

MEMORANDUM

30M12-93

TO: Mr. G.C.E. Burkhardt, (3)
Regional Structural Planning Eng.,
Central Region,
3501 Dufferin St., Downsview.

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

ATTENTION:

DATE: May 29, 1973.

OUR FILE REF.

IN REPLY TO JUN 11 1973

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Overpass Structures at the Crossing
of Hwy. #427 (S.B.L. and N.B.L.)
Disco Rd. (Realign.) - Goreway Drive (Ext.)
Borough of Etobicoke, Metropolitan Toronto
District No. 6 (Toronto)
W.O. 72-11002 -- W.P. 387-65

Attached we are forwarding to you our revised detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site. Please destroy the original report submitted to you on May 16, 1972.

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.

AGS/ao
Attch.

c.c. E. J. Orr
B. R. Davis
A. Rutka
R. S. Pillar
H. Greenland
B. J. Giroux
C. Mirza
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B. A. Singh
McCormick, Rankin & Associates Ltd.
Foundations Files
Documents

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

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FOUNDATION INVESTIGATION REPORT

For

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District No. 6 (Toronto)
W.O. 72-11002 -- W.P. 387-65

I. INTRODUCTION:

It is proposed to extend the present airport expressway northerly toward Finch Avenue; this expressway will closely follow existing Indian Line Rd. This expressway will be designated as Hwy. #427. In connection with this expressway a major complex will be required at the crossing of proposed Hwy. #427 and i) the Mimico Creek Diversion and ii) the Disco Road realignment - Goreway Drive extension. This is known as the Mimico Creek Complex. The western portion of this complex is located in the Town of Mississauga, County of Peel, while the eastern portion is in the Borough of Etobicoke, Metropolitan Toronto.

The Foundation Office was requested to carry out a subsurface investigation for the various components associated with the Mimico Creek complex. The request was contained in a memo from Mr. G.C.E. Burkhardt, Regional Bridge Planning Engineer, Central Region, dated December 29, 1971. Subsequently, an investigation was carried out by this Office to determine the subsoil, bedrock and groundwater conditions in this area.

This report will be concerned with the twin parallel overpass structures to be constructed at the crossing of Hwy. #427 (N.B.L. and S.B.L.) and the Disco Rd. realignment - Goreway Drive extension. As such it presents the factual

information obtained in this specific area, as well as recommendations pertaining to the foundation design of the proposed structures and the stability and settlement considerations associated with the approach fills.

Foundation reports for the other proposed structures within this complex will be presented in the following reports:

	<u>Report No.</u>
Ramp N.-E. over the Goreway Drive Extension	72-11003
Culvert - Mimico Creek Diversion	72-11004

2. SITE AND GEOLOGY:

The area under investigation is located in the immediate vicinity of Mimico Creek and Indian Line Road, which is partially in the Town of Mississauga and partially in Metropolitan Toronto. The east flowing Mimico Creek meanders along the floor of a valley which ranges from 100 to 180 feet in width. The creek channel is about 15 to 20 feet wide and 10 feet in depth with the water level varying between elevations 502 to 504 (3 to 4 feet of water). The grass and brush covered valley banks range from 22 to 26 feet in height. They are standing at slopes which vary from 2:1 to 3:1.

The surrounding terrain is flat to gently undulating in relief between about elevation 527 to 536. This area has been developed for small industrial enterprises.

Twin 517 feet long Bailey Bridge structures exist at the crossing of Indian Line Road and Mimico Creek.

The site is located in 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 cohesive glacial till whose thickness generally ranges 35 to 66 feet. In this region the Humber River, Etobicoke and Mimico Creeks have cut deep valleys into the overburden. There is, therefore, no large undrained depression, swamp or bog, although in many of the instream areas drainage is still imperfect. The overburden is underlain by

grey shale bedrock of the Meaford-Dundas formation, Ordovician Period. Available geological information indicates that the surface of the bedrock varies somewhere between elevation 460 and elevation 475.

3. FIELD AND LABORATORY WORK:

A total of eighteen boreholes, all of which were accompanied by a dynamic cone penetration test, was carried out at the site during the course of the field investigation. The boreholes and the cone penetration tests were advanced by means of a continuous flight auger machine (Penn Drill) or a diamond drill rig, both of which were adapted for soil sampling purposes.

Samples were obtained at required depths in a 2-inch O.D. split spoon sampler which was hammered into the soil. The method of driving the split-spoon conformed to the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Bedrock was proven at five of the boring locations by obtaining BX size rock core samples.

During sampling and drilling operations, detailed logs of the borings were made. These logs contain a record of the drilling and sampling techniques used, together with the soil types and bedrock encountered. The location and elevation of all the boreholes are shown on Drawing No. W.O. 72-11002 A and B, together with estimated stratigraphical sections across the site. Surveying at the site was carried out by the personnel from the Central Region Engineering Survey Section. The elevations given in this report are referred to a Geodetic datum.

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this examination, laboratory testing was carried out on selected representative samples to determine the following physical properties of the overburden:

- Natural Moisture Content
- Atterberg Limits
- Grain-Size Distribution

The results of these tests are plotted on the Record of Borelog sheets as well as the figures located in Appendix I of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant stratum across the site is a cohesive glacial till, the thickness of which varies from 35 feet to 60 feet. This cohesive deposit is underlain by shale bedrock.

In some localized areas the glacial till is overlain by cohesive and garbage fill material, with a combined thickness as much as 21.5 feet.

The boundaries of the various deposits, as determined in the boreholes, are shown on the accompanying Record of Borehole sheets. The stratigraphical sections, shown on Drawing No. 72-11002A and B have been inferred from this data. From ground surface downward, the soil types and bedrock encountered are as follows.

4.2) Fill Material:

At a few random locations (B.H.'s #11, #16 and #17), fill material ranging in thickness from 4.5 to 21.5 feet was encountered. The upper portion of fill material consists of either gravel and sand (B.H. #11) or clayey silt (B.H. #16). This upper fill material is underlain by up to 14 feet of sanitary fill material (garbage fill). However, at B.H. #17, no sanitary fill material was encountered, and the fill material mainly composed of clayey silt, sand and gravel.

Standard penetration testing carried out within the fill material, gave 'N' values which range from 3 to 34 blows/foot, which would indicate that it has been subjected to a poor to moderate compactive effort.

4.3) Glacial Till (Heterogeneous Mixture of Clayey Silt, Sand and Gravel):

Directly beneath the surficial deposits, where these exist, or a nominal topsoil cover (1 foot or less) elsewhere

is the predominant stratum across the site, which is composed of a heterogeneous mixture of clayey silt with sand and gravel. The thickness of this glacial till varies from 35 feet (B.H. #1) to 60 feet (B.H. #12). Occasional layers of sand and gravel, up to 4 feet in thickness, were encountered randomly throughout the deposit. The lower 5 to 15 feet of the stratum often contains numerous shale fragments, as well as occasional small boulders (up to 5 inches in size). Grain-size distribution curves, for samples of the cohesive stratum, obtained with 2" O.D. sampling equipment, are shown on Figure No. 2 in Appendix I.

Atterberg limit tests were performed on samples of the glacial till. The results, which are shown on the borelog sheets and on the Plasticity Chart, Figure #1, are tabulated below:

			<u>Range</u>
Liquid Limit	(W _L)	(%)	17 - 39
Plastic Limit	(W _P)	(%)	13 - 23
Natural Moisture Content	(W)	(%)	5 - 28

Based on these values it is estimated that the cohesive deposit has a matrix, which is inorganic and of low to intermediate plasticity.

The Standard Penetration Tests, carried out within this glacial till stratum, are plotted on the Record of Borehole sheets. This testing gave 'N' values which ranged from 2 blows/ft. to 100 blows for 1 inch. The lower 'N' values were encountered, in the upper few feet of the stratum at a few of the borings put down on the floor of the Mimico Creek valley. The consistency of this upper softened zone was determined by carrying out undrained shear strength testing both in the field and the laboratory. This testing gave undrained shear strength values which ranged from 500 to 700 p.s.f. These results are summarized on the Record of Borelog sheets appended to this report. Based on the testing results it is estimated that the consistency of the overall deposit varies from stiff to hard, with the exception of the upper softened zone which is in the firm range.

4.4) Shale Bedrock:

The cohesive glacial till stratum is directly underlain

by bedrock which was proven in five of the boreholes by obtaining up to 10 feet of BX size rock core samples. In addition, the surface of the bedrock, at a number of other boring locations, was inferred to exist at the level where the hammer driven casing met practical refusal. Over the site the bedrock surface was found to vary randomly between elevations 460 and 476. The bedrock is composed of a grey shale - the upper 3 feet of which is in a weathered condition. Below this weathered zone the shale bedrock is in a sound state as evidenced by the high percentage of core recovered.

5. GROUNDWATER CONDITIONS:

The groundwater level conditions across the site, during the period of the investigation (February 1972), were observed by taking readings in the open boreholes. The results of the readings are shown on the borelog sheets, as well as on Drawing No. 72-11002A.

The observations indicate that the groundwater level is located between elevations 503 and 507, which corresponds to levels which range from 4 to 23 feet below existing ground surface. These levels correspond closely to the water level in the creek, which was at about elevation 502 to 503.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to extend the present airport expressway northerly toward Finch Ave. following closely to the existing Indian Line Rd. This expressway will be designated as Hwy. #427. Interchanges are contemplated at the crossings of Dixon Rd., Belfield Expressway (Hwy. #409), Rexdale Blvd. and Finch Ave. In addition, structures will be required at the crossing of the Mimico Creek complex, American Drive, proposed Goreway Drive, Canadian National Railway, the Woodbine Racetrack Entrance and Morningstar Drive. At present the northern limit of this project has not been decided upon.

The Mimico Creek complex can be divided into three different parts:

- i) Mimico Creek Diversion and related retaining walls,
- ii) proposed overpass structures at the crossing of Hwy. #427 (N.B.L. and S.B.L.) and Disco Rd. (realignment) - Goreway Drive, and
- iii) proposed structure for a ramp N-Belfield E.

A plan (unnumbered) showing the proposed scheme for the Mimico Creek complex was provided by McCormick and Rankin Consulting Engineers, Port Credit, Ontario.

This report will deal with the proposed twin overpass structures. Reports for i) and iii) will be presented under separate cover (W.O. 72-11003 and 4, respectively).

The Mimico Creek diversion will be carried beneath the Goreway Drive extension and the Disco Rd. realignment in a 7,100 feet long double concrete box culvert approximately 39 feet wide and 20 feet high. It is understood that the profile grade of the invert of the culvert will vary from elevation 502, at the west end, to 500 at the east end, which corresponds to depths of from 7 to 18 feet below existing ground surface. Outside of these limits the diversion will be located in an open channel section. The depth of the channel will vary from 10 to 30 feet with side slopes of $2\frac{1}{2}:1$.

