOUNDATIONS

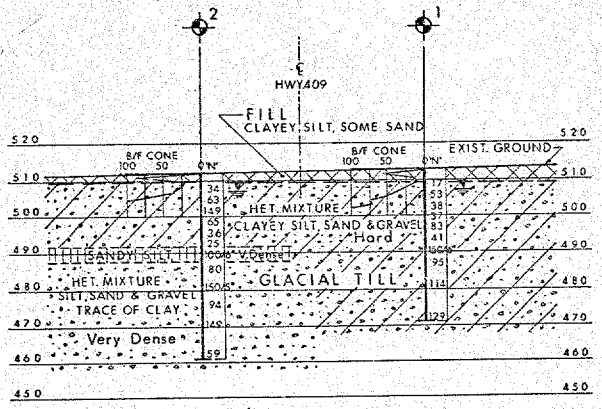
| | |
|---|---|
| B | BREADTH OF FOUNDATION |
| L | LENGTH OF FOUNDATION |
| D | DEPTH OF FOUNDATION BENEATH GROUND |
| N | DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY |
| $k_s$ | MODULUS OF SUBGRADE REACTION |

## SLOPES

| | |
|---|---|
| H | VERTICAL HEIGHT OF SLOPE |
| D | DEPTH BELOW TOE OF SLOPE TO HARD STRATUM |
| $\beta$ | ANGLE OF SLOPE TO HORIZONTAL |




A – A



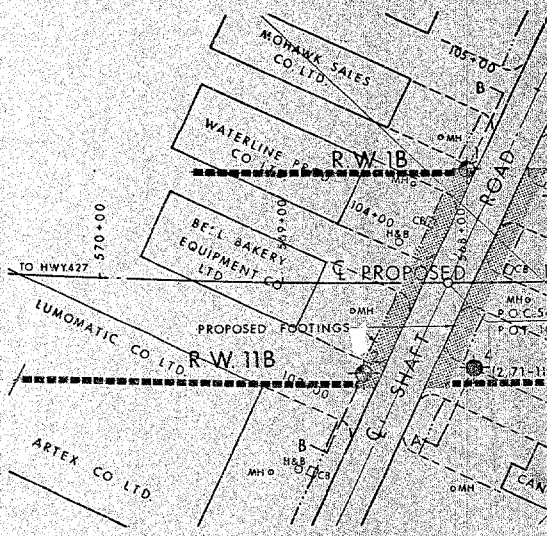

B – B

## SECTIONS

SCALE

VERT. 20 10 0 20

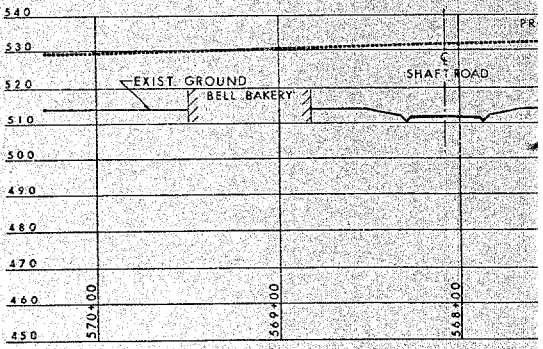
HORIZ. 40 20 0 40 FT.




