

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 3165-189

DIST. 9 REGION

W.P. No. 118-86-01

CONT. No. 89-32

W. O. No.

STR. SITE No. 3-41

HWY. No. 417

LOCATION Woodroffe Ave. Underpass

No of PAGES -

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

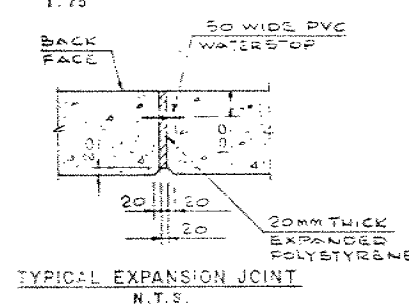
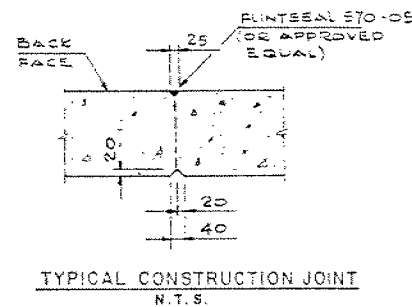
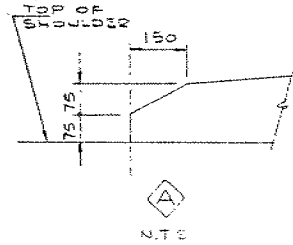
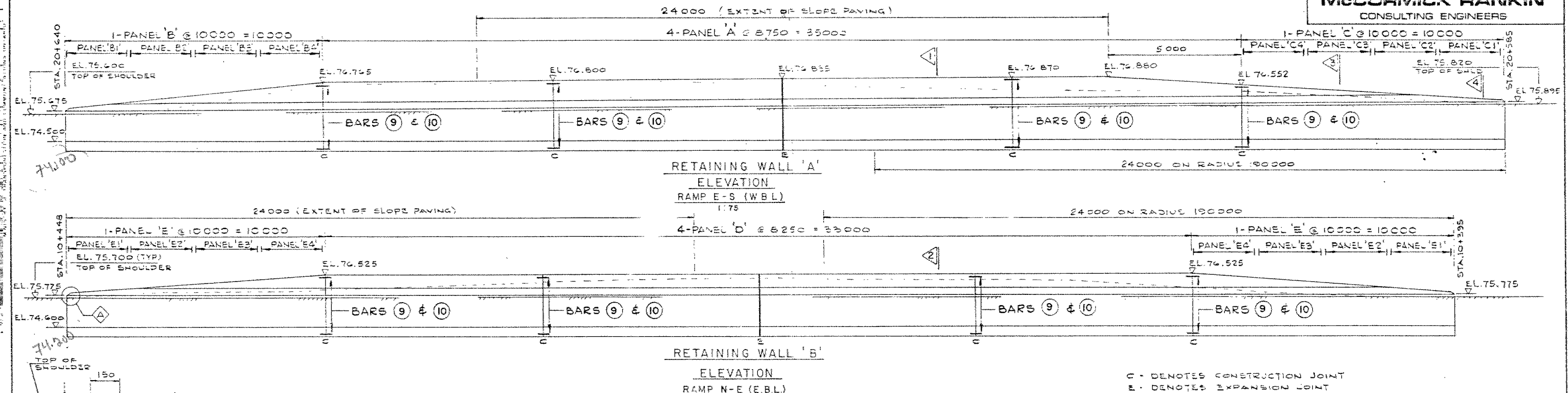
REMARKS:

NO PLANNING  
SHOWN, HOW TO  
LAYOUT IN FIELD?

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

DISTRICT 9  
CONT No  
WP No 118-86-01  
RETAINING WALLS UNDER  
WOODROFFE AVE. STRUCTURE  
DETAILS  
McCORMICK RANKIN  
CONSULTING ENGINEERS