The proposed profile grade of the 48 feet wide Goreway Drive Extension - Disco Road realignment, in the vicinity of the proposed structures, will range from 526 to 531. To reach this grade lines fills varying from 5 to 25 feet in height will have to be built. In some areas the roadway complex will be located immediately above the double concrete box culvert.

Twin parallel overpass structures will be required at the crossing of Hwy. #427 (N.B.L. and S.B.L.) and the Goreway Dr. extension - Disco Rd. realignment. The structures, which will be approximately 50 feet apart, will be located immediately east of the existing Indian Line Rd. bailey bridge structures. The 96 feet wide N.B.L. structure is to have three spans (66' - 83' - 82'), while the 48 feet wide S.B.L. structure will also have three spans (80' - 80' - 75'). Fill will have to be placed to form the

north and south approaches to these two structures, as well as the ramp 'N-E' structure located to the west; these fills will be common to all three structures. The profile grade of Hwy. #427, in the vicinity of the structures will vary from elevation 556 to 567. At these grades the clear height of the approaches in the longitudinal and transverse direction will range from 33 to 36 feet and 30 to 52 feet, respectively.

The predominant stratum across the site is composed of a 35 to 60 feet thick cohesive glacial till which is underlain by shale bedrock. In isolated areas the glacial till is overlain by up to 21.5 feet of either parent granular subsoil or cohesive fill and sanitary fill.

In the subsections to follow the foundation support for the twin overpass structures will be discussed. In addition, the stability and settlement considerations associated with the approaches will be discussed in detail in relation to the geometry proposed.

6.2) Probable Sequence of Construction:

It is understood that the sequence of construction on the Mimico Creek complex will be as follows:

- 1) Construction of the proposed Mimico Creek diversion in the dry (both the rigid frame culvert and open channel sections), as well as the ancillary retaining walls. Two possible schemes are being considered for the support of the piers associated with the twin Hwy. #427 overpass structures as well as the ramp N-E structure. The first is to found the piers on spread footings located in the parent glacial till stratum. The alternative is to found them on pile or deep foundations with the pier pile caps located at a relatively high elevation in the fill placed to form the Goreway Drive Extension - Disco Rd. realignment. If the former is adopted, and if scheduling permits, it would be advantageous to construct the pier foundations jointly with the box culvert. By doing this a common

excavation could be utilized thus minimizing the material handling on this project.

- ii) Channelize Mimico Creek through the diverted section.
- iii) Backfill the existing Mimico Creek Channel.
- iv) Construct embankments required to form the Disco Rd. realignment - Goreway Drive extension sections.
- v) Place and compact fill to form the common approaches to the three structures, then construct the remaining foundations and superstructures.

6.3) Foundations - Twin Overpass Structures - Hwy. #27 (N.B.L. and S.B.L.):

6.3.1) Piers:

1) Spread Footing Support:

The predominant stratum across the site is a competent cohesive glacial till. The piers for these structures can, therefore, be supported on spread footings founded in this stratum. An allowable bearing value of 2.5 t.s.f. can be used in the design of footings founded at or below the following elevations:

<u>Location</u>	<u>Structure</u>	<u>Footing at or Below Elev.</u>	<u>Reference B.H.'s</u>
South Pier	N.B.L. and S.B.L.	500	6, 7 and 8
North Pier	N.B.L. and S.B.L.	503	11, 12 and 13

At least 4 feet of earth cover should be provided above the base of the foundations in order to satisfy the frost protection requirements in the area.

The footing excavations will extend some 3 to 20 feet below the existing ground surface. Temporary cuts of this height should be inherently stable with respect to a deep-seated rotational type of failure in the subsoil, providing the slopes are no steeper than 1:1. If steeper working faces are required, then the excavation should be sheeted in accordance with the provisions set forth in the Trench Excavators Act. As discussed

previous the footing may be constructed along with the double concrete box culvert required for the Mimico Creek diversion, so that a common excavation could be utilized.

The spread footings - culvert excavation will be located anywhere from 5 to 10 feet below the groundwater level recorded during the period of the investigation. The excavation will be carried out in a relatively impervious glacial till, therefore, no major dewatering problems are anticipated. The subsurface investigation has indicated that occasional random water bearing sand and gravel layers are located within the cohesive glacial till. If the excavation intersects such zones some groundwater seepage can be expected. This could be handled using conventional techniques, such as pumping from sumps. If these isolated granular zones are encountered at the footing founding level "boiling" may develop in these zones due to the unbalanced hydrostatic groundwater pressure head. This would reduce the bearing capacity of this portion of the foundation subsoil. In this regard it is recommended that all isolated granular zones encountered at footing level, be completely subexcavated. The subexcavation should then be brought up to grade using mass concrete.

The foundation subsoil will settle due to the imposed foundation loading. The subsoil is composed of a competent cohesive glacial till, thus the settlement will be of a recompression nature. For a spread footing foundation, of the size contemplated, imposing the aforementioned pressure, it is estimated that the settlement will not exceed $3/4$ inch, provided the subsoil is not softened by groundwater seepage or uncontrolled surface runoff. It may be advantageous to protect the subsoil, at the footing foundation level, by covering it with a lean concrete working slab immediately after completion of the excavation.

ii) Deep Foundation Support:

As an alternative the piers could be founded on end-bearing piles driven to practical refusal within the lower portion of the glacial till deposit. Under these circumstances the pile caps

could be located at a relatively high elevation in the fill placed to form the Goreway Dr. extension - Disco Rd. realignment. In any event, 4 feet of earth cover should be provided above the underside of the pile caps for frost protection purposes. The pile driving in the field should be controlled by employing the Hiley Dynamic Pile Driving Formula. For estimating purposes it can be assumed that the full capacity of the piles will be realized at the tip elevations quoted below:

<u>Structure</u>	<u>Piers</u>	<u>Estimated Pile Tip Elev.</u>
N.B.L.	South	475 to 480
	North	478 to 482
S.E.L.	South	473 (To Bedrock)
	North	485

Piles driven as recommended could be designed for the ultimate capacity of the pile section chosen (e.g. 12BP74 steel H-piles can be designed using an allowable load of 95 tons/pile). No rock or bouldery fill should be placed in areas where piles are to be driven.

In some areas the end bearing piles may be located in close proximity to the culvert structure. In these instances some complications may develop during the pile driving. If this proves to be the case consideration could be given to founding the piers on caissons located in the glacial till or alternatively on bedrock as outlined in the table to follow:

<u>Structure</u>	<u>Pier Location</u>	<u>Estimated Base Elev. of Caisson</u>	<u>Founded</u>
N.B.L.	South and North	480	Glacial Till
S.B.L.	South	473	on Bedrock
	North	485	Glacial Till

Caissons could be installed through the dense bouldery portion of the glacial till using churn drilling operations. The allowable bearing load of the caissons will be dependent on the diameter adopted. For preliminary estimating purposes

an allowable load of 200 tons per caisson can be used in designing a 30 inch diameter installation.

As noted on the individual borelog sheets some water bearing granular layers are present within the glacial till. If these are intercepted some seepage may occur in the caisson with subsequent loss of ground. In order to ensure the integrity of the caisson, under these circumstances, it may be necessary to place tremie concrete under water in the lower portion of the unit.

6.3.2) Abutments:

The abutments for both structures can be 'perched' within the approach fills and supported on end-bearing piles driven to either practical refusal within the hard cohesive glacial till stratum or alternatively to bedrock. The pile driving in the field should be controlled by employing the Hiley Dynamic Pile Driving Formula. For estimating purposes it can be assumed that the design capacity of the piles will be realized at the tip elevations presented below:

<u>Structure</u>	<u>Abutment Location</u>	<u>Estimated Tip Elevation</u>	<u>Founded</u>
N.B.L.	South	480 west end - Stepping	Glacial Till
	North	up to - 487 east end - 475 to 480	Glacial Till
S.B.L.	South	475	on Bedrock
	North	480	Glacial Till

The approach fills will induce some settlement in the glacial till subsoil. This settlement will induce a negative skin frictional load on the piling sections employed. This effect will have to be taken into consideration when designing the piles, this could be accomplished by using a design capacity equivalent to approximately 85 percent of the ultimate capacity of the pile section chosen. For example, 12 BP 74 steel H-piles could be designed using an allowable load of 80 tons/pile.

No bouldery or rock fill should be placed in areas where piles are to be driven.

6.4) Approaches:

6.4.1) Stability Considerations:

As discussed previously common approaches will be constructed to the twin Hwy. #427 structures as well as the ramp N-Belfield-E structure. The clear heights of the approaches will vary from 34 feet to 52 feet in the longitudinal and transverse directions, respectively. To realize these grades fills up to 50 feet in height will have to be placed. Under the proposed scheme side slopes ranging from 2:1 to 3:1 are to be employed. In addition, provisions have been made to allow for berms (maximum 20 feet in length) in some of the more critical areas. It is understood that a locally available cohesive type of material will be used for fill.

Over the major portion of the area under investigation the parent cohesive glacial till is competent. This being the case embankments of the height contemplated should be inherently stable with respect to a deep-seated rotational type of failure within the foundation subsoil. An exception to this pattern occurs along the Mimico Creek Valley floor, namely between Stations 692+60 and 695+00 (chainages along Turning Roadway E-N - Hwy. #427 N.B.L. Structure). Here the upper 3 to 4 feet of the glacial till is in a softened condition (refer to B.H.'s #104, 105 and 106 on Drawing 72-11002B). This problem can be overcome by subexcavating this surficial softened zone; specific recommendations with regard to this treatment will be discussed in detail in the paragraphs to follow.

The approaches will be relatively high. It will, therefore, be necessary to ensure the long term stability of these fill sections. In this regard, it is recommended that a number of measures be adopted; these are listed below.

- i) Excavation of the sanitary fill material and backfilling operations should be carried out as recommended in our foundation report W.O. 72-11162.
- ii) In those areas where fills will be placed to a height in excess of 20 feet the topsoil cover should be stripped from within the plan limits of the embankment sections.
- iii) In some areas fills are to be placed on the existing slopes of the Mimico Creek Valley. In order to ensure

the stability in these sections it is recommended that the topsoil be stripped from the existing slopes and the new fill 'keyed' into the banks in accordance with current M.T.C. practices (Standard No. DD-414).

- iv) If cohesive material is used as fill it will be imperative to ensure that it is placed and compacted at a moisture content which is close (± 1 percent) to the optimum compaction water content, as determined by the Proctor testing procedure. Cohesive fills should always be compacted in a dry environment. This being the case it would be advantageous to place a working mat of well compacted select granular material over the areas where fills are to be built to a height in excess of 20 feet. This mat should have a minimum thickness of 24 inches.

