

DOCUMENT MICROFILMING IDENTIFICATION

01-20 SEPT 1976

GEOCREs No. 30M12-65

DIST 6 REGION Central

W.P. No. 127-56-60

CONT. No. 78-60

W. C. No. 73-11072

STR. SITE No. 24-RW1

HWY. No. 401/410/403

LOCATION Retaining Wall #1  
between structure #27 &  
#43

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. ~~5~~ 5

REMARKS: documents to be unfolded  
before microfilming

# memorandum



To: Mr. R. Dorton  
Manager, Structural Office

Date: 80 01 21

Mr. G.A. Wrong  
Head, Pavement & Foundation  
Design Section

RE: Contract 78-60 - Installation of Liner Inside Culvert E-9

Culvert E-9 on the above contract is a 946' long, 10'2" X 6'6" steel multi-plate pipe. The culvert was installed in very poor ground conditions and following installation buckling occurred in the roof over a section about 240' long. A temporary bracing system was installed and the culvert was later repaired by installing a grouted tunnel liner. The liner was designed by the pipe manufacturer. During installation the liner also failed over a short 8' section and the failure again took the form of buckling of the roof. After this failure the contractor's grouting methods were changed and no further failures took place. The buckled plates were later removed and new plates were installed in this short section. During this repair it was obvious that there had been no physical contact between the original pipe and the new liner however, the buckling did occur adjacent to a wooden block which had been installed as bracing between the tunnel and the liner.

The contractor contends that the failure of the liner was caused by failure of the original pipe. We contend that the failure was caused by the method of installation.

I am enclosing correspondence regarding this problem for your review, and would appreciate the opinion of one of your expert staff on the relative merits of the two arguments, as this will assist in the decision on payment of the contractor's repair costs. Please call me if you require any further information on the problem, I will be happy to supply any details you need. If necessary, we can arrange a meeting to discuss this matter.

*R.P. Northwood*

R.P. Northwood  
Area Construction Engineer

cc: I. Tremain





# PITTS ENGINEERING CONSTRUCTION LIMITED

30 COMMERCIAL ROAD, - TORONTO, ONTARIO, M4G 1Z6 Telephone: 421-7373 Telex: 05-23137

January 11, 1980

Ministry of Transportation & Communications,  
Construction Office,  
Central Region,  
3501 Dufferin Street,  
Downsview, Ontario,  
M3K 1N6

ATTENTION: Mr. R.P. Northwood, P. Eng.,  
Area Construction Engineer.

Dear Sir:

Re: MTC Contract 78-60,  
Intent to Claim No.3,  
Grouting of Tunnel Liner in Culvert E9.

Further to our intent to claim No. 3 on Contract 78-60 we offer the following:

In an examination of our claim for additional costs for installation of the Tunnel Liner in Culvert E9, it is important to note some of the details involved in the construction of the culvert.

The initial design of E9 called for 946 L.F. of 10'2" x 6'6" SPCSPA 12 gauge culvert placed with a normal type bedding.

Artesian conditions were encountered as construction progressed and consequently, the MTC on September 27, 1978 instructed Pitts (see instruction letters G22931, 32 & 33) to modify the bedding in an attempt to alleviate the problem.

In spite of the extra precautions taken, buckling of the culvert occurred. This could only be attributed to failure of the pipe bedding to adequately support the pipe. At the site meeting of October 27, 1979, Pitts were instructed that shoring of culvert E9 was necessary and the work would be paid under force account. The shoring was to be left in place until grading in the area was completed.

Cont'd.....

R.P. Northwood, P. Eng.

- 2 -

January 11, 1980

On December 14, 1978 Pitts were issued further instructions by the MTC (see letter G 42386) to supply and install additional shoring and bracing in E9 as a means of preventing further distortion. This shoring and bracing was to be left in place until remedial action on the pipe was determined.

MTC decided that a 113" x 61" grouted tunnel liner was required inside E9 as a means of strengthening the pipe against failure. Pitts submitted a price based on the quotation request as provided by the MTC.

There can be no doubt from the foregoing facts that the bedding support of culvert E9 was very questionable and beyond any control of the contractor.

The tunnel liner was installed by Pitts forces in September 1979 and grouting was commenced by BBR on October 9, 1979 in accordance with the methods and equipment as submitted in our letter of October 4, 1979.

In your letter of October 15th, 1979 you indicated that the MTC approved the grout design as submitted in our letter of October 4, but not the method of grouting. We suggest that the Grout mix design was discussed in detail due to the fact that when our proposal was reviewed there was some question regarding its adequacy. At no time was there any question raised about our proposed method of grouting and we could only construe this as an approval of our procedures. *AS 11/11/80*

As for the buckling of the tunnel liner, we still maintain that the lack of support at the haunch points of E9, as witnessed by the measures taken throughout construction, was the principal cause. We base our argument on the following:

1. The history of the installation of culvert E9 indicates that the soil conditions were less than desirable as a foundation for CSP pipe installation. Inadequate support was the cause of the initial problem, and since this condition was not changed, it would appear to be the cause of subsequent problems.

Cont'd.....

R.P. Northwood, P. Eng.,

January 11, 1980

2. The localized buckling in the 6 to 8 foot section of pipe took place after the grouting operations had ceased for the day. If the damage was caused by upward forces due to the tunnel liner floating, then this should have occurred when the grout was in its most liquid state, not after the pumping had stopped.

3. The area of localized buckling was not subjected to point loading as was suggested in your letter of October 15, 1979. When the damaged section was repaired, there was no blocking found which would induce a point load at this location. Since the liner was supported against upward movement on either side of the buckled section, only a downward force could have caused the damage. This downward force would have to come from culvert E9 buckling down.

4. In order for the liner to float in the grout, the grout would have to be in a liquid state. If the grout were liquid, then it would be forced in the path of least resistance. Since the buckling took place only some 15-20 feet behind the front line of flow. The forces would surely have caused the front line of flow to move out rather than buckle the top of the tunnel liner.

In conclusion we suggest that the extra work required to install and grout the liner in culvert E9 was caused by circumstances totally beyond our control. Since the MTC specified the corrective action required for culvert E9, we do not feel that the contractor (as indicated at site meeting #23) can be held responsible for all unforeseen circumstances & risk involved in installation.

With this in mind we submit our documented costs of \$4,839.69 along with our request for payment of these extra costs.

Trusting this meets with your approval.

*Indicated work at site meeting #23*

*Have me discuss with [unclear]*

Cont'd .....

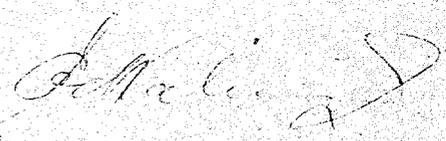
R.P. Northwood, P. Eng.,

- 4 -

January 11, 1980

Yours very truly,

PITTS ENGINEERING CONSTRUCTION LIMITED



for Sherman Ladner,  
Project Engineer.

SL/cd

c.c. F. Pahapill - Canadian BBR  
E. Kalnins

**PITTS ENGINEERING CONSTRUCTION LIMITED**

INVOICE

30 COMMERCIAL ROAD - TORONTO, ONTARIO M4G 1Z6  
 TELEPHONE: 421-7373

SOLD TO  
 Ministry of Transportation & Comm.,  
 District 6, Construction,  
 1201 Wilson Avenue,  
 Downsview, Ontario.

SHIPPED TO  
 INVOICE NO.  
 SAME Claim #3

M.T.C. Contract 78-60

| INVOICE DATE | YOUR ORDER NO. | COL.                     | SHIPPED VIA | PPD.                     | DATE SHIPPED | PACK SLIP NO. | TERMS |
|--------------|----------------|--------------------------|-------------|--------------------------|--------------|---------------|-------|
| Nov. 23/79   |                | <input type="checkbox"/> |             | <input type="checkbox"/> |              |               |       |

Labour

|   |           |
|---|-----------|
| Foreman - 61 hours @ \$10.64/hour               | \$649.04  |
| Labourers - 162 " @ \$10.14/hour                | 1642.68   |
|   | <hr/>     |
|   | 2291.72   |
| Plus 22% Payroll Burden                         | 504.18    |
|   | <hr/>     |
|   | 2795.90   |
| Plus 35% Overhead & Profit<br>On 1st. \$1000.00 | 350.00    |
| Plus 20% on \$1795.90                           | 359.18    |
|   | <hr/>     |
|   | 3505.08   |
| Plus 223 hrs. travel time<br>@ .40¢/hr.         | 99.20     |
|   | <hr/>     |
|   | \$3604.28 |

Equipment

|                                     |          |
|-------------------------------------|----------|
| Generator - 51.5 hours @ \$4.05/hr. | \$208.58 |
| Demolition Hammer -                 | 156.00   |
|                                     | <hr/>    |
| Plus 5% on Demo Hammer              | 7.80     |
|                                     | <hr/>    |
|                                     | \$372.38 |



# ENGINEERING CONSTRUCTION LIMITED

INVOICE

30 COMMERCIAL ROAD - TORONTO, ONTARIO M4G 1Z6  
TELEPHONE: 421-7373

SOLD TO

SHIPPED TO

INVOICE NO.

SAME Claim# 3

| INVOICE DATE | YOUR ORDER NO. | COL.                     | SHIPPED VIA | PPD.                     | DATE SHIPPED | PACK SLIP NO. | TERMS |
|--------------|----------------|--------------------------|-------------|--------------------------|--------------|---------------|-------|
| Nov. 28/79   |                | <input type="checkbox"/> |             | <input type="checkbox"/> |              |               |       |

### Material

|                                     |                 |
|-------------------------------------|-----------------|
| Liner Plates - 7 each               |                 |
| 7/4 x 1.5 ft./4 plates = 2.625 l.f. |                 |
| 2.625 l.f. x \$237.00/l.f. =        | \$622.13        |
| Grout Fitting- 1 @ \$18.00          | 18.00           |
|                                     | <u>640.13</u>   |
| Plus 5% FST                         | 32.01           |
|                                     | <u>672.14</u>   |
| Plus 7% PST                         | 47.05           |
|                                     | <u>719.19</u>   |
| Plus 20% Overhead & Profit          | 143.84          |
|                                     | <u>\$863.03</u> |
| <br>Total Amount of This Claim      | <br>\$ 4839.69  |

Remain  
79/10/29 774

Mr. J. W. MacDougall,  
Claims Engineer,  
Engineering Claims Office.

79 10 29

RE: Claim on Contract # 78-60,  
Pitts Engineering Construction Ltd.,  
Toronto area.

Attached please find, for your information, copy of Notification  
of Intent to Claim dated October 17, 1979 from Pitts Engineering  
Construction Limited regarding the above contract.

ORIGINAL SIGNED  
J. A. LELLIOTT  
J. A. Lelliott,

Construction Analyst.  
For: D. E. Thrasher,  
Manager,  
Construction Office.

JAL:pv  
c.c. J. B. Wilkes,  
A. C. Lennox,  
R. P. Northwood.



# PITTS ENGINEERING CONSTRUCTION LIMITED

30 COMMERCIAL ROAD, - TORONTO, ONTARIO, M4G 1Z6 Telephone: 421-7373 Telex: 06-23137



OCTOBER 9/1979

MILNE SITE OFFICE

CONTRACT 78-60

ATTENTION: R. BURLINGTON

ON TUESDAY OCTOBER 9, 1979 WE ATTEMPTED TO GROUT THE TUNNEL LINER INSIDE CULVERT E9 AS PER OUR PROPOSAL OF OCT. 3/79.

AS YOU ARE AWARE PROBLEMS WERE ENCOUNTERED WITH BUCKLING OF THE INSIDE TUNNEL LINER AND WE HAD TO DEVIATE FROM OUR PLANNED TAIL ENDURE. VERTICAL BRACES WERE INSTALLED AT APPROXIMATE 10 FOOT CENTRES THROUGHOUT THE LENGTH OF THE PIPE IN AN ATTEMPT TO PREVENT BUCKLING. AS WELL A NUMBER OF DIFFERENT GROUTING CONNECTIONS WERE MADE IN ORDER TO REDUCE THE FLOW PATH OF THE GROUT.