SHEET  
74

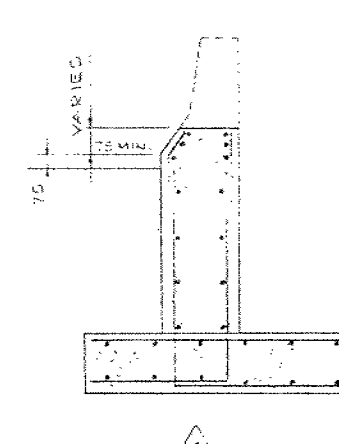
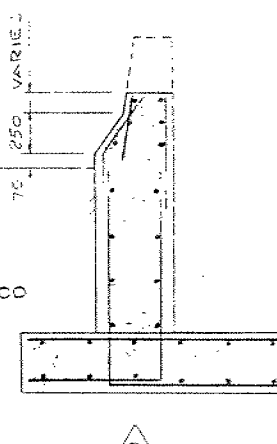
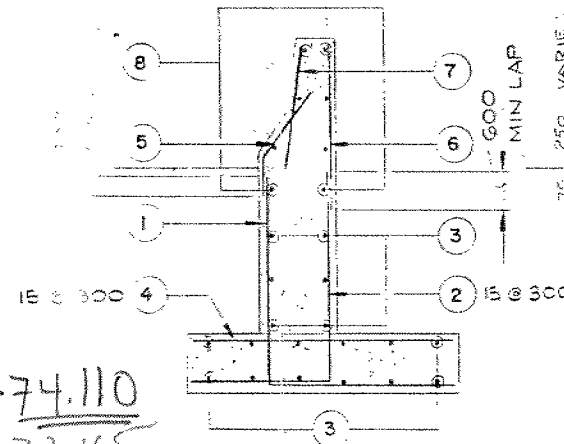
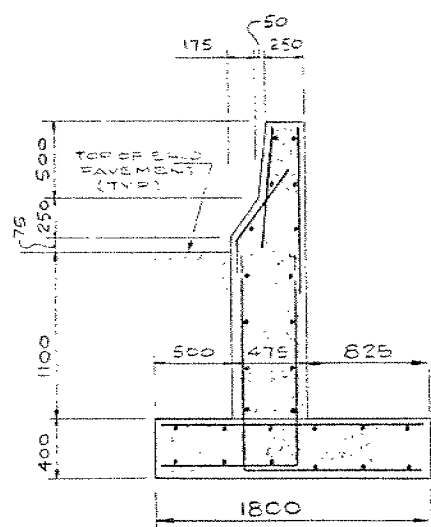
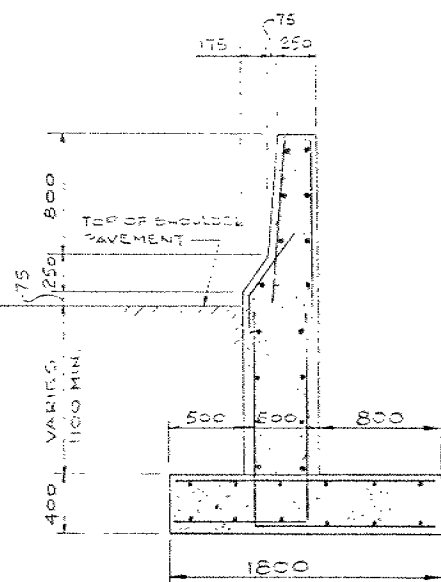


#### NOTES:

1. FOR LOCATION OF BARS (9) & (10) SEE ELEVATIONS 'A' & 'B' THIS DWG.
2. BAR (9) TO LAP WITH BAR (3)
3. BAR (10) TO LAP WITH BAR (8)
4. FOR REINFORCING STEEL SCHEDULE SEE DWG.
5. ALL REINFORCING 10 @ 300 UNLESS OTHERWISE NOTED.

#### NOTES:

1. ALL CONCRETE 30 MPa
2. CLEAR COVER TO REINFORCING 70-20mm EXCEPT AS NOTED.
3. REINFORCING STEEL SHALL BE GRADE 400
4. DESIGN BEARING CAPACITY  
S.L.S. - 200 Kpa  
U.L.S. - 600 Kpa
5. EQUIVALENT FLUID PRESSURES USED FOR COMPUTATION OF EARTH PRESSURES  
AT SERVICEABILITY - 6.5 Kpa/m  
AT ULTIMATE - 8.0 Kpa/m
6. ENGINEER TO INSPECT FOUNDING LEVEL PRIOR TO PLACING OF CONCRETE.



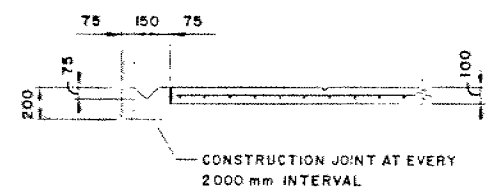
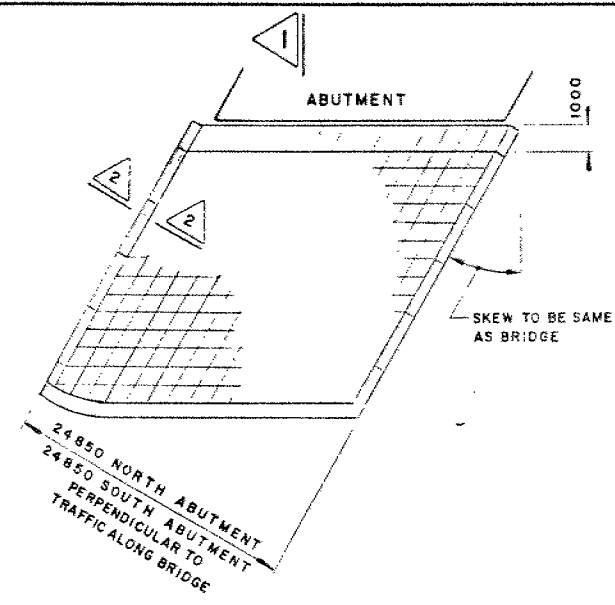
PROF.  
ENG.  
STAMP

DRAWING NOT TO BE SCALED  
100 mm ON OR G.N.A. DRAWING

REVISIONS	DATE	BY	DESCRIPTION
1	7/1/86	CHK K.W.F. ICC	ISSUED FOR CONSTRUCTION
2	7/1/86	CHK K.W.F. ICC	ISSUED FOR CONSTRUCTION
3	7/1/86	CHK K.W.F. ICC	ISSUED FOR CONSTRUCTION