The long term stability of a number of critical areas was determined in terms of effective stresses using programmes developed for the electronic computer. In this method of analysis the stability is governed by the stress-strain characteristics of the fill and parent subsoil as well as the build-up and subsequent dissipation of the excess pore water pressures set up due to the load application. For computational purposes the following parameters were assumed.

	<u>Cohesive Fill</u>	<u>Parent Cohesive Glacial Till</u>
Bulk Unit Weight (γ)	140 p.c.f.	140 p.c.f.
Apparent Effective Angle of Internal Friction (ϕ')	27°	27°
Apparent Effective, Cohesive Intercept (C')	150 p.s.f.	500 p.s.f.

Note: The assumed buildup in excess pore water pressure during loading will be shown on the drawings which will be listed below.

The results of the analyses, carried out in the critical areas are summarized on Drawing No. 72-11002 B and C. It was assumed in these analyses that all the provisions set forth in the previous paragraphs were adopted. A resumé of the

results follows:

a) Longitudinal or Forward Direction:

Here the clear height of the approaches will be of the order of 33 to 34 feet with the side slopes being 2:1. The approaches will be inherently stable in this direction.

b) East Side of South Approach:

In this area the clear height of the approach will have a maximum height of 52 feet extending from the grade of Turning Road 'E-N' to the invert of the relocated Mimico Creek Channel. The toe of the northern portion of the fill will be confined by Retaining Wall 'B' (refer to Sections A-A, B-B, C-C, Drawing 72-11002B). This section will be stable, providing the upper softened zone of the glacial till, encountered along the valley floor between Stations 692+60 and 695+00, is subexcavated. The approximate limits of this subexcavation is shown on the aforementioned sections. The subexcavation so formed should be backfilled with select granular material to a level at least 1 foot above the existing ground surface, any other suitable fill can be used above this level.

South of the retaining wall section the slopes will range from 2:1 to $2\frac{1}{2}$:1, and incorporate berms. Two typical cross sections (Nos. D-D and E-E) are shown on Drawing No. 72-11002 C. The results of the stability computations have indicated that this area will be stable.

c) West Side of North Approach:

In this area the height of the embankment will extend from elevation 562 (Turning Rd. E-N) to 510; the side slope will be 2:1. Since there will be a nominal distance between the Goreway Drive extension embankment and the toe of the approach fill it is believed that it would be economically feasible to fill this area to elevation 530. If this procedure is adopted, the unsupported height of the approach would be limited to about 32 feet. Such a section would be inherently stable.

- d) West Side of the South Approach
East Side of the North Approach:

In these areas the fill heights will be of the order of 30 feet, with the side slopes varying from 2:1 to 3:1. Fills of this height will be stable.

6.4.2) Settlement Considerations:

The approach fills, which will have a maximum height of 50 feet, will induce settlement in the underlying cohesive glacial till due to the load application. The glacial till is competent in nature and thus the settlement will be of a recompression nature. Based on the computations carried out it is estimated that the magnitude of this settlement will be of the order of $2\frac{1}{2}$ to 3 inches. The major portion of this settlement should occur within the first year following the placement and compaction of the fill.

7. MISCELLANEOUS:

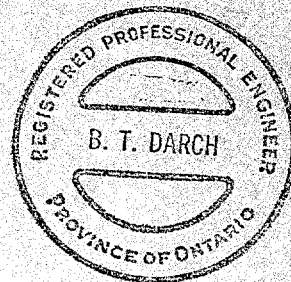
The field work for this project was carried out during the period of January 27 to February 31, and April 4 to 13, 1972, under the supervision of Messrs. V. Korlu, Project Foundations Engineer and H. Szymanski, Foundations Office Technician.

The drilling equipment was owned and operated by Master Soil Investigation Ltd., Toronto.

This report was written by Mr. B. T. Darch, Senior Foundations Engineer, and reviewed by Mr. M. Devata, Supervising Foundations Engineer.

B. T. Darch
B. T. Darch, P. Eng.

M. Devata
M. Devata, P. Eng.



BTD/ao
May 5, 1972.

APPENDIX I

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 72-11002

LOCATION Co-ords. 15,879,003 N; 971,063 E.

ORIGINATED BY VK

W.P. 387-- 65

BORING DATE Feb. 3, 1972

COMPILED BY TST

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT % 10 20 30
							20	40	60	80	100	+ FIELD VANE x LAB. VANE					
509.6	Ground Level																
0.0	Het. mix. of clayey silts sand & occ. gravel. Very Stiff - Hard Glacial Till Silty sand with gravel		1	SS	13												
			2	SS	88												
			3	SS	49	500											
			4	SS	39												
			5	SS	120												
			6	SS	107 1/6"	490											
			7	SS	109 1/6"												
	Glacial Till		8	SS	125												
			9	SS	58	480											
473.6			10	SS	100 1/3"												
36.0	End of Borehole Probable Bedrock					470											

503.
1 18 56 25

11 31 47 11

FOUNDATION SECTION

CHECKED BY S.E.

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.3

FOUNDATION SECTION

JOB 72-11002 LOCATION Co-ords. 15,878,996 N; 970,851 E. ORIGINATED BY VK
W.P. 387-65 BORING DATE Jan. 27, 1972 COMPILED BY TST
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY S.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					SHEAR STRENGTH P.S.F.					WATER CONTENT %		
							20	40	60	80	100	+ FIELD VANE x LAB. VANE					w_p	w	w_L
513.0	Ground Level																		
0.0	Sand and gravel with clayey silt. Compact					510									36 29 27 8				
508.0			1	SS	10														
5.0	Het. mix. of clayey silt, sand & gravel		2	SS	39										505.				
	Glacial Till		3	SS	25														
	Very Stiff to Hard		4	SS	30	500													
			5	SS	28														
			6	SS	21														
			7	SS	20	490													
			8	SS	17														
			9	SS	59	480													
474.9			10	SS	69 1/4"														
38.1	End of Borehole Probably Bedrock		11	SS	100 1"	470													

FOUNDATION SECTION

ORIGINATED BY VK

COMPILED BY TST

CHECKED BY S. L.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %			
							\circ UNCONFINED \bullet QUICK TRIAXIAL	+ FIELD VANE x LAB. VANE	w_p ——— w ——— w_L			
510.8	Ground Level											
0.0						510						
	Sand and gravel		1	SS	8							
			2	SS	4							
	Het. mix. of clayey silt and sand		3	SS	41							
			4	SS	24							
	Glacial Till		5	SS	16							
	Stiff to Hard		6	SS	65							
	Sand and gravel		7	SS	74							
			8	SS	40							
			9	SS	100/6"							
	with shale frags.		10	SS	63/6"							
469.3			11	SS	100/1"							
461.5	End of Borehole Probable Bedrock					470						

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 72-11002 LOCATION Co-ords. 15,879,054 N; 970,817 E. ORIGINATED BY VI
W.P. 387-65 BORING DATE Jan. 28, 1972 COMPILED BY TST
DATUM Geodetic BOREHOLE TYPE Auger, BXL Core CHECKED BY S.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT 20 40 60 80 100					SHEAR STRENGTH P.S.F.					WATER CONTENT % w_p — w — w_L
												○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					
512.8	Ground Level																
0.0	Het. mix. of clayey sil and sand, trace of gravel Glacial Till Stiff to Hard					510											
			1	SS	12												
			2	SS	11												
			3	SS	31												
			4	SS	54	500											
			5	SS	48												
			6	SS	57												
			7	SS	26	490											
			8	SS	18												
			9	SS	36	480											
			10	SS	100/11"												
472.8	with shale frags.																
440.0	weathered Shale Bedrock			BXL		470											
465.8	sound			BXL													

506.5
3 35 48 14

0 5 47 48

FOUNDATION SECTION

ORIGINATED BY VK

COMPILED BY TST

CHECKED BY *S.A.*

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 12

FOUNDATION SECTION

3 72-11002

LOCATION Co-ords. 15,879,138 N; 970,884 E.

ORIGINATED BY VK

N.P. 387-65

BORING DATE Feb. 1, 1972

COMPILED BY TST

DATUM Geodetic

BOREHOLE TYPE Auger, BXL Core

CHECKED BY S.P.

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	BLOWS/FOOT	RESISTANCE	RESISTANCE	RESISTANCE	RESISTANCE		
510.5	Ground Level												
0.0	Het. mix. of clayey silt, sand & gravel		1	SS	9								
			2	SS	37								
	Glacial Till		3	SS	46								
	Stiff to Hard		4	SS	19								
			5	SS	13								
			6	SS	46								
	Sand and Gravel		7	SS	52								
			8	SS	130	8"							
			9	SS	100	5"							
			10	SS	100	3"							
			11	SS	100	2"							
			12	SS	100	2"							
160.5			13	SS	100	1"							
50.0	Weathered		14	BXL	NR								
	Shale Bedrock												
150.5	Sound		15	RC	90%								
60.0	End of Borehole												

FOUNDATION SECTION

CHECKED BY S.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %			
							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB. VANE	w_p ——— w ——— w_L	10 ——— 20 ——— 30		
513.0	Ground Level											
0.0	Het. mix. of clayey silt, sand & gravel		1	SS	4	510						0 44 42 14
			2	SS	2							505.0
	Glacial Till		3	SS	82							
	Firm to Hard		4	SS	96/3"	500						
			5	SS	106							
			6	SS	22							
			7	SS	108/4"	490						
	Sand & gravel		8	SS	60/2"							22 39 28 11
	shale frags.		9	SS	60/3"	480						
			10	SS	100/5"							
472.8			11	SS	100/1 1/2"							
40.2	End of Borehole Probable Bedrock					470						

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 16

FOUNDATION SECTION

72-11002 LOCATION Co-ords. 15,879,190 N; 970,960 E. ORIGINATED BY HS & VK
 W.P. 387-65 BORING DATE Feb. 2 & 27 Jan. 1972 COMPILED BY TST
 DATUM Geodetic BOREHOLE TYPE Auger, NX Casing, Washboring CHECKED BY S.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.			WATER CONTENT %				
							○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB. VANE		w_p — w — w_L				
528.9	Ground Level													
0.0	Fill material, clayey silt with sand and gravel.		1	SS	10									7 29 48 16
521.4			2	SS	34									
7.5			3	SS	22 1/2"									
	Garbage Fill		4	SS	38									
			5	SS	3									
507.4			6	SS	5									
21.5	Glacial Till		7	SS	23									505.5
	Het. mix. of clayey silt sand & gravel		8	SS	23									7 23 43 27
	Stiff to Hard		9	SS	13									
			10	SS	137									
	Sand and gravel		11	SS	11 1/2"									16 40 26 18
			12	SS	100 1/4"									
			13	SS	107									
	with shale frags.		14	SS	100 2/3"									
			15	SS	91 1/8"									
463.9	weathered		16	SS	300 1/5"									
65.0	Shale Bedrock		17	BXL	40%									
458.9	Sound													
70.0	End of Borehole													
													</	