## PLAN

SCALE

20 10 0 20

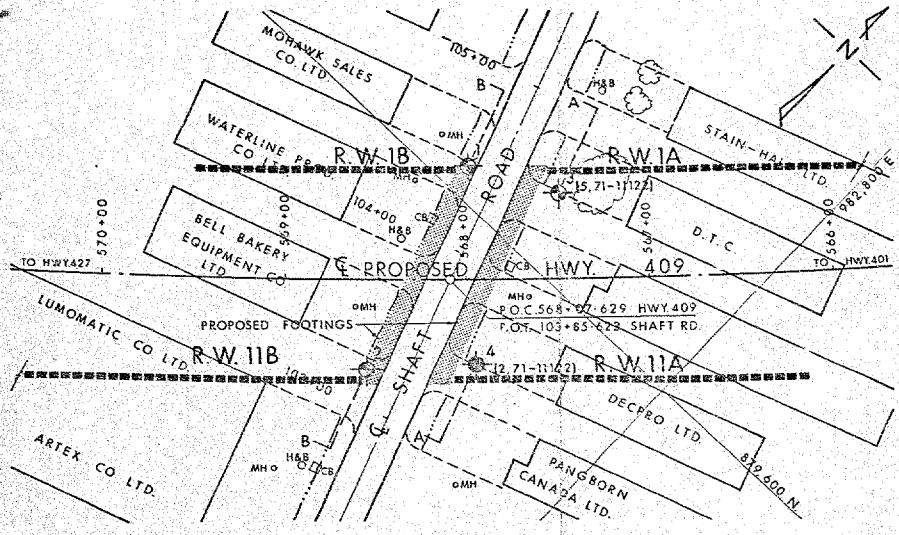



## PROFILE

SCALE

VERT. 20 10 0 20

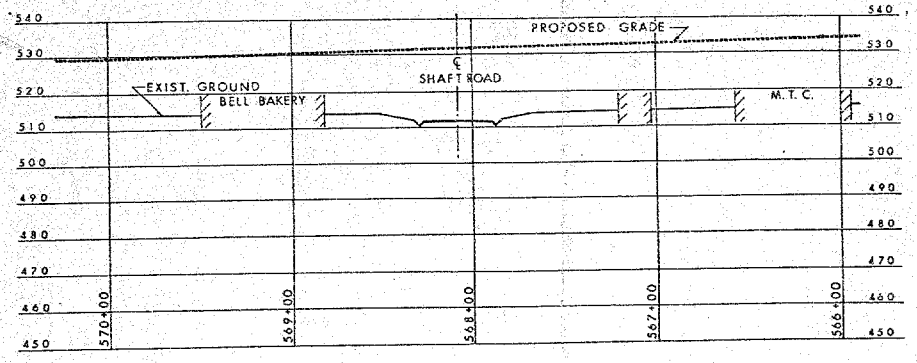
HORIZ. 40 20 0 40




PLAN

SCALE

20 10 0 20 FT.

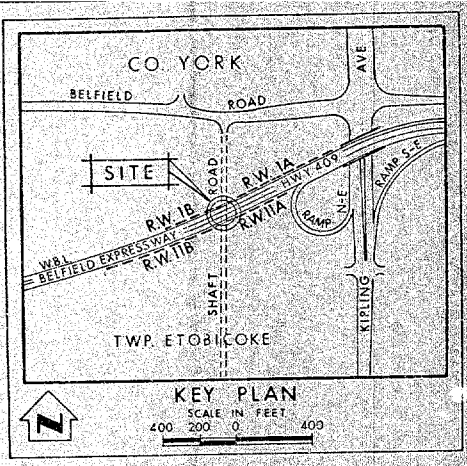



PROFILE

SCALE

VERT. 20 10 0 20

HORIZ. 40 20 0 40 FT.




KEY PLAN

SCALE IN FEET

400 200 0 400

## LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation, Oct. 1972

| NO. | ELEVATION | CO-ORDINATES NORTH | CO-ORDINATES EAST |
|---|---|---|---|
| 1 | 513.2 | 879,615 | 982,643 |
| 2 | 512.0 | 879,497 | 982,675 |
| 3 | 513.6 | 879,639 | 982,685 |
| 4 | 512.2 | 879,540 | 982,718 |