IN SPITE OF THESE ADDITIONAL MEASURES BEING TAKEN, LOCALIZED BUCKLING OCCURRED IN A 6 TO 8 FOOT SECTION OF THE PIPE. (THE TOP OF THE LINER BUCKLED DOWN)

1. PRIOR TO THIS BUCKLING TAKING PLACE, ONE OF THE PLUGS ON THE SIDE OF THE LINER HAD BEEN REMOVED AND WHEN THE GROUT STARTED TO GUSH OUT, THE HOLE WAS PLUGGED BY A WORKER PLACING THE PALM OF HIS HAND OVER IT, THEN BY PLACING A WOODEN WEDGE IN THE HOLE. THIS INDICATES THAT THERE WAS MINIMAL PRESSURE AT THIS POINT. ALSO AT THE TIME OF OCCURANCE GROUTING PROCEDURES HAD STOPPED FOR THE DAY.

WE CAN ONLY DEDUCE THAT THE BUCKLING IS BEING CAUSED BY A FORCE NOT ACCOUNTED FOR IN THE DESIGN OF THIS STRUCTURE.

CONT'D.....

**PITTS ENGINEERING CONSTRUCTION LIMITED**

30 COMMERCIAL ROAD, - TORONTO, ONTARIO, M4G 1Z6 Telephone: 421-7373 Telex: 06-23137

IT IS A DOCUMENTED FACT THAT SOIL CONDITIONS AT THIS LOCATION (CULVERT E-9) ARE NOT VERY STABLE AND INDEED THE ORIGINAL CULVERT HAD UNDERGONE CONSIDERABLE DEFORMATION DUE TO LACK OF SUPPORT (CAUSED BY SETTLEMENT) UNDER THE HAUNCHES OF THE PIPE. WE ARE OF THE OPINION THAT THE ADDITIONAL WEIGHT OF THE GROUT, WHICH MUST INITIALLY BE CARRIED BY THE OUTSIDE CULVERT IS CAUSING FURTHER DEFORMATION OF THE OUTSIDE PIPE. (SEE ATTACHED DIAGRAM) THIS DEFORMATION WOULD BE IN THE FORM OF OUTWARD & DOWNWARD MOVEMENT AT THE HAUNCH POINTS AND DOWNWARD AT THE TOP CENTRE OF THE PIPE. THIS PUTS CONSIDERABLE PRESSURE ON THE TOP OF THE INSIDE LINER CAUSING IT TO DEFORM DOWN ALSO.

PITTS ENGINEERING AND OUR SUBCONTRACTOR B.B.R. HAVE ENCURRED "EXTRA COSTS" (AND WILL CONTINUE TO DO SO) IN CARRYING OUT THE GROUTING OF CULVERT E-9. THIS CAN BE WITNESSED BY THE FACT THAT 2 DAYS WILL BE UTILIZED TO DO THE WORK ORIGINALLY SCHEDULED FOR ONE DAY.

WE CONTEND THAT THE REASONS FOR THESE "EXTRA COSTS" WERE BEYOND OUR CONTROL AND APPEAL TO THE M.T.C. FOR REIMBURSEMENT OF THE FOLLOWING :

1. COSTS FOR INSTALLATION AND REMOVAL OF VERTICAL BRACING INSIDE THE TUNNEL LINER.
2. REPAIRS TO THE 6 TO 8 FOOT SECTION WHICH HAS UNDERGONE EXCESSIVE BUCKLING.
3. COSTS OF ANY ADDITIONAL MEASURES THE MTC MAY DEEM NECESSARY TO ENSURE PROPER COMPLETION OF THIS WORK.





# PITTS ENGINEERING CONSTRUCTION LIMITED

30 COMMERCIAL ROAD, - TORONTO, ONTARIO, M4G 1Z6 Telephone: 421-7373 Telex: 06-23137

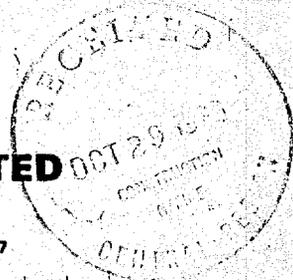
WE SUGGEST THAT IN AN ATTEMPT TO PREVENT FURTHER BUCKLING, VERTICAL BRACING WITH TOP AND BOTTOM HEADERS BE USED ON THE REMAINDER OF THE PIPE AND GROUTING OPERATION BE CARRIED OUT SIMILAR TO THOSE USED ON OCT. 9/79.

HOPING THIS MEETS WITH YOUR APPROVAL.

PITTS ENGINEERING CONSTRUCTION LTD.

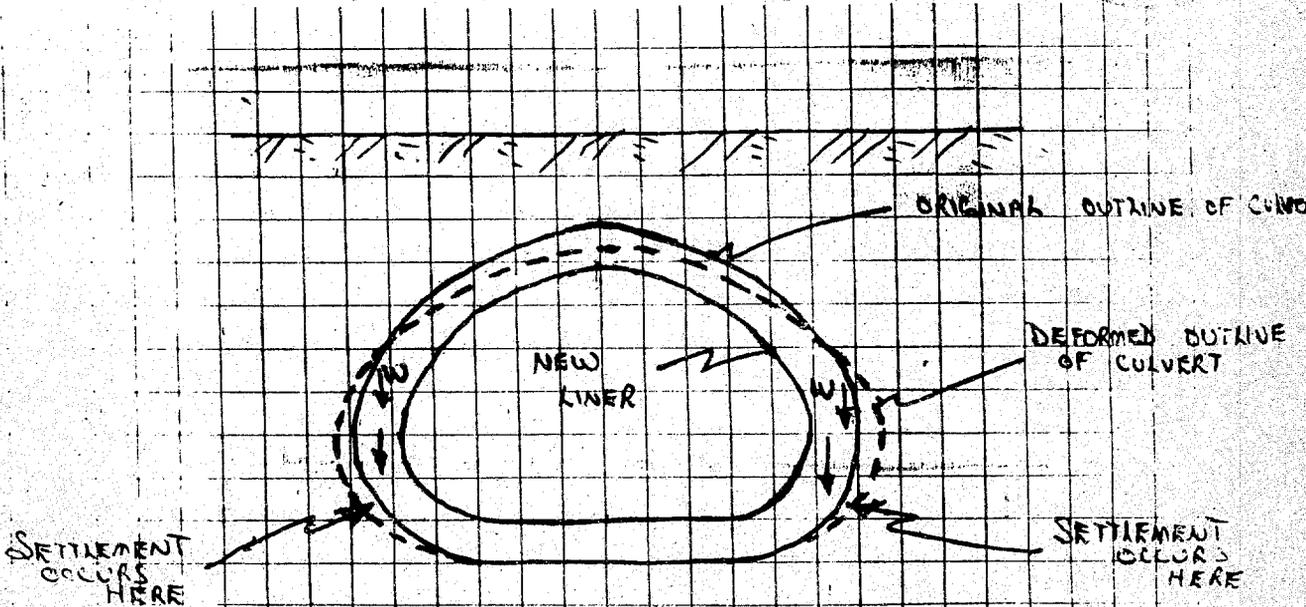
SHERMAN LADNER  
PROJECT ENGINEER.





# PITTS ENGINEERING CONSTRUCTION LIMITED

30 COMMERCIAL ROAD, - TORONTO, ONTARIO, M4G 1Z8 Telephone: 421-7373 Telex: 06-23137

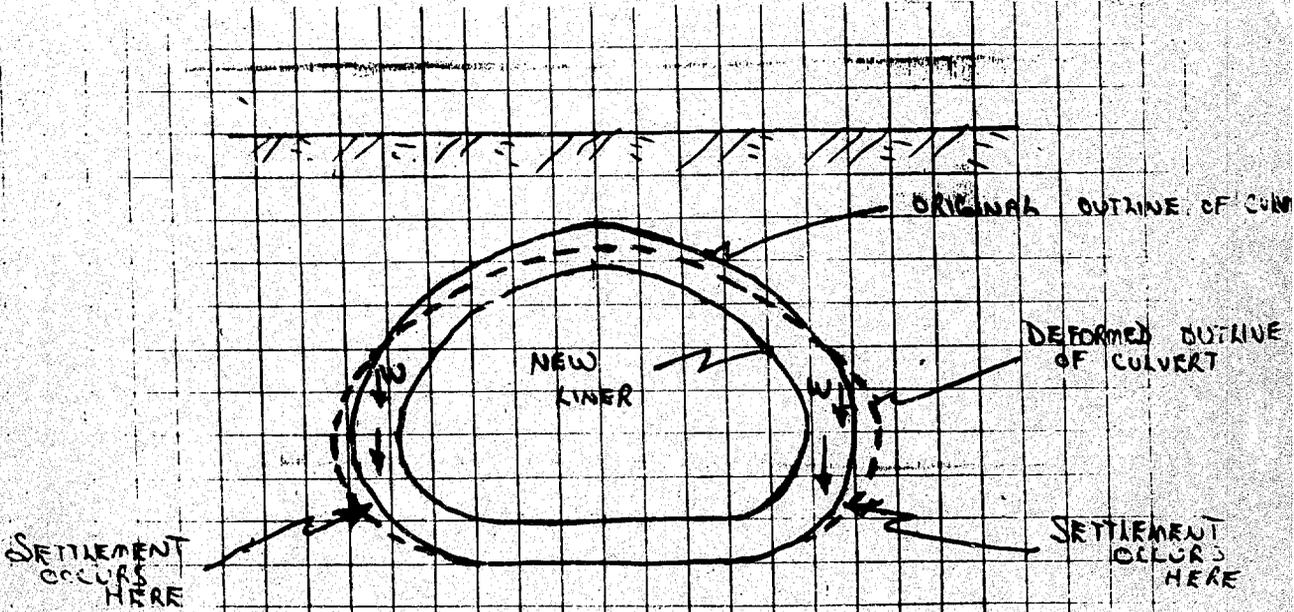


IT IS OUR CONTENTION THAT THE EXTRA WEIGHT OF THE  
 BOUT, WHICH MIGHT INITIALLY BE TAKEN BY THE OUTSIDE CULVERT,  
 IS CAUSING FURTHER SETTLEMENT AT THE HAUNCH POINTS WHICH  
 RESULTS IN THE HAUNCHES OF THE PIPE DEFORMING OUT  
 & THE TOP CENTRE OF THE PIPE DEFORMING DOWN.  
 THIS EXERTS A FORCE ON THE TOP OF THE INSIDE LINER  
 CAUSING IT TO BUCKLE.

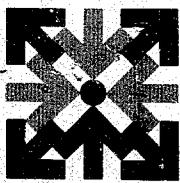


# PITTS ENGINEERING CONSTRUCTION LIMITED

30 COMMERCIAL ROAD, - TORONTO, ONTARIO, M4G 1Z6 Telephone: 421-7373 Telex: 06-23137



IT IS OUR CONTENTION THAT THE EXTRA WEIGHT OF THE BRANT, WHICH MUST INITIALLY BE TAKEN BY THE OUTSIDE CULVERT, IS CAUSING FURTHER SETTLEMENT AT THE HAUNCH POINTS WHICH RESULTS IN THE HAUNCHES OF THE PIPE DEFORMING OUT & THE TOP CENTRE OF THE PIPE DEFORMING DOWN. THIS EXERTS A FORCE ON THE TOP OF THE INSIDE TUNNEL LINER CAUSING IT TO BUCKLE.



# The Proctor & Redfern Group

Proctor & Redfern Limited  
Consulting Engineers and Planners  
75 Eglinton Avenue East  
Toronto, Ontario M4P 1H3  
Telephone (416) 486-5225 Telex 06-22506



28 January 1980

Mr. J.B. Wilkes, P.Eng.  
Executive Director  
Highway Engineering Division  
Ministry of Transportation  
and Communications  
Room 234, Central Building  
1201 Wilson Avenue  
Downsview, Ontario  
M3M 1J8

Dear Mr. Wilkes

## Geotechnical Services Agreement

Further to our meeting of January 3, 1980, I am responding to your request for comments on the proposed changes in the Ministry's Agreement for Geotechnical Services. The following points are made for your serious consideration and reflect the opinions of a cross-section of our members as gathered by John Gartner, P.Eng. of Gartner Lee Associates Limited:

1. Geotechnical drilling is a very specialized form of contracting. One of the advantages of utilizing consultants is that they can exercise their judgement and choose a driller who best meets their needs for that particular project.
2. The choice of a drilling contractor is one of the first professional acts that a geotechnical engineer makes on a project .....and this choice is a professional judgement.
3. The expertise exhibited by different contractors will vary. As an example, one contractor may have developed a special ability in the diamond drilling of shale. Another might be expert in the installation of multiple piezometers. Yet another might have the experience and knowledge to produce drilling for soils design projects much more cost effectively than a competitor.
4. The knowledgeable geotechnical consultant will be familiar with these contractors and he will make his choice accordingly. In fact, many consultants not only choose the drilling company, but they request a specific driller.