FOUNDATION SECTION

ORIGINATED BY VK

COMPILED BY TST

CHECKED BY *S.L.*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION	RESISTANCE	LIQUID LIMIT ——— w_L	PLASTIC LIMIT ——— w_P	WATER CONTENT ——— w	BULK DENSITY γ P.C.F.	REMARKS						
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT 20 40 60 80 100							SHEAR STRENGTH P.S.F.			WATER CONTENT % w_p w w_L		
							SHEAR STRENGTH P.S.F.							WATER CONTENT %					
512.6	Ground Level																		
0.0	Fill Material	X																	
508.1			1	SS	23	510							5 24 51 20						
4.5			2	SS	77								▼ 505.						
	Glacial Till		3	SS	75														
	Het.mix.of clayey		4	SS	40	500													
	silt, sand & gravel		5	SS	18														
			6	SS	27								14 21 41 21						
	Very Stiff to Hard		7	SS	34	490													
			8	SS	95														
			9	SS	100/3"	480													
476.6	with shale frags.		10	SS	100/3"														
36.0	weathered shale																		
	End of Borehole																		
	Probable Bedrock					470													

FOUNDATION SECTION

ORIGINATED BY VK

COMPILED BY TST

CHECKED BY *S.R*

[illegible]

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 101

FOUNDATION SECTION

72-11002 LOCATION Co-ords. 15,878,702 N; 971,133 E.

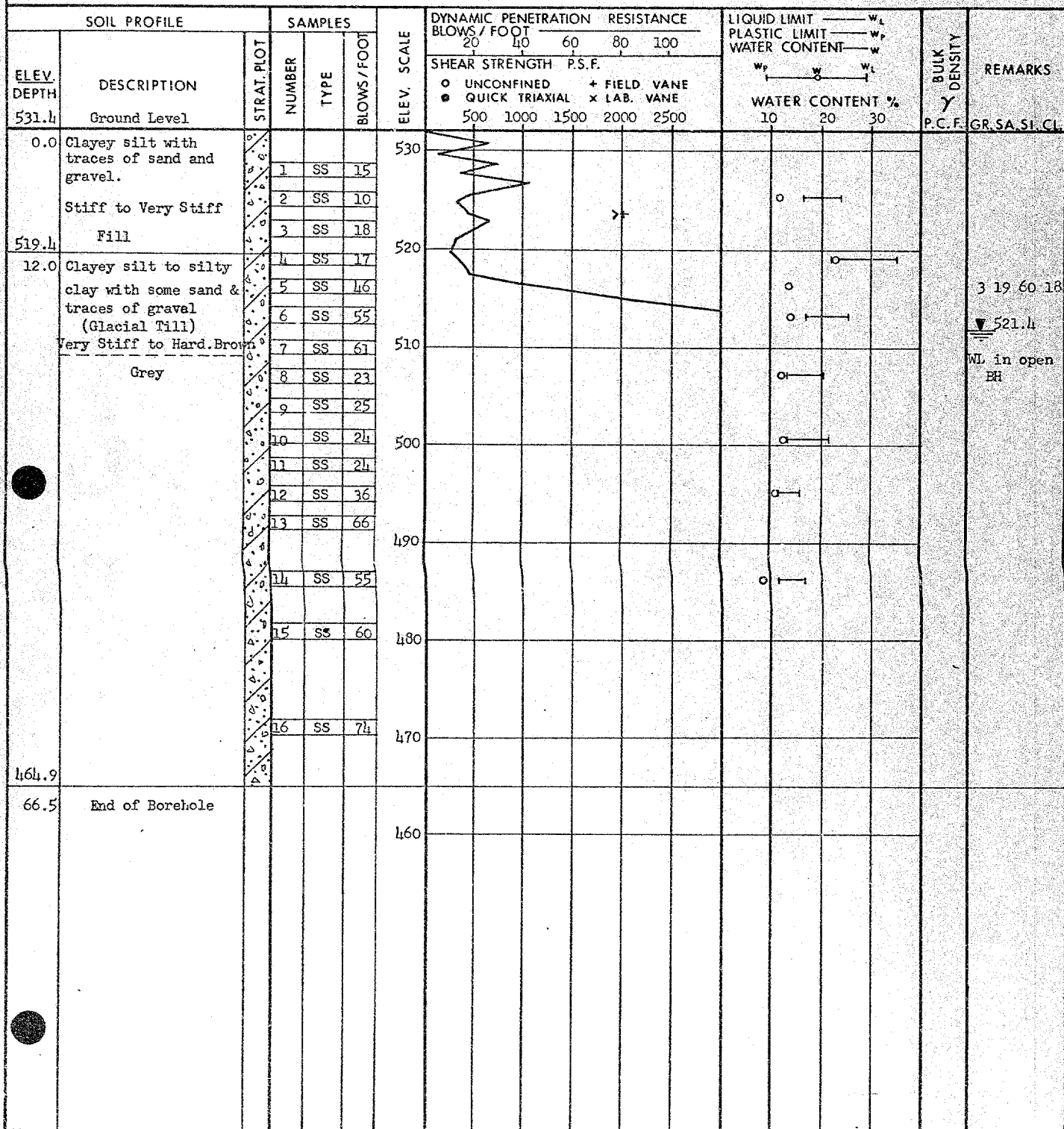
ORIGINATED BY HS

W.P. 387-65 BORING DATE Apr. 4, 1972

COMPILED BY HS

DATUM Geodetic BOREHOLE TYPE Pendraill

CHECKED BY



DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 102

FOUNDATION SECTION

72-11002

LOCATION Co-ords. 15,878,832 N; 971,073 E.

ORIGINATED BY HS

W.P. 387-65

BORING DATE April 6, 1972

COMPILED BY HS.

DATUM Geodetic

BOREHOLE TYPE Pendrill

CHECKED BY

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS/FOOT	20 40 60 80 100	SHEAR STRENGTH P.S.F.	w_c w_u		
528.0	Ground Level										
524.0	Clayey silt with some sand & gravel - Fill Very Stiff		1	SS	20						
4.0	Clayey silt to silty clay with some sand & trace of gravel. (Glacial Till) Very Stiff to Hard		2	TW	PH						
			3	SS	85						
			4	SS	50						
			5	SS	68						
			6	SS	58						
			7	SS	34						
			8	SS	34						
			9	SS	100/2"						
			10	SS	64						
			11	SS	65						
			12	SS	50						
			13	SS	115						
			14	SS	100/5"						
			15	SS	100/5"						
		467.7	Fragments of shale below el. 483.		16	SS	100/3"				
60.3	End of Borehole										

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No.103

FOUNDATION SECTION

72-11002

LOCATION Co-ords. 15,878,905 N; 970,997 E.

ORIGINATED BY HS

W.P. 387-65

BORING DATE April 7, 1972

COMPILED BY HS

DATUM Geodetic

BOREHOLE TYPE Pendrill

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		BULK DENSITY γ P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80			100		
							SHEAR STRENGTH P.S.F.						WATER CONTENT % 10 20 30		
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE									
528.5	Ground Level														
	Clayey silt with some sand & traces of grav (Glacial Till)		1	TW	PH										
	& occ. silty sand layers		2	SS	33										
	Firm to Hard		3	SS	37										
	Brown		4	SS	60										
	Grey		5	SS	24										
			6	SS	15										
			7	SS	20										
			8	TW	PH										
			9	SS	36										
			10	SS	55										
			11	SS	85										
			12	SS	29										
			13	SS	47										
			14	SS	26										
	Fragments of shale below El. 483.		15	SS	120/6"										
			16	SS	107/6"										
468.3			17	SS	100/2"										
60.2	End of Borehole														

FOUNDATION SECTION

ORIGINATED BY HS

COMPILED BY HS

CHECKED BY

[illegible]

FOUNDATION SECTION

JOB	72-11002	LOCATION	Co-ords. 15,878,858 N; 971,130 E.	ORIGINATED BY	HS
W.P.	387-65	BORING DATE	April 12, 1972	COMPILED BY	HS
DATUM	Geodetic	BOREHOLE TYPE	Pendrill	CHECKED BY	<i>JK</i>

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %			
							20 40 60 80 100		w_p ——— w ——— w_L			
510.5	Ground Level											
	Topsoil (Black)		1	TW	PM	510					126	WL in open B
	----- Firm -----		2	TW	PH						134	
	Brown		3	SS	53							
	Clayey silt to silty		4	SS	34	500						
	clay with some sand &		5	SS	35							
	traces of gravel		6	SS	115							
	(Glacial Till)		7	SS	103 1/6"	490						
	occ. silty sand layers		8	SS	100 1/2"							
	Stiff to Hard		9	SS	100 1/4"							
	Grey		10	SS	100 1/5"							
	Fragments of Shale		11	SS	100 1/3"	480						
	below El. 483.		12	SS	100 1/4"							
470.5												
40.0	End of Borehole					470						

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 106

FOUNDATION SECTION

JOB 72-11002

LOCATION Co-ords. 15,878,757 N; 971,227 E.

