Peto MacCallum Ltd.
CONSULTING ENGINEERS

# FOUNDATION TECHNICAL MEMORANDUM

**For**

**OXFORD ROAD 55 UNDERPASS**
**HIGHWAY 403**
**MTO WEST REGION 59 STRUCTURE REHABILITATIONS**
**SITE 23-291, CONTRACT 8**
**GWP 3094-12-00**
**GEOGRAPHIC TOWNSHIP OF BRANTFORD**
**BRANT COUNTY, ONTARIO**

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June 12, 2017

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**FOUNDATION TECHNICAL MEMORANDUM**
**For**
Oxford Road 55 Underpass Highway 403
MTO West Region 59 Structure Rehabilitations
Site 23-291, Contract 8, GWP 3094-12-00
Geographic Township of Brantford
Brant County, Ontario

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## 1. INTRODUCTION

The Foundation Engineering Services for the present project involve the detail foundation investigation and design for the rehabilitation of 59 structures in MTO West Region along Highways 4, 6, 401, 402 and 403. Ten (10) Group Work Projects (GWP) are contemplated to be completed between 2014 and 2020.

This technical memorandum summarizes the factual results of geotechnical data based on the review and compilation of existing subsurface information from relevant reports in the MTO GEOCRES Library for the Oxford Road 55 Underpass Highway 403. The Foundation Engineering recommendations from the initial foundation reports are summarized with reference to the "Canadian Highway Bridge Design Code" (CHBDC) and follow in general the "Guidelines for Professional Engineers providing Geotechnical Engineering Services".

From the Minutes of Meeting Report, dated June 3, 2016, it is understood that semi-integral conversion may not be the preferred rehabilitation strategy and that Preservation Management Strategy (PMS) consisting of expansion joint replacement, patch, waterproof and pave, patch repairs and concrete sealer applied to the concrete barrier walls is to be undertaken at this underpass structure location.

The purpose of the technical memorandum is to summarize the subsurface and groundwater conditions and foundation recommendations based on available reports at the structure location for the design project team's reference.

The elevations in this report are expressed in meters, unless otherwise noted.

## 2. PROJECT SITE BACKGROUND AND GEOLOGY

The Oxford Road 55 Underpass Highway 403 is located about 27.5 km west of City of Brantford west limits, and 3.2 km southeast of the crossing of Highways 2 and 53 in the Geographic Township of Brantford, Brant County, Ontario. A key plan is shown in Figure 1.

The existing underpass is a two-span post-tensioned concrete voided slab structure that carries two through lanes of Oxford Road 55 over Highway 403. The topography of the immediate vicinity is relatively flat. Agricultural lands at the north and south sides were observed in the vicinity of the structure.

Physiographically, the site of the underpass structure is located in the region referred to as the "Mount Elgin Ridges", which consists of a series of ridges and vales. The ridges composed mainly pale brown calcareous clay or silty clay deposit, and it is common to find alluvium of gravel, sand or silt in the vales. The ridges are well drained, while poor drainage prevails in the hollows. The bedrock at the site location consists of grey to greenish grey shales and shaly dolomites containing gypsum lenses, which belongs to the Salina Formation of the Upper Silurian Epoch The bedrock surface is approximately at depth of 13.9 (45.6 ft.) to 44.8 m (147.0 ft.), elevation 243.8 (800.0 ft.) to 274.3 (900.0 ft.) (Cowan, 1975. Geological Report 119).

## 3. SOURCE OF INFORMATION

The following reports and drawings, appended in Appendix A, were available for review and information for the underpass structure, subsoil information and original foundation recommendations.

1. Foundation Investigation Report for The Overhead Structure of Hwy. #53 and Proposed Hwy. #403, District #4, Hamilton, W.O. 72-11044, W.P. 164-60-00, Cont. 83-10, Foundations Office, Design Services Branch, Central Bldg., Downsview, Department of Transportation and Communications, dated June 8, 1972, GEOCRES No. 40P2-28. (Reference 1)

2. Memorandum for Hwy. #53 Interchange, W.P. 164-60-00, Site 23-291, Hwy. #403, District #4, (Hamilton), Pavement & Foundation Design Section, Room 313, Central Building, dated May 01, 1981. (Reference 2)

2A. Revised Records of Borehole Nos. 3, 4, 5, and 6 and revised Bore Hole Locations & Soil Strata Drawing, HWY. 53 Interch. U'pass, DWG 2, Site No. 23-291, Dist. 4, HWY No. 403, W.P. No. 164-60-01, Pavement & Foundation Design Section, Room 313, Central Building, dated March 30, 1981. (Reference 2A)

3. Pile Information To Be Added to DWG-4, "Footing and Pier Details", Hwy. 53 Interchange U'pass, Hwy 403, WP 164-60-01, Site 23-291, dated October 19, 1981. (Reference 3)

4. General Arrangement Drawing, Hwy. 53 Interch. U'pass, DWG. 1, Sheet 92, Site No. 23-291, Dist. No. 4, Hwy. 403, Cont. No. 83-10, WP No. 164-60-01, dated October, 1981. (Reference 4)

5. Footing & Pier Details Drawing, Hwy. 53 Interch. U'pass, DWG 4, Sheet 95, Site No. 23-291, Dist. No. 4, Hwy. 403, Cont. No. 83-10, WP No. 164-60-01, dated October, 1981. (Reference 5)

6. Abutment Layout Drawing, Hwy 53 Interch. U'pass, DWG 6, Sheet 97, Site No. 23-291, Dist. No. 4, Hwy. 403, Cont. No. 83-10, WP No. 164-60-01, dated October, 1981. (Reference 6)

## 4. SITE RECONNAISSANCE

As part of the current foundation engineering assessment study, a site reconnaissance of the Oxford Road 55 Underpass Highway 403 structure was carried out on August 28, 2015.

The site photographs present the conditions of the Oxford Road 55 Underpass structure including visible portions of the abutments, wingwalls and pier columns, and embankment slope assessment based on visible areas and apparent areas of soil erosion.

The site inspection revealed that the vicinity of the underpass structure abutment locations was covered by vegetation. Weep holes were observed in the abutment walls, which appeared to be open and currently functional to drain the water from behind the walls. Grasses were observed

growing at the toe of abutment walls (Photographs 1 and 4). Vertical cracks were observed on the abutment walls. Both embankment slopes adjacent to the abutments were observed to be vegetated and no evidence of slope erosion was noted (Photographs 2, 3, 5 and 6). Cracks were observed on the wingwalls of the east and west abutments. Light spalling of concrete was observed at the joint of east abutment wall and southeast wingwall (Photograph 3), and salt staining was observed at the vertical and horizontal cracks on the southwest wingwall (Photograph 4). The concrete pier columns at the time of site reconnaissance were observed with minor surficial cracks with no spalling of concrete or exposure of rebar (Photograph 7).

## 5. PREVIOUS FOUNDATION INVESTIGATION AND SUBSURFACE CONDITIONS

In accordance with the original foundation investigation report prepared by the Department of Transportation and Communications, dated June 8, 1972 (Reference 1), a three-span twin-overpass structures at the crossing of Highway 403 and Oxford Road 55 (Highway 53) was proposed. The subsurface conditions presented in Reference 1 were based on the field investigation carried out on March 29 and 30, and April 4 to 12, 1972, which included a total of eight sampled boreholes 1 to 8. Dynamic cone penetration tests (DCPT) were carried out adjacent to boreholes 5 and 6.

The sampled boreholes were advanced to 13.0 (42.7 ft.) to 16.8 (55.0 ft.) m, elevation 271.5 (890.7 ft.) to 275.1 (902.6 ft.). The two DCPTs were advanced to approximate termination depths of 3.0 (9.8 ft.) and 3.8 (12.5 ft.) m, elevation 285.2 (935.7 ft.) and 284.5 (933.3 ft.). However, a memorandum dated May 1, 1981 (Reference 2) indicated that the original proposal had been changed to a single three-span underpass structure at the same crossing area, and a revised drawing and foundation investigation report were prepared for the contract purposes. Based on Reference 2A, a revised borehole locations and soil strata drawing, dated March 30, 1981 and revised Records of Borehole Nos. 3, 4, 5 and 6 from the original geotechnical investigation were prepared. Currently, a single two-span structure is crossing over the Highway 403 at the site.

The general subsurface conditions presented in this section are based on the revised Records of Borehole Nos. 3, 4, 5 and 6 (Reference 2A), which were advanced to 13.0 to 16.2 m, elevation 272.1 to 275.2.

The general layout of the single two-span underpass structure is shown in Reference 4.

The boreholes were drilled by employing continuous flight auger machines and equipped with 83 mm I.D. hollow stem augers.

The dimensions of the spoon sampler and the energy used in driving it conform to the requirements of the Standard Penetration Test.

The samples obtained were visually examined in the field after recovery and again in the laboratory upon arrival by using some simple routine tests. Laboratory tests, including moisture content determinations, Atterberg limits and grain size analyses, were conducted on selected samples to determine the physical properties of the soil specimens from the various layers.

## 5.1 General

Generally, based on the revised Records of Borehole Nos. 3, 4, 5 and 6 (Reference 2A), firm to hard silty clay overlaid compact to very dense silt to sandy silt, which in turn overlaid very stiff to hard silty clay (glacial till).

### 5.1.1 Silty Clay

A 4.9 to 7.6 m thick firm to hard silty clay stratum was encountered in all boreholes surficially, which extended to 4.9 to 7.6 m, elevation 281.0 to 283.4. N values recorded ranged from 5 to over 100.

Grain size distribution results of three selected samples determined the samples included 0 to 8% gravel, 13 to 21% sand, 51 to 57% silt and 20 to 26% clay sized particles. The Atterberg liquid limits ranged from 23 to 32 and the corresponding plastic limits ranged from 15 to 19. The plasticity index values ranged from 8 to 14. Moisture content determinations ranged from 12 to 24%.

### 5.1.2 Silt to Sandy Silt

A 3.1 to 6.7 m thick silt to sandy silt layer was encountered in all boreholes at 4.9 to 7.6 m, elevation 281.0 to 283.4, which extended to 9.1 to 11.6 m, elevation 276.7 to 279.1. N values recorded within this layer ranged generally between 11 and 59. Low N values of 5 and 1 were recorded in boreholes 4 and 5, respectively. The general compactness of the layer was compact to very dense.

Based on Reference 1, since the silt to sandy silt deposit was under the groundwater level, the low N values were disturbed due to the unbalanced hydrostatic heads, which caused boiling in the borings. Reference 1 indicated that the very low N values were caused by the loosening effect of the upward hydrostatic pressure in the boreholes and should be disregarded.

Grain size distribution results of two selected silt to sandy silt samples determined the samples included 0 and 1% gravel, 3 and 14% sand, 89 and 79% silt and 8 and 6% clay sized particles, respectively. Moisture content determinations ranged from 7 to 30%.

### 5.1.3 Silty Clay (Glacial Till)

A 1.8 to 7.1 m thick very stiff to hard silty clay (glacial till) deposit was encountered in all boreholes at 9.1 to 11.6 m, elevation 276.7 to 279.1, which extended to the termination depths 13.0 to 16.2 m, elevation 272.1 to 275.1. N values recorded ranged from 24 to more than 100.

Grain size distribution result of a selected sample determined the sample included 5% gravel, 37% sand, 47% silt and 11% clay sized particles. The Atterberg liquid limits were 14 and 16 and the corresponding plastic limits were 12. The plasticity index values were 2 and 4. Moisture content determinations ranged from 7 to 19%.

### 5.1.4 Groundwater

Groundwater was observed in boreholes 3, 4 and 5. The boreholes were left open for a few days to establish the groundwater level following completion of drilling. The groundwater was first observed at 2.0 to 2.3 m, elevation 286.0 to 286.6, and had further risen in the open boreholes.

The stabilized groundwater levels in the boreholes were established at 0.3 m, elevation 287.9 to 288.3, within a few days after drilling completion.

Based on Reference 1, it was assumed the noted groundwater level was near the yearly high water table of the area.

## 6. FOUNDATION

### 6.1 Previous Foundation Recommendations

The foundation recommendations presented in Reference 1 were provided for a three-span twin-overpass structures to carry the proposed Highway 403 over Oxford Road 55 (Highway 53). A memorandum dated May 1, 1981 (Reference 2) indicated that the original proposal was changed to a single three-span underpass structure at the same crossing area.

The previous foundation recommendations presented in the following sections are based on the memorandum (Reference 2). The recommendations were provided for a single three-span underpass structure at the junction of Highway 403 and Oxford Road 55 (Highway 53). At the site location, firm to hard silty clay overlaid compact to very dense silt to sandy silt, which in turn overlaid very stiff to hard silty clay (glacial till), based on Reference 2A.

It should be noted that the current structure is a single two-span underpass structure.

#### 6.1.1 Structure Foundation

The memorandum (Reference 2) recommended that spread foundations to support the proposed structure including abutments, pier and retaining walls may be placed at or below elevation 286.0. A design load of 450 kPa was recommended, and the anticipated settlement of the footings under the design load was about 30 mm.

As an alternative, it was also recommended the piers and abutments be supported on end-bearing steel ‘H’ piles driven into the compact to hard glacial till stratum. The memorandum

indicated that HP 310 x 110 steel 'H' piles with reinforced tips could be utilized. The maximum permissible load recommended was 1100 kN. The minimum depth levels that the piles were to be driven based on Reference 2 were approximately elevation 277.0 at the west abutment and adjacent retaining walls, elevation 273.0 at the piers, and elevation 274.0 at the east abutment and adjacent retaining walls. The piles were to be driven according to M.T.C. Standards SS 103-11 or SS 103-10. It was recommended not to apply less than 50,000 Joules per blow of driving energy.

The additional pile data presented in Reference 3 included pile data, pile design data and pile construction data, which were added to and presented in the Footing and Pier Details Drawing (Reference 5).

For pile data, it was recommended that HP 310 x 110 steel 'H' piles be used for abutments and piers, and HP 310 x 79 steel 'H' piles be used at the northeast and southwest retaining walls. The additional information (Reference 3) indicated that the pile length shown on the drawing was the theoretical length below cut-off, and the driving shoes on all piles should be in accordance with Standard DD 3301.

The pile design data presented in Reference 3 was summarized as below:

| **PILE TYPE** | **CAPACITY AT S.L.S. TYPE II** | **FACTORED CAPACITY AT U.L.S** |
|---|---|---|
| HP 310 x 110 Steel 'H' Pile | 900 kN | 1600 kN |
| HP 310 x 79 Steel 'H' Pile | 650 kN | 1150 kN |

For pile construction data presented in Reference 3, it was recommended that the piles be driven in accordance with Standard SS 103-10 or SS 103-11 using an ultimate capacity of 2700 kN per pile for HP 310 x 110 piles and 1950 kN per pile for HP 310 x 79 piles, and the piles must be driven below elevation 277.0 for the west abutment and the southwest retaining wall, elevation 273.0 for the piers, and elevation 274.0 for the east abutment and the northeast retaining wall.

