THURBER ENGINEERING LTD.

MEMORANDUM

To: Christopher Schueler, P.Eng.
AECOM

Date: April 15, 2016

From: Sydney Pang, P.Eng.
Alastair Gorman, P.Eng.
(Reviewed by P.K. Chatterji, P.Eng.)

File: 19-4406-20

DRAFT
PRELIMINARY FOUNDATION ASSESSMENT
CNR OVERHEAD (WBL) STRUCTURE
HIGHWAY 115
(SITE 26-081.2)

1 INTRODUCTION

This memorandum presents a brief summary of a geotechnical assessment of the CNR Overhead (WBL) structure which carries Highway 115 over the CNR tracks in the County of Peterborough. It also contains preliminary geotechnical recommendations for use in the assessment of the existing foundations at this site. It is understood that the proposed rehabilitation is expected to include concrete deck repairs, waterproofing and paving, elimination of expansion joints with semi-integral abutment conversion, and all required substructure repairs (soffit, wingwalls, piers and abutment walls).

The recommendations provided in this memorandum are for planning, structure evaluation and preliminary design purposes only. Additional investigation and analyses may be required in any subsequent detail design phases of the project.

The following reference numbers apply to this site:

- Current W.P. 4006-13-01
- Site No. 26-081.2
- GEOCRES No. 31D-282
- Historic W.P. 19-81-05

2 SITE DESCRIPTION

The site is located just east of the interchange between Highway 115 and Ashburnham Drive in the Geographic Township of Otonabee in the County of Peterborough. The WBL bridge carries the westbound lanes of Highway 115 (Highway 7 Peterborough Bypass) over the CNR tracks. This bridge is approximately 20 m north of another bridge which carries the eastbound lanes over

CNR. Based on the description in Section 6.3.3 of the RFP, the existing bridge, constructed in 1984, is a 3 span (15 m + 16 m + 15 m) pre-stressed pre-cast concrete I-beam bridge. The overall deck width is 17 m, with an asphalt riding surface of 16 m carrying three lanes of traffic in the westbound direction of Highway 115. A historic General Layout drawing dated 1982 confirms the bridge approach span length of 15.0 m, but shows a centre span length of 15.5 m and bridge widths varying from about 19 m at the west abutment to about 16 m at the east abutment. The structure was last rehabilitated in 1995 which generally involved expansion joint repairs.

The natural terrain in the vicinity of the bridge is generally flat with the highway embankment standing above the surrounding ground. The historic data indicates that the original grade in the vicinity of the bridge ranged between approximate Elevations 199 and 200 m. Highway 115 was constructed to approximate Elevation 208 m. A historic General Layout drawing indicates that the approach fills were constructed with forward slopes inclined at 2H : 1V, resulting in overall embankment heights of up to 8 m.

The mapping in the Physiography of Southern Ontario by Chapman and Putnam shows that the site lies within the physiographic region known as the Peterborough Drumlin Field. This area is a heavily drumlinized till plain. The drumlins are composed of highly calcareous sandy and silty tills with varying quantities of limestone rubble and boulders. The overburden in this region is underlain by highly fossiliferous limestone bedrock.

3 SUBSURFACE CONDITIONS

A site investigation was completed by the Pavement & Foundation Design Section, Engineering Materials Office of the Ministry of Transportation and Communications (MTC) and reported in November 1981. A total of four boreholes were drilled and sampled at this site. Boreholes 1, 2, 3 and 4 were located near the west abutment, west pier, east pier and east abutment, respectively. These boreholes were advanced to depths of 13.4 to 18.6 m below the original ground surface.

Results of the boreholes indicated that the subsurface conditions consisted of a thin layer of topsoil overlying a deposit of sandy silt to sand and silt glacial till containing increasing amounts of gravel, cobbles and boulders with depth. The till is compact to very dense as indicated by SPT 'N' values ranging from 13 blows per 0.3 m penetration to greater than 100 blows for less than 0.3 m penetration. A lower 'N' value of 8 blows indicating a loose zone was encountered near the ground surface in Borehole 2. Bedrock underlies the till and was cored in Boreholes 2 and 4, and inferred by auger refusal in Boreholes 1 and 3. The bedrock was described as limestone, light grey, fine grained, hard and sound with irregular very thin dark grey shale seams. Core recovery was 92% or greater, but no RQD values and fracture indices were reported. Bedrock elevations encountered in the boreholes are as follows:

Borehole	Location	Top of Rock Elevation (Depth)
1	West Abutment	186.3 m (13.4 m) – inferred
2	West Pier	186.3 m (13.3 m) – proven
3	East Pier	186.0 m (13.4 m) – inferred
4	East Abutment	186.0 m (14.0 m) – proven

The short term groundwater levels observed in three of the open boreholes were up to approximate Elevations 198.2 to 198.5 m, or 1.2 to 1.5 m depths at the time of the investigation.