2...../

5. Thus, the choice of the drilling contractor by the Ministry method denies the consultant the exercise of his professional judgement over a most crucial part of the project, the collection of samples and evaluation of sub-surface conditions.
6. Under the proposed method, the Ministry is asking the consultant to assume the contractual liability, and thus the legal and professional liability for the retention of a drilling contractor, yet the consultant has little significant say in the choice of that drilling contractor. It is suggested that there is a point of legal liability here that requires careful scrutiny.

It would be of interest to know how wide a variance exists in the rates for equipment supplied by contractors and by consultants who own and operate similar equipment. It is suggested, however, that if any firm is not working in the best interests of the Ministry then there may be more effective methods of control rather than the modifications to the Agreement as proposed by the Ministry.

Respectfully submitted

The Proctor & Redfern Group



K.G. Smith, P.Eng.  
Chairman  
CEO/MTC Advisory Committee

KGS/eas

cc: Mr. John F. Gartner



## Memorandum

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

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

Attention: Date: September 26, 1973

Our File Ref. In Reply to

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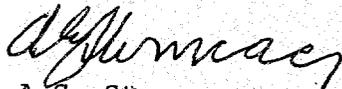
Subject:

FOUNDATION INVESTIGATION REPORT  
For  
The Proposed Retaining Wall No. 1  
for Ramp "E-S"  
Between Structures No. 27 and No. 43  
Hwy. 401/410/403 Interchange  
City of Mississauga  
Reg. Mun. of Peel  
District No. 6 (Toronto)  
W.O. 73-11072 - W.P. 127-66-60

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.

AGS/zh  
Attch.

  
A.G. Stermac,  
PRINCIPAL FOUNDATIONS ENGINEER.

cc: E.J. Orr  
B.R. Davis  
A. Rutka  
R.S. Pillar  
D.P. Collins  
B.J. Giroux  
C. Mirza  
G.A. Wrong  
B.A. Singh

Foundations Files ✓  
Documents.

FOUNDATION INVESTIGATION REPORT  
For  
The Proposed Retaining Wall No. 1  
for Ramp "E-S"  
Between Structures No. 27 and No. 43  
Hwy. 401/410/403 Interchange  
City of Mississauga  
Reg. Mun. of Peel  
District No. 6 (Toronto)  
W.O. 73-11072 - W.P. 127-66-60

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1. INTRODUCTION:

In conjunction with the proposed Hwy. 401/403/410 interchange complex, it is proposed to construct a retaining wall for Ramp "E-S" between Structures No. 43 and No. 27, in the City of Mississauga, District No. 6, Toronto.

The foundation office was requested to carry out a sub surface investigation at the site of the above mentioned structure. The request was contained in a memo from Mr. G.C.E. Burkhardt, Regional Structural Planning Engineer, Central Region, dated August 16, 1973.

Subsequently, an investigation was carried out by this office to determine the subsoil and groundwater conditions at this site. This report contains all the factual data obtained from this investigation, together with recommendations pertaining to the foundation design of the proposed retaining structure.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The area under investigation is located approximately 1/2 mile west of Heart Lake Road immediately south of Hwy. 401, in the City of Mississauga, Reg. Mun. of Peel. The terrain is flat to

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    - 6.4) Related Considerations.
  7. MISCELLANEOUS.
-

gently undulating in relief. The land is developed for farming purposes.

The site is located in the physiographic region known as the "Peel Plain". The characteristic deposit in the vicinity of the area under investigation, is composed of a cohesive glacial till underlain by shale bedrock.

3. FIELD AND LABORATORY WORK:

Four sampled boreholes were put down in the vicinity of the proposed retaining structure. The borings were advanced by means of an auger machine (C.M.E. #750) adapted for soil sampling purposes.

Samples of the subsoil were recovered at required depths with a 2 inch O.D. split-spoon sampler, which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. The bedrock was proven by obtaining BXL size core samples.

The locations and elevations of all the borings were surveyed in the field by construction personnel from the Toronto District office, and are shown on Drawing No. 73-11072A, together with an inferred stratigraphical profile. Across the site all elevations in the report are referenced to a Geodetic Datum.

All samples were visually examined and identified in the field and subsequently in the laboratory. Following this examination, laboratory testing was carried out on selected representative samples to determine the physical properties of the overburden, namely:

- Natural Moisture Contents
- Atterberg Limits
- Grain-Size Distributions

The results of this testing are plotted on the Record of Borehole sheets and summarized on Figure No. 1 and Figure No. 2, all of which are contained in the Appendix to this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant stratum across the site is a heterogeneous mixture of clayey silt to silty clay, sand and gravel (glacial till), underlain by shale bedrock at depths ranging from 4.5 to 7.5 feet.

4.2) Heterogeneous Mixture of Clayey Silt to Silty Clay With Some Sand and Gravel (Glacial Till):

The predominant stratum across the site is a deposit of heterogeneous mixture of clayey silt to silty clay with some sand and gravel (glacial till). The thickness of this deposit varies from 4.5 ft. (Borehole No. 4) to 7.5 ft. (Borehole No. 1).

Atterberg Limit tests were carried out on representative samples of the glacial till. The results, which are shown on the Record of Borehole sheets and on the Plasticity Chart (Figure No. 1) are tabulated below:

|                              |     | <u>Range</u> | <u>Average</u> |
|------------------------------|-----|--------------|----------------|
| Liquid Limit $W_L$           | (%) | 30-46        | 38             |
| Plastic Limit $W_P$          | (%) | 18-26        | 22             |
| Natural Moisture Content $W$ | (%) | 10-16        | 13             |

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

Grain-size distribution curves for typical samples of the cohesive stratum are shown in an envelope form on Figure No. 2 of the Appendix.

Standard Penetration tests, carried out within this glacial deposit, are plotted on the Record of Borehole sheets. The testing gave 'N' values ranging from 37 blows/ft. to in excess of 100 blows per foot. It is estimated that the consistency of the glacial till is generally hard.

4.3) Bedrock - Shale with Occasional Limestone Layers:

The glacial till is underlain by bedrock which was proven at four of the boring locations by obtaining BXL size core samples. Over the site, the bedrock surface was found to vary between elevations 586.7 and 589.4. The bedrock is found to be shale with occasional interbedded limestone layers. The upper 4 inches (Borehole No. 3) to 18 inches (Borehole No. 2) of the bedrock was found to be in a weathered condition.

5. GROUNDWATER CONDITIONS:

The groundwater level across the site during the period of the investigation (September, 1973) was observed by taking readings in the open boreholes. The results of the observations are shown on the Record of Borehole sheets, as well as on Drawing No. 73-11072A.

The observations indicate that the groundwater level across the site varies between elevations 589.4 and 590.2, i.e. 3.5 feet to 4.8 feet below existing ground surface.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct a retaining wall and parapet walls along Ramp "E-S" to accommodate Ramp "W-N" between structures No. 27 and No. 43. The pertinent details for the proposed retaining structure are as follows:

- Approximate length - 245 ft.
- Proposed profile grade Ramp "E-S" - elevation 593 to elevation 597
- Clear height of wall (maximum) - 23 ft.
- Location (Refer to Drawing No. 73-11072A)

The predominant stratum across the site is a shallow deposit of 4.5 to 7.5 ft. thick competent cohesive glacial till, underlain by shale bedrock.

### 6.2) Retaining Structure Foundations:

The entire retaining structure can be founded on spread footing located within the glacial till or shale bedrock.

Footings founded within the glacial till could be designed using an allowable bearing pressure of 3 t.s.f. However, for footings founded in the shale bedrock an allowable bearing pressure of up to 10 t.s.f. may be used. In all cases, a minimum of 4 feet of cover should be provided above the underside of the footing for frost protection purposes. Care should be taken to ensure that the foundation base is not softened by uncontrolled surface run-off or groundwater seepage. It would be advantageous however, to protect the foundation base with a lean concrete working slab.

The excavation will be carried out in the relatively impervious glacial till or shale bedrock and in view of this no major dewatering problems are anticipated.

### 6.3) Parapet Walls:

The north parapet wall between the retaining structure and Structure No. 27 can be founded in the fill material using an allowable pressure of 1.0 t.s.f. In any case adequate frost cover should be provided to the base of the parapet wall.

The south parapet wall between the retaining structure and Structure No. 43 according to available information may be located with natural subsoil (glacial till). Recommendation given in sub section 6.2 will be applicable.

### 6.4) Related Considerations:

The wall will be inherently stable with respect to a deep-seated rotational type of failure within foundation subsoil.

In computing the sliding resistance between the base of the footing and the cohesive foundation subsoil (glacial till) an adhesive value of 2,500 p.s.f. should be used. If footings are located within the shale bedrock a coefficient of friction of 1.0 may be used.

If the structure is to be designed as a rigid wall, a coefficient of earth pressure at rest ( $K_c$ ) of 0.5 should be assumed for the granular backfill behind the wall, when designing the wall section. If some movement at the top of the wall is permitted, a coefficient of active earth pressure ( $K_a$ ) of 0.33 may be used.

In order to relieve the build-up of excess hydrostatic pressure behind the retaining wall, suitable drainage measures should be provided. Backfill behind the wall should be carried out in accordance with current M.T.C. practices, specifically Standard No. S.D.4-58.

7. MISCELLANEOUS:

The field work, carried out during the period of September 7, 1973, was supervised by Mr. V. Korlu, Project Foundation Engineer, who also prepared this report.

Equipment used was owned and operated by Dominion Soils Company of Toronto.

This project was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who also reviewed this report.



*V. Korlu*  
V. Korlu, P. Eng.

*M. Devata*  
M. Devata, P. Eng.

VK/zh  
September 25, 1973.

*APPENDIX I*

---

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1

JOB 73-11072 LOCATION Co-ords. 15,855,930 N; 958,588 E.  
 W.P. 127-66-60 BORING DATE Sept. 7, 1973  
 DATUM Geodetic BOREHOLE TYPE Auger and cone with CME 750

ORIGINATED BY VK  
 COMPILED BY VK  
 CHECKED BY /

| SOIL PROFILE |  |             | SAMPLES |      |            | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE                           |                       |  |   | LIQUID LIMIT $w_L$                    |  |  | BULK DENSITY $\gamma$ | REMARKS             |
|--------------|--|-------------|---------|------|------------|-------------|--|-----------------------|--|---|---------------------------------------|--|--|-----------------------|---------------------|
| ELEV. DEPTH  | DESCRIPTION  | STRAT. PLOT | NUMBER  | TYPE | BLOWS/FOOT |             | BLOWS / FOOT   | SHEAR STRENGTH P.S.F. |  |   | WATER CONTENT %                       |  |  |                       |                     |
|              |  |             |         |      |            |             | O UNCONFINED + FIELD VANE<br>P QUICK TRIAXIAL X LAB VANE |                       |  | $w_p$ $w$ $w_L$<br>———— ——— ———<br>———— ——— ———<br>———— ——— ——— | 15    30    45<br>P.C.F. GR SA SI. CL |  |  |                       |                     |
| 594.2        | Ground Level   |             |         |      |            |             |  |                       |  |   |                                       |  |  |                       |                     |
| 0.0          | Het. mix. of clayey silty to silty clay with some sand & gravel. |             | 1       | SS   | 52         | 590         |  |                       |  |   |                                       |  |  |                       | 589.4<br>7 10 57 20 |
| 586.7        | Glacial Till Hard weathered                                      |             | 2       | SS   | 17         |             |  |                       |  |   |                                       |  |  |                       |                     |
| 7.5          | Shale Bedrock with occ. interbedded limestone                    |             | 3       | EXL  | 90% Rec    |             |  |                       |  |   |                                       |  |  |                       |                     |
| 582.7        |  |             |         |      |            |             |  |                       |  |   |                                       |  |  |                       |                     |
| 11.5         | End of Borehole  |             |         |      |            | 580         |  |                       |  |   |                                       |  |  |                       |                     |