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

DISTRICT 9	
CONT No	
WP No 118-86-01	
CONCRETE SLOPE PAVING WOODROFFE AVE. STRUCTURE DETAILS	SHEET 75
McCORMICK RANKIN CONSULTING ENGINEERS	

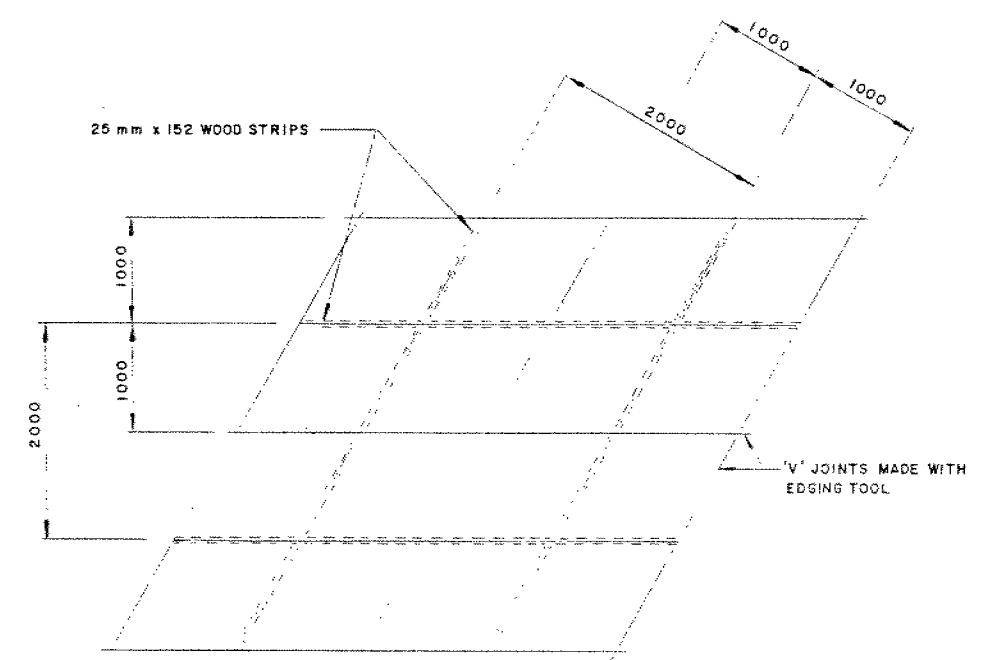
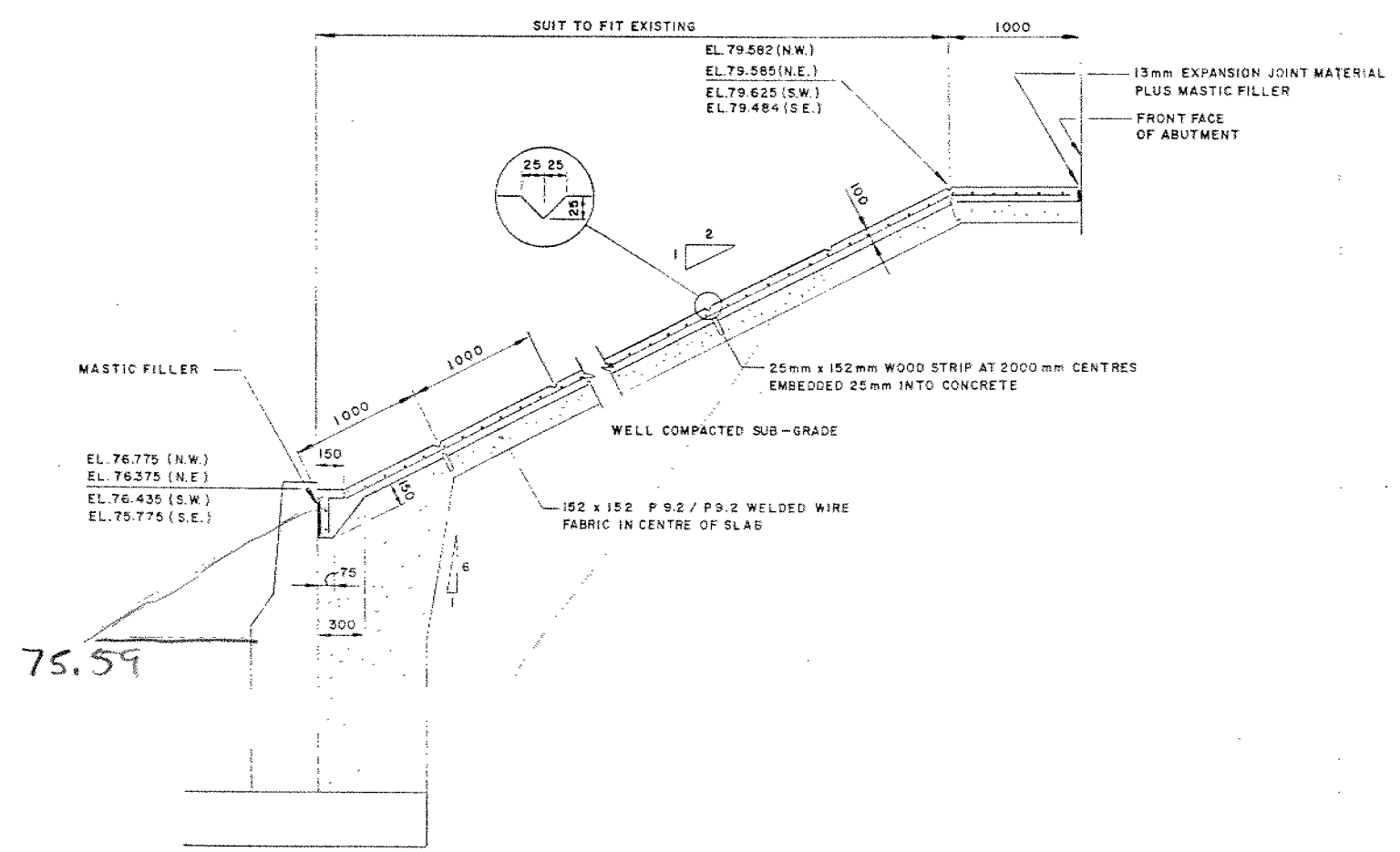