— NOTE —

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

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO

DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

# SHAFT ROAD

HIGHWAY NO. 409 (BELFIELD EXPRESSWAY) DIST. NO. 6

CO. YORK

TWP. ETOBICOKE LOT CON

## BORE HOLE LOCATIONS & SOIL STRATA

| | | | |
|---|---|---|---|
| SUBMD. V.K. | CHECKED V.K. | W.P. NO. 218-65-16 | DRAWING NO. 72-11116A |
| DRAWN O.L. J. | CHECKED | W.O. NO. 72-11116 | |
| DATE 22 NOV. 1972 | SITE NO. | | BRIDGE DRAWING NO. |
| APPROVED PRINCIPAL FOUNDATION ENGINEER | CONT. NO. | | |

REGISTERED PROFESSIONAL ENGINEER ONTARIO V. KORLU

SYNO-TRACE 500-8-71

Design Services Branch,
1201 Wilson Avenue,
Downsview 464, Ontario.

October 20, 1972.

Telephone: 248-3282.

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

Dear Sirs:

This letter confirms our request of October 13, 1972, for the supply of a diamond drill together with all necessary equipment, as specified under the terms of our Contract Agreement, at Belfield Rd. and Martingrove Rd. on October 16, 1972, in Metro Toronto.

Mobilization will be from Toronto, Ontario.

Our Project Numbers are W.O. 72-11116 and 71-11035.

Yours truly,

M. Devata,
Supervising Foundations Eng.,
For: A. G. Stermac,
Principal Foundations Eng.

MD/ao

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

Foundations Files
Documents

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. G.C.E. Burkhardt, (2) Regional Structural Planning Eng., Central Region, 90 Floral Pkwy., Downsview.

ATTENTION:

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

DATE: December 12, 1972.

OUR FILE REF.

IN REPLY TO

SUBJECT:

*Foundation Investigation Report*
*For*
*Proposed Overpass Structure at the Crossing of*
*Hwy. #409 (Belfield Expressway) and Shaft Rd.*
*Borough of Etobicoke, County of York*
*District 6 (Toronto)*
*W.O. 72-11116 -- W.P. 218-65-16*

Please refer to our report dated November 20, 1972, on the above-mentioned subject.

The Hwy. No. appearing in the headings of the covering memo and the first page of the report should be changed from Hwy. #401 to Hwy. #409.

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

/ao

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

Foundations Files
Documents

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: G. Burkhardt,
Reg. Structural Planning Engineer,
3501 Dufferin Street,
TORONTO, Ontario.

FROM: Structural Office,
West Building, DOWNSVIEW.

ATTENTION:

DATE: December 22nd, 1972

OUR FILE REF.

IN REPLY TO

SUBJECT: Shaft Road Overpass,
Bridge #11,
W.P.#218-65-16, Site #37-1005,
Hwy. #409, District #6.

72-11-116

Attached herewith are prints of the Preliminary Bridge Plan Drawing D-37-1005-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is $140,000 which includes tender, materials, engineering and sundry construction.

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

C. S. Grebski,
Structural Design Engineer.

CSG:dp
Attach.

cc. W. D. Birch,
A. E. McKim,
B. R. Davis,
A. Stermac, ✓
Foundation Office,
J. Anderson,
R. Fitzgibbon.

No comments
M. Devata
29th Dec/72

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

**MEMORANDUM**

TO:
A. Stermac,
Principal Foundation Engineer,
Room 107, West Building.

ATTENTION:

FROM:
Structural Office,
West Bldg., DOWNSVIEW.

DATE:
February 27th, 1973.

OUR FILE REF.

IN REPLY TO

SUBJECT:
Shaft Road Overpass,
Bridge #11,
W.P.#218-65-16, Site #37-1005,
Hwy. #409, District #6.

73-11-116

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

Kindly give us your comments at your earliest convenience.

C.S. Grebski,
Structural Design Engineer.

CSG:dp
Attach.

cc. Foundation Office.