OFFICE REPORT J SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2

JOB 73-11072 LOCATION Co-ords. 15,856,088 N; 958,567 E. ORIGINATED BY VK  
 W.P. 127-66-60 BORING DATE Sept. 7, 1973 COMPILED BY ix  
 DATUM Gcotic BOREHOLE TYPE Auger and core with CME 750 CHECKED BY

| SOIL PROFILE |   |             | SAMPLES |      |            | ELEV. SCALE | DYNAMIC PENETRATION RESISTANCE<br>BLOWS / FOOT | LIQUID LIMIT $w_L$<br>PLASTIC LIMIT $w_p$<br>WATER CONTENT $w$<br>$w_p$ — $w$ — $w_L$ | BULK DENSITY<br>$\gamma$ | REMARKS  |
|--------------|---|-------------|---------|------|------------|-------------|--|---|--------------------------|----------|
| ELEV. DEPTH  | DESCRIPTION   | STRAT. PLOT | NUMBER  | TYPE | BLOWS/FOOT |             |  |   |                          |          |
| 593.7        | Ground Level  |             |         |      |            |             |  |   |                          |          |
| 0.0          | Soft mix of clayey silty<br>to silty clay with<br>some sand & gravel. |             | 1       | SS   | 37         | 590         |  |   |                          |          |
| 588.7        | Glac. Till Hard   |             | 2       | GS   | 75         |             |  |   |                          | 590.2    |
| 5.0          | Weathered<br>sand   |             | 3       | BXL  | 66         |             |  |   |                          | 0 5 60 3 |
| 579.7        | Shale with occasional<br>interbedded limestone<br>layers.             |             | 4       | BXL  | 100        |             | 580  |   |                          |          |
| 14.0         | End of Borehole   |             |         |      |            | 570         |  |   |                          |          |

OFFICE REPORT ON SOIL EXPLORATION





DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 5 (6, 73-11038)

JOB 73-11072 LOCATION Co-ords. 15,856,181 N; 958,571 E. ORIGINATED BY VK  
 W.P. 127-61-60 BORING DATE June 18, 1973 COMPILED BY VK  
 DATUM Geodetic BOREHOLE TYPE Drill with Tri-cone and BXL Bits CHECKED BY \_\_\_\_\_

| SOIL PROFILE |   | STRAT. PLOT | SAMPLES |      |            | ELEV. SCALE  | DYNAMIC PENETRATION RESISTANCE<br>BLOWS / FOOT |  |  |                     | LIQUID LIMIT $w_L$<br>PLASTIC LIMIT $w_p$<br>WATER CONTENT $w$ |  |  | BULK DENSITY<br>$\gamma$ | REMARKS |
|--------------|---|-------------|---------|------|------------|--|--|--|--|---------------------|--|--|--|--------------------------|---------|
| ELEV. DEPTH  | DESCRIPTION   |             | NUMBER  | TYPE | BLOWS/FOOT |  | SHEAR STRENGTH P.S.F.                          |  |  |                     | WATER CONTENT %  |  |  |                          |         |
|              |   |             |         |      |            | ○ UNCONFINED + FIELD VANE<br>● QUICK TRIAXIAL × LAB VANE |  |  |  | $w_p$ — $w$ — $w_L$ |  |  |  |                          |         |
| 592.9        | Ground Level  |             |         |      |            |  |  |  |  |                     |  |  |  |                          |         |
| 590.9        | Glacial Till  |             |         |      |            | 590  |  |  |  |                     |  |  |  |                          |         |
| 584.1        | Weathered Sand  |             |         |      |            |  |  |  |  |                     |  |  |  |                          |         |
| 579.5        | Shale Bedrock with occ. interbedded limestone layers. |             | 1       | BXL  | 100%       | 580  |  |  |  |                     |  |  |  |                          |         |
| 573.5        | End of Borehole                                       |             |         |      |            |  |  |  |  |                     |  |  |  |                          |         |
|              |   |             |         |      |            | 570  |  |  |  |                     |  |  |  |                          |         |

586.9

OFFICE REPORT SOIL EXPLORATION

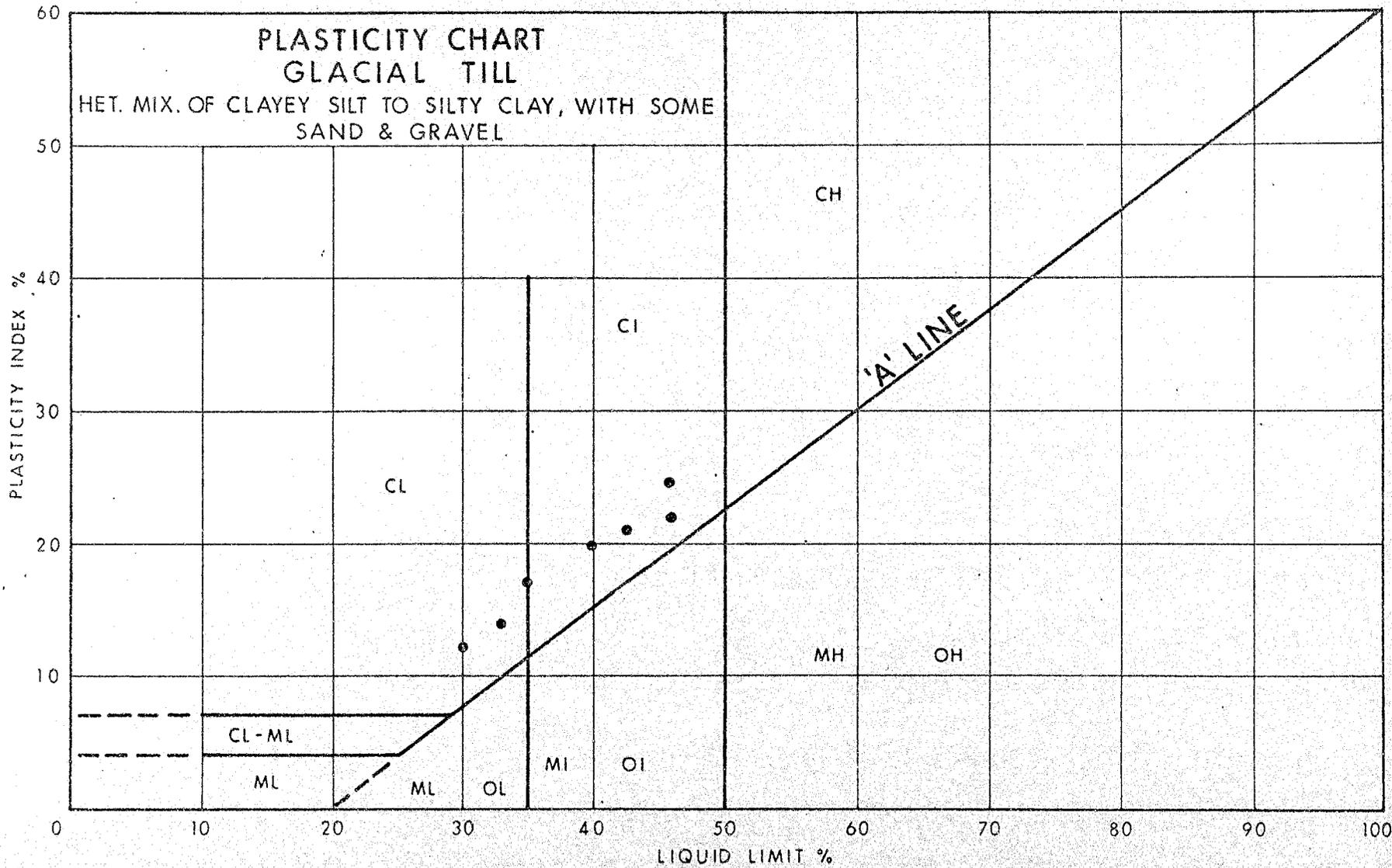
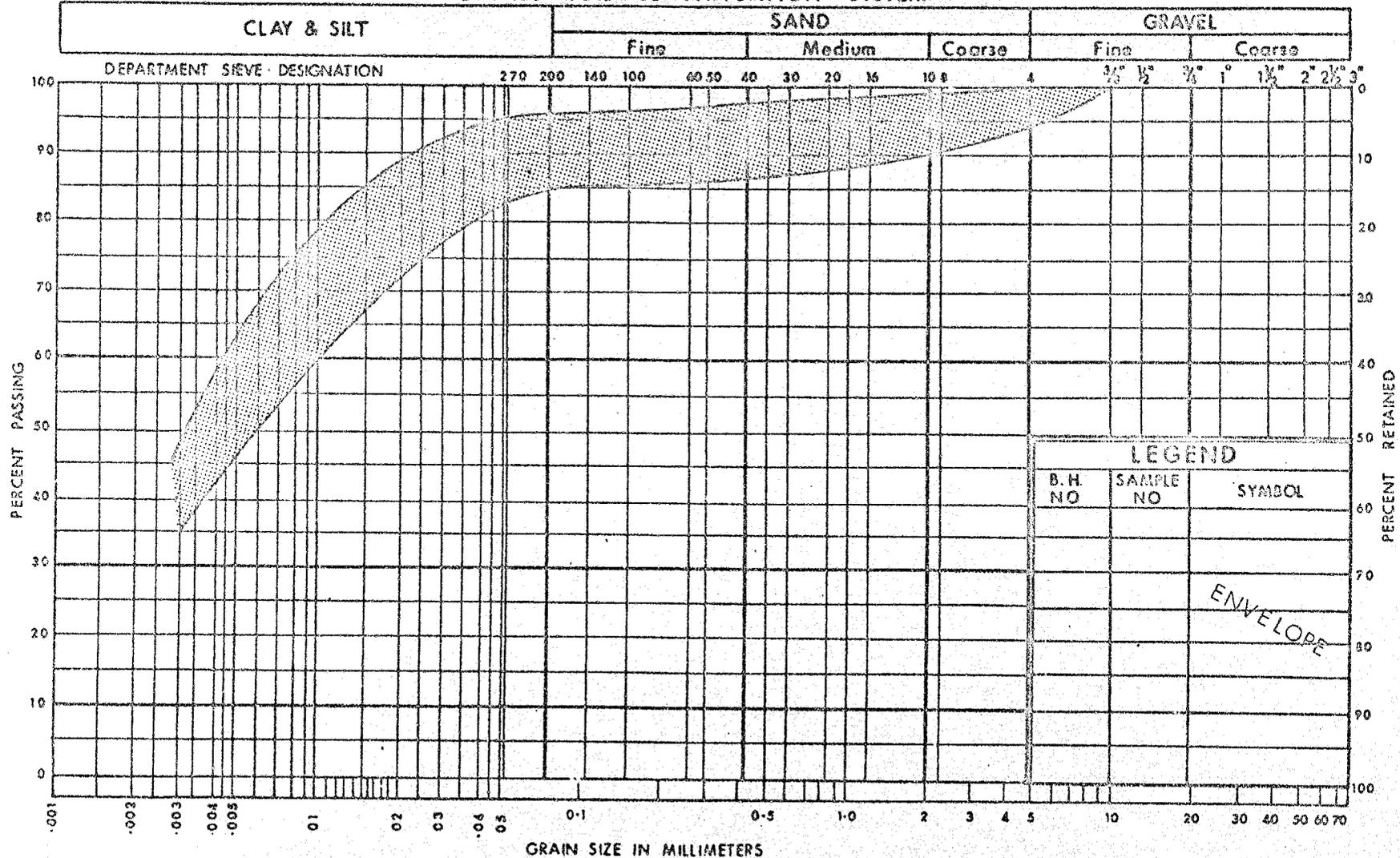


FIG. 1

### UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS  
DESIGN SERVICES BRANCH

**GRAIN SIZE DISTRIBUTION**  
**GLACIAL TILL**  
HET. MIX. OF CLAYEY SILT TO SILTY CLAY, WITH SOME SAND & GRAVEL

W.P. No. 127 - 66 - 60  
JOB No. 73 - 11072  
**FIG. 2**

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION RESISTANCE

'N'-STANDARD PENETRATION RESISTANCE : - 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>c LB./SQ. FT.</u> | <u>DENSENESS</u> | <u>'N' BLOWS / FT.</u> |
|--------------------|----------------------|------------------|------------------------|
| VERY SOFT          | 0 - 250              | VERY LOOSE       | 0 - 4                  |
| SOFT               | 250 - 500            | LOOSE            | 4 - 10                 |
| FIRM               | 500 - 1000           | COMPACT          | 10 - 30                |
| STIFF              | 1000 - 2000          | DENSE            | 30 - 50                |
| VERY STIFF         | 2000 - 4000          | VERY DENSE       | > 50                   |
| HARD               | > 4000               |                  |                        |