ORIGINATED BY HS

W.P. 387-65

BORING DATE April 13, 1972

COMPILED BY HS

DATUM Geodetic

BOREHOLE TYPE Pendrill

CHECKED BY

[illegible]

PLASTICITY CHART

GLACIAL TILL

FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY & SILT

SAND

GRAVEL

Fine

Medium

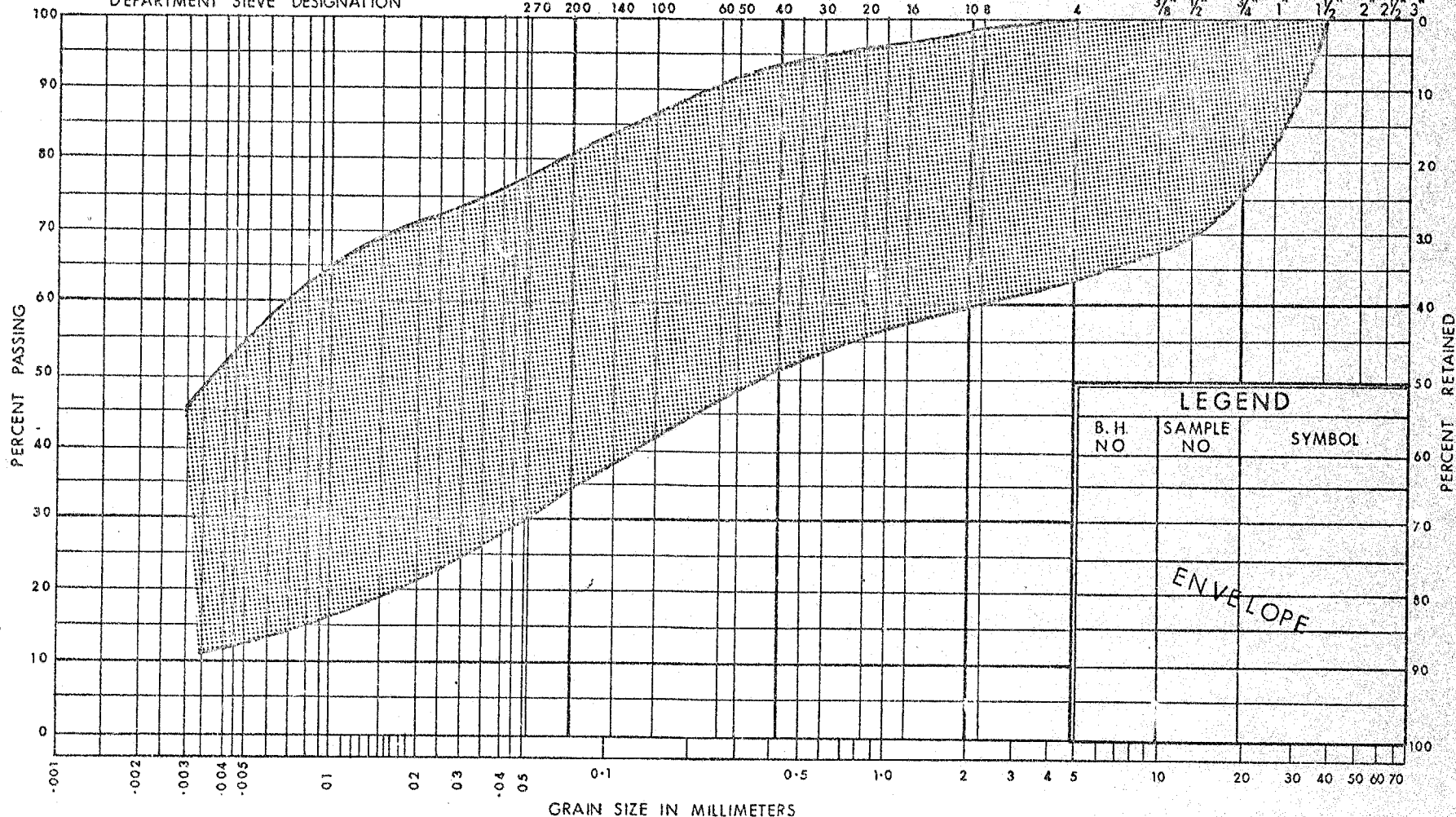
Coarse

Fine

Coarse

DEPARTMENT SIEVE DESIGNATION

270 200 140 100 60 50 40 30 20 16 10 8 4 3/8" 1/2" 3/4" 1" 1 1/2" 2" 2 1/2" 3"



LEGEND

B.H. NO	SAMPLE NO	SYMBOL

ENVELOPE

DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS



DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION
GLACIAL TILL

W.P. No. 387 - 65

JOB No. 72 - 11002

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 :-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
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

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	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
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 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
σ	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

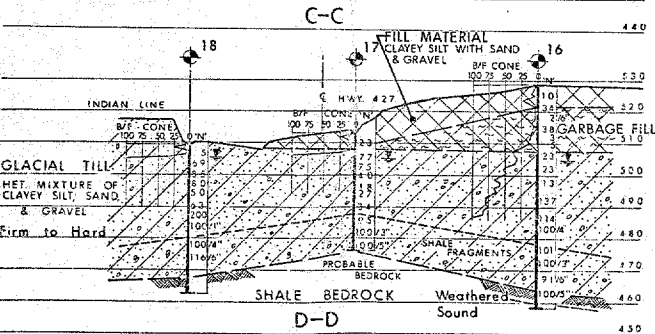
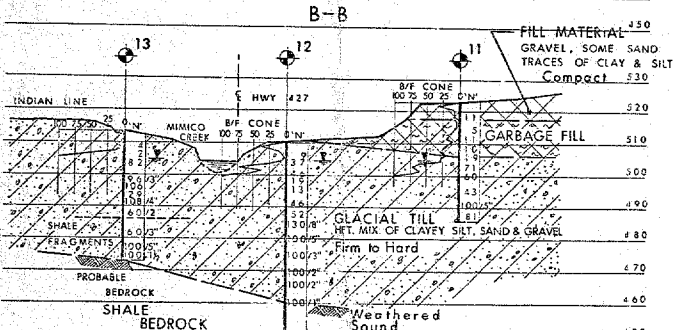
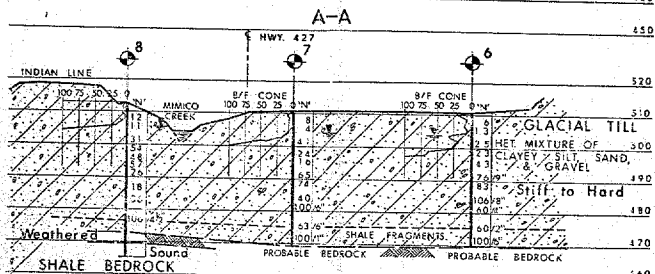
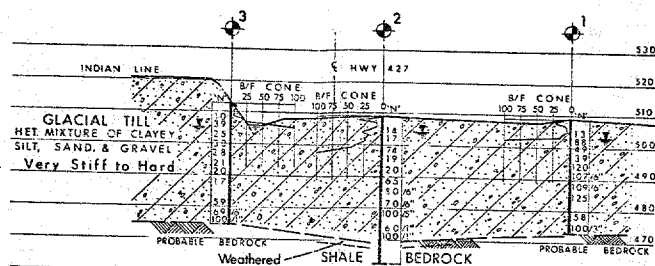
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

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

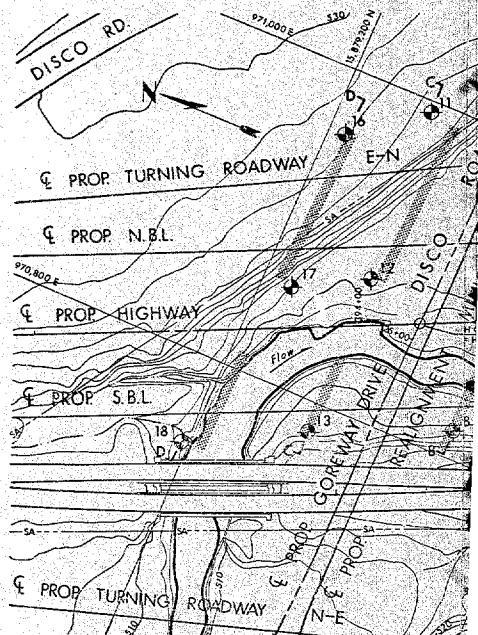
SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



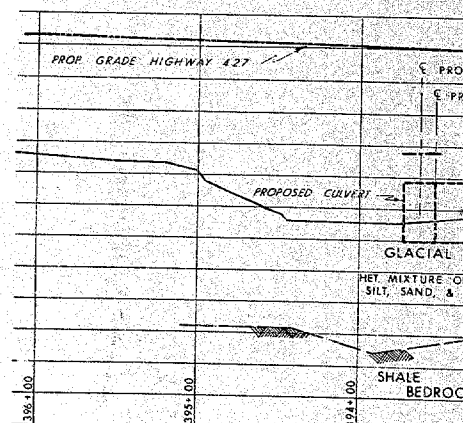
SECTIONS

40 30 20 10 0 20 40 FT HORIZ.
20 10 5 0 10 20 FT VERT



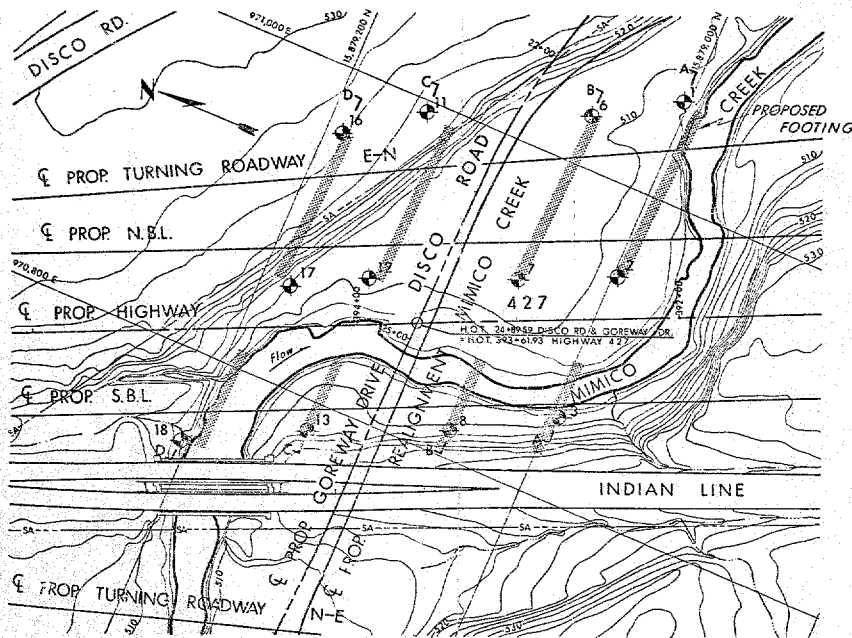
PLAN

40 30 20 10 0 20



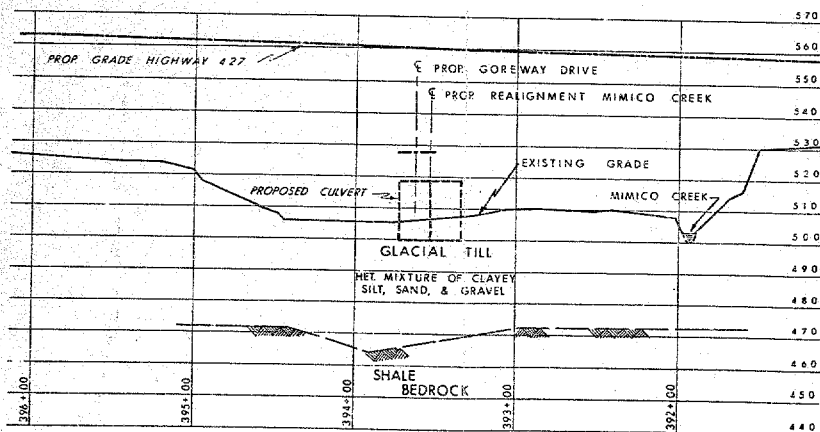
PROFILE

40 30 20 10 0 20
20 10 5 0 10 20 FT VERT



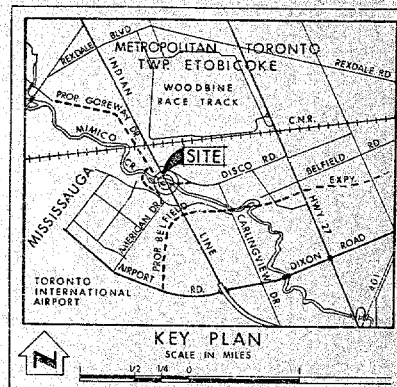
PLAN

40 30 20 10 0 20 40 FT



PROFILE

40 30 20 10 0 20 40 FT HORIZ
20 10 5 0 5 10 20 FT VERT



KEY PLAN

SCALE IN MILES

LEGEND

- Bore Hole
- ⊕ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- Water Levels established at time of field investigation

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	509.6	15879003	971.063
2	508.9	15878997	970.946
3	513.0	15878996	970.851
4	510.3	15879051	971.032
7	510.8	15879054	970.920
8	512.8	15879054	970.817
11	522.5	15879145	970.993
12	510.5	15879138	970.884
13	513.0	15879135	970.782
16	528.9	15879192	970.960
17	512.6	15879182	970.850
18	509.3	15879205	970.745

— 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.