2

NOTE:

• CLASS OF CONCRETE 20 MPa - INSITU.

SLOPE PAVING LAYOUTS



WOOD FRAME AND "V" JOINT LAYOUT

2.807  
3.21  
3.19  
3.709

1.185  
1.785  
1.845  
1.185

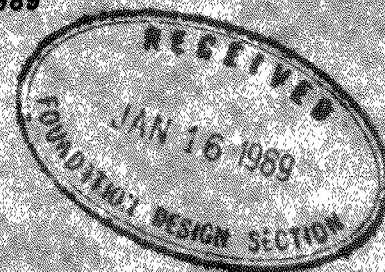
3.992  
3.995  
4.035  
3.894

REVISIONS				
DATE	BY	DESCRIPTION		
DESIGN	K N	CHECK	W F	LOADING
DRAWING	J W B	CHECK	K N	SITE NO 3-41 W 1 CWC 2

# MCCORMICK RANKIN

CONSULTING ENGINEERS

January 13, 1989



Mr. E.C. Lane, P. Eng.  
Head, Structural Section  
Eastern Region  
Ministry of Transportation Ontario  
355 Counter Street  
Postal Bag 4000  
Kingston, Ontario  
K7L 5A3

Attention: Mr. A. Van Dalen

RE: W.P. 118-88-01, Hwy. 417  
Woodroffe Ave. to Maitland Ave.  
District 9 Ottawa  
Retaining Walls Under Woodroffe Ave. Structure  
Our File: W.O. 1811-100

Dear Sir:

We are in receipt of the memorandum dated December 23rd, 1988 from the Ministry's Foundation Design Section (Mr. T. Sangiullano, P. Eng.). In addition, we have reviewed your memorandum, dated January 4th, 1989, responding to Mr. Sangiullano's comments.

We concur generally with your assessment of the performance of barrier walls and toe-walls constructed above the frost depth in the Ottawa area. However, in view of the comments raised by the Foundation Design Section we have undertaken to revise the drawings for the wall as follows:

- (a) We have added notes on the drawings to clarify that the low tapered sections of the toe-walls not supported on caissons are unreinforced, and to identify the dimensions for the toe-wall cross-sections in these areas.
- (b) As an added precaution to mitigate any adverse effects of frost heave on the underside of the toe-walls between caissons, we have added 25 mm of expanded polystyrene.

McCORMICK RANKIN

Mr. E.C. Lane, P. Eng.  
January 13, 1989

Page 2

We trust these minor revisions to the contract drawings will meet with your approval. Two (2) copies of the drawings reflecting these changes are enclosed for your review.

If you have any questions regarding this submission please do not hesitate to telephone.

Yours very truly,

McCORMICK RANKIN

RS:dw

cc: Mr. T. Sangiuliano, P. Eng.

Dr. R. Skelton, P. Eng.

# memorandum

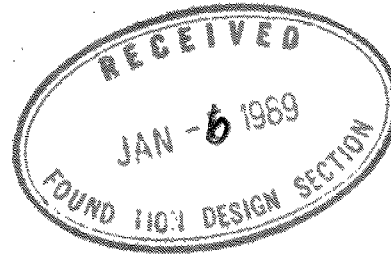


545-4719

To: T. Sangiuliano  
Foundation Engineer  
Foundation Design Section  
Downsview, Ontario

From: Structural Section  
Eastern Region  
Kingston, Ontario

Re: W.P. 118-86-01, Site 3-41  
Retaining Walls Under the  
Woodroffe Avenue Structure  
Highway 417, District 9 - Ottawa



I refer to your memorandum dated December 23, 1988, concerning review of the revised contract drawings, Sheets 74 and 75, as prepared by McCormick, Rankin Associates.

It is agreed that the sections of wall mentioned in your letter are founded above the 1.8 m frost penetration depth. However, since these sections of the wall do not appear to be retaining surcharged fills, I feel we should take a risk and see what happens. There are many miles of concrete median barrier on Highway 417 in the same general area which do not appear to heave, even after a few winters.

With regard to the toe walls shown on Standard Drawing OPSD-513.03, it is noted that these walls are designed for 2:1 surcharged fills. Problems are envisaged when installed in poor subsoil areas, in particular with walls built to the 1.8 m maximum height. Perhaps a cautionary note should be added to the standard drawing.