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10% , SOME 10-25% , WITH 25-40% , > 40% SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

|      |                     |      |                   |
|------|---------------------|------|-------------------|
| S.S. | SPLIT SPOON         | T.W. | THINWALL OPEN     |
| W.S. | WASHED SAMPLE       | T.P. | THINWALL PISTON   |
| S.T. | SLOTTED TUBE SAMPLE | O.S. | OESTERBERG SAMPLE |
| A.S. | AUGER SAMPLE        | F.S. | FOIL SAMPLE       |
| C.S. | CHUNK SAMPLE        | R.C. | ROCK CORE         |

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

|     |   |      |                 |
|-----|---|------|-----------------|
| U   | UNCONFINED COMPRESSION                    | L.V. | LABORATORY VANE |
| UU  | UNCONSOLIDATED UNDRAINED TRIAXIAL         | F.V. | FIELD VANE      |
| CIU | CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL | C    | CONSOLIDATION   |
| CID | " " DRAINED "                             | S    | SENSITIVITY     |
| CAU | " ANISOTROPIC UNDRAINED "                 |      |                 |
| CAO | " " DRAINED "                             |      |                 |

# ABBREVIATIONS & SYMBOLS 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   |
| $w_s$      | 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                  |
| $c_u$      | APPARENT COHESION  |
| $\phi_u$   | APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION                   |
| $\mu$      | COEFFICIENT OF FRICTION  |
| $S_1$      | 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   |
| $\epsilon$ | LINEAR STRAIN  |
| $\gamma$   | SHEAR STRAIN   |
| $\nu$      | POISSON'S RATIO ( $\mu$ IS ALSO USED)                  |
| E          | MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)        |
| G          | MODULUS OF SHEAR DEFORMATION                           |
| K          | MODULUS OF COMPRESSIBILITY                             |
| $\eta$     | COEFFICIENT OF VISCOSITY                               |

## EARTH PRESSURE

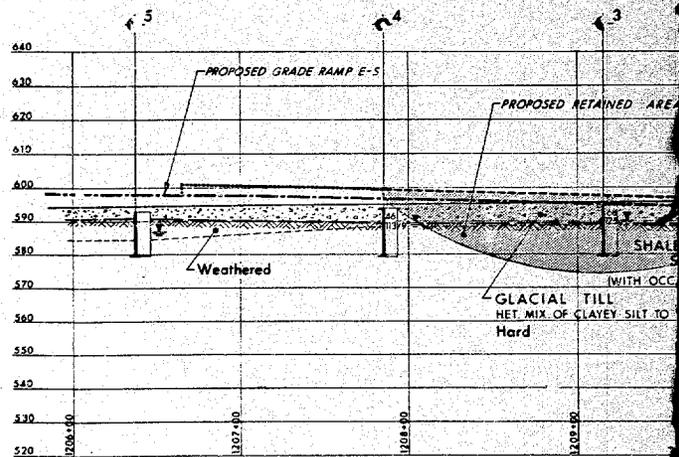
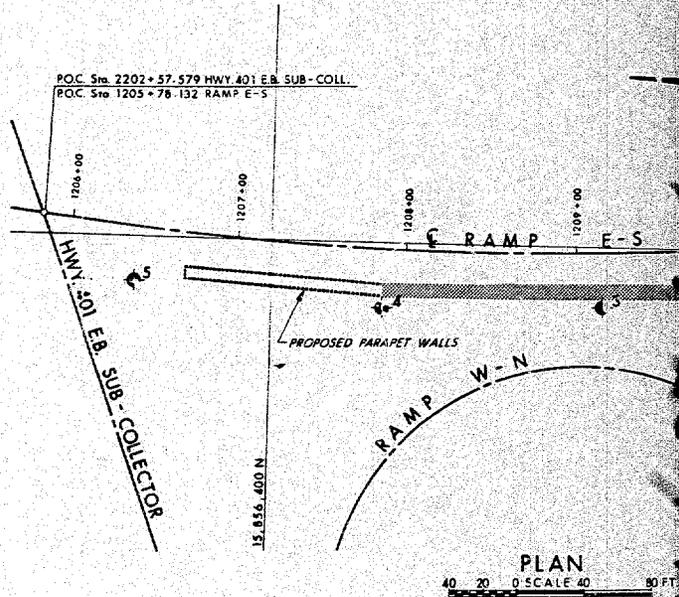
|          |   |
|----------|---|
| d        | DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE   |
| $\delta$ | ANGLE OF WALL FRICTION  |
| K        | DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS |
| $K_0$    | COEFFICIENT 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   |

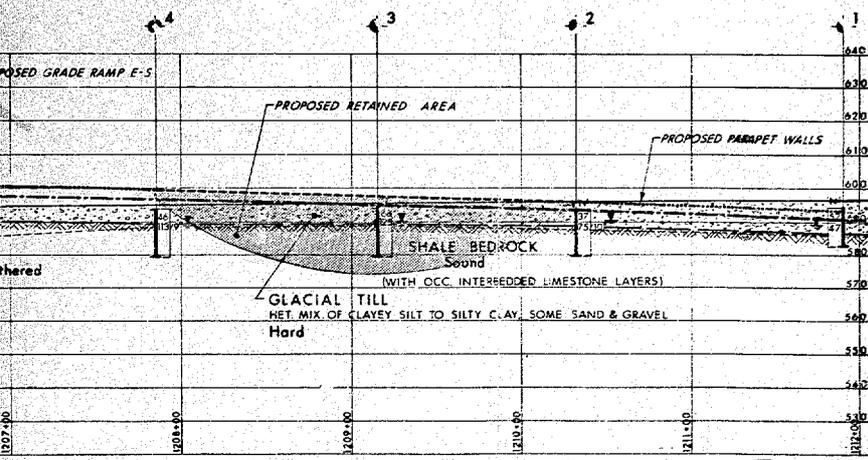
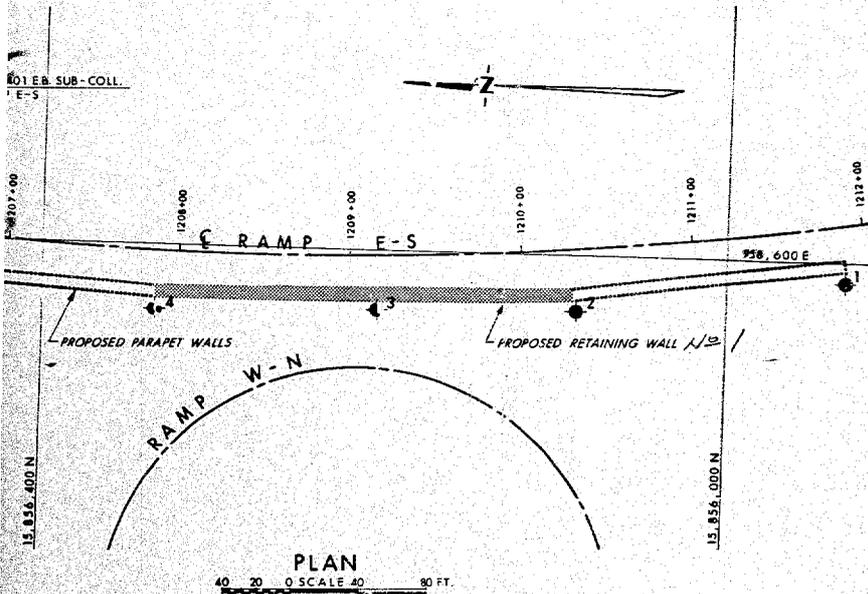
## SLOPES

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



PROFILE - RAMP E-S

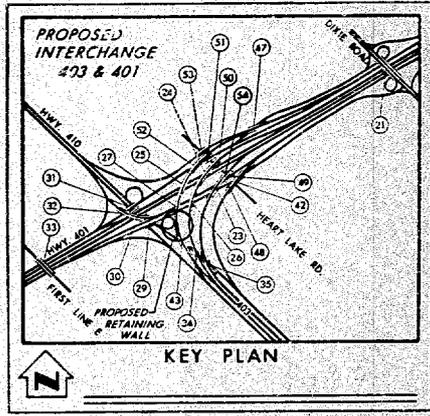
HORIZ. 40 20 0 SCALE 40 80 FT  
 VERT. 20 10 0 20 40 FT



PROFILE - RAMP E-S  
 HORIZ. 40 20 0 SCALE 40 80 FT.  
 VERT. 20 10 0 20 40 FT.



REF No FENCO3983-75K-115



**LEGEND**

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation, June & Sept 1973

| NO. | ELEVATION | CO-ORDINATES |         |
|-----|-----------|--------------|---------|
|     |           | NORTH        | EAST    |
| 1   | 594.2     | 15,855,930   | 958,588 |
| 2   | 593.7     | 15,856,088   | 958,567 |
| 3   | 594.9     | 15,856,205   | 958,565 |
| 4   | 593.8     | 15,856,335   | 958,562 |
| 5   | 592.9     | 15,856,481   | 958,574 |

**NOTE FOR CONTRACT DOCUMENT:**  
 The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the TORONTO District Office.

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

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

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO  
 DESIGN SERVICES, BRANCH—FOUNDATIONS OFFICE

**RETAINING WALL**  
 (BETWEEN STRUCTURES No.27 & No.43)  
 HIGHWAY NO. 401 DIST. NO. 6  
 CO. PEEL  
 TOWN OF MISSISSAUGA LOT CON

**BORE HOLE LOCATIONS & SOIL STRATA**

|                             |           |                    |             |
|-----------------------------|-----------|--------------------|-------------|
| SUBMIT V.K.                 | CHECKED   | WP NO. 127-66-50   | DRAWING NO. |
| DRAWN S.R.                  | CHECKED   | WO NO. 73-11072    | 73-11072 A  |
| DATE SEPT 21, 1973          | SITE NO.  | BRIDGE DRAWING NO. |             |
| APPROVED <i>[Signature]</i> | CONT. NO. |                    |             |

PRINCIPAL FOUNDATION ENGINEER



**Memorandum**

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

From: G.C.E. Burkhardt,  
Structural Section,  
Central Region

Attention: Mr. M. Devata

Date: 1977-10-20

Our File Ref.

In Reply to

Subject: RE: Retaining Wall No. 1,  
Highway 401/403/410 Interchange,  
Site 24, W.P. 127-66-60,  
District 6

Please be advised that the W.P. number for the above mentioned structure has been changed from 127-66-50 to W.P. 127-66-60. All future reference to this retaining wall, will be associated with the new W.P. number. Retaining Wall No. 1 includes the perched barrier walls that connect the retaining wall to bridges No. 27 and 43.

This change in W.P. number has become necessary, as a result of the retaining wall's exclusion from contract number 76-120, and its subsequent inclusion into the group W.P. 127-66-37.

We are making the necessary changes in this retaining wall's Foundation Report that we have in our possession, but we would ask that you send us one additional copy of the report with the new W.P. number.