No comments.
M. Devata
March 21/73

Aug 72 - 111164 Finalized
Mylar sent to Structure Office
25 May 73

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30M11-146

DIST. 6 REGION CENTRAL

W.P. No. 218-65-16

CONT. No. 74-64

W. O. No. 72-11116

STR. SITE No. _____

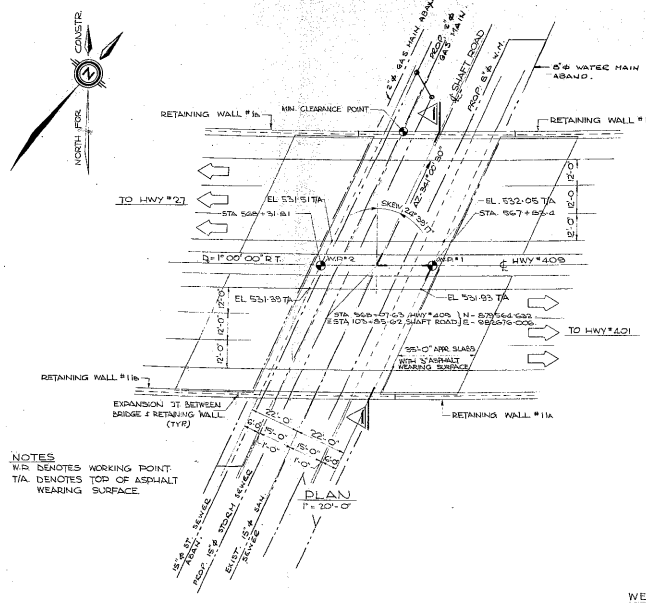
HWY. No. 409

LOCATION HWY 409 + SHAFT RD. OVERPASS

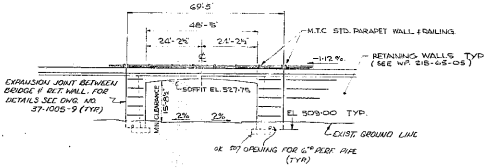
OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT 2

REMARKS: 0 documents to be unfolded before microfilmed

61-30 SEPT. 1976



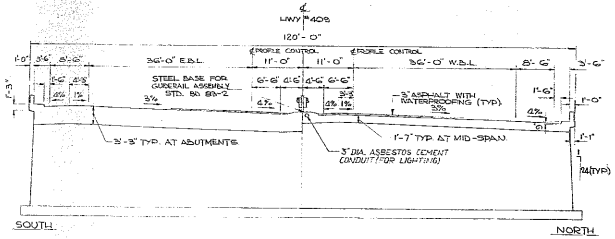

NOTES
W.P. DENOTES WORKING POINT.
T/A DENOTES TOP OF ASPHALT WEARING SURFACE.



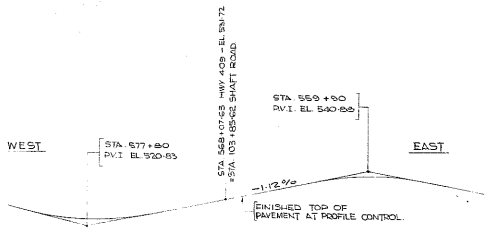

SOUTH ELEVATION
1" = 20'-0"

FUNCTIONS OF 24° 39' 17" SKEW

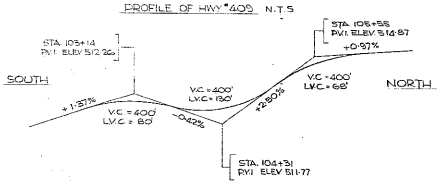
| | |
|---|---|
| SIN | 0.417168 |
| COS | 0.908837 |
| TAN | 0.458998 |
| SEC | 1.100856 |



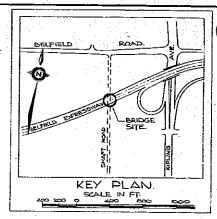

1" = 10'-0"




PROFILE OF HWY "409" N.T.S




PROFILE OF SHAFT ROAD. N.T.S.




NOTES

CLASS OF CONCRETE
APPROACH SLABS - 5000 P.S.I.
CURBS, PARAPET WALLS & FRAME - 4000 P.S.I.
REMAINDER - 3000 P.S.I.