REVISION	DATE	BY	DESCRIPTION
1	MAR 23 1972	S.R.	SECTIONS C-C & D-D CORRECTED TO SHOW GARBAGE FILL

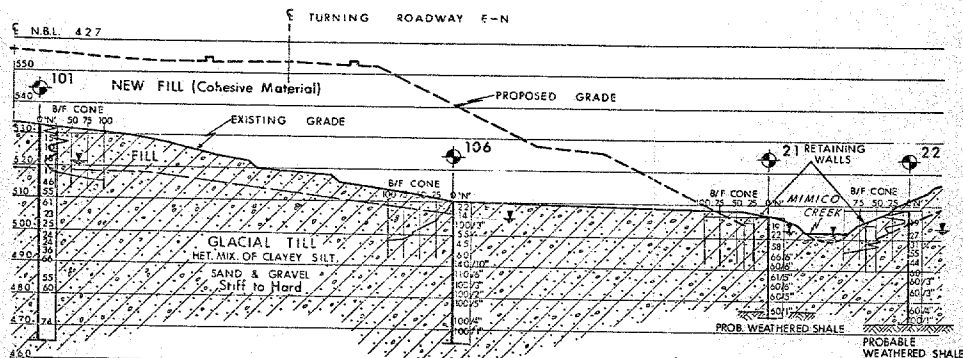
DEPARTMENT OF TRANSPORTATION & COMMUNICATIONS
DESIGN SERVICES BRANCH FOUNDATION OFFICE

DISCO ROAD & GOREWAY DRIVE

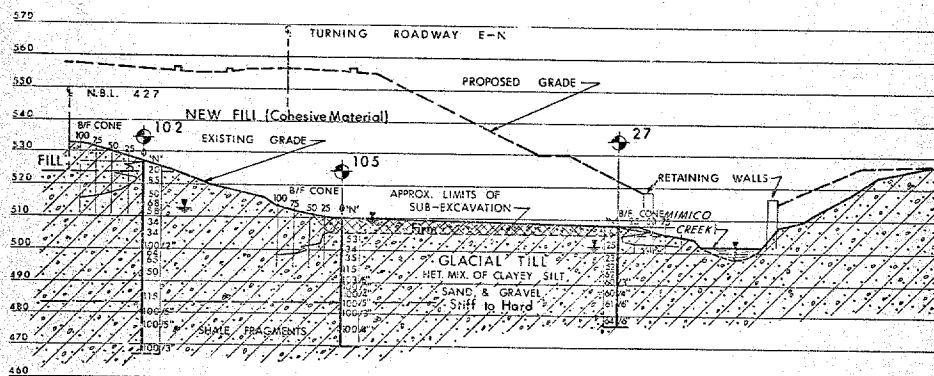
HIGHWAY NO. 427 DIST. NO. 6
CO. YORK METRO TORONTO
TWP. ETOBICOKE LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

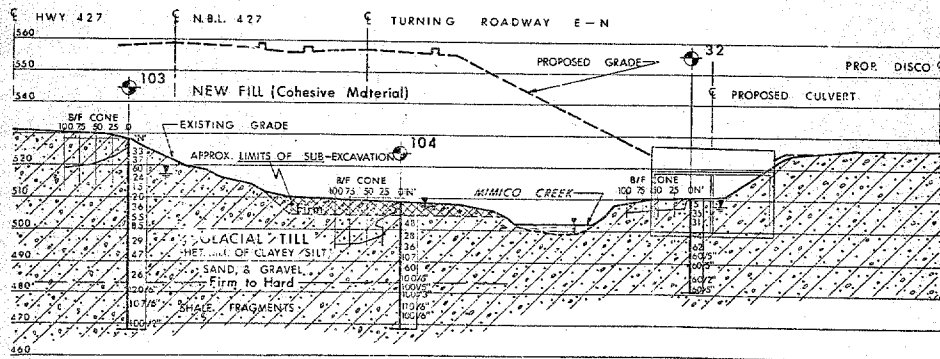
SUBMIT M.R.	CHECKED	W.P. NO. 387-65	M&T DRAWING NO.
DRAWN T.T.	CHECKED	JOB NO. 72-11002	72-11002A
DATE MARCH 17, 1972	SITE NO.	BRIDGE DRAWING NO.	
APPROVED	PRINCIPAL FOUNDATION ENGINEER	CONT. NO.	



A-A

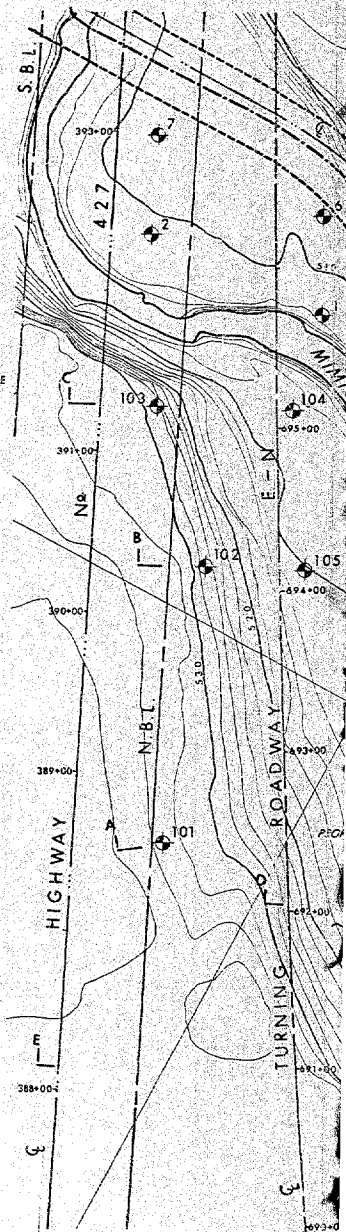


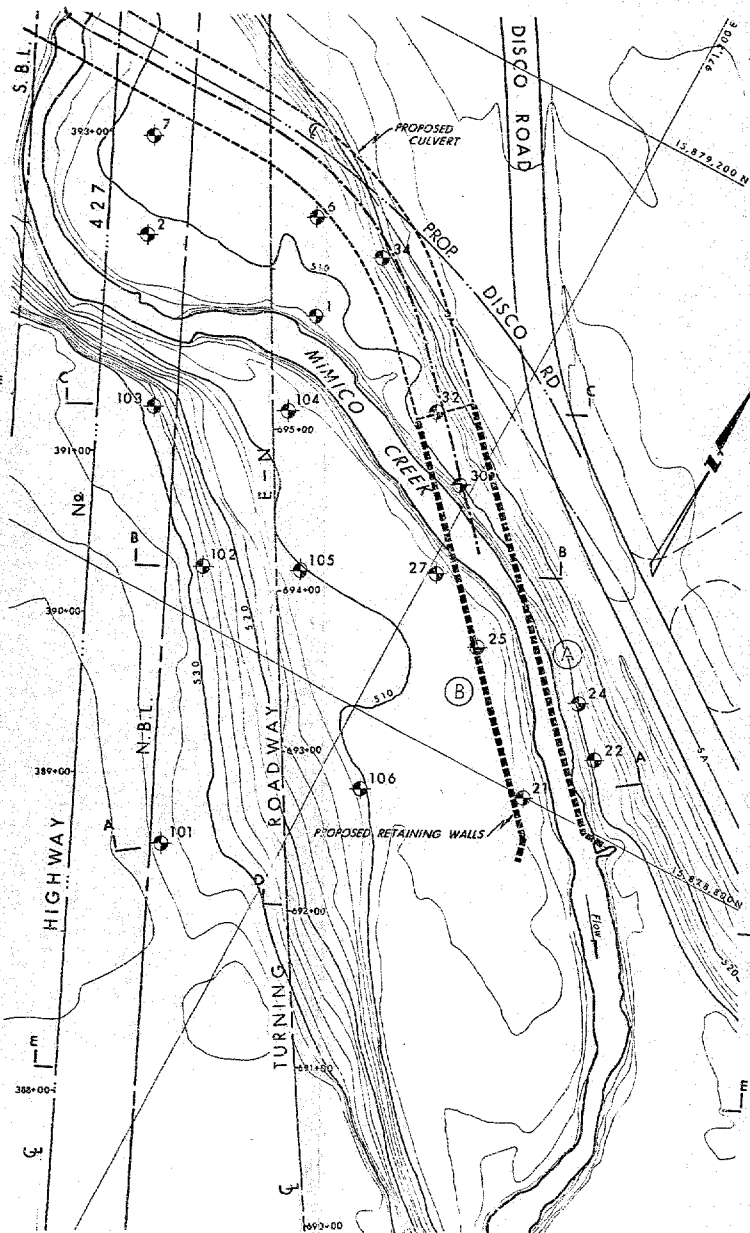
B-B



C-C

20 10 0 SCALE 30 40 FT.