*Michael N. Gergely*

MG:gj

M.N. Gergely,  
Assist. Structural  
Project Engineer,  
for:  
G.C.E. Burkhardt,  
Head, Structural Section

*DWG REVISED &  
REVISION REPORT  
sent to*

*WO  
73-11072*

*So  
10/2/77*



73-11072

Fig. 2

**UNIFIED SOIL CLASSIFICATION SYSTEM**

CLAY & SILT

SAND

GRAVEL

Fine

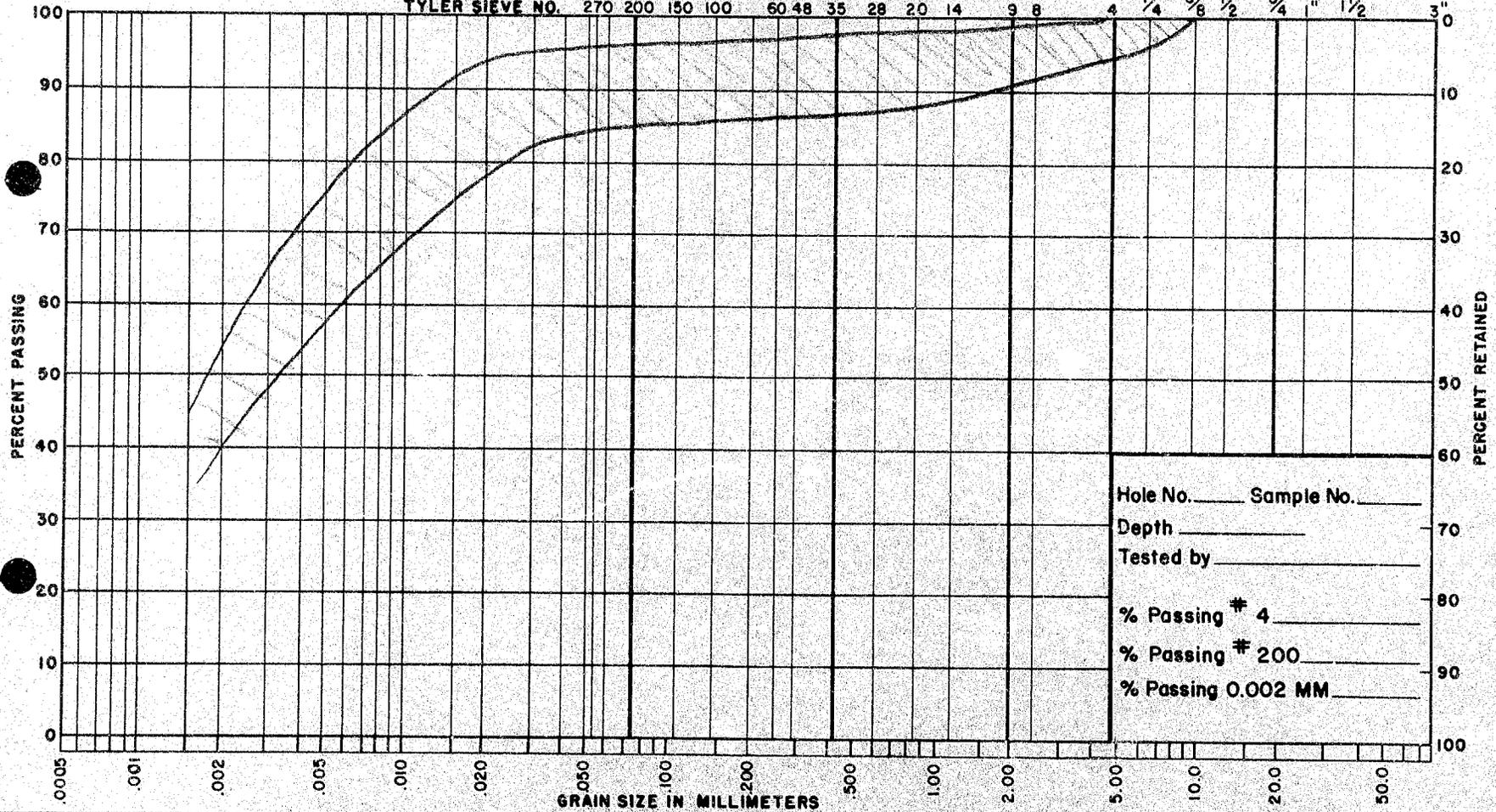
Medium

Coarse

Fine

Coarse

TYLER SIEVE NO. 270 200 150 100 60 48 35 28 20 14 9 8 4 1/4 3/8 1/2 3/4 1" 1 1/2 3"



Hole No. \_\_\_\_\_ Sample No. \_\_\_\_\_

Depth \_\_\_\_\_

Tested by \_\_\_\_\_

% Passing # 4 \_\_\_\_\_

% Passing # 200 \_\_\_\_\_

% Passing 0.002 MM \_\_\_\_\_

NOTES \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

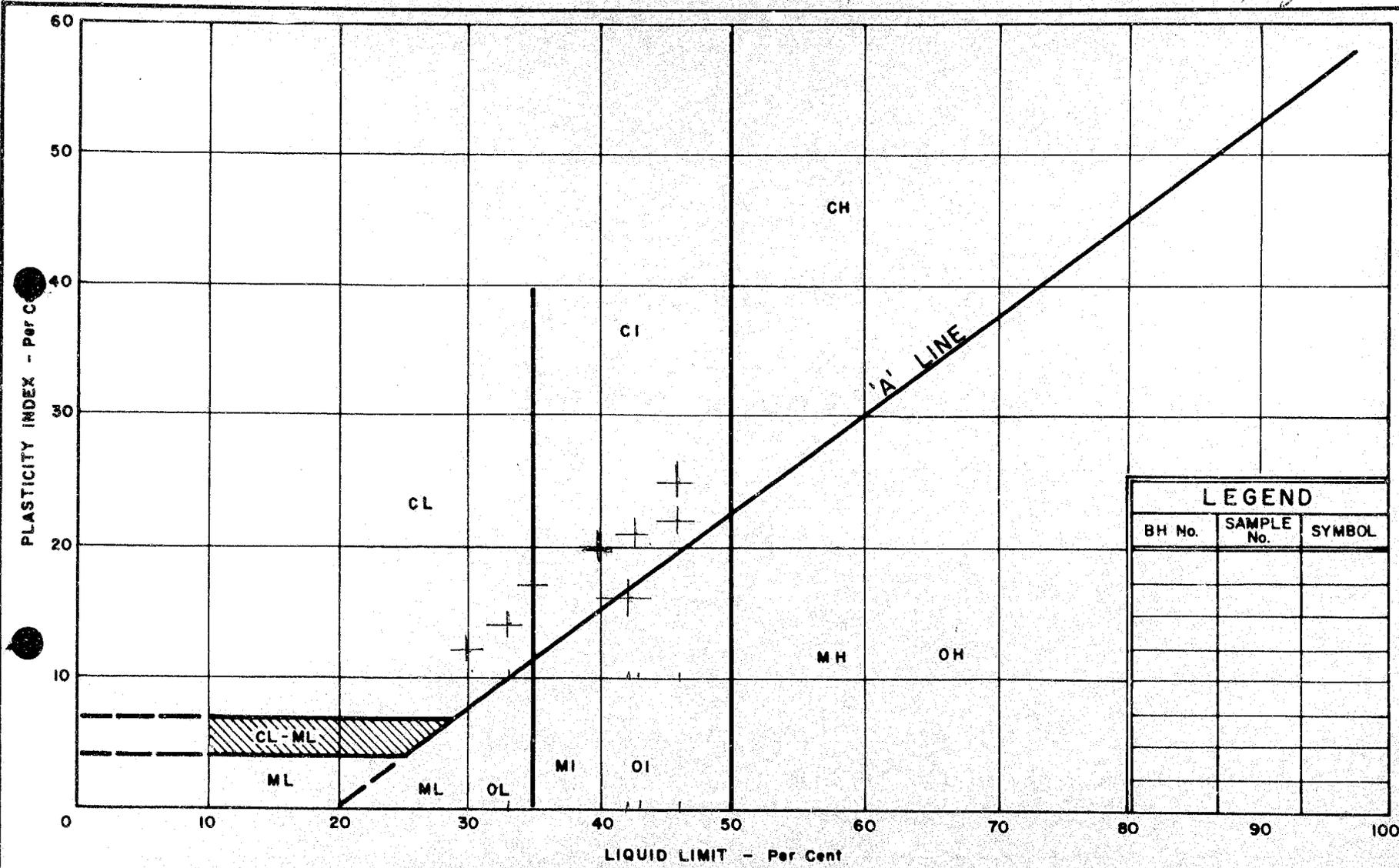
DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH SECTION  
**GRAIN SIZE DISTRIBUTION**

Job No. \_\_\_\_\_ W.P. No. \_\_\_\_\_

Location \_\_\_\_\_

73-11072

Fig. 1



| LEGEND |            |        |
|--------|------------|--------|
| BH No. | SAMPLE No. | SYMBOL |
|        |            |        |
|        |            |        |
|        |            |        |
|        |            |        |
|        |            |        |
|        |            |        |
|        |            |        |
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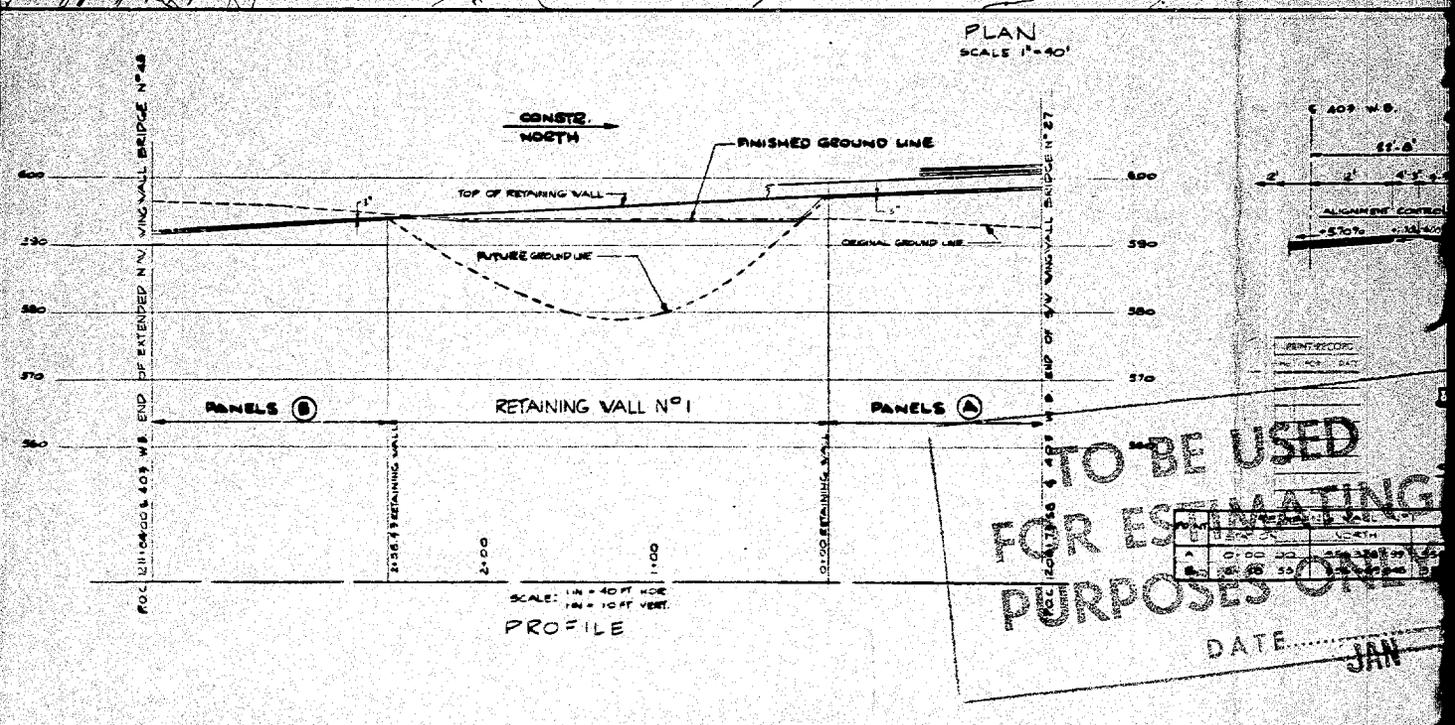
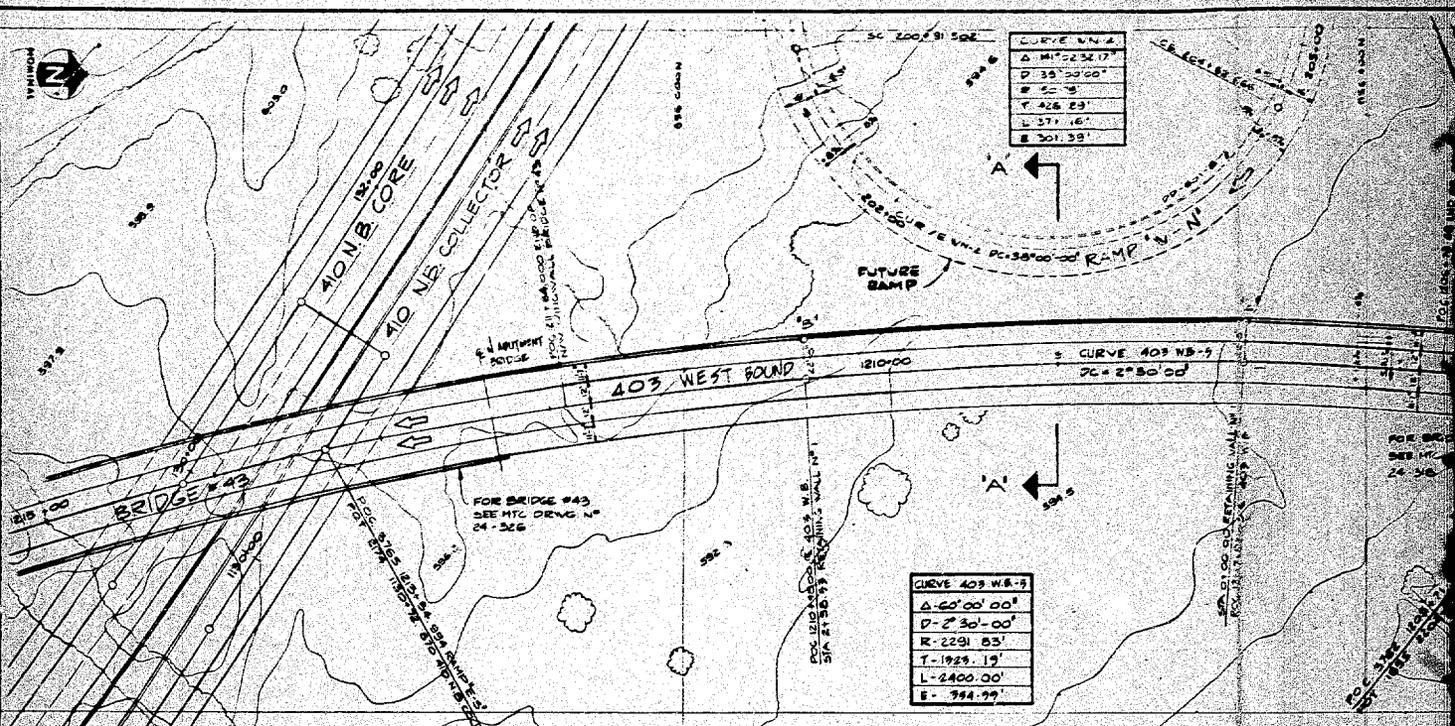