Further, it was recommended in Reference 3 that the earth pressure should be calculated in accordance with Subsection 6.6.1.2.2 of “Ontario Highway Bridge Design Code” (OHBDC).

### 6.1.2 Approach Embankments

The memorandum (Reference 2) indicated that up to 7.5 m high fills were required to establish the proposed profile grades of Oxford Road 55 (Highway 53) (elevation 296.5). No stability problems were expected for the approach fills provided the approaches were constructed with 2 horizontal to 1 vertical forward and side slopes. It estimated that the cohesive portion of the subsoil would settle in the range of 25 to 30 mm due to the construction of approach fills and that the settlement would take place over a long term period.

It was recommended that the well compacted acceptable material were to be used for the fill, and no material that had grain sizes larger than 75 mm was to be placed at the locations where piles had to be driven.

### 6.1.3 Other Considerations

The memorandum (Reference 2) recommended a minimum 1.2 m cover for the pile caps for frost protection.

The following values were recommended to estimate the earth pressures on the abutment walls.

| | |
|---|---|
| Unit weight of Granular Backfill (kN/m$^3$): | 21.2 |
| Coefficient of Active Earth Pressure ($K_a$): | 0.35 |
| Coefficient of Earth Pressure at Rest ($K_o$): | 0.5 |

The memorandum recommended that a suitable drainage system should be provided to relieve the build-up of excess hydrostatic pressure behind the abutment walls.

6.1.4 Drawings

Based on the General Arrangement (GA) Drawing (Reference 4), the proposed structure adopted was a single two-span underpass structure to carry Oxford Road 55 (Highway 53) over Highway 403. A post-tensioned concrete slab structure was to be constructed. In Reference 4, the profile of Highway 403 was designed at elevation 288.360 (Sta. 16+713 of Highway 403) with a 0.850% gradient increase to Highway 401 direction, and a 0.349% gradient increase to City of Brantford direction.

The average original ground level measured at the centreline of Oxford Road 55 (Highway 53) was at approximate elevation 289.0 based on GA Drawing (Reference 4). The profile of Oxford Road (Highway 53) was designed to be raised approximately 6.5 to 7.0 m, at the west and east abutment locations, respectively. The maximum top of the pavement elevation was set at Working Point (WP) #2 (elevation 296.084) with a 3.496% gradient decrease to WP #1 (elevation 293.814) towards Highway 401 and a 2.000% gradient decrease to WP #3 (elevation 295.931) towards Brantford.

In addition, based on the General Arrangement Drawing (Reference 4), the compacted fill was to be placed underneath the retaining wall footing at the west side of the structure prior to pile driving, and the maximum particle size of the fill was to be 75 mm.

Based on the Footing and Pier Details Drawing (Reference 5), the top of the 900 mm thick pile caps were to be placed at elevation 288.20 at the west and east abutments, and the top of the 1500 mm

thick pile caps for the centre piers were to be placed at elevation 288.00, and the top of the 750 mm thick pile caps for the retaining walls were to be placed at elevation 291.30.

The following table summarizes the pile data based on the Footing and Pier Details Drawing (Reference 5). The pile lengths shown in the following table were the theoretical lengths below cut-off.

| LOCATION | BATTER | NO. | LENGTH (mm) | PILE CUT-OFF ELEVATION (m) |
|---|---|---|---|---|
| West Abutment (HP 310 x 110 Piles) | 1:3 | 45 | 11,250 | 287.60 |
| | 1:12 | 12 | 10,750 | |
| Southwest Retaining Wall (HP 310 x 79 Piles) | 1:3 | 5 | 14,750 | 290.85 |
| | 1:12 | 6 | 14,000 | |
| Pier (HP 310 x 110 Piles) | 1:5 | 32 | 14,250 | 286.80 |
| | 1:10 | 16 | 14,000 | |
| East Abutment (HP 310 x 110 Piles) | 1:3 | 45 | 14,500 | 287.60 |
| | 1:12 | 12 | 13,750 | |
| Northeast Retaining Wall (HP 310 x 79 Piles) | 1:3 | 5 | 18,000 | 290.85 |
| | 1:12 | 6 | 17,000 | |

The additional pile information, including pile data, pile design data and pile construction data from Reference 3 was incorporated and indicated in the Notes of Footing and Pier Details Drawing (Reference 5).

Based on the Abutment Layout Drawing (Reference 6), 75 mm diameter wall drains (or weep holes) were placed at 3000 mm centre to centre spacing with non-metallic material behind each abutment wall and a 219 mm outside diameter steel sleeve pipes for 150 mm diameter subdrain pipe through wingwalls were placed. The wall drains in the abutment walls were observed during the site visit on August 28, 2015; however the 150 mm diameter drainage pipes in the wingwalls were not observed as they were buried below ground level based on the GA Drawing (Reference 4).

## 6.2 Assessment of Foundation Parameters

Based on the previous investigation and subsurface conditions encountered, the following table summarizes the foundation design parameters that were recommended in the previously referenced reports and drawings and the updated geotechnical reaction at SLS and factored geotechnical resistance at ULS are provided.

| FOUNDATION DESIGN PARAMETERS | | | | | |
|---|---|---|---|---|---|
| FOUNDATION TYPE (LOCATION) | PILE TIP ELEVATION[1] | PREVIOUS LIMIT STATE DESIGN VALUES[2] | | LIMIT STATE DESIGN VALUES UPDATED TO CURRENT INDUSTRY PRACTICE[3] | |
| | | SLS TYPE II BEARING CAPACITY | ULS FACTORED CAPACITY | SLS BEARING REACTION/LOAD | ULS FACTORED GEOTECHNICAL RESISTANCE/LOAD |
| West abutment (HP 310 x 110 Piles) | Below 277.0 | 900 (kN) | 1600 (kN) | 900 (kN) | 1600 (kN) |
| Southwest Retaining Walls (HP 310 x 79 Piles) | Below 277.0 | 650 (kN) | 1150 (kN) | 650 (kN) | 1150 (kN) |
| Piers (HP 310 x 110 Piles) | Below 273.0 | 900 (kN) | 1600 (kN) | 900 (kN) | 1600 (kN) |
| East abutment (HP 310 x 110 Piles) | Below 274.0 | 900 (kN) | 1600 (kN) | 900 (kN) | 1600 (kN) |
| Northeast Retaining Walls (HP 310 x 79 Piles) | Below 274.0 | 650 (kN) | 1150 (kN) | 650 (kN) | 1150 (kN) |

**Notes**:
1. Pile tip elevations provided were based on Reference 3.
2. Limit State Design values from References 3 and 5.
3. Limit State Design values based on CHBDC (2014 Edition) and CFEM.
4. Provided that the piles were driven to an adequate depth into the hard glacial till (with N values equal to or more than 100 blows), it should be sufficient to develop the previously recommended design capacity. No verification of the driven depths of the piles could be made based on the available data.
5. No field verification data was available for review.

The Peak Ground Acceleration (PGA) for the site is 0.075 (National Building Code of Canada, 2015). The soil classification for seismic design should be in accordance with Clause 4.4.3.2 of the CHBDC (2014).

The foundation frost penetration depth at the site is 1.2 m according to OPSD 3090.101.

## 7. DISCUSSION

It is understood that semi-integral conversion may not be the preferred rehabilitation strategy and that Preservation Management Strategy (PMS) consisting of expansion joint replacement, patch, waterproof and pave, patch repairs and concrete sealer applied to the concrete barrier walls is to be undertaken at this underpass structure location. From a geotechnical point of view, at the present time, foundation work for underpass structure is not expected.

However, if any major rehabilitation is undertaken for the proposed interchange at this location, it is recommended that the foundation capacity at the abutment locations be verified prior to any major construction work. Further, the Structural Engineer should verify the pile type and configuration used for the underpass structure.

A temporary support system may be required for the rehabilitation of the underpass structure and the construction for temporary support system should conform to OPSS 404 and 539. The contractor is responsible for the selection, detailed design and performance of the roadway protection scheme. The contractor should monitor the movement of the roadway protection system.

The embankment slopes to both abutments are visually stable without signs of erosion at the time of site reconnaissance.

Furthermore, it is suggested that the wall drains or weep holes in the abutment walls should be maintained and cleaned at a regular basis to prevent any clogging of the holes. Regular maintenance of the weep holes will keep the water flowing from behind the abutment walls and will mitigate hydrostatic pressure build up behind the abutment walls.

## 8. CLOSURE

This Technical Memorandum was originally prepared by Mr. G. Zhao, P.Eng. This report was updated by Mr. N. Rahman, P.Eng., Project Engineer and was reviewed by Mr. B. R. Gray, M.Eng, P.Eng., Principal Consultant. Mr. R. Ng, MBA, PhD, P.Eng., MTO Designated Principal Contact conducted an independent review of the report.

We trust this memo is sufficient for your immediate needs. Please, do not hesitate to contact us if you have any inquiries and/or comments.

Yours very truly,

Peto MacCallum Ltd.


Nazibur Rahman, P.Eng.
Project Engineer


Brian R. Gray, M.Eng, P.Eng.
Principal Consultant


Robert Ng, MBA, PhD, P.Eng.
MTO Designated Principal Contact

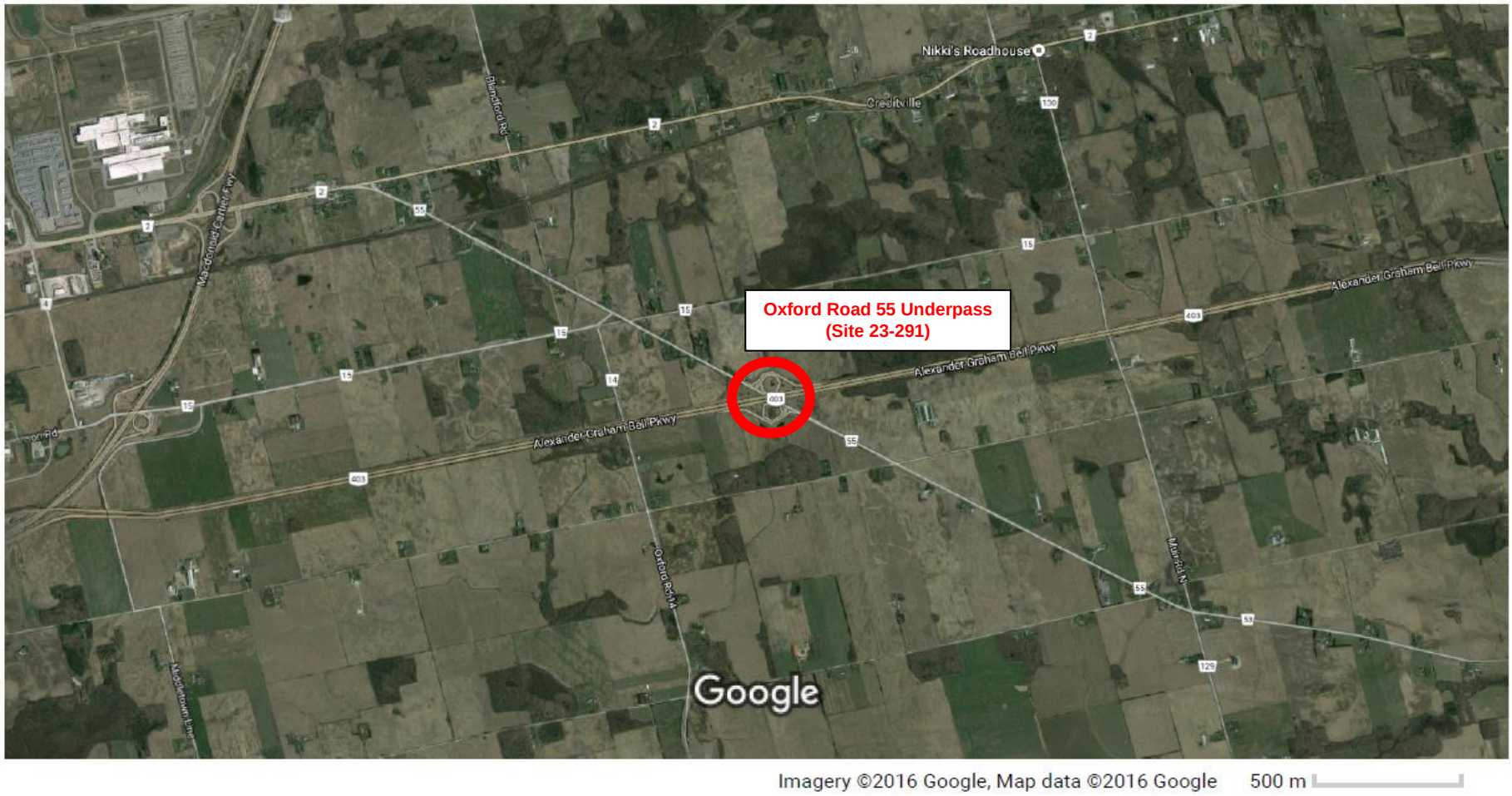
NR/RN/BRG:nk-an

# TABLE 1

## LIST OF STANDARD SPECIFICATIONS REFERENCED IN REPORT

| DOCUMENT | TITLE |
|---|---|
| OPSS 404 | Construction Specification for Support Systems |
| OPSS 539 | Construction Specification for Temporary Protection Systems |
| OPSD 3090.101 | Foundation Frost Depth for Southern Ontario |

## Figure 1 – Key Plan



# APPENDIX A

Appendix A – Previous Foundation Investigation Reports (GEOCRES 40P2-28)

Reference 1. Foundation Investigation Report for The Overhead Structure of Hwy. #53 and Proposed Hwy. #403, District #4, Hamilton, W.O. 72-11044, W.P. 164-60-00, Cont. 83-10, Foundations Office, Design Serivces Branch, Central Bldg., Downsview, Department of Transportation and Communications, dated June 8, 1972, GEOCRES No. 40P2-28.

Reference 2. Memorandum for Hwy. #53 Interchange, W.P. 164-60-00, Site 23-291, Hwy. #403, District #4, (Hamilton), Pavement & Foundation Design Section, Room 313, Central Building, dated May 01, 1981.

Reference 2A. Revised Record of Borehole Nos. 3, 4, 5, 6 and revised Bore Hole Locations & Soil Strata Drawing, HWY. 53 Interch. U'pass, DWG 2, Site No. 23-291, Dist. 4, HWY No. 403, W.P. No. 164-60-01, Pavement & Foundation Design Section, Room 313, Central Building, dated March 30, 1981.

Reference 3. Pile Information To Be Added to DWG-4, "Footing and Pier Details", Hwy. 53 Interchange U'pass, Hwy. 403, W.P. 164-60-01, Site 23-291, dated October 19, 1981.