SEE DWG. 72-11002A

KEY PLAN
SCALE IN MILES

LEGEND

- Bore Hole
- ⊕ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- ↓ Water Levels established at time of field investigation APRIL, 1972

NO.	ELEVATION	CO-ORDINATES NORTH EAST
21	507.6	15,878,800 971,319
22	508.7	15,878,834 971,348
27	509.1	15,878,897 971,207
32	510.5	15,878,984 971,158
101	531.4	15,878,702 971,133
102	528.0	15,878,832 971,073
103	528.3	15,878,905 970,997
104	508.6	15,878,942 971,076
105	510.5	15,878,858 971,130
106	510.5	15,878,757 971,227

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

DISCO ROAD & GOREWAY DRIVE

HIGHWAY NO. 427 DIST. NO. 6
CO. YORK METRO TORONTO
TWP. ETOBICOKE LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBWD. H.S. CHECKED: W.R. NO. 387-65 M&T DRAWING NO.
DRAWN T.T. CHECKED: J.C.B. NO. 72-11002 72-11002B
DATE MAY 7, 1972 SITE NO. BRIDGE DRAWING NO.
APPROVED: [Signature] CONT. NO.
REVISION: 12-SECTION 130-0145

PLAN
SCALE

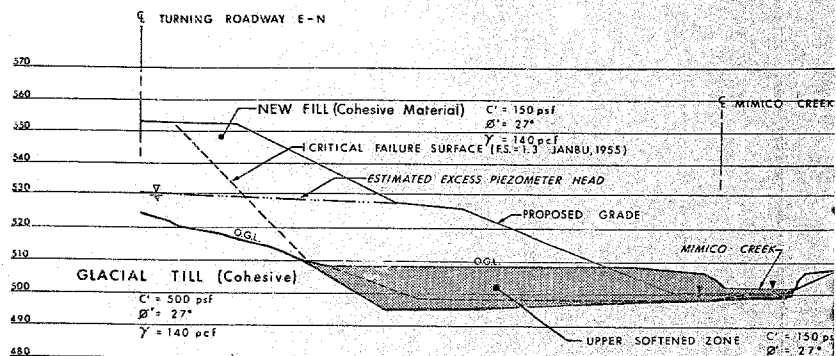
20 30 20 10 0 20 40 FT

LEGEND

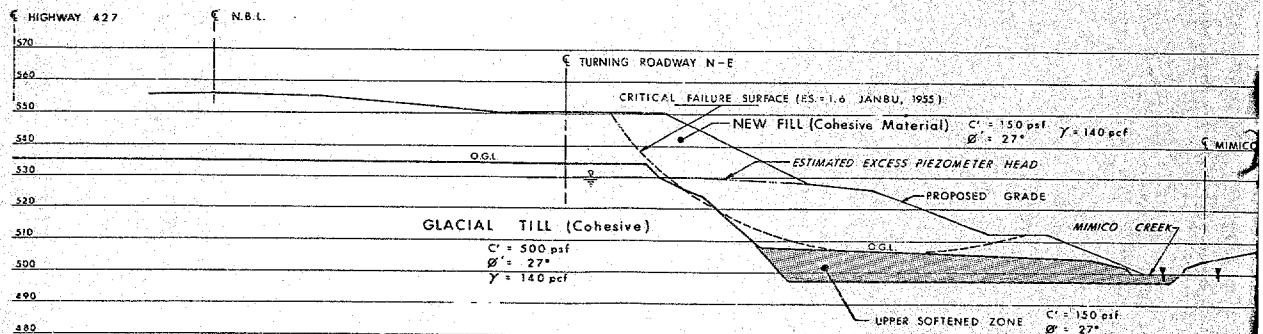
C' - Apparent Effective Cohesive Intercept (p.s.f.)

ϕ' - Apparent Effective Angle of Internal Friction (Degrees)

γ - Bulk Density (p.c.f.)



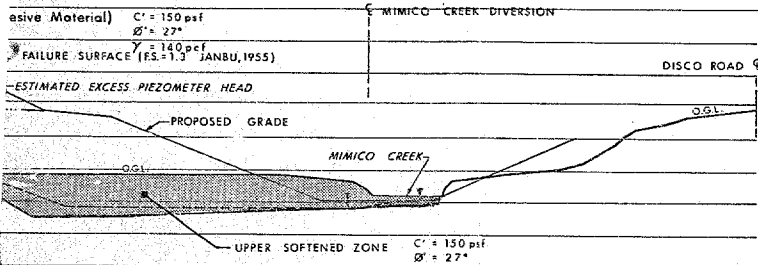
D—D



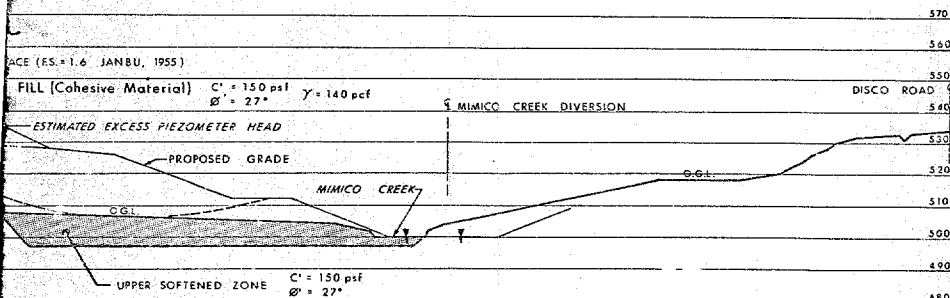
E—E

SECTIONS

20 10 0 SCALE 20 40 FT



D—D



E—E

SECTIONS D—D & E—E
 SEE DRAWING 72-11002B

SECTIONS

20 10 0 SCALE 20 40 FT

SEE DWG. 72-11002A



KEY PLAN
 SCALE IN MILES

LEGEND

- ⊕ Bore Hole
- ⊗ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- ⬇ Water Levels established at time of field investigation

NO.	ELEVATION	STATION	OFFSET

— 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.

DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION & COMMUNICATIONS
 DESIGN SERVICES BRANCH FOUNDATIONS OFFICE

DISCO ROAD & GOREWAY DRIVE

HIGHWAY NO. 427 DIST. NO. 6
 CO. YORK METRO TORONTO
 TWP. ETOBICOKE LOT CON

STABILITY ANALYSES

SUBMD. B.T.D. CHECKED	W.P. NO. 387-65	M.B.T. DRAWING NO.
DRAWN I.T. CHECKED	JCB NO. 72-11002	72-11002C
DATE MAY 7, 1972	STE NO.	BRIDGE DRAWING NO.
APPROVED	DESIGNED	CONT. NO.



Ministry of
Transportation and
Communications

Memorandum

To: C. Mirza,
Head, Soil Mechanics Section,
West Building, Downsview.

From: Structural Office,
West Building, Downsview.

Attention:

Date: January 21, 1976.

Our File Ref.

In Reply to

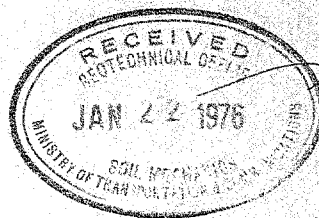
Subject:

Hwy. 427 O'pass at Disco Rd.,
W.P. # 387-65 Site # 37-994
Highway # 427 District # 6

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.

CSG/cf
Attch.

C. S. Grebski,
Structural Design Engineer.





Memorandum

To: Mr. M. Ernesaks,
Central Region,
3501 Dufferin Street,
Toronto, Ontario.

From: Structural Office,
West Building, Downsview.

Attention:

Date: January 27, 1976.

Our File Ref.

In Reply to

Subject: Highway 427 Overpass at Disco Road,
W.P. 387-65, Site 37-994
Highway 427, District 6.

Please find enclosed four sets of prints of drawings 37-994-1 to -19 for your use.

This structure has recently been redesigned and the enclosed drawings supersede all drawings previously sent to you.

One print of drawing 37-994-1 is being forwarded to the Systems Design Project Review Section.

One set of prints is also being forwarded to the following:

Estimating Section
Regional Structural Planning
Assistant Construction Engineer (Structures)
District.
Structural Maintenance Engineer
Soil Mechanics Section

MS/cf
Enc.

M. Stoyanoff
M. Stoyanoff,
Structural Contract Engineer.

c.c. J. Wear
B. Giroux
G. Burkhardt
A. McKim
H. Greenland
W. Birch
✓ C. Mirza
R. Fitzgibbon
J. Anderson





Memorandum

Lent 76-01
387-65-00

To: Mr. J.E. Callaghan,
Director,
Design & Construction Branch.

From: G.A. Metcalfe

Attention:

Date: 77 07 18

Our File Ref.

In Reply to

Subject:

The Engineering Materials Office and the Structural Office have carried out a comprehensive study in preparing this report.

This office and the Estimating Office provided some input pertaining to construction procedure, vibratory rollers, etc.

The Engineering Materials and Structural Office have initiated some changes and are requesting a Research study be carried out on vibratory roller forces.

Recommend the report be distributed to interested sections in the Ministry.

G.A. Metcalfe,
Contract Management Engineer.