DEPARTMENT OF HIGHWAYS  
**MATERIALS and TESTING DIVISION**

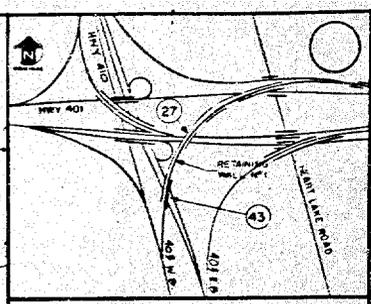
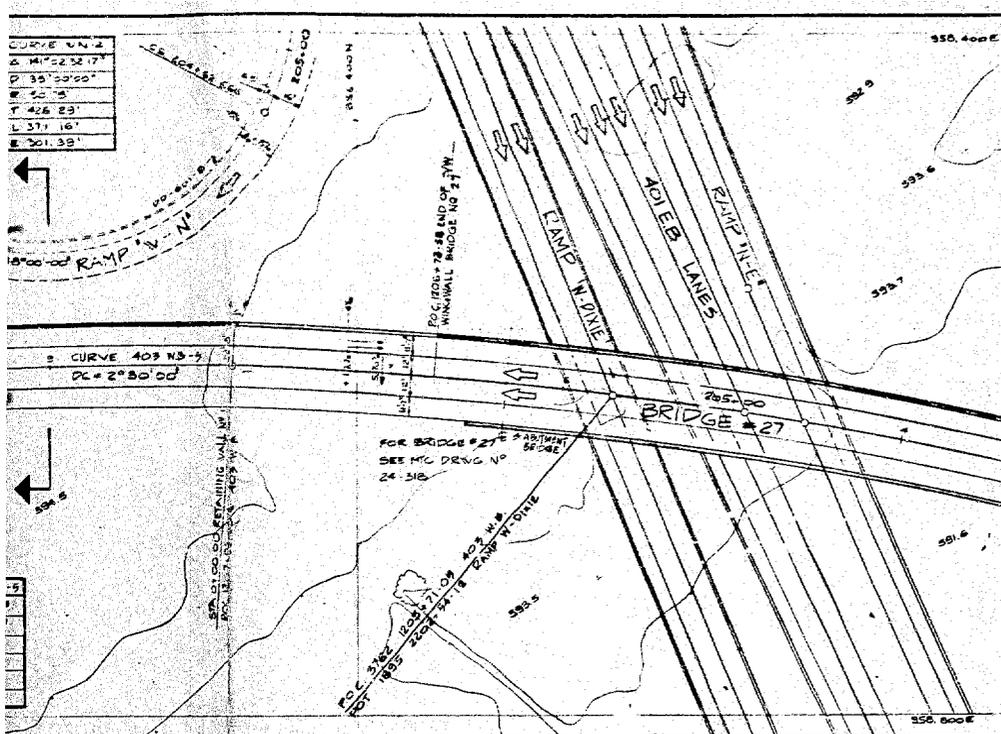
*Het. Mix of Silty clay to clayey silt with some sand and trace of gravel - Glacial till*

### PLASTICITY CHART

WP No. \_\_\_\_\_  
 JOB No. \_\_\_\_\_

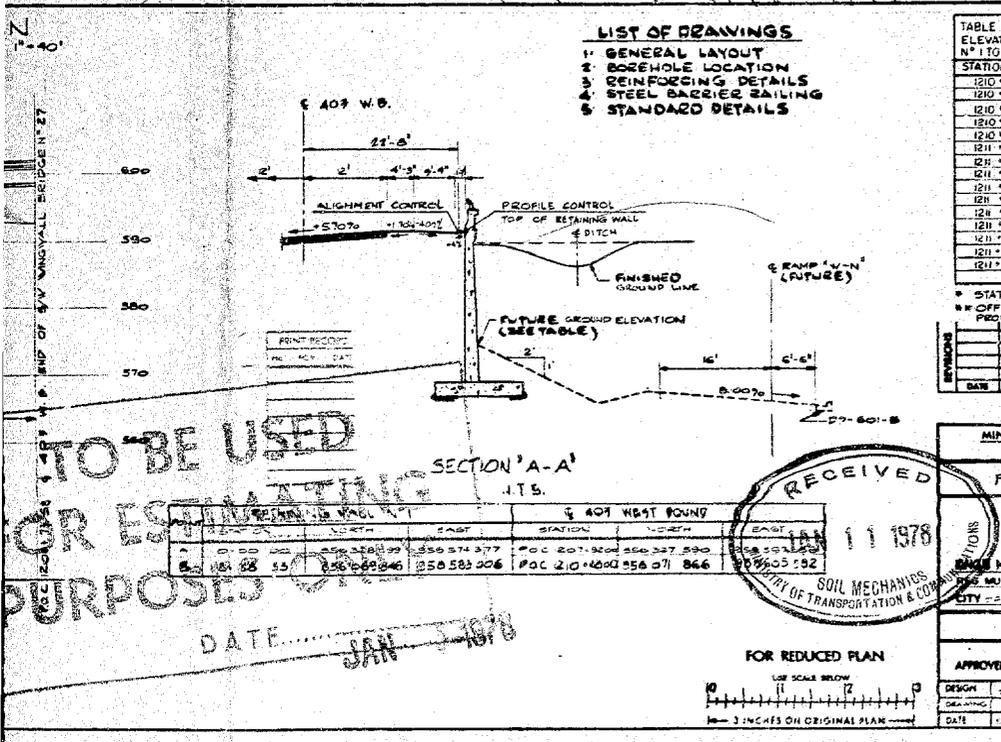


|                 |
|-----------------|
| CURVE ON 2      |
| Q 141°22'32"17" |
| P 39°59'50"     |
| R 50' 4"        |
| T 426.83'       |
| L 371.16'       |
| E 301.38'       |



**TABLE FOR RETAINING WALL ELEVATIONS**

| STATION | ELEVATION | FUTURE GROUND LINE |
|---------|-----------|--------------------|
| 0+00    | 596.974   | 596.72             |
| 0+10    | 596.866   |                    |
| 0+20    | 596.757   |                    |
| 0+30    | 596.650   | 590.50             |
| 0+40    | 596.539   |                    |
| 0+50    | 596.426   |                    |
| 0+60    | 596.313   | 584.30             |
| 0+70    | 596.198   |                    |
| 0+80    | 596.079   |                    |
| 0+90    | 595.963   | 580.60             |
| 1+00    | 595.838   |                    |
| 1+10    | 595.717   |                    |
| 1+20    | 595.596   | 579.00             |
| 1+30    | 595.470   |                    |
| 1+40    | 595.345   |                    |
| 1+50    | 595.216   | 580.12             |
| 1+60    | 595.086   |                    |
| 1+70    | 594.955   |                    |
| 1+80    | 594.822   | 582.80             |
| 1+90    | 594.686   |                    |
| 2+00    | 594.551   |                    |
| 2+10    | 594.413   | 586.40             |
| 2+20    | 594.275   |                    |
| 2+30    | 594.134   |                    |
| 2+40    | 593.994   | 591.30             |
| 2+50    | 593.848   |                    |
| 2+60.53 | 593.723   | 595.47             |



**LIST OF DRAWINGS**

1. GENERAL LAYOUT
2. BOREHOLE LOCATION
3. REINFORCING DETAILS
4. STEEL BARRIER ZAILING
5. STANDARD DETAILS

**TABLE FOR BARRIER WALL ELEVATIONS FROM RET WALL N° 1 TO BRIDGE N° 43**

| STATION*    | ELEVATION** |
|-------------|-------------|
| 1210+50.000 | 593.70      |
| 1210+60.000 | 592.96      |
| 1210+70.000 | 593.41      |
| 1210+80.000 | 592.52      |
| 1210+90.000 | 593.10      |
| 1211+00.000 | 592.92      |
| 1211+10.000 | 592.79      |
| 1211+20.000 | 592.63      |
| 1211+30.000 | 592.47      |
| 1211+40.000 | 592.32      |
| 1211+50.000 | 592.18      |
| 1211+60.000 | 592.00      |
| 1211+70.000 | 591.82      |
| 1211+80.000 | 591.59      |
| 1211+90+00  | 591.41      |

**TABLE FOR BARRIER WALL ELEVATIONS FROM BRIDGE N° 27 TO RET WALL**

| STATION*    | ELEVATION** |
|-------------|-------------|
| 1206+60.000 | 598.12      |
| 1206+70.000 | 598.04      |
| 1206+80.000 | 597.99      |
| 1206+90.000 | 597.95      |
| 1207+00.000 | 597.89      |
| 1207+10.000 | 597.80      |
| 1207+20.000 | 597.71      |
| 1207+30.000 | 597.51      |
| 1207+40.000 | 597.51      |
| 1207+50.000 | 597.42      |
| 1207+60.000 | 597.32      |
| 1207+70.000 | 597.21      |
| 1207+80.000 | 597.11      |
| 1207+90.000 | 597.00      |

\* STATION ON Q. OF 403 WEST BOUND  
 \*\* OFFSET 23'-7" RIGHT OF Q. OF 403 N.B. COINCIDES WITH PROFILE CONTROL OF R/W.