Reference 4. General Arrangement Drawing, Hwy. 53 Interch. U'pass, DWG. 1, Sheet 92, Site No. 23-291, Dist. No. 4, Hwy. 403, Cont. No. 83-10, WP No. 164-60-01, dated October, 1981.

Reference 5. Footing & Pier Details Drawing, Hwy. 53 Interch. U'pass, DWG 4, Sheet 95, Site No. 23-291, Dist. No. 4, Hwy. 403, Cont. No. 83-10, WP No. 164-60-01, dated October, 1981.

Reference 6. Abutment Layout Drawing, Hwy 53 Interch. U'pass, DWG 6, Sheet 97, Site No. 23-291, Dist. No. 4, Hwy. 403, Cont. No. 83-10, WP. No. 164-60-01, dated October, 1981.

**DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS**

**MEMORANDUM**

TO: Mr. G.C.E. Burkhardt, (4)
Regional Structural Planning Engineer,
Central Region,
90 Floral Pkwy.,
ATTENTION: Downsview, Ontario.

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

DATE: June 8, 1972.

OUR FILE REF.

IN REPLY TO

JUN 16 1972

SUBJECT:

40P2-28
GEOCRES No:

FOUNDATION INVESTIGATION REPORT
For
The Overhead Structure of Hwy. #53 and
Proposed Hwy. #403, District #4, Hamilton
W.O. 72-11044 -- W.P. 164-60-00

CONT 83-10

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
Attch.
cc: D. W. Farren
B. R. Davis
A. Rutka
P. J. Harvey
C. R. Robertson
B. J. Giroux
T. J. Kovich
G. A. Wrong
B. A. Singh

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FOUNDATION INVESTIGATION REPORT
For
The Overhead Structure of Hwy. #53 and
Proposed Hwy. #403 District #4 Hamilton
W.O. 72-11044 W.P. 164-60-00

## 1. INTRODUCTION:

The Foundations Office was requested by Mr. S. Jants, Bridge Planning Technician, Southwestern Region, to carry out a foundation investigation at the site of the proposed crossing of Hwy. #53 and Hwy. #403, some 17.1 miles west of Brantford west limits. The request was dated March 1, 1972. The field and subsequent laboratory investigations were carried out under the supervision of this Office. Boreholes were located in the field and ground elevations at borehole locations were related to geodetic benchmarks by personnel of the Engineering Surveys Office, Southwestern Region.

Presented in this report are the results of the investigations, together with recommendations concerning foundations.

## 2. DESCRIPTION OF THE SITE AND GEOLOGY:

The proposed bridge site is located along existing Hwy. #53, some 2 miles south-east of the crossing of Hwys. #2 and 53. The immediate vicinity is relatively flat; the land is under cultivation, occupied by crops and pastures. Hwy. #53 has concrete pavement of 20 ft. width, the grade of the road at the proposed crossing is 1-2 feet higher than the general ground surface.

Geologically, the area belongs to the physiographic region known as the "Mount Elgin Ridges", consisting of a succession of ridges and vales. The ridges are morains of pale brown calcareous clay or silty clay, while in the vales it is common to find alluvium of gravel, sand or silt. The ridges are well drained, while poor drainage prevails in the hollows.

## 3. FIELD AND LABORATORY INVESTIGATIONS:

Some eight sampled boreholes and adjacent to B.H.'s 5 and 6, two dynamic cone penetration tests were carried out, during the course of the field work. Borings were placed at the locations of the proposed footings as shown on attached Drawing #72-11044A. The estimated stratigraphical sections through the locations of the abutments and the piers are also shown on the drawing. Samples were taken by means of split spoon samplers, which were driven to the soils according to the method called Standard Penetration Test. Penetration resistances (N= blows/ft.) together with the results of laboratory tests are recorded on the attached borelogs.

Upon recovery and again in the laboratory all the soil samples were examined and classified by using some simple routine tests.

Representative samples were further tested in the laboratory in order to determine natural moisture contents, Atterberg limits and grain-size characteristics of the various layers.

## 4. SUBSOIL CONDITIONS:

### 4.1) General:

Subsoil at the site from ground level downward was found to comprise of clayey silts, silts to sandy silts and sandy silts with clay and gravel (Glacial Till). Some minor variations of the stratigraphy were noted in the individual boreholes. A brief description of the deposits is as follows:

### 4.2) Clayey Silt with Some Sand and Traces of Gravel:

The uppermost deposit within a depth of 14-23 feet was identified to be clayey silt with some sand and traces of gravel, extending from ground level to elevation 922 feet-932 feet. The consistency of the surficial 5-6 feet of soils is firm to stiff, with penetration "N" values of 5 blows/ft. to 15 blows/ft.. Beneath this elevation the consistency increases rapidly; "N" values generally ranging from 20 blows/ft. to over 100 blows/ft.. The range of plastic limits was recorded to be from 15% to 19%, and liquid limits from 23% to 32%. The natural moisture contents lie at or below the plastic limits.

4.3) Silt to Sandy Silt Traces of Clay:

Underlying the clayey silts a 10-27 feet thick layer of silt to sandy silt was recorded, extending down to elevation 896 feet - 914 feet. This basically granular type material contains traces of clay particles, amounting some 5-8% of the total weight. The range of the constituent sand grains was measured to be 3% - 50% and those of silts 44% - 89%. Since this deposit is located totally under the groundwater level, some boiling in the borings was evident on account of the unbalanced hydrostatic heads. Due to this condition the obtained penetration "N" values were rather erratic, ranging from 1 blow/ft. to 89 blows/ft.. The very small values may safely be disregarded, because these are the results of the loosening effect of the upward water pressure in the boreholes. The natural moisture contents of the samples vary between 16% and 21%, occasionally reaching 30% by dry weight.

4.4) Sandy Silts with some Clay and Gravel (Glacial Till):

The silts were underlain by glacial tills, extending to the bottom of the borings, the deepest of which was 55 feet below ground level, terminating at elevation 890 feet. The glacial deposit was classified to be sandy silt with some clay and gravel. Due to the presence of 11-16% of clay, the material is essentially cohesive. Grain-size analyses performed on samples taken in this deposit yielded 5-10% gravel, 31-37% sand, 43-47% silt and 11-16% clay-size particles. The average plastic limit moisture content was found to be 12%, the liquid limit 15%, with 8-10% natural moisture within the samples tested. The over consolidated nature of the glacial till was further emphasised by the hard consistency, the majority of penetration "N" values being over 100 blows/ft..

4.5) Groundwater Conditions:

Very high water levels were encountered in every borehole as shown on the borelog sheets. Groundwater was usually first observed around elevation 938 - 940 feet, some 6 - 8 feet below ground surface. Waterlevels, however, have further risen in the open boreholes, and stabilized at some 1-2 feet below ground level, within a few days. It is assumed that the noted water level was near the yearly high water table of this area.

## 5. DISCUSSION AND RECOMMENDATIONS:

### 5.1) General:

It is proposed to build a twin-overpass structure at the crossing of future Hwy. #403, Line D and Hwy. #53 in the Township of East Oxford. The bridge is planned to have three spans, the end spans being 80 feet long with a 113.5 feet long central span. It is postulated that perched abutments will be constructed. The grade of proposed Hwy. #403, at the crossing will be roughly at elevation 569 feet, some 20 - 21 feet above the existing grade of Hwy. #53.

The foundation investigation revealed a soil stratigraphy, consisting of a surficial stratum of clayey silts with firm to hard consistency, followed by silts to sandy silts, which in turn is underlain by hard glacial tills.

### 5.2) Foundations:

Beneath the uppermost 5 - 6 feet layer the very stiff to hard clayey silts were found to possess sufficient shear strength to support the proposed bridge on spread footings. Foundations under the piers as well as under the abutments may consequently be designed with spread footings. Footings should be placed at or below elevation 940 feet, using design loads up to 3 TSF on the footing bases. A minimum cover of 4 feet should be provided for frost protection.

Alternatively, the perched abutments, or if desired, the piers as well as the abutments can be designed to be supported on end-bearing piles, driven into the hard glacial till. The use of steel H piles appears to be the most economical. Piles should be driven according to Standard BD-82-7 using the appropriate design load. It is estimated that at the locations of the east abutments and east piers safe loads equal to the structural strength of the particular pile used will be reached by driving the piles to elevation 890 - 895 feet.

Under the west abutments and the west piers above bearing capacities may be reached by driving the piles to approximate elevation 900 feet. Pile caps at the abutment locations may be poured within the approach fills. In this case no bouldery material should be used for the fills at these locations, to facilitate pile driving through the

.....5

embankments. At the pier locations pile caps should be placed 4 feet below finished ground level.

5.3) Approach Fills and Excavations:

No stability problems are foreseen for the approach fills, provided that they are built with 2 horizontal to 1 vertical slopes.

No special dewatering scheme will likely be necessary for the footing excavations, since the clayey silts have sufficient cohesive strength to resist quick conditions, when excavated below groundwater level. Seepage water in the excavations may be handled by conventional open pumping. If the excavations remain open for some time, a lean concrete working slab might be necessary at the bottom of the excavations to prevent the soils from softening.

6. MISCELLANEOUS:

The field work carried out during the period of March 29 - April 12, 1972 was supervised by Mr. J. Bangs, Project Foundations Engineer.

Equipment used was owned and operated by P.V.K. Drilling Company, Burford, Ontario.

This report was written by Mr. A. K. Barsvary, Senior Foundations Engineer and reviewed by Mr. K. G. Selby, Supervising Foundations Engineer.

A. K. Barsvary, P. Eng.


K. G. Selby, P. Eng.

AKB/ht

June 6, 1972.

# APPENDIX I

FORM OB-MT-126 (REV. 1971)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

# RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 72-11044 LOCATION Sta. 114 + 77, 91 Ft. Rt. of ℄ Hwy. 53 ORIGINATED BY W.V.

W.P. 164-60-00 BORING DATE April 12, 1972 COMPILED BY A.K.B.

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | SAMPLES NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE |
|---|---|---|---|---|---|---|
| 945.7 | Ground level. | | | | | |
| 0.0 | Clayey silt. | | 1 | SS | 12 | |
| | | | 2 | SS | 28 | 940 |
| | Traces of sand and gravel. | | 3 | SS | 17 | |
| | | | 4 | SS | 38 | |
| | Stiff to hard. | | 5 | SS | 65 | |
| | | | 6 | SS | 45 | 930 |
| | | | 7 | SS | 41 | |
| | Greyish brown. | | | | | |
| 922.7 | | | 8 | SS | 36 | |
| 23.0 | | | | | | 920 |
| | Silty sand to sandy silt, traces of clay. | | 9 | SS | 26 | |
| | | | 10 | SS | 89 | |
| | Stiff to hard. | | | | | 910 |
| | Grey. | | 11 | SS | 26 | |
| | | | 12 | SS | 20 | |
| | | | | | | 900 |
| 895.7 | | | 13 | SS | 16 | |
| 50.0 | Sandy silt with clay and gravel. Hard. | | | | | |
| 890.7 | Glacial Till. | | 14 | SS | 100/8" | |
| 55.0 | End of borehole. | | | | | |

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 —— $w$

WATER CONTENT % (10, 20, 30)

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

REMARKS GR. SA. SI. CL.

3 4 53 40

0 50 44 6

10 31 43 16

20
15 ⟷ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1971)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

# RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 72-11044 LOCATION Sta. 112 + 70, 76 Ft. Rt. of ℄ Hwy. 53 ORIGINATED BY J.B.

W.P. 164-60-00 BORING DATE April 11, 1972 COMPILED BY A.K.B.

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | SAMPLES NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE |
|---|---|---|---|---|---|---|
| 946.6 | Ground level. | | | | | |
| 0.0 | Clayey silt with traces of sand and gravel. Firm to hard. Greyish brown. | | 1 | SS | 5 | |
| | | | 2 | SS | 20 | 940 |
| | | | 3 | SS | 49 | |
| | | | 4 | SS | 85 | |
| | | | 5 | SS | 74 | |
| | | | 6 | SS | 34 | 930 |
| 926.6 | | | 7 | SS | 20 | |
| 20.0 | Silt to sandy silt. Traces of clay. Stiff to hard. | | 8 | SS | 11 | |
| | | | 9 | SS | 10 | 920 |
| 911.6 | | | 10 | SS | 30 | |
| 35.0 | Sandy silt with clay and gravel. Glacial Till. Hard. | | 11 | SS | 36 | 910 |
| | | | 12 | SS | 100/8" | |
| 898.5 | | | ~~13~~ | ~~SS~~ | ~~100~~/9"900 | |
| 48.1 | End of borehole. | | | | | |

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 —— $w$

WATER CONTENT % (10 20 30)

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

| REMARKS | GR. SA. SI. CL. |
|---|---|
| | 3 9 53 35 |
| | 0 11 84 5 |

20
15 ⊕ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1971)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

# RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 72-11044 LOCATION Sta. 114 + 41, 37 Ft. Rt. of ℄ Hwy. 53 ORIGINATED BY J.B.

W.P. 164-60-00 BORING DATE April 7 - 10, 1972 COMPILED BY A.K.B.

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger. CHECKED BY

| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | SAMPLES NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE |
|---|---|---|---|---|---|---|
| 945.8 | Ground level. | | | | | |
| 0.0 | Clayey silt some sand | | 1 | SS | 5 | |
| | Firm to hard. | | 2 | SS | 21 | 940 |
| | | | 3 | SS | 51 | |
| | Greyish brown. | | 4 | SS | 40 | |
| | | | 5 | SS | 30 | |
| 929.3 | | | 6 | SS | 12 | 930 |
| 16.5 | Silt to sandy silt. | | 7 | SS | 11 | |
| | Traces of clay. | | | | | |
| | Stiff to hard. | | 8 | SS | 15 | 920 |
| 915.8 | | | 9 | SS | 30 | |
| 30.0 | Sandy silt with clay | | | | | |
| | and traces of gravel. | | 10 | SS | 29 | 910 |
| | Glacial Till. | | 11 | SS | 28 | |
| | Very stiff to hard. | | 12 | SS | 33 | |
| | Grey. | | | | | 900 |
| | | | 13 | SS | 100/8" | |
| 892.8 | | | 14 | SS | 100/7" | |
| 53.0 | End of borehole. | | | | | |

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. CL. |
|---|
| 0 21 57 22 |
| 0 3 89 8 |
| 5 37 47 11 |

20
15 ⊕ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1971)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

# RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 72-11044 LOCATION Sta. 112 + 59, 29 Ft. Rt. of ℄ Hwy. 53 ORIGINATED BY J.B.

W.P. 164-60-00 BORING DATE April 6, 1972 COMPILED BY A.K.B.