The available GEOCRES information is attached in Appendix A.

4 SITE OBSERVATIONS

Foundation engineering staff from Thurber visited the site on January 14, 2016 to observe conditions related to the geotechnical performance.

There was no obvious sign of settlement or distress at the foundation elements.

The original design drawings indicated that the forward slopes and adjacent sideslopes are at an inclination of 2H : 1V. The approach embankments appeared stable with no obvious signs of instability or bulging.

Selected photographs of the structure and the approaches are attached in Appendix B.

5 EXISTING FOUNDATIONS

Based on a historic General Arrangement (GA) drawing for the structure, Drawing 1, and a foundation drawing, Drawing 3, Contract 83-57, WP 19-81-05 dated November 1982, both abutments were designed to be supported by conventional HP 310 x 110 piles driven to bedrock. There was no available construction records to indicate that all of those piles had indeed fully penetrated the glacial till to reach bedrock. Based on the available borehole information, it is possible that some piles did not penetrate through the portion of the till which contains boulders and cobbles, and instead met practical refusal and terminated within the glacial till. According to the same drawings, both piers are supported on spread footings founded on the dense to very dense glacial till. The forward slopes and adjacent approach sideslopes were designed to have an inclination of 2H to 1V. The forward slopes were to be protected by a layer of crushed rock placed on well compacted slope surfaces.

The pile caps and footings for the abutments and piers, respectively, are shown as being founded at the following approximate elevations:

Foundation Element	Reference Borehole	Design Underside Elev. of Pier Footing	Design Underside Elev. of Abutment Pile Cap	Design Approximate Pile Length	Design Pile Tip Elev.
West Abutment	1	-	203.0	18.2 to 17.4	184.8 to 185.6
West Pier	2	197.25 m	-	-	-
East Pier	3	197.25 m	-	-	-
East Abutment	4	-	203.0	18.2 to 17.4	184.8 to 185.6

The drawings also do not show design geotechnical resistances for the footings and the piles.

The MTC report from GEOCRES recommended that the pier footings be founded on the dense glacial till at or below Elevation 198.0 m using a factored capacity at ULS of 500 kPa for design. The SLS condition is not considered to govern design for shallow footings on unyielding soil. This report also recommended that perched abutments be supported on spread footings founded on compacted Granular A using a factored capacity at ULS of 700 kPa and a capacity at SLS Type II (up to 25 mm settlement) of 300 kPa.

The report did not provide recommendations for driven piles or other deep foundation types. Based on the table above, both pier footings are founded on the dense to very dense glacial till and it is assumed that the footings have been designed using the ULS value provided in the report and quoted above.

6 ASSESSMENT OF EXISTING FOUNDATIONS

Based on the information provided by the historical drawings and the GEOCRES report, a factored geotechnical resistance at ULS of 500 kPa for the pier footings founded on the dense to very dense till has been assessed in accordance with the requirements of the CHBDC. The SLS condition does not apply to footings founded on unyielding soils. These recommendations are consistent with those provided in the GEOCRES report. In addition, for sliding resistance at the footing and glacial till interface, an ultimate coefficient of friction, tan δ, of 0.5 may be used for evaluation. The above values can be used for carrying out an assessment of the existing structure and for preliminary design of any modifications that may be necessary.

For the HP 310 x 110 abutment piles driven to practical refusal in the very dense till, it is recommended that an axial geotechnical resistance at ULS of 1,400 kN and a geotechnical resistance at SLS of 1,200 kN be used for assessment.

The RFP listed semi-integral abutment conversion as a rehabilitation requirement. From a foundation engineering perspective, the structure could be converted to have semi-integral abutments. Structural and other assessments will be required to determine if this bridge is acceptable for semi-integral abutment conversion.

7 EXCAVATION AND BACKFILL

It is anticipated that temporary excavations in the order of 2 to 3 m deep will be required for semi-integral abutment conversion at this site. All temporary excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). For the purpose of OHSA, the pavement granular, approach fill and glacial till are classified as Type 3 soils. All excavations must be carried out in a manner that avoids undermining or destabilising the existing bridge foundations, existing approach slopes and the adjacent highway.