GAM/sc

G-103 SEP 1976

GEOCRES No. 30m12-93

DIST. 6 REGION CENTRAL

W.P. No. 387-65

CONT. No. 76-01

W.O. No. 72-11000

STR. SITE No. 37-974

HWY. No. 427

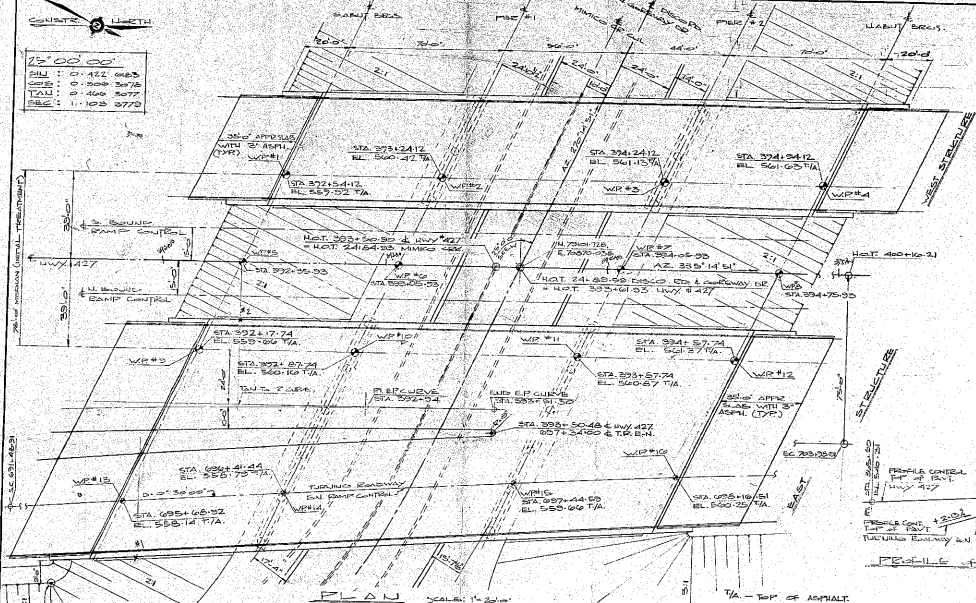
LOCATION Hwy 427 overpass at
Disco Road

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT 2

REMARKS: @ documents to be unfolded
before microfilming

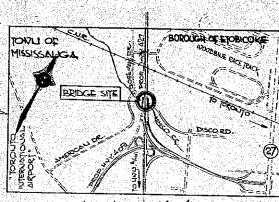
15.00.00

DATE : 0.422.00
 DES : 0.400.00
 TAU : 0.400.00
 SEC : 1.100.00



LIST OF DRAWINGS

- 1 - GENERAL PLAN
- 2 - BRIDGE LAYOUT - WEST SIDE
- 3 - BRIDGE LAYOUT - EAST SIDE
- 4 - BRIDGE LAYOUT - WEST SIDE
- 5 - BRIDGE LAYOUT - EAST SIDE
- 6 - BRIDGE LAYOUT - WEST SIDE
- 7 - BRIDGE LAYOUT - EAST SIDE
- 8 - BRIDGE LAYOUT - WEST SIDE
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- 13 - BRIDGE LAYOUT - EAST SIDE
- 14 - BRIDGE LAYOUT - WEST SIDE
- 15 - BRIDGE LAYOUT - EAST SIDE
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- 19 - BRIDGE LAYOUT - EAST SIDE
- 20 - BRIDGE LAYOUT - WEST SIDE
- 21 - BRIDGE LAYOUT - EAST SIDE
- 22 - BRIDGE LAYOUT - WEST SIDE
- 23 - BRIDGE LAYOUT - EAST SIDE
- 24 - BRIDGE LAYOUT - WEST SIDE

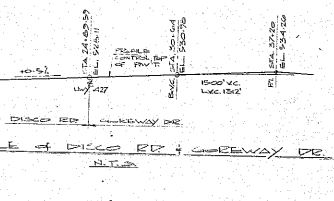
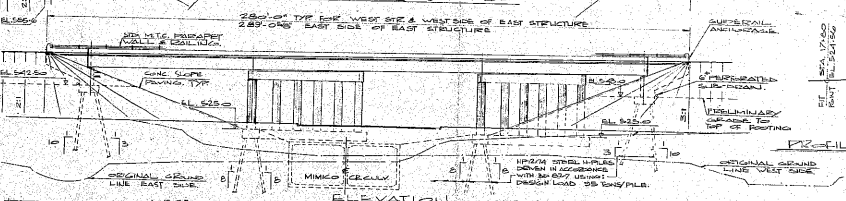


GENERAL NOTES

- 1. BRIDGE SPAN: 3000 P.F.I.
- 2. BRIDGE SPAN: 3000 P.F.I.
- 3. BRIDGE SPAN: 3000 P.F.I.
- 4. BRIDGE SPAN: 3000 P.F.I.
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- 22. BRIDGE SPAN: 3000 P.F.I.
- 23. BRIDGE SPAN: 3000 P.F.I.
- 24. BRIDGE SPAN: 3000 P.F.I.

CONSTRUCTION NOTES

- 1. BRIDGE SPAN: 3000 P.F.I.
- 2. BRIDGE SPAN: 3000 P.F.I.
- 3. BRIDGE SPAN: 3000 P.F.I.
- 4. BRIDGE SPAN: 3000 P.F.I.
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- 15. BRIDGE SPAN: 3000 P.F.I.
- 16. BRIDGE SPAN: 3000 P.F.I.
- 17. BRIDGE SPAN: 3000 P.F.I.
- 18. BRIDGE SPAN: 3000 P.F.I.
- 19. BRIDGE SPAN: 3000 P.F.I.
- 20. BRIDGE SPAN: 3000 P.F.I.
- 21. BRIDGE SPAN: 3000 P.F.I.
- 22. BRIDGE SPAN: 3000 P.F.I.
- 23. BRIDGE SPAN: 3000 P.F.I.
- 24. BRIDGE SPAN: 3000 P.F.I.



CURVE DATA

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4	171.00	171.00	171.00	171.00	171.00	171.00	171.00	171.00
5	171.00	171.00	171.00	171.00	171.00	171.00	171.00	171.00
6	171.00	171.00	171.00	171.00	171.00	171.00	171.00	171.00
7	171.00	171.00	171.00	171.00	171.00	171.00	171.00	171.00
8	171.00	171.00	171.00	171.00	171.00	171.00	171.00	171.00
9	171.00	171.00	171.00	171.00	171.00	171.00	171.00	171.00
10	171.00	171.00	171.00	171.00	171.00	171.00	171.00	171.00

CROSS SECTION THROUGH STRUCTURE - HIGHWAY 427



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

ONTARIO

72-11-001

HWY 427 SPAN AT DISCO RD

APPROX 1.1 MI. NORTH OF DISCO RD

BRIDGE NO. 427

BRIDGE OF 100 FT. SPAN

BRIDGE OF 100 FT. SPAN

BRIDGE OF 100 FT. SPAN

BRIDGE OF 100 FT. SPAN

BRIDGE OF 100 FT. SPAN

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BRIDGE OF 100 FT. SPAN

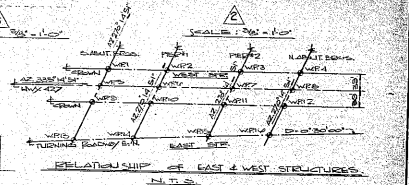
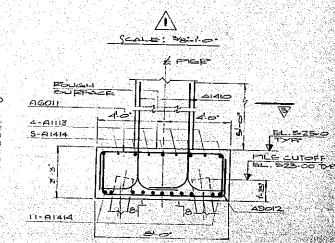
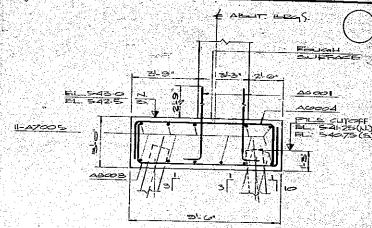
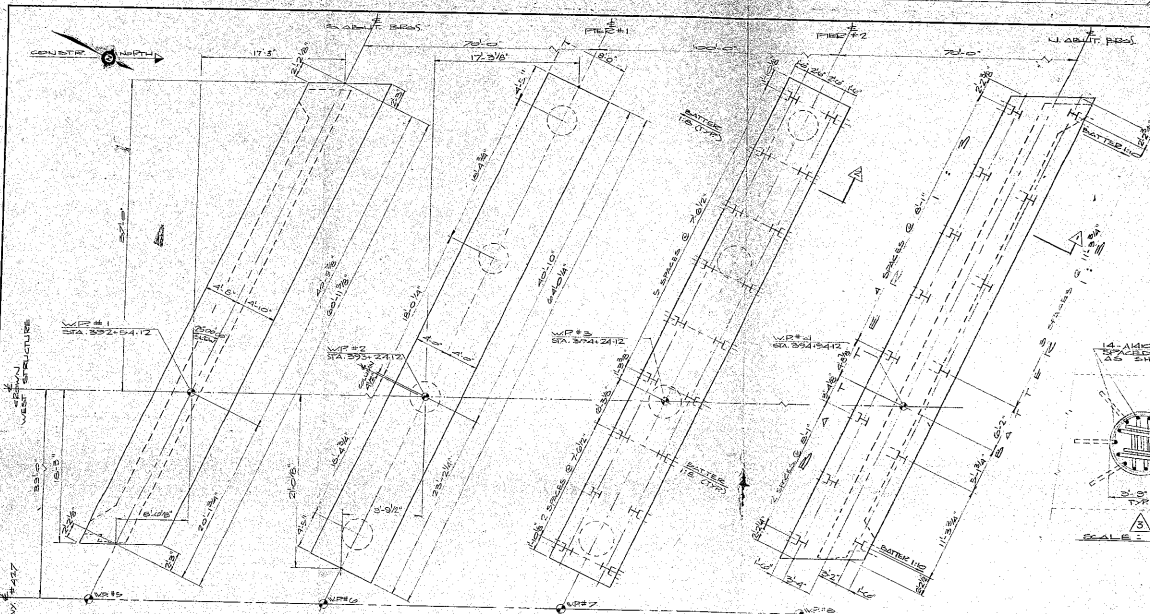
BRIDGE OF 100 FT. SPAN

BRIDGE OF 100 FT. SPAN

BRIDGE OF 100 FT. SPAN

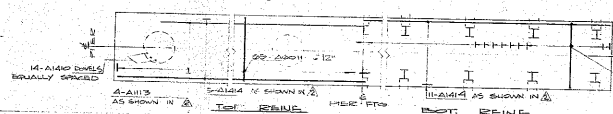
BRIDGE OF 100 FT. SPAN

BRIDGE OF 100 FT. SPAN

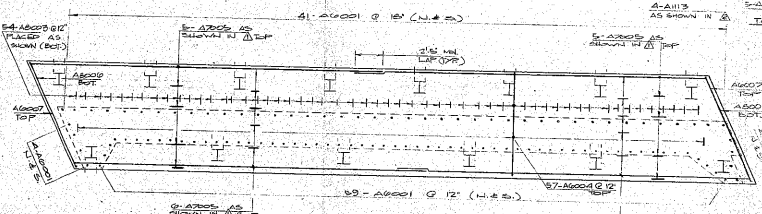


FOOTING LAYOUT
SCALE: 1/4" = 1'-0"

NOTE:
THE PROVINCIAL CO-ORDINATES
SEE DRAWING 27-934-12



PLAN OF PIER FOOTING SCALE: 1/4" = 1'-0"



PLAN OF ABUTMENT FOOTING
SCALE: 1/4" = 1'-0"

LOCATION	ABUTMENT	PIER #1	PIER #2
BATTER	1:3	1:5	1:5
QUANTITY	12	12	12
LENGTH (FT)	75'-0"	66'-0"	62'-0"
TYPE	HP 12 x 74	W 14 x 74	W 14 x 74

NOTE: HP 12 x 74 STEEL H-PILES TO BE DRIVEN IN ACCORDANCE WITH BD 62-7 VARIOUS DESIGN LOADS 55 TONS PER PILE SPACING MEASURED AT UNDERSIDE OF PILE

DATE	BY	DESCRIPTION

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS ONTARIO	
HWY 427 OPAS AT DISCO RD APPROX. 1.1 MI. NORTH OF DIXON RD	
PROJECT NO. 427	PIER NO. 2
MUNICIPALITY OF MID-DURHAM	CONTRACT NO. 27-934-12
DRAWING NO. 27-934-12	