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | SAMPLES NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE |
|---|---|---|---|---|---|---|
| 946.9 | Ground level. | | | | | |
| 0.0 | Clayey silt with some sand and traces of gravel. Firm to hard. Greyish brown. | | 1 | SS | 7 | |
| | | | 2 | SS | 15 | 940 |
| | | | 3 | SS | 28 | |
| | | | 4 | SS | 31 | |
| | | | 5 | SS | 41 | |
| | | | 6 | SS | 33 | |
| | | | 7 | SS | 27 | 930 |
| 921.9 | | | 8 | SS | 24 | |
| 25.0 | Silt to sandy silt. Traces of clay. | | 9 | SS | 25 | 920 |
| 911.9 | Very stiff to soft. | | 10 | SS | 5 | |
| 35.0 | Sandy silt with some clay and gravel. Glacial Till. Very stiff to hard. | | 11 | SS | 24 | 910 |
| | | | 12 | SS | 33 | |
| | | | 13 | SS | 100/9" | 900 |
| 893.9 | | | 14 | SS | 100/6" | |
| 53.0 | End of borehole. | | | | | |

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 —— $w$

WATER CONTENT % (10 20 30)

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

REMARKS GR.SA.SI.CL.

6 13 55 26

20
15 ⊕ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1971)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

# RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 72-11044 LOCATION Sta. 116 + 12, 30 Ft. Lt. of ℄ Hwy. 53 ORIGINATED BY J.B.

W.P. 164-60-00 BORING DATE March 29, 1972 COMPILED BY A.K.B.

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| SOIL PROFILE ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | SAMPLES NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100 / SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE | LIQUID LIMIT $w_L$ PLASTIC LIMIT $w_P$ WATER CONTENT $w$ WATER CONTENT % 10 20 30 | BULK DENSITY $\gamma$ P.C.F. | REMARKS GR.SA.SI.CL. |
|---|---|---|---|---|---|---|---|---|---|---|
| 945.4 | Ground level. | | | | | | | | | |
| 0.0 | Clayey silt with some sand & traces of gravel. Stiff to hard. Greyish brown. | | 1 | SS | 16 | | | | | |
| | | | 2 | SS | 35 | 940 | | | | |
| | | | 3 | SS | 59 | | | | | 8 21 51 20 |
| | | | 4 | SS | 100 | | | | | |
| | | | 5 | SS | 100/9" | | | | | |
| | | | 6 | SS | 118 | 930 | | | | |
| | | | 7 | SS | 25 | | | | | |
| 922.9 | | | | | | | | | | |
| 22.5 | Sandy silt with traces of clay. Stiff to hard. | | 8 | SS | | | | | | 1 14 79 6 |
| | | | 9 | SS | 13 | 920 | | | | |
| | | | 10 | SS | 59 | | | | | |
| 910.4 | | | | | | 910 | | | | |
| 35.0 | Sandy silt with some clay & gravel. Glacial Till. Hard. | | 11 | SS | 100/9" | | | | | |
| 902.7 | | | 12 | SS | 100/3" | | | | | |
| 42.7 | End of borehole. | | | | | | | | | |

20
15 ⊖ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1971)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

# RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 72-11044 LOCATION Sta. 114 + 24, 41 Ft. Lt. of ℄ Hwy. 53 ORIGINATED BY J.B.

W.P. 164-60-00 BORING DATE March 30, 1972 COMPILED BY A.K.B.

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS/FOOT |
|---|---|---|---|---|---|
| 945.8 | Ground level. | | | | |
| 0.0 | Clayey silt with some sand and traces of gravel. Firm to hard. Greyish brown. | | 1 | SS | 7 |
| | | | 2 | SS | 12 |
| | | | 3 | SS | 37 |
| | | | 4 | SS | 61 |
| | | | 5 | SS | 30 |
| 929.8 | | | 6 | SS | 35 |
| 16.0 | Silt to sandy silt. Traces of clay. Very stiff to hard. | | 7 | SS | 24 |
| | | | 8 | SS | 28 |
| | | | 9 | SS | 35 |
| | | | 10 | SS | 23 |
| 907.8 | | | 11 | SS | 29 |
| 38.0 | Sandy silt with clay and gravel. Glacial Till. | | | | |
| 901.8 | | | | | |
| 44.0 | End of borehole. | | | | |

ELEV. SCALE: 940, 930, 920, 910

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

G.R.SA.SI.CL.

W.L. not observed.

20
15 ⊕ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1971)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

# RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 72-11044 LOCATION Sta. 115 + 94, 80 Ft. Lt. of ℄ Hwy. 53 ORIGINATED BY J.B.

W.P. 164-60-00 BORING DATE April 5, 1972 COMPILED BY A.K.B.

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE |
|---|---|---|---|---|---|---|
| 945.7 | Ground level. | | | | | |
| 0.0 | Clayey silt with some sand, traces of gravel. Stiff to hard. Greyish brown. | | 1 | SS | 12 | |
| | | | 2 | SS | 20 | 940 |
| | | | 3 | SS | 58 | |
| | | | 4 | SS | 44 | |
| | | | 5 | SS | 60 | |
| 927.7 | | | 6 | SS | 21 | 930 |
| 18.0 | Silt to sandy silt. Traces of clay. Very soft to firm. | | 7 | SS | 4 | |
| | | | 8 | SS | 1 | |
| | | | | | | 920 |
| 914.7 | | | 9 | SS | 7 | |
| 31.0 | Sandy silt with sand and gravel. Glacial Till. Hard. Greyish brown. | | 10 | SS | 100/8" | |
| | | | 11 | SS | 100/9" | 910 |
| 902.6 | | | 12 | SS | 100/7" | |
| 43.1 | End of borehole. | | | | | |

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.CL.

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1971)

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
DESIGN SERVICES BRANCH

# RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 72-11044 LOCATION Sta. 113 + 87, 92 Ft. Lt. of ℄ Hwy. 53 ORIGINATED BY J.B.

W.P. 164-60-00 BORING DATE April 4, 1972 COMPILED BY A.K.B.

DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger CHECKED BY

| ELEV. DEPTH | DESCRIPTION | STRAT. PLOT | NUMBER | TYPE | BLOWS/FOOT | ELEV. SCALE |
|---|---|---|---|---|---|---|
| 946.1 | Ground level. | | | | | |
| 0.0 | Clayey silt with traces of sand and gravel. Firm to hard. Greyish brown. | | 1 | SS | 7 | |
| | | | 2 | SS | 10 | 940 |
| | | | 3 | SS | 61 | |
| | | | 4 | SS | 54 | |
| 932.1 | | | 5 | SS | 55 | |
| 14.0 | Sandy silt, traces of clay. Stiff to hard. | | 6 | SS | 21 | 930 |
| | | | 7 | SS | 31 | |
| | | | 8 | SS | 15 | |
| | | | | | | 920 |
| | | | 9 | SS | 12 | |
| 911.1 | | | 10 | SS | 54 | |
| 35.0 | Sandy silt, some clay and gravel. Glacial Till. Hard. Greyish brown. | | 11 | SS | 100/10" | 910 |
| | | | 12 | SS | 100/8" | |
| | | | | | | 900 |
| 897.1 | | | 13 | SS | 100 | |
| 49.0 | End of borehole. | | | | | |

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 —— $w$

WATER CONTENT %
10 20 30

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

REMARKS GR.SA.SI.CL.

2 9 59 30

0 22 73 5

20
15 ⊕ 5 % STRAIN AT FAILURE
10

# 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

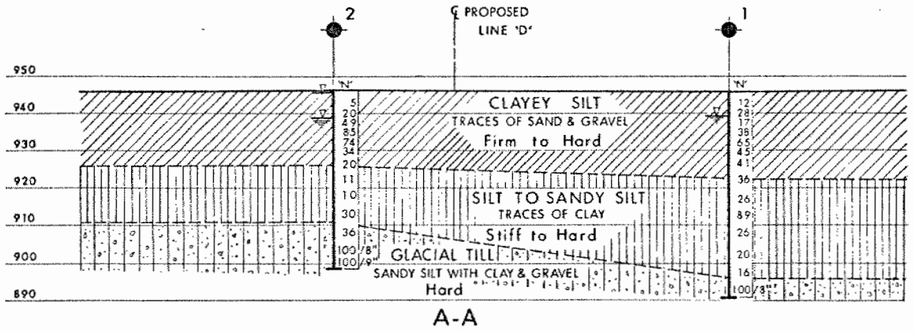
| | |
|---|---|
| d | DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE |
| $\delta$ | ANGLE OF WALL FRICTION |
| K | DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS |
| $K_o$ | COEFFICIENT OF EARTH PRESSURE AT REST |

## FOUNDATIONS

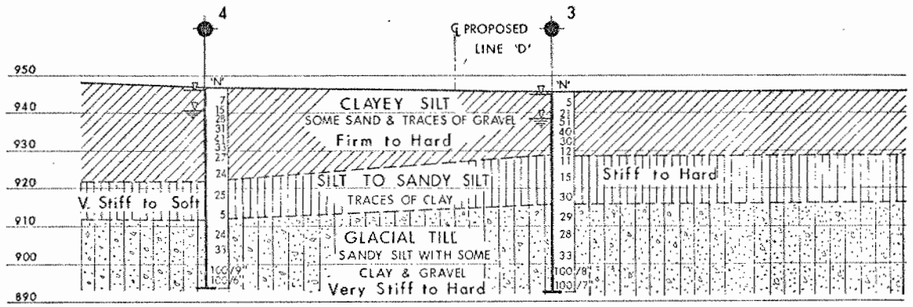
| | |
|---|---|
| B | BREADTH OF FOUNDATION |
| L | LENGTH OF FOUNDATION |
| D | DEPTH OF FOUNDATION BENEATH GROUND |
| N | DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY. DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY |
| $k_s$ | MODULUS OF SUBGRADE REACTION |

## SLOPES

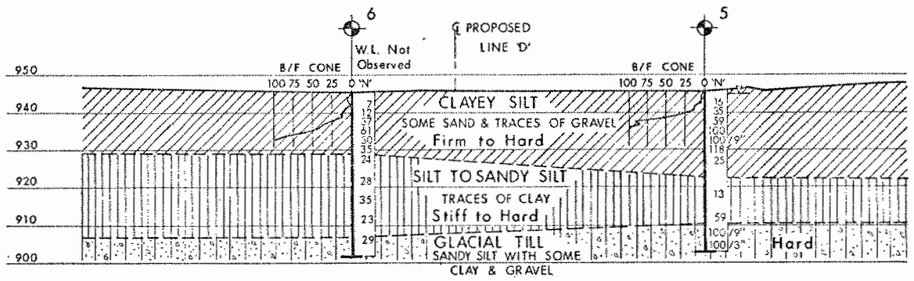
| | |
|---|---|
| H | VERTICAL HEIGHT OF SLOPE |
| D | DEPTH BELOW TOE OF SLOPE TO HARD STRATUM |
| $\beta$ | ANGLE OF SLOPE TO HORIZONTAL |



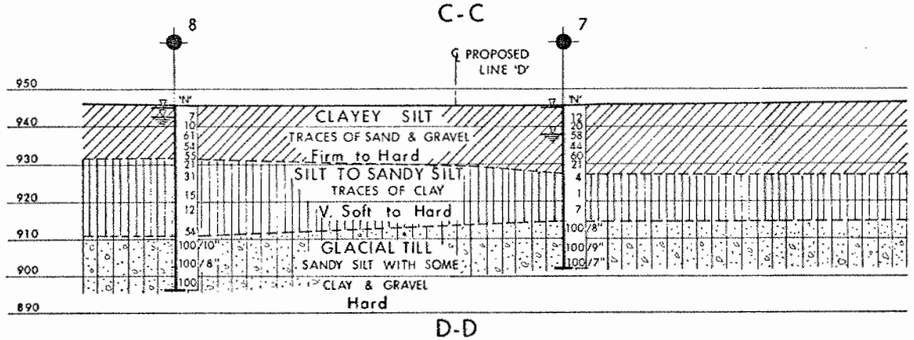

A-A




B-B



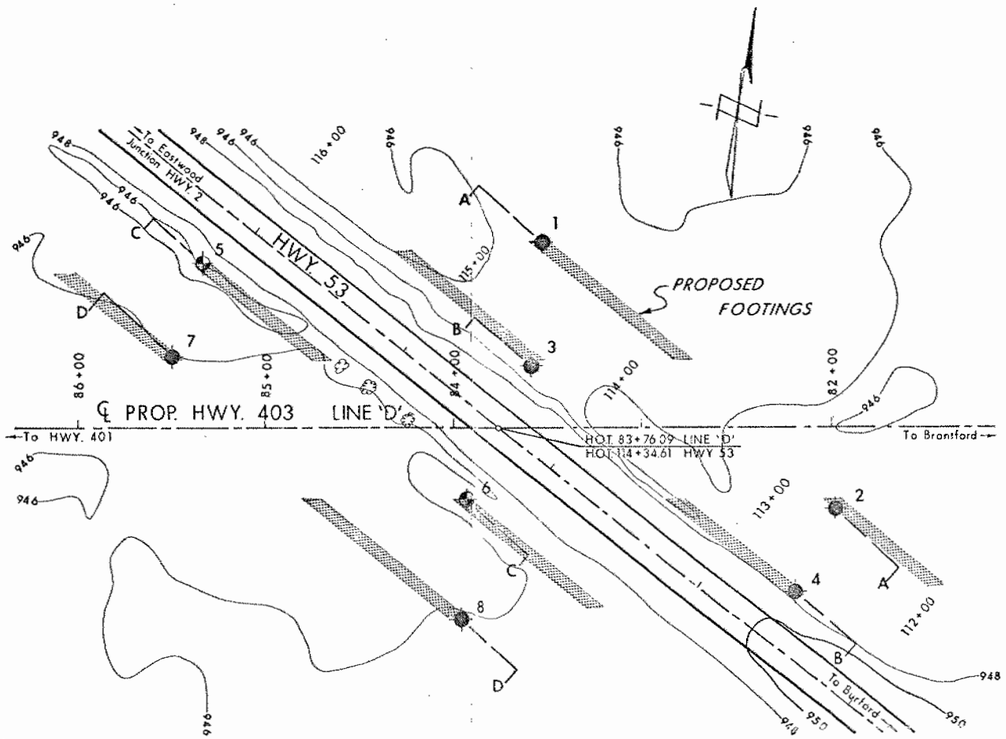

C-C




D-D

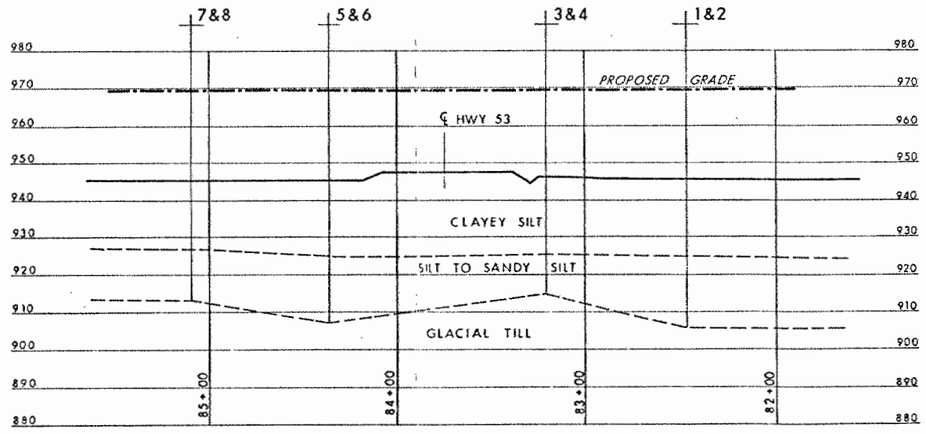
SECTIONS

SCALE
40 20 0 40 80 FT. HORIZONTAL
20 10 0 20 40 FT. VERTICAL




PLAN

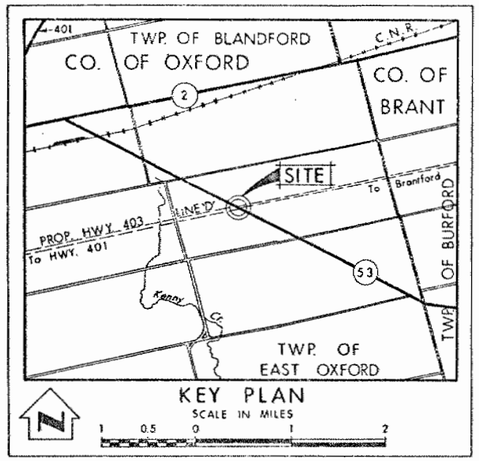
SCALE
40 20 0 40 80 FT.