A handwritten signature in cursive, appearing to read "A. Van Dalen".

A. Van Dalen  
for:  
E.C. Lane  
Head, Structural Section

ECL:AVD:bd

c.c. D. Kimmett, Att'n: D. Huddle  
Dr. R.S. Skelton (McCormick, Rankin Associates)

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

Copy for the information of

Structural Section  
Eastern Region  
355 Counter Street  
Postal Bag 4000  
Kingston, Ontario  
K7L 5A3  
(613) 545-4719

December 28, 1988

McCormick Rankin  
Consulting Engineers  
60 Briarwood Avenue  
Mississauga, Ontario  
L5G 3N6

Att'n: Dr. R. Skelton, P. Eng.

Dear Sir:

Re: W.P. 118-86-01, Highway 417  
Woodroffe Avenue to Maitland Avenue  
Retaining Walls under Woodroffe Avenue Underpass  
Site 03-41, Your File W.O. 1811-100

This will acknowledge receipt of your letter dated December 20th, 1988, forwarding the latest revised prints for these retaining walls.

It is understood that preliminary inquiries by the M.T.O. Foundation Design Section confirm the feasibility of the method. Access by caisson drilling equipment under the structure appears possible, albeit at a cost.

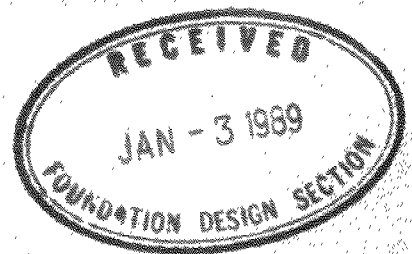
We have no further comments on the design of these retaining walls.

Yours truly

*A. Van Dalen / ps*  
A. Van Dalen  
for:  
E.C. Lane, P. Eng.  
Head, Structural Section

ECL:AVD:bd

c.c. D. Huddle  
T. Sangiuliano



# memorandum



To: E.C. Lane, P. Eng.  
Head, Structural Section  
Kingston

Date: 1988 12 23

Attention; A. Van Dalen

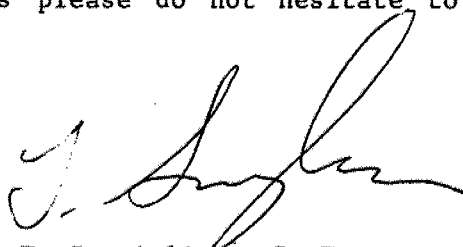
RE: Retaining Walls Under  
Woodroffe Ave. Structure  
W.P. 118-86-01, Hwy. 417  
District 9, Ottawa

This Section has reviewed the revised contract drawings (sheets 74 and 75) and the following geotechnical related comments are provided.

## Frost Protection

There are no sections or details provided for the foundations of the tapered retaining walls which are illustrated as shallow foundations for retaining wall 'A' and at the west end of retaining wall 'B'. It is assumed that these concrete toe walls are to be designed and constructed according to OPSD-513.03 and associated specifications. The frost protection illustrated on this standard drawing is substantially lower than the 1.8 m frost penetration depth in the Ottawa area. The structural consequences of differential frost heave and thaw cycles should be considered.

If you have any further queries please do not hesitate to contact this office.

A handwritten signature in black ink, appearing to read "T. Sangiuliano".

T. Sangiuliano, P. Eng.  
Foundation Engineer

TS/mmj

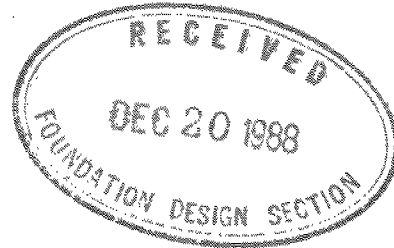
c.c. - R. Skelton  
McCormick, Rankin Assoc.

# McCORMICK RANKIN

CONSULTING ENGINEERS

December 20, 1988

Mr. E.C. Lane, P. Eng.  
Head, Structural Section  
Eastern Region  
Ministry of Transportation Ontario  
355 Counter Street  
Postal Bag 4000  
Kingston, Ontario  
K7L 5A3



Attention: Mr. A. Van Dalen

RE: W.P. 118-86-01 Hwy. 417  
Woodroffe Ave. to Maitland Ave.  
District 9 Ottawa  
Retaining Walls Under Woodroffe Ave. Structure  
Our File: W.O. 1811-100

Dear Sir:

We are in receipt of the memorandum dated November 25, 1988 from the Ministry's Foundation Design Section regarding the above project.

We have checked the S.L.S. 25 mm max. lateral deflection criteria recommended for the proposed retaining/barrier wall supported on caissons using the method proposed by Brom. In order to satisfy this criteria the diameter of the caissons should be increased from 450 mm to 600 mm and also the maximum caisson length extended nominally from 4.2 m to 4.5 m.

We have also reconfirmed the feasibility of constructing these slightly larger caissons with two contractors experienced in this type of work (Johnston Drilling Ltd. and Deep Foundation Ltd.).

Two (2) copies of revised contract drawings reflecting this change and also addressing other comments from the technical review, are submitted, herewith, for your review and approval. By copy of this letter and one (1) copy of the revised drawings we are also requesting the Foundation Design Section's review and comments.