Where space permits, temporary excavations may be formed with sideslopes not steeper than 1H : 1V. Flatter slopes may be required at locations where the exposed soils are less competent than what is assumed during design or where water seepage affects surficial stability. Where space restriction and staged construction is anticipated, roadway protection as per OPSS.PROV

539 will be required to support the ground adjacent to these temporary excavations (see Section 8 below).

Backfill to the abutments should consist of Granular A or Granular B Type II materials meeting the gradation and relevant requirements stipulated in OPSS.PROV 1010. Compaction procedures and equipment to be used adjacent to the existing structures must be in accordance with the relevant OPSS.PROV 501 requirements.

8 ROADWAY PROTECTION

If the selected rehabilitation strategy requires excavation in the approach fills behind the abutments, it is recommended that site investigation and field testing be carried out in each approach fill in order to characterize the fill, and to select parameters for the design of roadway protection. One borehole within each approach fill and within the probable extent of excavation is considered to be appropriate. The boreholes should extend for the full depth of fill or to twice the depth of excavation, whichever is the greater.

The design of roadway protection should be the responsibility of the Contractor. All shoring systems must be designed by a Professional Engineer experienced in such designs.

9 CLOSURE

The factual subsurface information used for foundation review and assessment of the existing foundation conditions was taken from the MTC report titled “Foundation Investigation Report for C.N.R. Overhead (W.B.L.) on Peterborough Bypass”, W.P. 19-81-05, Site 26-81, Highway 7, District 7, Port Hope, dated November 27, 1981.

THURBER

This memorandum was prepared by Dr. Sydney Pang, P.Eng., and was reviewed by Mr. Alastair Gorman, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.

Sydney Pang, P.Eng.
Senior Foundation Engineer

Alastair Gorman, P.Eng.
Project Manager, Senior Foundation Engineer

P.K. Chatterji, P.Eng.
Review Principal, Designated MTO Contact

Attachments

THURBER ENGINEERING LTD.

Appendix A

GEOCRES Information

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 31D-282

DIST. 7 REGION

W.P. No. 19-81-05

CONT. No. 83-57

W. O. No.

STR. SITE No. 26-81

HWY. No.

LOCATION C.N.R. O/H
Hwy 7 WBL

No. OF PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO DESIGN 1st 79 05

METRIC

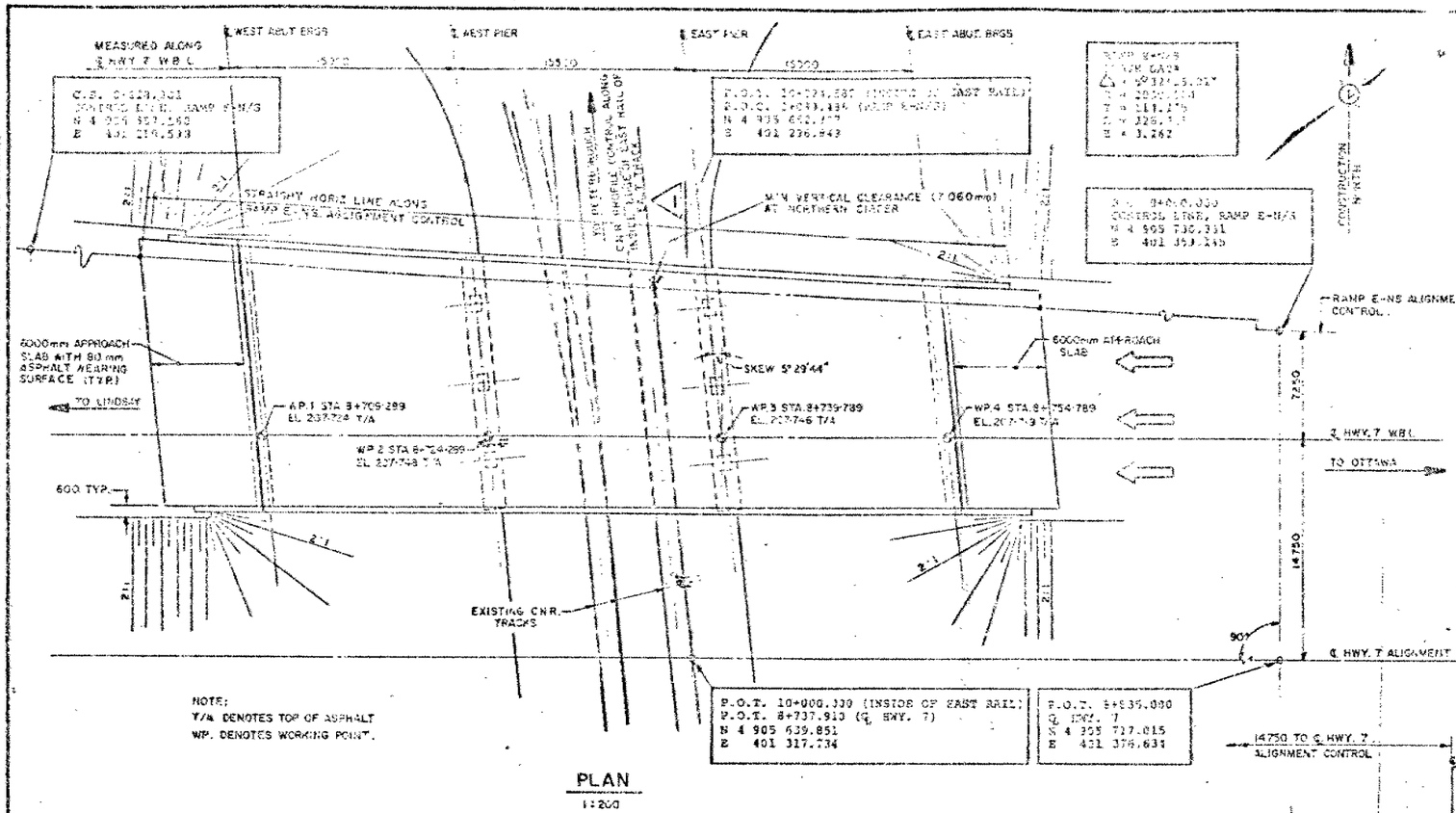
DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
ELEVATIONS, COORDINATES, CURVE AND ALIGNMENT DATA ARE IN METRES.
STATIONS ARE IN KILOMETRES + METRES.