℄ PROFILE — LINE 'D'

SCALE
40 20 0 40 80 FT. HORIZONTAL
20 10 0 20 40 FT. VERTICAL

REF. Nº E-4894-1




## LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation.
- HEAD Artesian Water ENCOUNTERED — APRIL, 1972

| NO. | ELEVATION | HWY 53 STATION | OFFSET |
|---|---|---|---|
| 1 | 945.7 | 114 + 77 | 91' RT. |
| 2 | 946.6 | 112 + 70 | 76' RT. |
| 3 | 945.8 | 114 + 41 | 37' RT. |
| 4 | 946.9 | 112 + 59 | 29' RT. |
| 5 | 945.4 | 116 + 12 | 30' LT. |
| 6 | 945.8 | 114 + 24 | 41' LT. |
| 7 | 945.7 | 115 + 94 | 80' LT. |
| 8 | 946.1 | 113 + 87 | 92' LT. |

— NOTE —

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

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

MINISTRY OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

# HIGHWAY 53

HIGHWAY NO. 403 LINE 'D' DIST. NO. 4
CO. OXFORD
TWP. EAST OXFORD LOTS 4 & 5 CON. 2

## BORE HOLE LOCATIONS & SOIL STRATA

| | | | |
|---|---|---|---|
| SUBM'D. A.B | CHECKED G.C | W.P NO 164-60-00 | DRAWING NO. 72-11044A |
| DRAWN O.E. | CHECKED G.C | JOB NO 72-11044 | |
| DATE JUNE 9, 1972 | | SITE NO. | BRIDGE DRAWING NO. |
| APPROVED A.Williamson PRINCIPAL FOUNDATION ENGINEER | | CONT. NO. | |

# memorandum

Ontario

To: Mr. V.F. Boehnke
Head, Structural Section
Southwestern Region

Date: 1981 05 01

Attention: S. Jants

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

Re: Hwy. #53 Interchange
W.P. 164-60-00; Site 23-291
Hwy. #403, District #4 (Hamilton)

## Introduction

In response to your request of 81 02 11 we have reviewed our original foundation investigation report, W.O. 72-11044 (issued on June 19, 1972), in which the recommendations were related to overpass twin-structures. Since that time, the original proposals have been changed to a three-span, single underpass structure. This new proposal also includes the construction of retaining walls adjacent to the four corners of the future structure. In light of this new proposal our recommendations (metric) are as follows.

## Structure Foundations

The entire structure (abutments, pier and retaining walls) may be supported on spread footing type foundations placed at or below El. 286. For design purposes a safe design load of 450 kPa may be assumed. The anticipated settlement of the footings under such a loading is about 30 mm.

As an alternative the footings may be supported on end-bearing steel 'H' piles driven into the very stiff to hard glacial till stratum. For HP 310 x 110 steel 'H' piles with reinforced tips, the maximum permissible load is 1100 kN. The piles should be driven to the following minimum levels:

West abutment and adjacent retaining walls: El. 277±
Pier: El. 273±
East Abutment and Adjacent retaining walls: El. 274±

The pile driving should be in accordance with M.T.C. Standards SS 103-11 or SS 103-10. The driving energy should not be less than 50,000 Joules per blow.

continued...../2

Approach Embankments

Fills up to 7.5 metres are required to attain the proposed profile grade (El. 296.5) of Hwy. #53 at this location. No stability problems are anticipated for fills of this height provided with 2:1 forward and side slopes. Long term settlement of the cohesive portion of the subsoil induced by the construction of the approach fills is estimated to be in the range of 25-30 mm.

The fill should consist of well compacted acceptable material. Care should be taken that no material having grain sizes larger than 75 mm is placed at locations were piles have to be driven.

Other Considerations

The frost protection requirements in this area is 1.2 m of earth cover.

In order to estimate the earth pressures on the abutment walls, the following values are recommended:

Unit weight of granular backfill: 21.2 $kN/m^3$
Coefficient of active earth pressure : $K_a = 0.35$
Coefficient of earth pressure at rest: $K_o = 0.5$

A suitable drainage system should be provided to relieve the build-up of excess hydrostatic pressure behind the walls.

Should spread footing type supports be selected, the base of the excavations should be protected against softening by pouring an approximate 15 cm thick lean concrete immediately upon exposure.

A shearing resistance value of 50 kPa against sliding is assumed to apply between the base of footings and the cohesive (silty clay) subsoil.

Miscellaneous

A revised, new metric drawing and foundation investigation report will be prepared for contract purposes.

Should additional information be required please contact our Office.

P. Payer
Foundations Engineer
For: K.G. Selby
Senior Foundations Engineer

PP:ea

cc: S.C. Grebski

DOCUMENT MICROFILMING IDENTIFICATION

Reference 2A

G.I.-30 SEPT. 1976

GEOCRES No. 40P2-28

DIST. 4 REGION

W.P. No. 164-60-01

CONT. No. 83-10

W. O. No.

STR. SITE No. 23-291

HWY. No. 403

LOCATION Hwy 53 and Hwy 403 Overhead

No of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

Ontario Ministry of Transportation and Communications

# RECORD OF BOREHOLE No 3

W P 164-60-01 LOCATION Sta. 13+346.2, 10.7 m Lt. ℄ Hwy. 53 ORIGINATED BY J.B.

DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY O.J.

DATUM Geodetic DATE 72 04 10 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 | PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL | UNIT WEIGHT γ | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | SHEAR STRENGTH: o UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE | WATER CONTENT (%) 10 20 30 | | GR SA SI CL |
| 288.3 | Ground Level | | | | | | 288 | | | | |
| | Silty Clay<br>Low Plasticity<br>Some Sand<br>Grayish Brown<br>Firm to Hard | | 1 | SS | 5 | | | | | | 0 21 57 22 |
| | | | 2 | SS | 21 | | 286 | | | | |
| | | | 3 | SS | 51 | | | | | | |
| | | | 4 | SS | 40 | | | | | | |
| | | | 5 | SS | 30 | | 284 | | | | |
| 283.3 | | | 6 | SS | 12 | | | | | | |
| 5.0 | Silt to Sandy Silt<br>Traces of Clay<br>Compact to Dense | | 7 | SS | 11 | | | | | | |
| | | | 8 | SS | 15 | | 282 | | | | |
| 279.1 | | | 9 | SS | 30 | | 280 | | | | 0 3 89 8 |
| 9.1 | Silty Clay With Sand<br>Trace of Gravel<br>(Glacial Till)<br>Very Stiff to Hard<br>Gray | | 10 | SS | 29 | | | | | | |
| | | | 11 | SS | 28 | | 278 | | | | |
| | | | 12 | SS | 33 | | | | | | |
| | | | 13 | SS | 100/ 20 cm | | 276 | | | | |
| 272.1 | | | 14 | SS | 100/ 18 cm | | 274 | | | | 5 37 47 11 |
| 16.2 | End of Borehole | | | | | | 272 | | | | |

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

Ontario Ministry of Transportation and Communications

# RECORD OF BOREHOLE No 4

W P 164-60-01 LOCATION Sta. 13+403.6, 9.1 m Lt. ℄ Hwy. 53 ORIGINATED BY J.B.

DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY O.J.

DATUM Geodetic DATE 72 04 06 CHECKED BY

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 288.6 | Ground Level | | | | | | | | | | |
| 0.0 | Silty Clay<br>Low Plasticity<br>Some Sand<br>Traces of Gravel<br>Firm to Hard<br>Grayish Brown | | 1 | SS | 7 | | 288 | | | | |
| | | | 2 | SS | 15 | | | | | | |
| | | | 3 | SS | 28 | | 286 | | | | 6 13 55 26 |
| | | | 4 | SS | 31 | | | | | | |
| | | | 5 | SS | 41 | | | | | | |
| | | | 6 | SS | 33 | | 284 | | | | |
| | | | 7 | SS | 27 | | | | | | |
| 281.0 | | | 8 | SS | 24 | | 282 | | | | |
| 7.6 | Silt to Sandy Silt<br>Traces of Clay<br>Loose to Compact | | 9 | SS | 25 | | 280 | | | | |
| 277.9 | | | 10 | SS | 5 | | 278 | | | | |
| 10.7 | Silty Clay With Sand<br>Trace of Gravel<br>(Glacial Till)<br>Very Stiff to Hard | | 11 | SS | 24 | | | | | | |
| | | | 12 | SS | 33 | | 276 | | | | |
| | | | 13 | SS | 100/ 23 cm | | 274 | | | | |
| 272.5 | | | 14 | SS | 100/ 15 cm | | | | | | |
| 16.2 | End of Borehole | | | | | | 272 | | | | |

+3, ×5 : Numbers refer to Sensitivity

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

Ontario Ministry of Transportation and Communications

# RECORD OF BOREHOLE No 5

W P 164-60-01 LOCATION Sta. 13+296.2, 9.1 m Rt. ℄ Hwy. 53 ORIGINATED BY J.B.

DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY

DATUM Geodetic DATE 72 03 29 CHECKED BY

| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | SAMPLES NUMBER | SAMPLES TYPE | SAMPLES 'N' VALUES | GROUND WATER CONDITIONS | ELEVATION SCALE |
|---|---|---|---|---|---|---|---|
| 288.2 / 0.0 | Ground Level | | | | | | 288 |
| | Silty Clay | | 1 | SS | 16 | | |
| | Low Plasticity | | 2 | SS | 35 | | |
| | Some Sand | | 3 | SS | 59 | | 286 |
| | Traces of Gravel | | | | | | |
| | Stiff to Hard | | 4 | SS | 100 | | |
| | Grayish Brown | | 5 | SS | 100/ 23 cm | | 284 |
| | | | 6 | SS | 118 | | |
| | | | 7 | SS | 25 | | |
| 281.3 | | | | | | | 282 |
| 6.9 | Sandy Silt | | 8 | SS | 1 | | |
| | Traces of Clay | | | | | | 280 |
| | | | 9 | SS | 13 | | |
| | Compact to Very Dense | | | | | | |
| 277.5 | | | 10 | SS | 59 | | 278 |
| 10.7 | Silty Clay With Sand | | | | | | |
| | Trace of Gravel | | 11 | SS | 100/ 23 cm | | |
| | (Glacial Till) | | | | | | 276 |
| 275.1 | Hard | | 12 | SS | 100/ 8 cm | | |
| 13.0 | End of Borehole | | | | | | 274 |

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH
o UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT Wp | NATURAL MOISTURE CONTENT W | LIQUID LIMIT $W_L$

WATER CONTENT (%) 10 20 30

UNIT WEIGHT γ

| REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|---|
| 8 21 51 20 |
| 1 14 79 6 |

+3, ×5 : Numbers refer to Sensitivity

20
15 ⊹ 5 (%) STRAIN AT FAILURE
10

Ontario Ministry of Transportation and Communications

# RECORD OF BOREHOLE No 6

W P 164-60-01 LOCATION Sta. 13+352.6, 12.2 m Rt. ℄ Hwy. 53 ORIGINATED BY J.B.

DIST 4 HWY 403 BOREHOLE TYPE Hollow Stem Auger COMPILED BY O.J.