McCORMICK RANKIN

Mr. E.C. Lane, P. Eng.  
December 20, 1988

Page 2

If you have any questions or require further information regarding this submission, please do not hesitate to call.

Yours very truly,

McCORMICK RANKIN

A handwritten signature in black ink, appearing to read "R. Skelton", written in a cursive style.

Dr. R. Skelton, P. Eng.

RS:dw

Encl.

cc: D. Huddle  
M. Devata  
T. Sangiuliano

# memorandum



To: Mr. E. C. Lane, P. Eng.  
Head, Structural Section  
Eastern Region

Date: 1988 11 25

Attention: Mr. A. Van Dalen

From: Foundation Design Section  
Room #315, Central Building

RE: Retaining Walls under Woodroffe Avenue, Structure  
WP 118-86-01, Hwy 417  
District 9, Ottawa

In response to McCormick Rankin Consulting Engineers letter dated November 23, 1988, this section has reviewed the revised design drawings (Sheet 74 and 75) pertaining to the aforementioned structure and the following comments are provided.

## CALCULATION OF LATERAL RESISTANCE OF CAISSONS

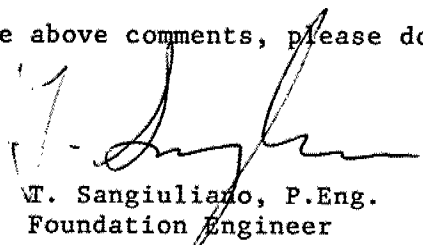
It appears that there has been a misinterpretation concerning allowable soil pressures, and associated deflection restrictions. Contrary to the statement 3(iv) provided in McCormick Rankins letter, deflection restrictions should NOT be neglected and in accordance to Limit States Design, the maximum deflection at S.L.S. Type II, should be restricted such that the proper function of the structure is not impaired. Consequently, the maximum deflection allowable is restricted to 25mm. This constant deflection parameter should be employed in calculating allowable loadings. If it is determined that these loadings exceed the factored capacity at U.L.S. (Factored Capacity =  $0.5 \times$  Ultimate Lateral Resistance), then the factored capacity at U.L.S. governs design. Otherwise, the loadings deduced in conjunction with the specified deflections shall govern design.

## DESIGN DRAWING REVIEW

The design drawings have been reviewed and from a geotechnical perspective, no queries have been identified.

If you have any questions regarding the above comments, please do not hesitate to contact this office.

TS:st

  
T. Sangiuliano, P.Eng.  
Foundation Engineer

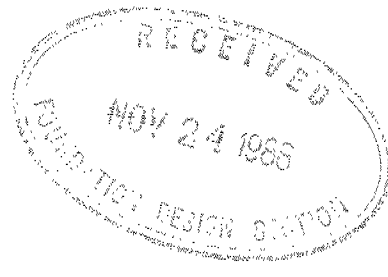
cc: R. Skelton, McCormick Rankin

# McCORMICK RANKIN

CONSULTING ENGINEERS

November 23, 1988

Mr. E.C. Lane, P. Eng.  
Head, Structural Section  
Eastern Region  
Ministry of Transportation, Ontario  
355 Counter Street  
Postal Bag 4000  
Kingston, Ontario  
K7L 5A3



Attention: Mr. A. Van Dalen

RE: W.P. 118-86-01, Hwy. 417  
Woodroffe Ave. to Maitland Ave.  
District 9, Ottawa  
Retaining Walls under Woodroffe Ave. Structure  
Our File: W.O. 1811-100

Dear Sir:

We enclose, herewith, two (2) copies of Drawing Sheet 74 and 75 showing details of the revised design developed for the retaining walls at Woodroffe Avenue on the above-noted project, for your approval.

The following is a summary of the factors and discussions which lead to the development of this design.

1. As you are aware, concerns were expressed by the Ministry's Foundation Design Section regarding the founding elevations and required bearing capacity for the spread foundations of the original reinforced concrete, cantilevered retaining walls proposed at this location. In a memorandum, dated October 27th, 1988 the Foundation Design Section recommended that the retaining wall footings would have to be founded at or below Elev. 73.5, some 0.6 m below the proposed founding elevation.
2. In view of the depths of excavation required to accommodate construction of walls lowered to this extent, and the associated difficulty and high costs of bracing or shoring these excavations, it was decided to consider other types of retaining wall structures for this project.

Mr. A. Van Dalen  
November 23, 1988

Page 2

3. Bin-type or tie-back wall systems were ruled out in view of their high costs and the need to provide a barrier wall configuration at the front face of the wall.

Accordingly, reinforced concrete barrier/toe-walls were investigated and their use was reviewed at a meeting on November 10th, 1988 between the undersigned and Karl Nussdorfer of McCormick Rankin and Mr. T. Sangiuliano and Mr. M. Devata of the Ministry's Foundation Design Section. At this meeting the option of supporting barrier/toewalls on shallow concrete caissons was discussed and it was agreed that geotechnical design criteria would be provided by the Ministry for the design of these caissons.