DIST. No. 7
CONT No
WP No 19-81-05

CNR OVERHEAD HWY 7 W.B.L.
PETERBOROUGH BY-PASS
GENERAL ARRANGEMENT

SHEET

MMM



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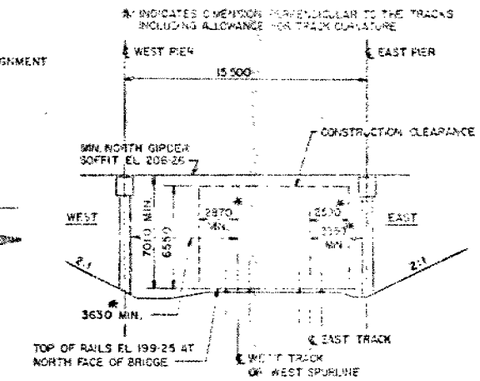
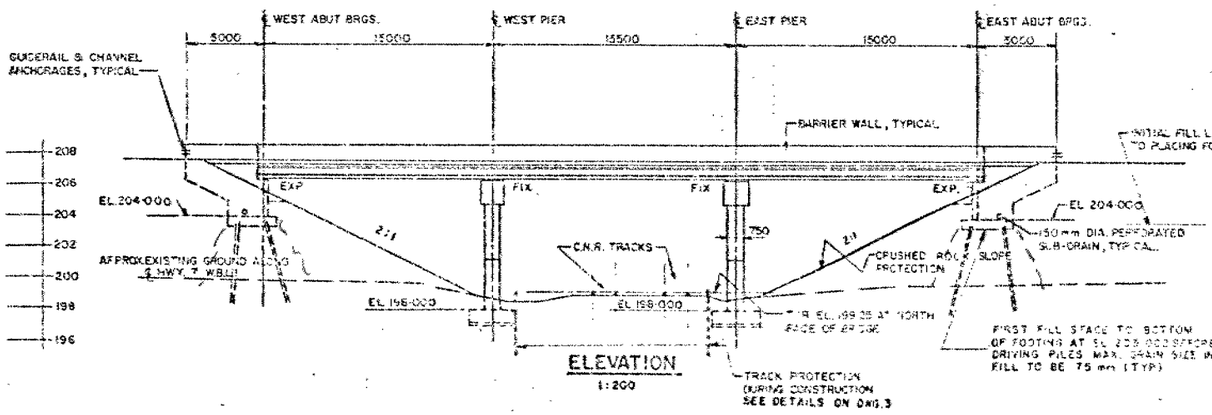


RAILWAY CLEARANCE DIAGRAM
N.T.S.