DATUM Geodetic DATE 72 03 30 CHECKED BY

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION SCALE | DYNAMIC CONE PENETRATION RESISTANCE PLOT | PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT | UNIT WEIGHT | REMARKS & GRAIN SIZE DISTRIBUTION (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV / DEPTH | DESCRIPTION | STRAT PLOT | NUMBER | TYPE | 'N' VALUES | | | SHEAR STRENGTH: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE | $W_p$ W $W_L$ | $\gamma$ | GR SA SI CL |
| 288.3 | Ground Level | | | | | | | 20 40 60 80 100 | WATER CONTENT (%) 10 20 30 | | |
| | Silty Clay Low Plasticity Some Sand Traces of Gravel Firm to Hard Grayish Brown | | 1 | SS | 7 | | | | | | |
| | | | 2 | SS | 12 | | | | | | |
| | | | 3 | SS | 37 | | | | | | |
| | | | 4 | SS | 61 | | | | | | |
| | | | 5 | SS | 30 | | | | | | |
| 283.4 | | | 6 | SS | 35 | | | | | | |
| 4.9 | Silt to Sandy Silt Trace of Clay Compact to Dense | | 7 | SS | 24 | | | | | | |
| | | | 8 | SS | 28 | | | | | | |
| | | | 9 | SS | 35 | | | | | | |
| | | | 10 | SS | 23 | | | | | | |
| 276.7 | | | | | | | | | | | |
| 11.6 | Silty Clay With Sand, Trace of Gravel (Till) Hard | | 11 | SS | 29 | | | | | | |
| 274.9 | | | | | | | | | | | |
| 13.4 | End of Borehole | | | | | | | | | | |

288 286 284 282 280 278 276 274

+3, ×5 : Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO 08-MT-3068 R-78

METRIC

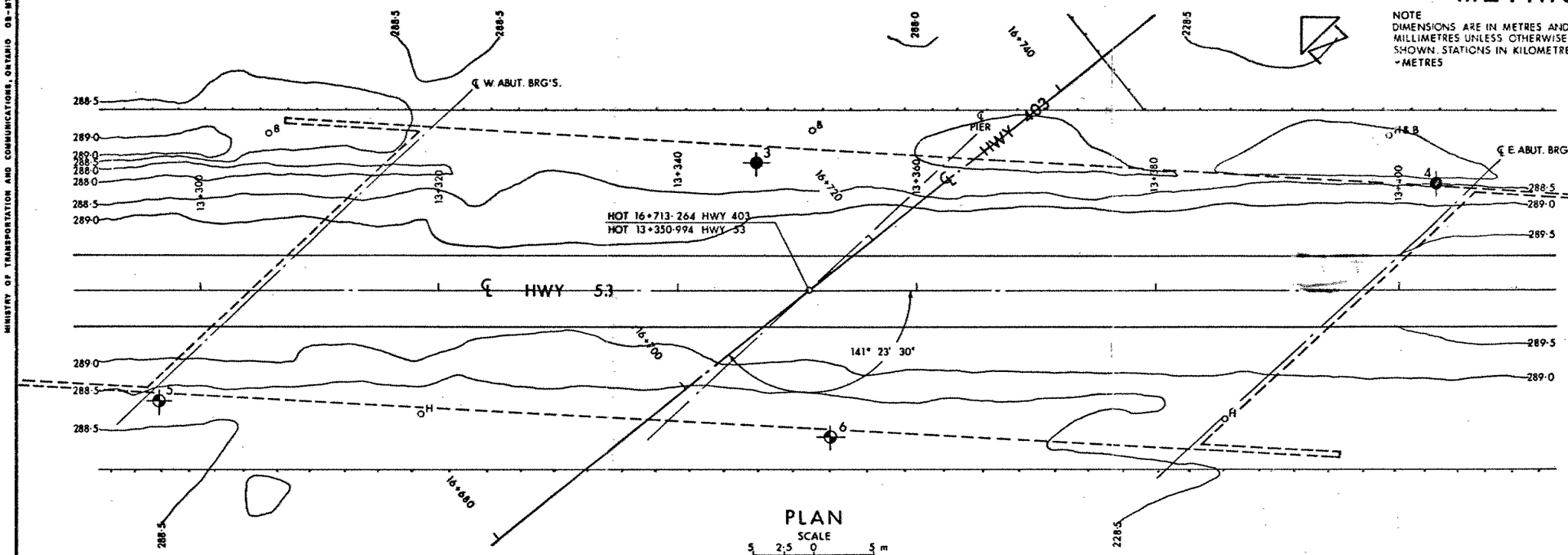
NOTE
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES + METRES

CONT No
W P No 164-60-01

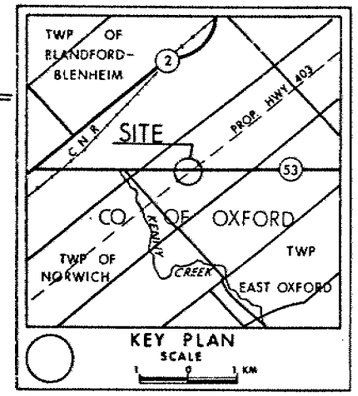
HWY. 53 INTERCH. U'PASS.

BORE HOLE LOCATIONS & SOIL STRATA

SHEET

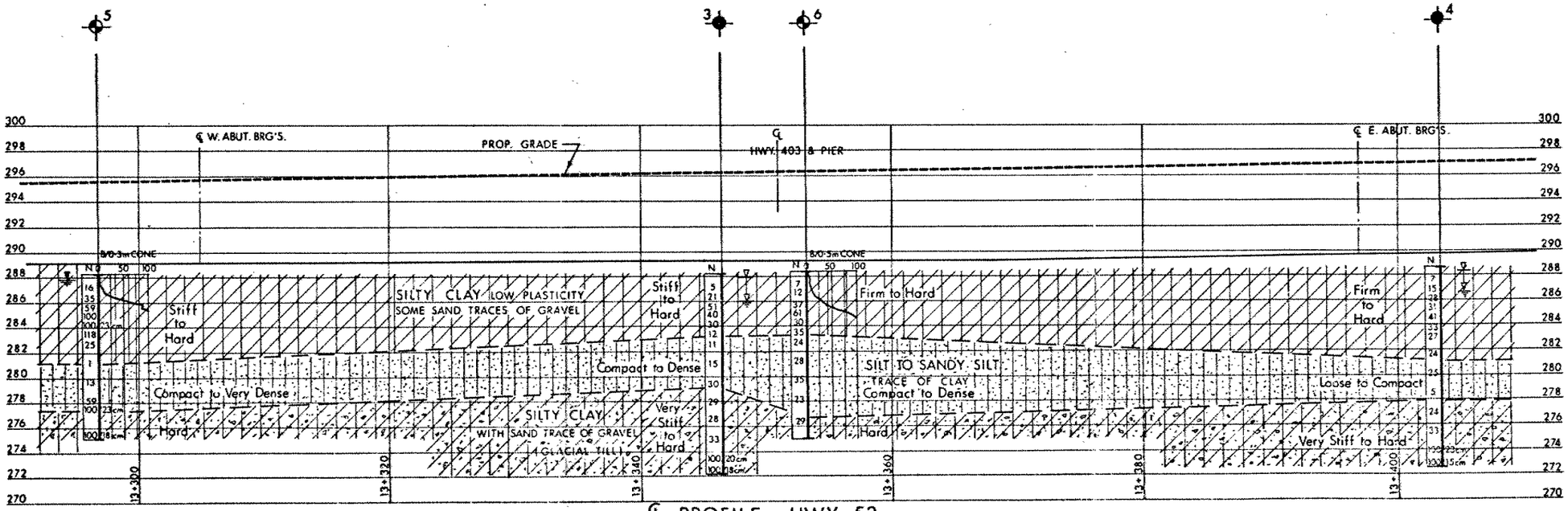



PLAN
SCALE 5 2·5 0 5 m




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)
- W L at time of investigation 72 04 10
- HEAD ARTESIAN CONDITION ENCOUNTERED




℄ PROFILE HWY 53
SCALE 5 2·5 0 5 m

| No | ELEVATION | STATION | OFFSET C/L HWY 53 |
|---|---|---|---|
| 3 | 288·3 | 13+346·2 | 10·7 LT. |
| 4 | 288·6 | 13+403·6 | 9·1 LT. |
| 5 | 288·2 | 13+296·2 | 9·1 RT. |
| 6 | 288·3 | 13+352·6 | 12·2 RT. |

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 |

Geocres No 40P2-28

| | | | |
|---|---|---|---|
| HWY No 403 | | | DIST 4 |
| SUBMITTED K | CHECKED | DATE 81 03 30 | SITE 23-291 |
| DRAWN DL J | CHECKED | APPROVED | DWG 2 |

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO OB-MT-3088M 6-72

# METRIC

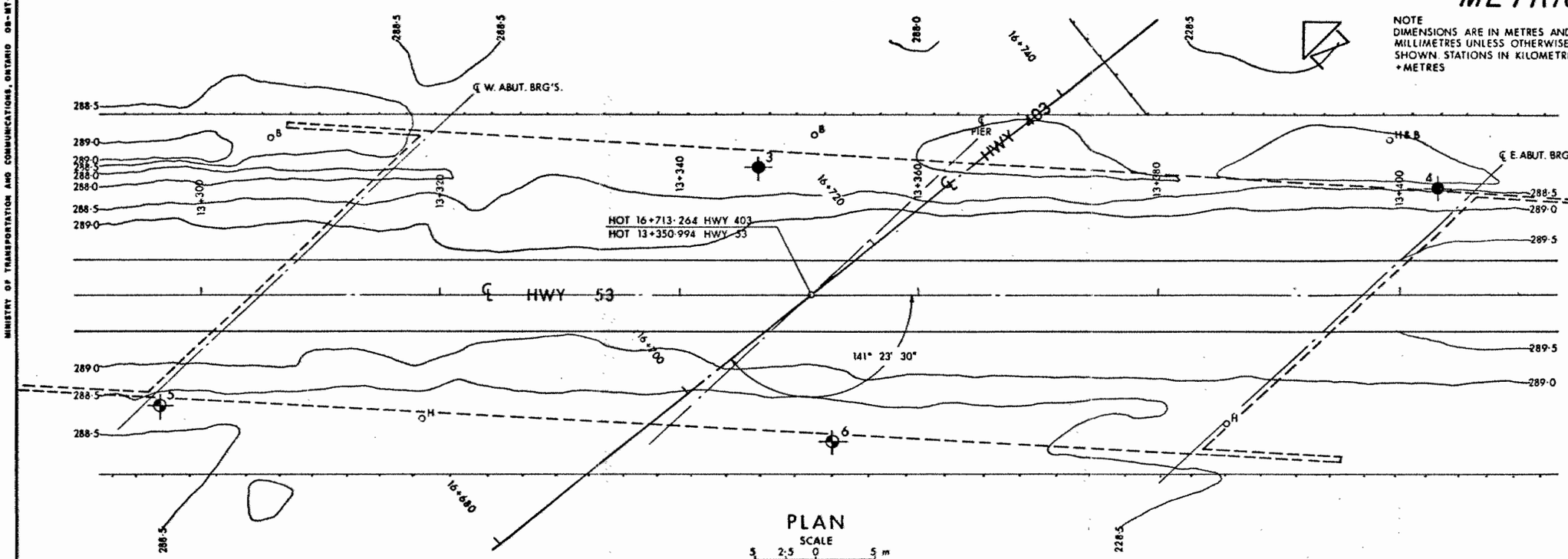
NOTE
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN. STATIONS IN KILOMETRES +METRES

CONT No
WP No 164-60-01

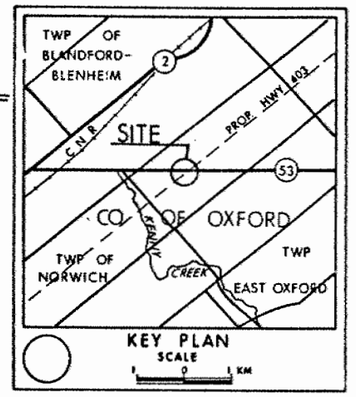
HWY. 53 INTERCH. U'PASS.

BORE HOLE LOCATIONS & SOIL STRATA

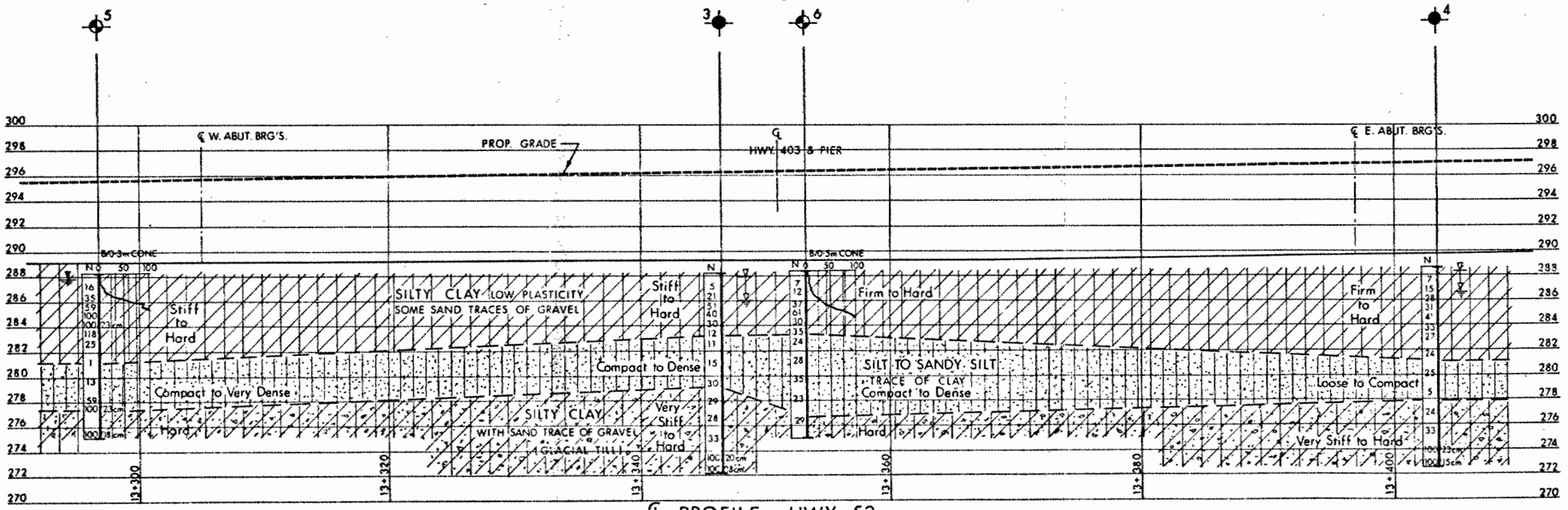
SHEET




PLAN
SCALE 5 2·5 0 5 m




KEY PLAN
SCALE 1 0 1 KM




℄ PROFILE HWY 53
SCALE 5 2·5 0 5 m

## 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)
- W L at time of investigation 72 04 10
- HEAD ARTESIAN CONDITION ENCOUNTERED

| No | ELEVATION | STATION | OFFSET C/L HWY 53 |
|---|---|---|---|
| 3 | 288·3 | 13+346·2 | 10·7 LT. |
| 4 | 288·6 | 13+403·6 | 9·1 LT. |
| 5 | 288·2 | 13+296·2 | 9·1 RT. |
| 6 | 288·3 | 13+352·6 | 12·2 RT. |

**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 |

Geocres No 40P2-28

| | | | |
|---|---|---|---|
| HWY No 403 | | | DIST 4 |
| SUBMIT K | CHECKED | DATE 81 03 30 | SITE 23-291 |
| DRAWN OL J | CHECKED | APPROVED | DWG 2 |

81 10 19

PILE INFORMATION TO BE ADDED TO DWG -4, "FOOTING AND PIER DETAILS"
HWY 53 INTERCHANGE U'PASS, HWY 403, WP 164-60-01 SITE 23-291

## PILE DATA

- PILES FOR ABUTMENTS AND PIER SHALL BE HP310x110 STEEL H-PILES.
- PILES FOR N.E. & S.W. RETAINING WALLS SHALL BE HP 310 x 79 STEEL H-PILES.
- PILE LENGTH SHOWN ON THE DRAWING IS THE THEORETICAL LENGTH BELOW CUT-OFF.
- DRIVING SHOES TO BE PROVIDED ON ALL PILES IN ACCORDANCE WITH STANDARD OPSD 3301.