Subsequently, the following criteria was provided by Mr. T. Sangiuliano to Mr. K. Nussdorfer by telephone:

- (i) Apply the ultimate load method for cohesionless soils by Broms.
- (ii) Loose till parameters:  
 $\phi = 30^\circ$   
 $K_p = 3$   
Soil Weight = 19 KN/m<sup>3</sup>  
Dense till parameters:  
 $\phi = 30^\circ$   
 $K_p = 3.3$   
Soil Weight = 20 KN/m<sup>3</sup>
- (iii) Neglect any contributions from both clay and topsoil overburden.
- (iv) Allowable soil pressures or deflection restrictions to be omitted.
- (v) Excavation to be limited to segmental sections of 3.0 metres.
4. In view of the 4.5 m restricted vertical clearance under the Woodroffe Avenue structure the feasibility of construction drilled caissons under the structure was reviewed with Johnston Drilling Ltd., an Ottawa contractor experienced in this type of work.

On the basis of these discussions, it was concluded that although it would be more expensive than normal caisson construction it is feasible to construct 4.2 m deep caissons under these conditions. Backhoe or truck-mounted drilling equipment would be utilized and it was recommended that the maximum diameter of the caisson be 18" (450 mm±), as diamond drilling equipment may be necessary to advance the caissons into rock where encountered. It should be noted that it is anticipated that the extent of caisson construction in rock is small.

Mr. A. Van Dalen  
November 23, 1988

Page 3

5. Subsequently, a memorandum from the Ministry's Foundation Design Section, dated November 15, 1988 has been received suggesting that the proposed concrete caisson foundation is not a practical alternative in view of the restricted vertical clearance, and the Foundation Section recommend construction of a cantilevered retaining wall similar to the original design but with the footings lowered in accordance with the recommendations summarized in their memorandum, dated October 27th, 1988. A shoring system with rakers is further recommended to support the forward fills and excavation and it is also recommended that footing excavation be limited to segmental sections not exceeding 3 metres.

This proposed system is seen as not being cost effective, as a raker system would constrain construction progress. Also, the new spread footing system would be in direct conflict with utilities.

6. In view of the Foundation Design Section's concerns, we have further confirmed the feasibility of constructing these caissons with both Johnston Drilling Ltd., and Deep Foundations Ltd., both experienced constructors, and have been assured that the caissons can be constructed under these conditions. Accordingly, in view of the considerable cost savings associated with this scheme, we recommend using the barrier/toe-wall design as detailed in the attached drawings.

By copy of this letter with attachments we invite comments/input from the Ministry's Foundation Design Section on the proposed wall.

We trust this submission will assist the Ministry in the review of the proposed walls. In the meantime, if you have any questions or require further information please do not hesitate to telephone.

Yours very truly,

McCORMICK RANKIN



Dr. R. Skelton, P. Eng.

RS:dw  
Encl.

cc: D. Huddle  
M. Devata  
T. Sangiuliano

# memorandum



To: E.C. Lane  
Head, Structural Section  
Kingston

Date: 1988 11 15

Atten: A. Van Dalen

From: Foundation Design Section  
Room 315, Central Building

RE: Retaining Walls to Support Forward Fills  
of the Woodroffe Avenue Underpass  
W.P. 118-86-01, Site 3-41  
District 9, Ottawa

Further to our letter dated 88 10 27, and a meeting with McCormick Rankin Consulting Engineers held at the Foundation Design Section office on 88 11 10, the proposed retaining wall foundations at the aforementioned structure were discussed. It was confirmed that in view of the existing soil conditions, the parameters and capacities originally provided by this Section are to be complied within the design of a spread footing foundation.

Alternatively, the option of supporting the retaining walls on shallow concrete caissons was discussed. The viability of this solution depends on the capability of caisson installation within the restricted vertical clearance beneath the bridge deck soffit and the associated costs. Additional research implemented subsequent to the meeting revealed that the proposed concrete caisson foundation is **not** a practically feasible alternative at this site in view of the restricted vertical clearance.

It is therefore recommended that the retaining wall be supported on spread footings as previously discussed. During construction it is recommended that a raker system be applied to temporarily support the forward fills and the footing excavation be limited to segmental sections not exceeding 3.0 metres.

We trust the above comments are to your satisfaction. If you require further information, please do not hesitate to contact this office.

A handwritten signature in black ink, appearing to read "T. Sangiuliano".

T. Sangiuliano, P. Eng.  
Foundation Engineer

TS/mmj

c.c. - R. Skelton, McCormick, Rankin Assoc.

# memorandum



To: E.C. Lane  
Head, Structural Section  
Kingston

Date: 1988 10 27

Atten: A. Van Dalen

From: Foundation Design Section  
Room 315, Central Building

RE: Retaining Walls to Support Forward Fills  
of the Woodroffe Avenue Underpass  
W.P. 118-86-01, Site 3-41  
District 9, Ottawa

As requested in your letter dated October 6, 1988, this Section has reviewed the design and construction of both the temporary and permanent retaining wall systems and provide the following comments.

## Conventional Reinforced-Concrete Retaining Wall

The structure foundations and earthworks related to the construction of the permanent cantilever reinforced-concrete retaining wall were examined. Recommendations for the foundation design were not originally supplied by this Section, but review reveals that the footings are founded partially in the native surficial clay deposit and partially in the loose sand till. It is recommended that all footings be founded within the till deposit. For capacities provided on sheet 74 of McCormick Rankin Consulting Engineering drawings, that is, factored capacity at U.L.S. equal to 600 kPa, and bearing capacity at S.L.S. Type II equal to 200 kPa, the footings should be founded on the dense till material at or below elevation 72.5 metres. This equates to excavation depths of up to 3.0 metres, and consequently should be sloped and/or braced. A braced excavated trench is more practical in this situation considering the presence of the existing highway.