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

**NOT TO BE USED FOR ESTIMATING PURPOSES ONLY**

**SECTION 'A-A'**  
I.T.B.

| WEST |         | STATION | EAST   |     |
|------|---------|---------|--------|-----|
| 0+00 | 1206.99 | 210+400 | 595.07 | 866 |
| 0+50 | 1206.99 | 210+400 | 595.07 | 866 |

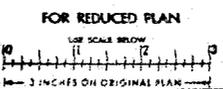


MINISTRY OF TRANSPORTATION AND COMMUNICATIONS  
 ONTARIO  
 FENCO CONSULTANTS LIMITED

**RETAINING WALL N° 1**

MAIN HWYWAY No. 401 DIST. No. 6

DATE: JAN 3 1978



**GENERAL LAYOUT**

|          |                         |
|----------|-------------------------|
| APPROVED | CONTRACT No.            |
| DESIGN   | W.P. No. 27-66-60       |
| DRAWING  | SITE No. 24-RW1 SHEET 1 |
| DATE     |                         |

DOCUMENT WORKING INVESTIGATION

GEOCRE'S No. 30 H 12-68

DIST. 6 REGION CENTRAL

W.P. No. 127-16-60

CONT. No. 78-60

W. O. No. 73-11072

STR. SITE No. 24- RW1

HWY. No. 40 / 410 / 403

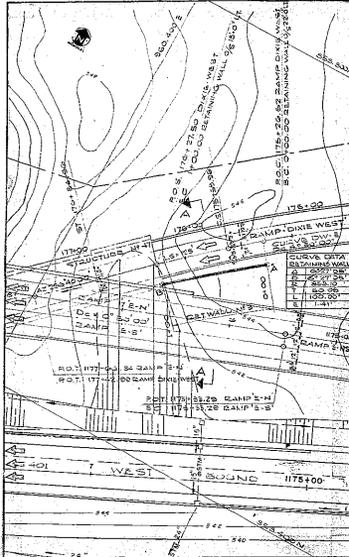
LOCATION BETHUNE HALL # 1

BETWEEN STRUCTURE # 27 AND # 43

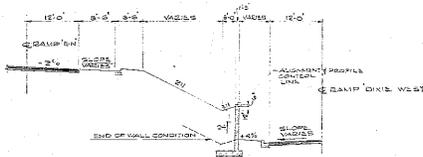
OVER-SIZE OR COLLIERIES TO BE INDICATED WITH THIS REPORT. 5

REMARKS:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

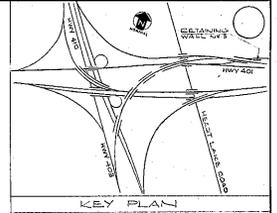


PLAN  
SCALE 1"=40'



SECTION A-A  
SCALE 1"=10'

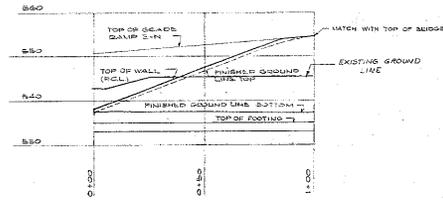
| POINT | RETAINING WALL NO. 3 |             |             | CAMP DIXE WEST |             |             |
|-------|----------------------|-------------|-------------|----------------|-------------|-------------|
|       | STATION              | NORTH       | EAST        | STATION        | NORTH       | EAST        |
| A     | 0+00                 | 858,914.642 | 860,676.854 | RDG 716+2652   | 858,914.641 | 860,684.030 |
| B     | 1+00                 | 858,580.010 | 860,489.160 | RDG 716+2750   | 858,580.261 | 860,485.564 |



GENERAL NOTES  
 CLASS OF CONCRETE  
 RET. WALL 3000 P.S.I.  
 FOOTINGS 3000 P.S.I.  
 CLEAR COVER TO REINFORCING STEEL  
 RET. WALL 3"  
 REINFORCING STEEL SHALL BE HARD GRADE (G60)

| STATION | ELEVATIONS |                     |                      |
|---------|------------|---------------------|----------------------|
|         | P.C.L.     | FINISHED GROUND TOP | FINISHED GROUND BOT. |
| 0+00    | 858.15     | 857.08              | 857.65               |
| 0+10    | 848.00     |                     |                      |
| 0+20    | 841.53     | 843.20              | 857.44               |
| 0+30    | 848.71     |                     |                      |
| 0+40    | 846.25     |                     |                      |
| 0+50    | 848.25     | 847.40              | 857.34               |
| 0+60    | 851.75     |                     |                      |
| 0+70    | 852.57     |                     |                      |
| 0+80    | 848.00     | 853.50              | 857.41               |
| 0+90    | 851.04     |                     |                      |
| 1+00    | 854.72     | 854.72              | 857.05               |

CONCRETE QUANTITIES  
 CONCRETE FOR RET. WALL 71.0 CU. YDS.



RETAINING WALL NO. 3  
 SCALE VERT. 1"=10'  
 HORIZ. 1"=20'

FOR REDUCED PLAN



| NO. | DATE | REVISION |
|-----|------|----------|
|     |      |          |
|     |      |          |
|     |      |          |

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS  
 CHICAGO  
 FOUNDATION OF CANADA ENGINEERING  
 CORPORATION LIMITED

RETAINING WALL NO. 3

ENGINE HIGHWAY No. 401  
 DIST. No. 5  
 DIST. MUN. OF OREGON  
 CITY OF MISSISSAUGA  
 LOT 9 CON. II, C.

GENERAL DRAWING

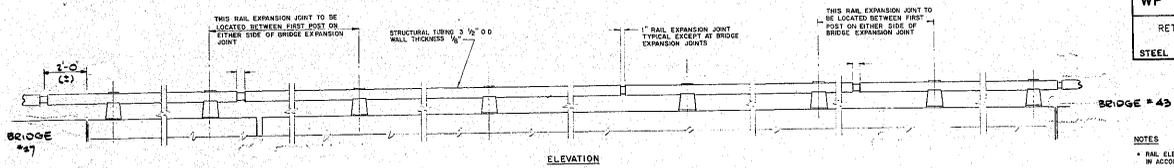
| APPROVED                                      | CONTRACT No. |
|---|--------------|
| DESIGN: S.C. CHECK: M.S.R. W.P. No. 107-65-80 |              |
| DRAWN: S.F.W. CHECK: S.Y. SITE No. 84/9/3     |              |
| DATE: MAR 75 DRAWN: SHEET 1                   |              |

30M12-65



30412-65

|                             |  |
|-----------------------------|--|
| CONT No<br>WP No 127-66-60  | <br>SHEET |
| RETAINING WALL #1           |  |
| STEEL RAILING (SINGLE TUBE) |  |

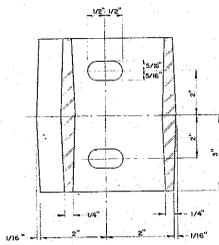
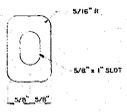
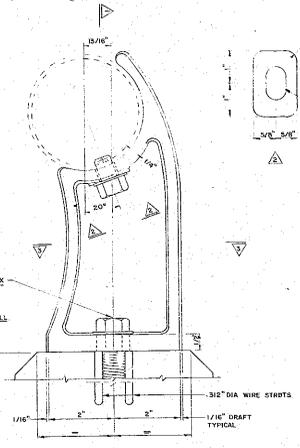
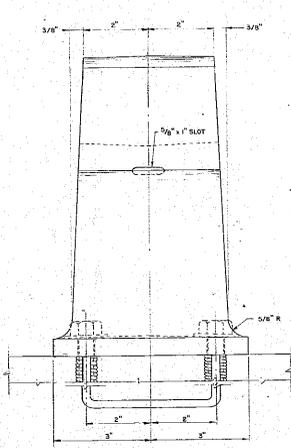
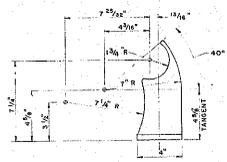
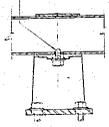
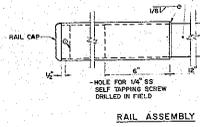


| DISTANCE<br>END TO END<br>OF RAIL | POST SPACING |         |
|-----------------------------------|--------------|---------|
|                                   | MINIMUM      | MAXIMUM |
| UNDER 40'                         | 9'-0"        | 12'-0"  |
| OVER 40'                          | 10'-0"       | 12'-0"  |

GALVANIZING ON MATED SURFACES OF TUBES TO HAVE MINIMUM THICKNESS NOT EXCEEDING .003" TO ENSURE SLIDING FIT

OUTSIDE DIAMETER OF UNGALVANIZED SPlice TUBE TO BE 5/16" (L 1/16") LESS THAN MEASURED I.D. OF GALVANIZED OUTER TUBE

PIPE TO BE DRILLED AND TAPPED IN FIELD FOR GALV. HEX CAP SCREW 1/2" x 1" LG.



- NOTES**
- RAIL ELEMENTS SHALL BE STRUCTURAL TUBING SUPPLIED IN ACCORDANCE WITH ASTM A36
  - STEEL IN POSTS SHALL BE CAST STEEL SUPPLIED IN ACCORDANCE WITH ASTM A27-60 GRADE 65-35
  - RAIL TUBING SHALL BE SPICED WITH SPICES IN LENGTHS OF 2'-0" (EXCLUDING SPICES) EXCEPT AS NOTED
  - POSTS AND RAILS SHALL BE GALVANIZED IN ACCORDANCE WITH CAN. HAS. ALL GALVANIZING SHALL BE DONE AFTER FABRICATION
  - ELECTRODES SHALL BE A LOW HYDROGEN SPECIFICATION & TUBE FOR ONE (1) TUBE
  - ANCHORAGE FOR POSTS TO CONCRETE SHALL BE REINFORCED WITH #4 BARS OF 200# UNREINFORCED BARS AND ANCHOR BOLTS SHALL BE GALVANIZED IN ACCORDANCE WITH CAN. HAS. UNREINFORCED SHALL BE GIVEN A GENERAL COATING OF WHITE NON-STRAINING GREASE & 1/2" THICK TEMPLATES 6" x 6" SHALL BE PROVIDED FOR EACH ANCHORAGE
  - HEX CAP SCREWS AND WASHERS FOR FASTENING STEEL TUBING TO POSTS SHALL BE GALVANIZED (SEA GRAY) CAP SCREWS SHALL NOT BE TIGHTENED ON POSTS ADJACENT TO BRIDGE EXPANSION JOINTS
  - RAIL TUBING SHALL BE PRESENT TO FOLLOW ROAD CURVATURE WHERE ROAD IS LESS THAN 500 FEET
  - RAIL POSTS SHALL BE SET PERPENDICULAR TO GRADE
  - WHERE LENGTH OF POSTS IS NOT SHOWN, POST LOCATION SHALL BE DETERMINED BY THE CONTRACTOR
  - RAIL MAY BE CUT OR REINFORCED WITH PIPE POST FIRST TO BE SURFACE TREATED WITH ZINC
  - WHEN CONNECTING TO EXISTING RAILING, RAIL MUST BE MADE CONTINUOUS AND POST SPACING DETERMINED WITH REFERENCE TO EXISTING POSTS
  - ALTERNATIVE ALUMINUM RAIL AND POST DESIGN WILL BE PERMITTED SUBJECT TO PRIOR APPROVAL BY A.I.C. ALUMINUM DESIGN SHALL BE SUBMITTED IN ACCORDANCE TO THE DESIGN SHOWN ON THIS DRAWING, WITH A CONTRIBUTION TO PERMIT COMPLETE INTERCHANGEABILITY WITH GALVANIZED STEEL POSTS AND RAILS

| ITEM                                     | MT   | LINEAR  | BENDING | LOCATION |
|--|------|---------|---------|----------|
| POST AND ANCHORAGE                       | REQD | FEET    | RADIUS  |          |
| END CAP                                  |      |         |         |          |
| 3 1/2" TUBE WITH SPICES (20'-0" LONG)    | 25   | 504'-4" |         |          |
| 3 1/2" TUBE WITHOUT SPICES (12'-0" LONG) | 1    | 12'-0"  |         |          |

- POST AND ANCHORAGE TO INCLUDE ALL BOLTS, WASHERS AND NUTS AND TEMPLATES AS SHOWN OR INDICATED IN NOTES
- END CAP TO INCLUDE SS SELF TAPPING FASTENER
- LENGTH FOR 3 1/2" TUBE WITH SPICES GIVEN IN TABLE DOES NOT INCLUDE 12" PROTRUSION OF SPICE TUBE

STANDARD DRAWING  
 APR 20 1966  
 SS 110-21  
 JAN 14 1966  
 DRAWN BY: [ ]  
 CHECKED BY: [ ]  
 DATE: [ ]  
 DRAWING NO: [ ]

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS CANADA 22-21-15 1-75