## PILE DESIGN DATA

HP 310 x 110 { DESIGN LOAD AT S.L.S. TYPE II = 900.0 KN ←
FACTORED CAPACITY AT U.L.S. = 1600.0 KN ←

HP 310 x 79 { DESIGN LOAD AT S.L.S. TYPE II = 650.0 KN ←
FACTORED CAPACITY AT U.L.S. = 1150.0 KN ←

## PILE CONSTRUCTION DATA

PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS 103-10 OR SS 103-11 USING AN ULTIMATE CAPACITY OF
2700.0 KN PER PILE FOR HP 310x110 PILES AND
1950.0 KN PER PILE FOR HP 310x 79 PILES, BUT MUST BE DRIVEN BELOW,

EL: 277.0 FOR THE WEST ABUTMENT AND S.W. RETAINING WALL,
EL. 273.0 FOR THE PIER AND
EL. 274.0 FOR THE EAST ABUTMENT AND N.E. RETAINING WALL.

Earth pressure should be calculated as per Subsection 6.6.1.2.2 of the OHBDC.

D. H. Dundas
81 10 23

1041

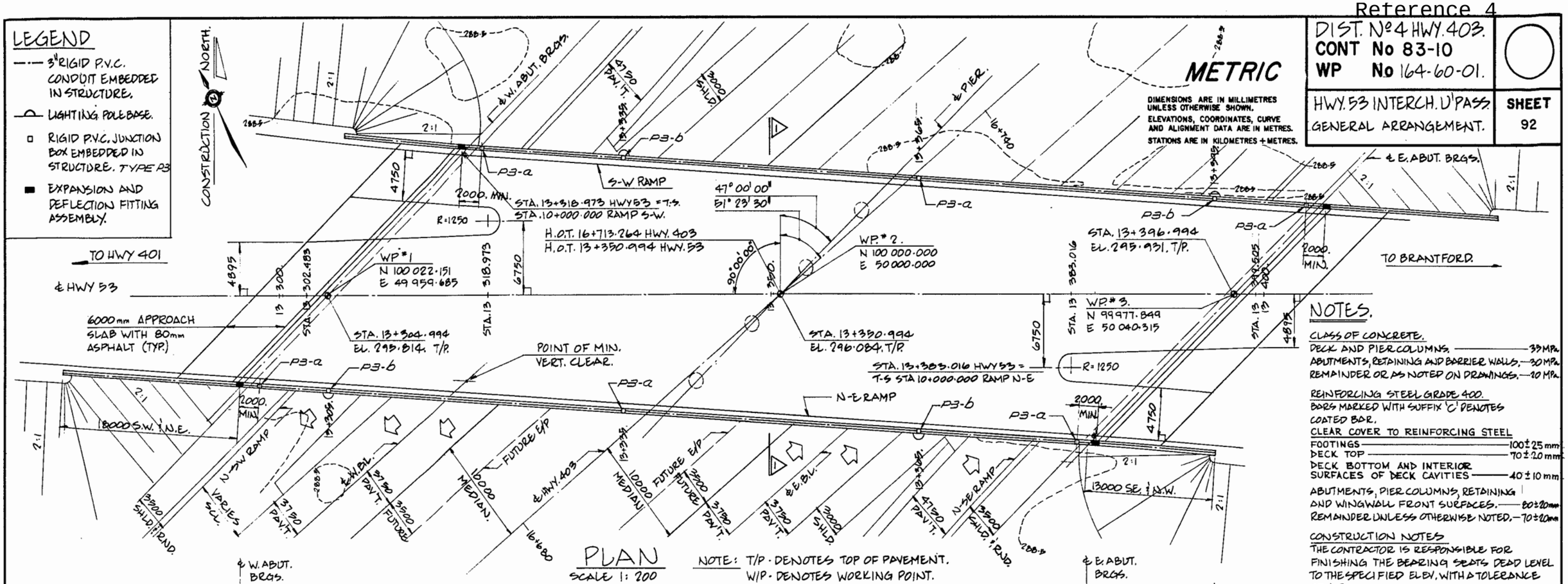
| DIST. Nº 4 HWY. 403. | |
|---|---|
| CONT No 83-10 | |
| WP No 164-60-01. | |
| HWY. 53 INTERCH. U'PASS. GENERAL ARRANGEMENT. | SHEET 92 |

## METRIC

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

## LEGEND

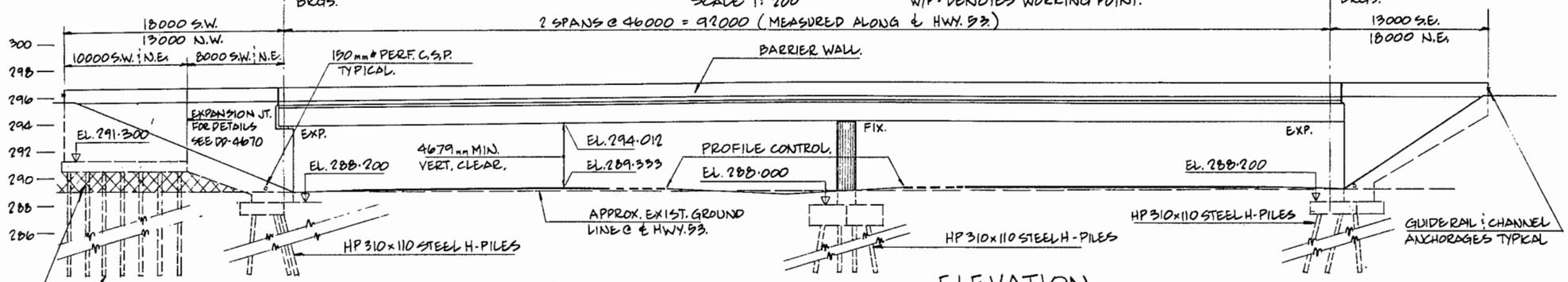
- 3" RIGID P.V.C. CONDUIT EMBEDDED IN STRUCTURE.
- LIGHTING POLE BASE.
- RIGID P.V.C. JUNCTION BOX EMBEDDED IN STRUCTURE. TYPE P3
- EXPANSION AND DEFLECTION FITTING ASSEMBLY.




## PLAN

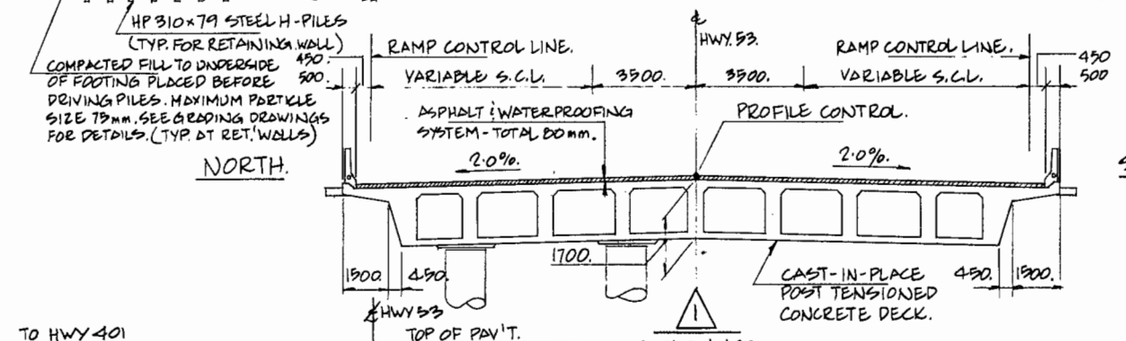
SCALE 1: 200

NOTE: T/P · DENOTES TOP OF PAVEMENT.
W/P · DENOTES WORKING POINT.

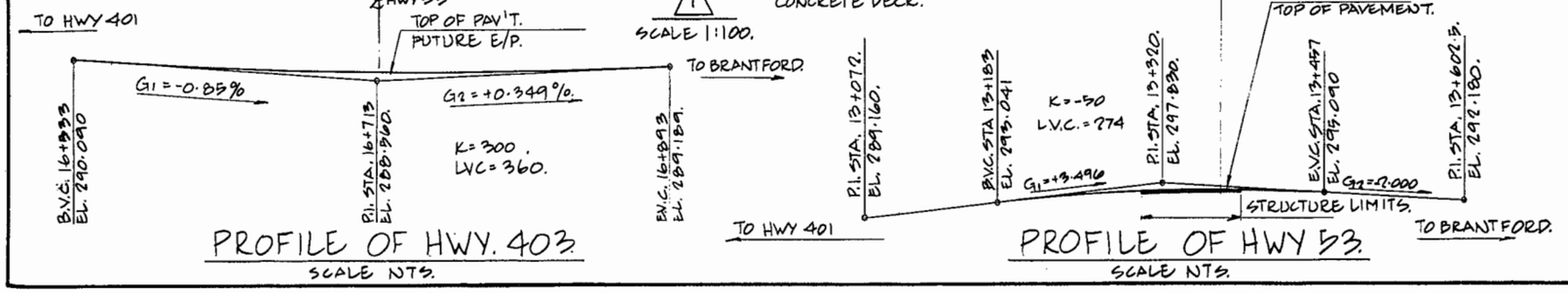



## ELEVATION.

SCALE 1:200.




SCALE 1:100.




## PROFILE OF HWY. 403

SCALE NTS.




## PROFILE OF HWY 53.

SCALE NTS.

## NOTES.

CLASS OF CONCRETE.
DECK AND PIER COLUMNS. — 35 MPa.
ABUTMENTS, RETAINING AND BARRIER WALLS. — 30 MPa.
REMAINDER OR AS NOTED ON DRAWINGS. — 20 MPa.

REINFORCING STEEL GRADE 400.
BARS MARKED WITH SUFFIX 'C' DENOTES COATED BAR.
CLEAR COVER TO REINFORCING STEEL
FOOTINGS — 100 ± 25 mm.
DECK TOP — 70 ± 20 mm.
DECK BOTTOM AND INTERIOR SURFACES OF DECK CAVITIES — 40 ± 10 mm.
ABUTMENTS, PIER COLUMNS, RETAINING AND WINGWALL FRONT SURFACES. — 80 ± 20 mm.
REMAINDER UNLESS OTHERWISE NOTED. — 70 ± 20 mm.

CONSTRUCTION NOTES
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEV. WITH A TOLERANCE OF ± 3 mm.

CONCRETE QUANTITIES.
CONCRETE QUANTITIES ARE LISTED BELOW FOR THE APPROPRIATE CONCRETE LUMP SUM TENDER ITEMS.
CONCRETE IN ABUTMENTS, WINGWALLS AND RETAINING WALLS. — 743 m³.
CONCRETE IN PIER. — 98 m³.
CONCRETE IN PRESSTRESSED CONCRETE BRIDGE DECK. — 1801 m³.
CONCRETE IN APPROACH SLABS. — 75 m³.
CONCRETE IN BARRIER WALLS. — 55 m³.

## LIST OF DRAWINGS.

1. GENERAL ARRANGEMENT.
2. BOREHOLE LOCATION ¦ SOIL STRATA.
3. FOOTING LAYOUT ¦ ALIGNMENT.
4. FOOTING ¦ PIER DETAILS.
5. FOOTING ¦ PIER REINFORCEMENT.
6. ABUTMENT LAYOUT.
7. ABUTMENT REINFORCEMENT.
8. DECK LAYOUT.
9. LONGITUDINAL CABLE DETAILS.
10. TRANSVERSE CABLE DETAILS.
11. CABLE DETAILS AND SCREED ELEVATIONS.
12. DECK REINFORCEMENT I.
13. DECK REINFORCEMENT II.
14. DECK REINFORCEMENT III.
15. DECK REINFORCEMENT IV.
16. DECK REINFORCEMENT V.
17. BARRIER WALL.
18. 6000mm APPROACH SLAB.
19. STANDARD DETAILS
20. AS CONSTRUCTED ELEV. AND DIM.
21. BRIDGE DATE AND SITE Nº DATA.
22. PILE DRIVING - DROP HAMMERS.
23. PILE DRIVING - STEAM AND DIESEL HAMMERS.
24. BRIDGE ELECTRICAL DETAILS

REGISTERED PROFESSIONAL ENGINEER — CIVIL — D.C. BATCHELOR — PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

| REVISIONS | | | |
|---|---|---|---|
| DATE | BY | DESCRIPTION | |
| DESIGN DCB | CHECK SMF | LOADING ONHDC-A-1 | DATE 81-10. |
| DRAWING JTF | CHECK DCB | SITE No 23-291 | DWG 1. |

Reference 5

DIST. Nº 4 HWY 403
CONT No 83-10
WP No 164-60-01

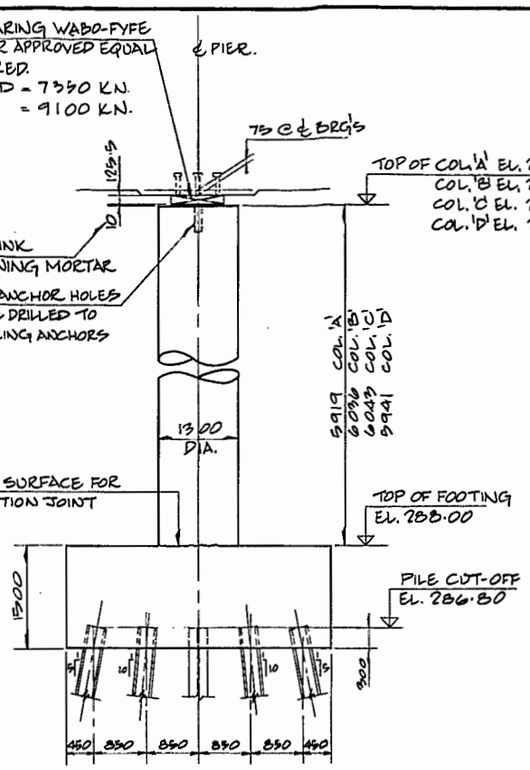
HWY 53 INTERCH. U'PASS
FOOTING & PIER DETAILS

SHEET 95

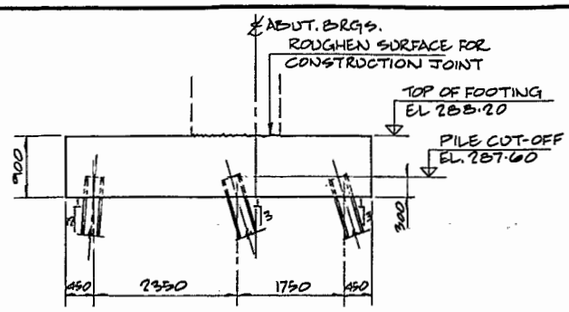
# METRIC

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

FIXED BEARING WABO-FYFE
SS-2100 OR APPROVED EQUAL
4- REQUIRED.
DEAD LOAD = 7350 KN.
DL.+L.L. = 9100 KN.