Alternatively, the footings may be founded in the upper till deposit according to Table 1.

Table 1

<u>Structure</u>	<u>Elevation (m)</u>	<u>Factored Capacity at U.L.S. (kPa)</u>	<u>Bearing Capacity at S.L.S. Type II</u>
Retaining Walls (North/South)	<73.5	200	100

As the table illustrates, the footings are at a higher elevation, (but still lower than the founding elevations of the proposed retaining walls), and the capacities have been reduced.

.....2

The capacities provided are based on a footing width of 1.8 m which is the present footing design width as provided by McCormick Rankin Consulting Engineers. The underside of all footings should be provided with a minimum 1.8 metres of earth cover for frost protection.

Settlements within the founding till deposit will be immediate in nature (i.e. occur during or immediately after construction) and of magnitude less than 25 mm.

The sliding resistance of the retaining wall can be calculated using the appropriate forces and an unfactored coefficient of friction of 0.6.

In view of the water table elevation (generally at the bedrock surface), no dewatering problems are anticipated for footing excavation. Conventional pumping techniques will suffice in discharging any localized seepage.

Free draining material such as Granular 'A' or Granular 'B' is recommended as appropriate backfill to the retaining wall to prevent hydrostatic pressure build-up. Weep holes should be designed to drain any accumulation of water in the backfill.

#### Temporary Shoring

The fills can be temporarily supported during construction using a soldier pile-timber lagging cantilever wall system. Pertinent design parameters that are recommended are summarized in Table 2 below.

Table 2

<u>Soil</u>	<u>Shear Strength Parameters</u>		
	<u>Cu (kPa)</u>	<u><math>\phi</math></u>	<u>(KN/m<sup>3</sup>)</u>
*Fill	-	30	22
Clay	70	0	19
Till	-	30	20

\* It is assumed that the existing fill is cohesionless.

Rock anchors may be used to provide additional earth support using a bond stress of 500 kPa.

It is recommended that soldier piles be driven to the required depth rather than installed in pre-augered holes because the latter may necessitate liners to prevent caving of the till deposit.

The shoring system should be installed in segmental incremental stages not exceeding 5.0 metres in length. This will ensure the stability of the forward slopes during the lagging installation.

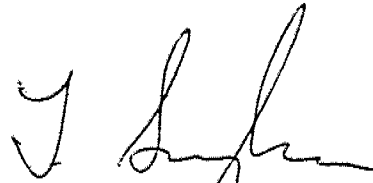
#### Overall Longitudinal Stability

Stability analyses was carried out in terms of total stress to evaluate the overall stability of the forward slopes as a result of the excavation at the toe. A minimum factor of safety of 1.3 was incorporated in the analysis. The results reveal that no stability problems are anticipated where the forward slope is cut back a distance of 3.0 metres. The soil parameters used in the analysis are provided in Table 2.

#### Overview of Retaining Wall Selection

It is assumed that a thorough and complete cost comparison and technical feasibility study preceded the selection of the conventional reinforced-concrete cantilever retaining wall. Previous experience with similar settings have proven that perhaps bin-type walls or a tieback wall system are the most practical and economical solutions. The application of these types of walls eliminates the need for interim roadway protection, extensive excavations and large quantities of granular backfill. Illustrations of these types of walls are provided in Figure 1-3. These types of walls definitely warrant consideration in the selection of a retaining wall system under the aforementioned conditions.

We trust the above comments meet with your satisfaction. If you require any further information please do not hesitate to contact this office.



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Figure 1  
Bin-type Steel Retaining Wall

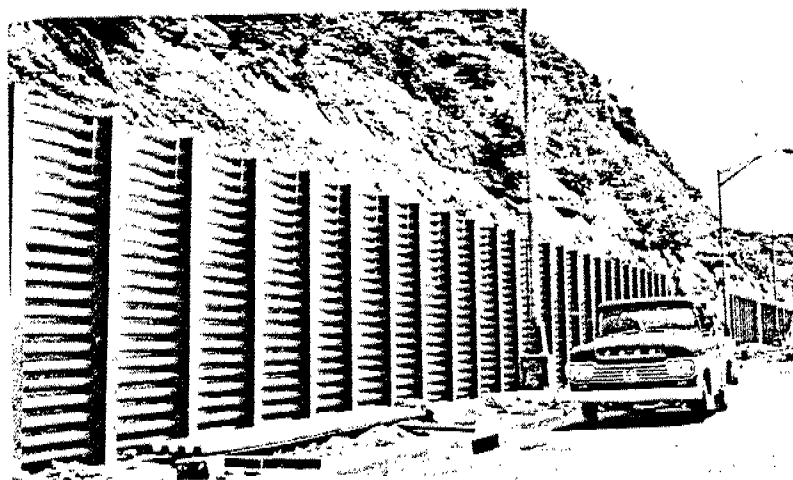


Figure 2  
Corrugated Steel Lagging  
behind a row of H Piles