CLEAR COVER ON PRIME STEEL.
FOOTINGS & ABUTMENTS - 3"
DECK - 2" TOP, 1½" BOTT.
CURBS & APPROACH SLABS - 2"
PARAPETS - 1½"

CONSTRUCTION NOTE
BACKFILL BEHIND BOTH ABUTS. TO BE PLACED SIMULTANEOUSLY.
FOR LIGHTING DETAILS SEE ELECTRICAL DRAWINGS.

LIST OF DRAWINGS

37-1005-1. GENERAL LAYOUT.
2. BOREHOLE LOCATIONS & SOIL STRATA.
3. FOOTING LAYOUT & DETAILS.
4. FRAME DETAILS.
5. WING WALLS & CURBS.
6. 35 FOOT APPROACH SLAB.
7. PARAPET WALL DETAILS.
8. STANDARD STEEL PARAPET RAIL.
9. STANDARD DETAILS.

Spread footing in competent cohesive clay till, O.K.

30 m 11-146
EDCO# No.

| PRINT RECORD | | |
|---|---|---|
| No. | FOR | DATE |
| V | I.F. H.W | 1969-2 |

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO

# SHAFT ROAD OVERPASS
BRIDGE #11

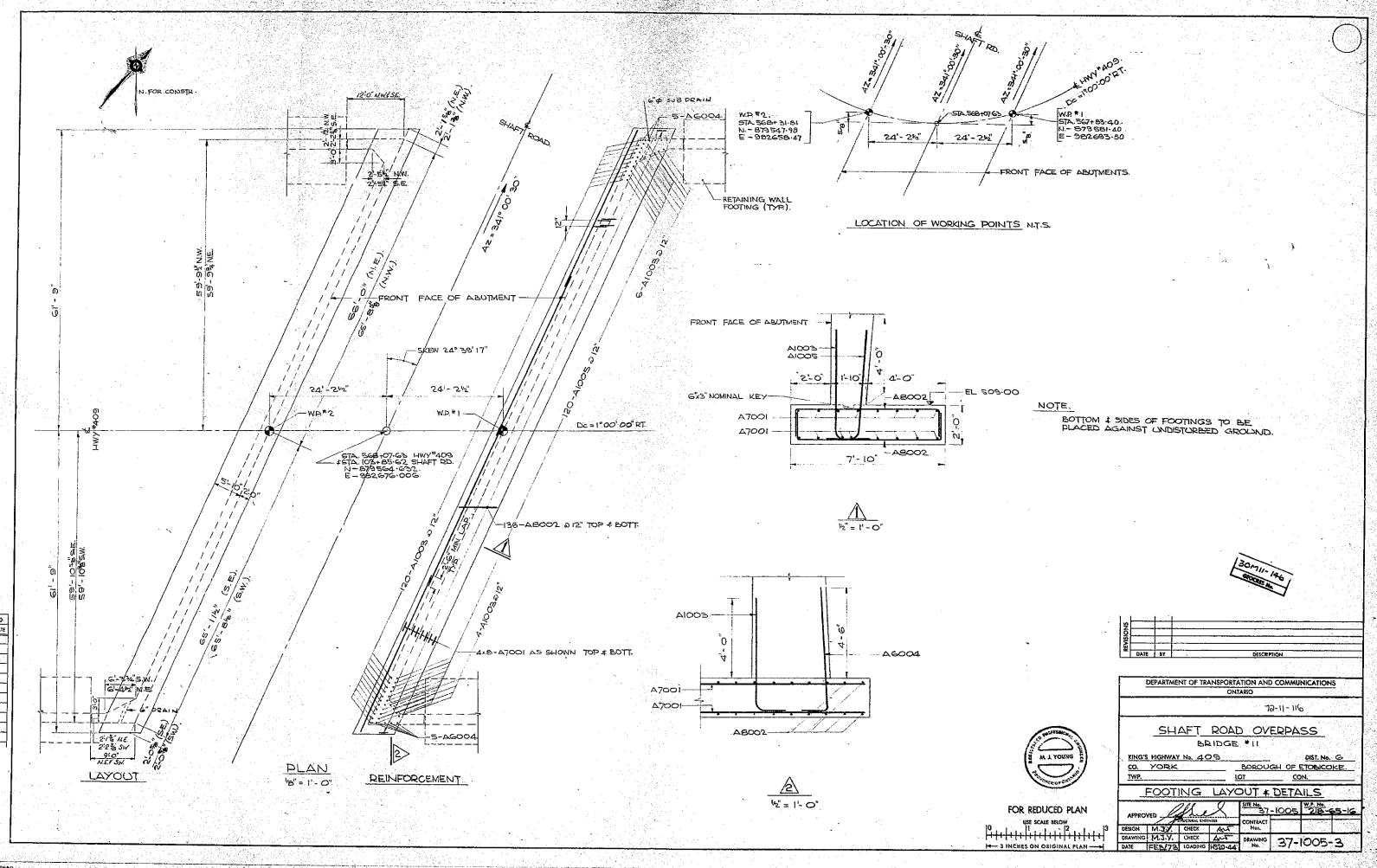
KING'S HIGHWAY No. 409 DIST. No. 6
CO. YORK BOROUGH OF ETOBICOKE
TWP. LOT CON.