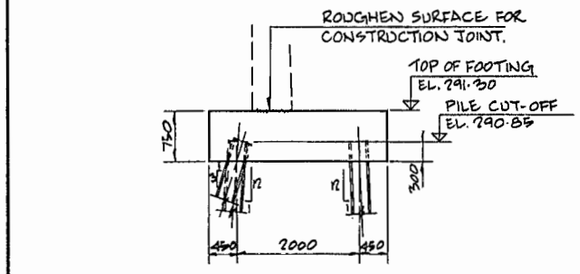



3
SCALE 1:50

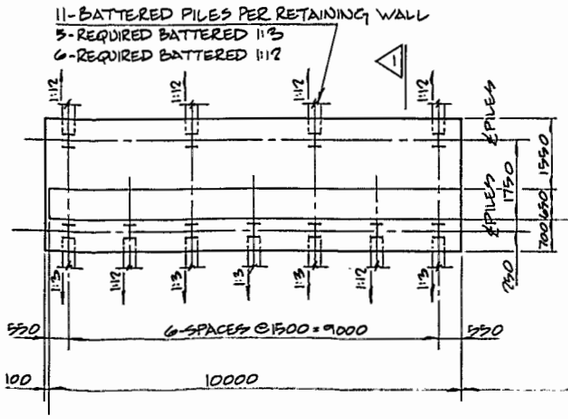



2
SCALE 1:50

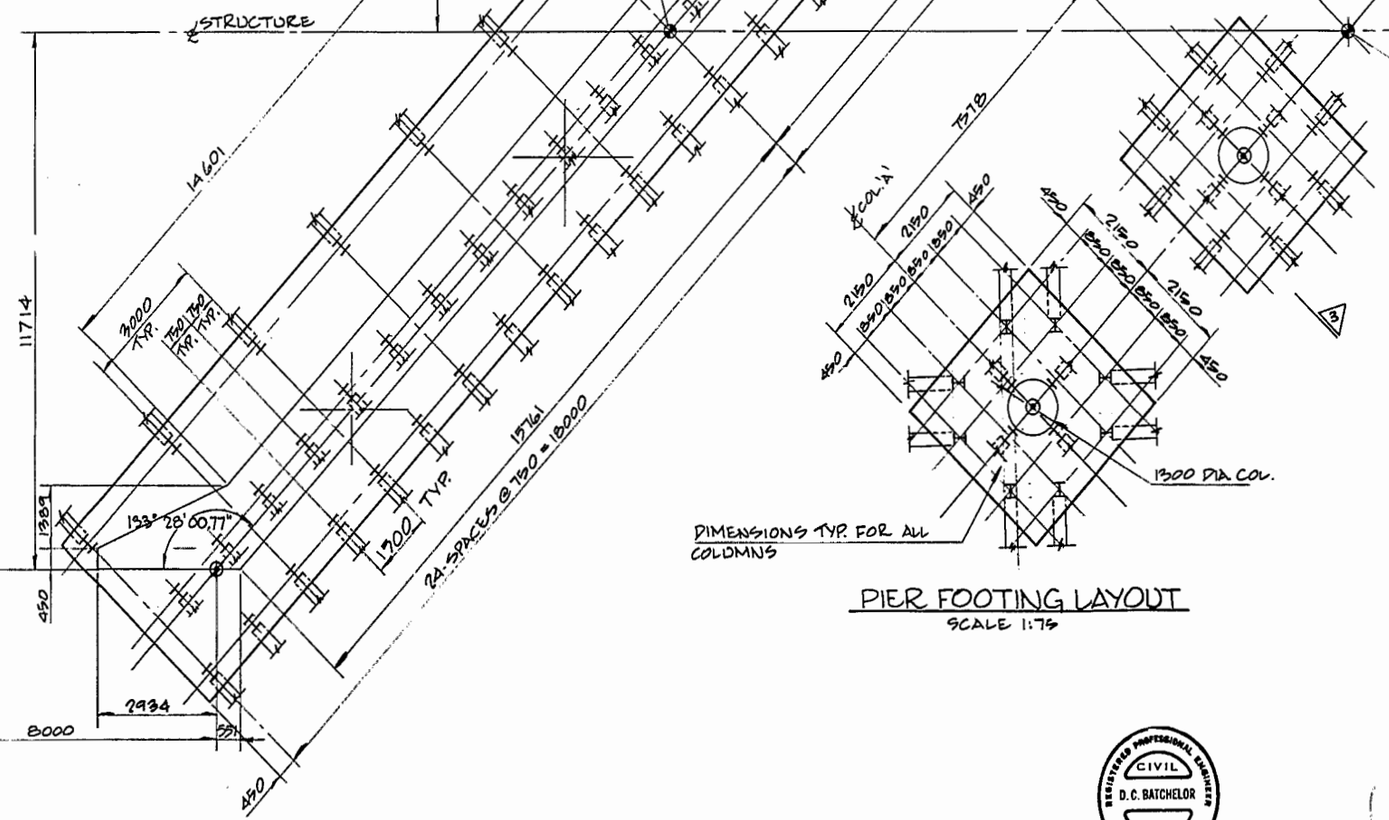
| PILE DATA | | |
|---|---|---|
| LOCATION | N° | LENGTH (EACH PILE) |
| WEST ABUTMENT | | |
| 1:3 | 45 | 11250 |
| 1:12 | 12 | 10750 |
| RETAINING WALL | | |
| 1:3 | 5 | 14750 |
| 1:12 | 6 | 14000 |
| PIER | | |
| 1:5 | 32 | 14250 |
| 1:10 | 16 | 14000 |
| EAST ABUTMENT | | |
| 1:3 | 45 | 14500 |
| 1:12 | 12 | 13750 |
| RETAINING WALL | | |
| 1:3 | 5 | 18000 |
| 1:12 | 6 | 17000 |




1
SCALE 1:50




## RETAINING WALL FOOTING LAYOUT
SCALE 1:75




## ABUTMENT FOOTING LAYOUT
SCALE 1:75

## PIER FOOTING LAYOUT
SCALE 1:75

NOTES

PILE DATA
- PILES FOR ABUTMENTS AND PIERS SHALL BE HP310×110 STEEL H-PILES
- PILES FOR N.E. & S.W. RETAINING WALL SHALL BE HP310×79 STEEL H-PILES.
- PILE LENGTH SHOWN ON THE DRAWING IS THE THEORETICAL LENGTH BELOW CUT-OFF
- DRIVING SHOES TO BE PROVIDED ON ALL PILES IN ACCORDANCE WITH STANDARD DD 3301.

PILE DESIGN DATA.

HP310×110 { DESIGN LOAD AT S.L.S. TYPE II = 900.0 KN ; FACTORED CAPACITY AT U.L.S. = 1600.0 KN
HP310×79 { DESIGN LOAD AT S.L.S. TYPE II = 650.0 KN ; FACTORED CAPACITY AT U.L.S. = 1150.0 KN

PILE CONSTRUCTION DATA

PILES TO BE DRIVEN IN ACCORDANCE WITH STANDARD SS 103-10 OR SS 103-11 USING AN ULTIMATE CAPACITY OF 2700.0 KN PER PILE FOR HP310×110 PILES AND 1950.0 KN PER PILE FOR HP310×79 PILES, BUT MUST BE DRIVEN BELOW,
EL. 277.0 FOR WEST ABUTMENT AND S.W. RETAINING WALL,
EL. 273.0 FOR THE PIERS AND
EL. 274.0 FOR THE EAST ABUTMENT AND N.E. RETAINING WALL.
PILE SPACING MEASURED AT UNDERSIDE OF FOOTINGS.

REGISTERED PROFESSIONAL ENGINEER — CIVIL — D.C. BATCHELOR — PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

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

| | | | |
|---|---|---|---|
| DESIGN PCB | CHECK SMF | LOADING CHBDC-A-91 | DATE 81-10 |
| DRAWING MKS | CHECK PCB | SITE No 29-291 | DWG 4. |

DIST. Nº 4 HWY 403
CONT No 83-10
WP No 164-60-01

HWY 53 INTERCH. U'PASS
ABUTMENT LAYOUT

SHEET 97

## METRIC

DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

| WEST ABUT. WING WALL OFFSETS TO ℄ HWY 53 | | |
|---|---|---|
| STA. | SOUTH | NORTH |
| 13+275 | 7044 | |
| 13+280 | 7353 | |
| 13+285 | 7662 | |
| 13+290 | 7970 | |
| 13+295 | 8279 | |
| 13+300 | 8588 | 15209 |
| 13+305 | | 14706 |
| 13+310 | | 14302 |
| 13+315 | | 13962 |
| 13+320 | | 13660 |

| EAST ABUT. WING WALL OFFSETS TO ℄ HWY 53 | | |
|---|---|---|
| STA. | SOUTH | NORTH |
| 13+380 | 13527 | |
| 13+386 | 13836 | |
| 13+390 | 14161 | |
| 13+395 | 14535 | |
| 13+400 | 14994 | 8711 |
| 13+405 | | 8402 |
| 13+410 | | 8093 |
| 13+415 | | 7784 |
| 13+420 | | 7476 |
| 13+425 | | 7167 |

STA. 13+278.081 W.A.
STA 13+423.907 E.A.

FOR OFFSETS SEE TABLE

RAMP CONTROL LINE

WINGWALL OFFSET LINE TO ℄ HWY 53

℄ HWY. 53 & CROWN LINE

℄ STRUCTURE

℄ BRG. (INTERIOR)

℄ BRG. (EXTERIOR)

CAST CLEATS 35mm BELOW APPROACH SLAB SEAT TO RECEIVE 40 OF EXPANDED POLYSTYRENE (TYP.)

2% EXP. JT.

CONSTRUCTION JT. BREAST WALL ONLY

W.P. Nº1 STA 13+304.994 W.A.
W.P. Nº3 STA 13+396.994 E.A.

43° 28' 00.77" SKEW

W.P. Nº2 W.A.
W.P. Nº5 E.A.

NON-SHRINK NON-STAINING MORTAR.

℄ BRGS.

BEARING ANCHOR HOLES TO BE CORE DRILLED TO SUIT BEARING ANCHORS

75mm DIA. WALL DRAINS AT 3000mm c/c FORMED WITH NON-METALLIC MATERIAL, ELEVATION TO BE DETERMINED BY THE ENGINEER

CONST. JT. OPTIONAL TO CONTRACTOR FULL WIDTH OF BALLAST WALL

BULLNOSE SECTION BEYOND

VARY TO ACCOMMODATE 'J' GAP BETWEEN DECK AND BALLAST WALL AT TIME OF CASTING BALLAST WALL

FOR EXPANSION JOINT DETAIL SEE DWG 19.

EL. PT.

EL. 292.102 W.A.
EL. 292.230 E.A.

CONST. JT.

13+310

3906 3789

16140 16140

### PLAN
SCALE 1:75

TOP OF BALLAST WALL TO BE FINISHED TO SUIT ADJOINING DECK SECTION

* ELEVATION POINT AT BACK OF BALLAST WALL

EL. 295.348 W.A.
EL. 295.529 E.A.
EL. 295.484 W.A.
EL. 295.640 E.A.
EL. 295.569 W.A.
EL. 295.705 E.A.
EL. 295.794 W.A.
EL. 295.917 E.A.
EL. 295.686 W.A.
EL. 295.769 E.A.
EL. 293.686 W.A.
EL. 293.816 E.A.
EL. 293.841 W.A.
EL. 293.957 E.A.
EL. 293.792 W.A.
EL. 293.894 E.A.
EL. 293.744 W.A.
EL. 293.833 E.A.

EXPANSION JOINT IN WALL.

CONST. JT.

EL 291.30

EL. 290.550

719mm O.D STEEL SLEEVE PIPE FOR 150mm DIA. DRAINAGE PIPE THROUGH WINGWALLS FOR DETAILS SEE DD3515

CONSTRUCTION JT. IN ABUT. WALL FOR DETAILS SEE DD4670

CONST. JT. IN BALLAST WALL ONLY

EL. 292.102 W.A.
EL. 292.230 E.A.

EL. 288.20

### SCALE 1:75

WABO-TYFE BEARINGS OR APPROVED EQUAL
B1-900 4-REQUIRED (INTERIOR)
B2-900 4-REQUIRED (EXTERIOR)
D.L. = 2900 KN.
D.L.+L.L. = 3800 KN.
LATERAL HORIZ. LOAD = 180 KN.
TOTAL MOVEMENT. = 75mm (+15mm -60mm)

LEGEND
W.A. – WEST ABUTMENT
E.A. – EAST ABUTMENT

NOTE
+VE. – EXPANSION.
-VE. – CONTRACTION.

### SCALE 1:50

### SCALE 1:75

### SCALE 1:50

### SCALE 1:50

### SCALE 1:50

REGISTERED PROFESSIONAL ENGINEER CIVIL D.C. BATCHELOR PROVINCE OF ONTARIO

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| DESIGN DCB | CHECK SMF | LOADING OHBDC-A-79 | DATE 81-10 |
| DRAWING W.A.S. | CHECK DCB | SITE No 75-291 | DWG 6. |

# APPENDIX B

Site Photographs

**Photograph 1**: Looking at the east abutment of the Oxford Road 55 Underpass structure. Vertical cracks were observed on the abutment wall. Weep holes were observed in the abutment wall. Grasses are growing at the toe of abutment wall (August 28, 2015).

**Photograph 2**: Looking at the northeast wingwall and the adjacent slope of the east abutment of the Oxford Road 55 Underpass Structure. Surficial cracks were observed on the wingwall. The slope is vegetated and effect of erosion on the embankment slope face was not observed (August 28, 2015).

**Photograph 3**: Looking at the southeast wingwall and the adjacent slope of the east abutment of the Oxford Road 55 Underpass Structure. Surficial cracks were observed on the wingwall. Light spalling of concrete was observed at the joint of abutment wall and wingwall. The slope is vegetated and effect of erosion on the embankment slope face was not observed (August 28, 2015).

**Photograph 4:** Looking at the west abutment of the Oxford Road 55 Underpass structure. Vertical cracks were observed on the abutment wall. Horizontal and vertical cracks were observed on the southwest wingwall, where white salt staining was observed. Weep holes were observed in the abutment wall. Grasses are growing at the toe of abutment wall (August 28, 2015).

**Photograph 5**: Looking at the northwest wingwall and the adjacent slope of the west abutment of the Oxford Road 55 Underpass Structure. Cracks were observed on the wingwall. The slope is vegetated and effect of erosion on the slope face was not observed (August 28, 2015).

**Photograph 6**: Looking at the southwest wingwall and the adjacent slope of the west abutment of the Oxford Road 55 Underpass Structure. Surficial cracks were observed on the wingwall. The slope is vegetated and effect of erosion on the slope face was not observed (August 28, 2015).

**Photograph 7**: Looking south at the piers of Oxford Road 55 Underpass Structure. Minor surficial cracks were observed on the piers (August 28, 2015).