## GENERAL LAYOUT

M. A. YOUNG
REGISTERED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO

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

| | | | |
|---|---|---|---|
| APPROVED | | SITE No. | 37-1005 |
| | REGIONAL ENGINEER | W.P. No. | 218-68-16 |
| DESIGN | M.Y. | CHECK | A.W. |
| DRAWING | M.Y. | CHECK | A.W. |
| DATE | FEB/73 | LOADING | H-S20-44 |
| CONTRACT No. | | | |
| DRAWING No. | 37-1005-1 | | |


N. FOR CONSTR.
SHAFT ROAD
HWY #409
FRONT FACE OF ABUTMENT
W.P. #2
W.P. #1
Dc = 1°00'00" RT.
5 - A6004
RETAINING WALL FOOTING (TYP.)
6" ø SUB DRAIN
5 KEW 24° 38' 17"
24'-2½"
136 - A8002 @ 12" TOP & BOTT.
120 - A1003 @ 12"
4 - A1003 @ 12"
4 x 8 - A7001 AS SHOWN TOP & BOTT.
5 - A6004
6 - A1003 @ 12"
LOCATION OF WORKING POINTS N.T.S.
STA. 568+07.63 HWY #409
STA. 105+85.62 SHAFT RD.
N. - 879 564.65
E. - 982 670.006
STA. 568+31.81
N. - 879 547.98
E. - 982 658.47
STA. 567+83.40
N. - 879 551.40
E. - 982 683.50
STA. 568+07.63
FRONT FACE OF ABUTMENTS
A1003
A1005
A8002
EL 509.00
6"x3" NOMINAL KEY
A7001
A6004
7'-10"
NOTE.
BOTTOM & SIDES OF FOOTINGS TO BE PLACED AGAINST UNDISTORBED GROUND.
LAYOUT
PLAN
REINFORCEMENT
FOR REDUCED PLAN
USE SCALE BELOW
3 INCHES ON ORIGINAL PLAN
PRINT RECORD
DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
ONTARIO
72-11-116
SHAFT ROAD OVERPASS
BRIDGE #11
KING'S HIGHWAY No. 409
DIST. No. 6
CO. YORK
BOROUGH OF ETOBICOKE
TWP.
LOT
CON.
FOOTING LAYOUT & DETAILS
APPROVED
DESIGN M.J.Y.
DRAWING M.J.Y.
DATE FEB/73
CHECK
LOADING
CONTRACT No.
DRAWING No. 37-1005-3
SIR No. 37-1005
W.P. No. 216-65-16
30M11-146
GROSS WT.
REVISIONS
DATE BY DESCRIPTION