GENERAL NOTES:

1. CLASS OF CONCRETE:
   - PRESTRESSED GIRDERS - 55MPa
   - DECK, DIAPHRAGMS, PIERS, ABUTMENTS AND BARRIER WALLS - 30 MPa
   - APPROACH SLABS, FOOTINGS AND REMAINDER - 20 MPa
2. CLEAR COVER TO REINFORCING STEEL:
   - FOOTINGS 100 mm ± 25 mm
   - PIERS, CNR PROTECTION WALLS, ABUTMENTS AND WINGWALLS FROM SURFACES 50 mm ± 20 mm
   - BOTTOM OF DECK 40 mm ± 10 mm
   - REMAINDER 75 mm ± 20 mm UNLESS OTHERWISE NOTED.
3. - REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED.
   - BARS MARKED WITH THE SUFFIX 'C' SHALL BE COATED BARS.
4. CONSTRUCTION NOTES:
   - THE CONTRACTOR SHALL FINISH THE BEARING SEATS TO A LEVEL WITHIN THE SPECIFIED ELEVATIONS TO A TOLERANCE OF ± 3 mm.
5. CONCRETE QUANTITIES:
   CONCRETE QUANTITIES LISTED BELOW ARE FOR THE APPROPRIATE LUMP SUM CONTRACT ITEMS.

• CONCRETE IN PIERS, ABUTMENTS AND WINGWALLS	261m³
• CONCRETE IN DECK AND DIAPHRAGMS	213m³
• CONCRETE IN BARRIER WALLS	28m³
• CONCRETE IN APPROACH SLABS	49m³



ELEVATION
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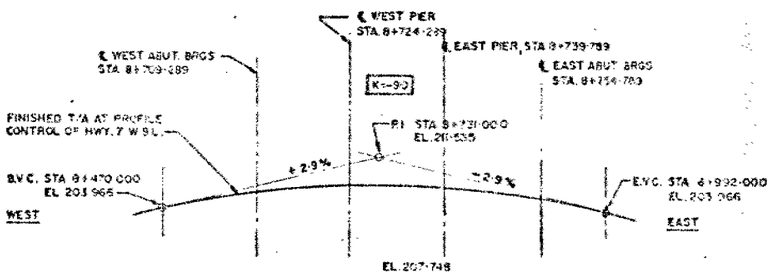
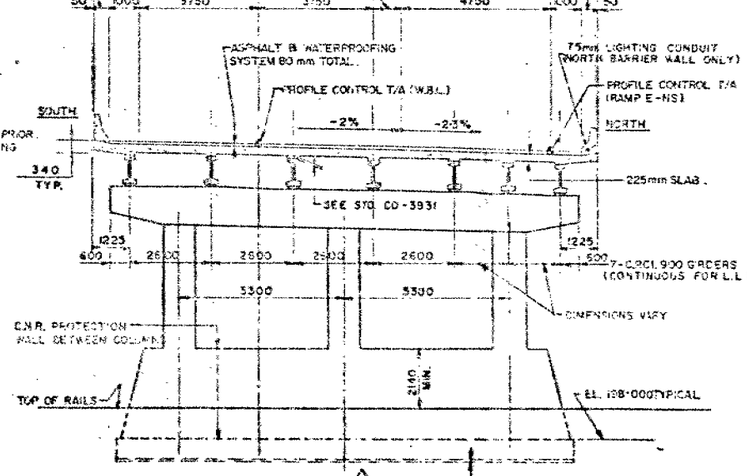


PROFILE OF HWY. 7 W.B.L.
N.T.S.



SECTION 1
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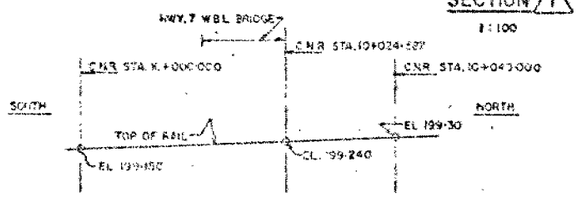


PROFILE OF C.N.R. EAST RAIL OF EAST TRACK
N.T.S.

LIST OF DRAWINGS:

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS			
DATE	BY	DESIGN OF ℄	
DESIGN	DR	CHECK	QUANTITIES
DRAWN	CHECK	SITE NO.	

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO DB-SR 11M 81-06

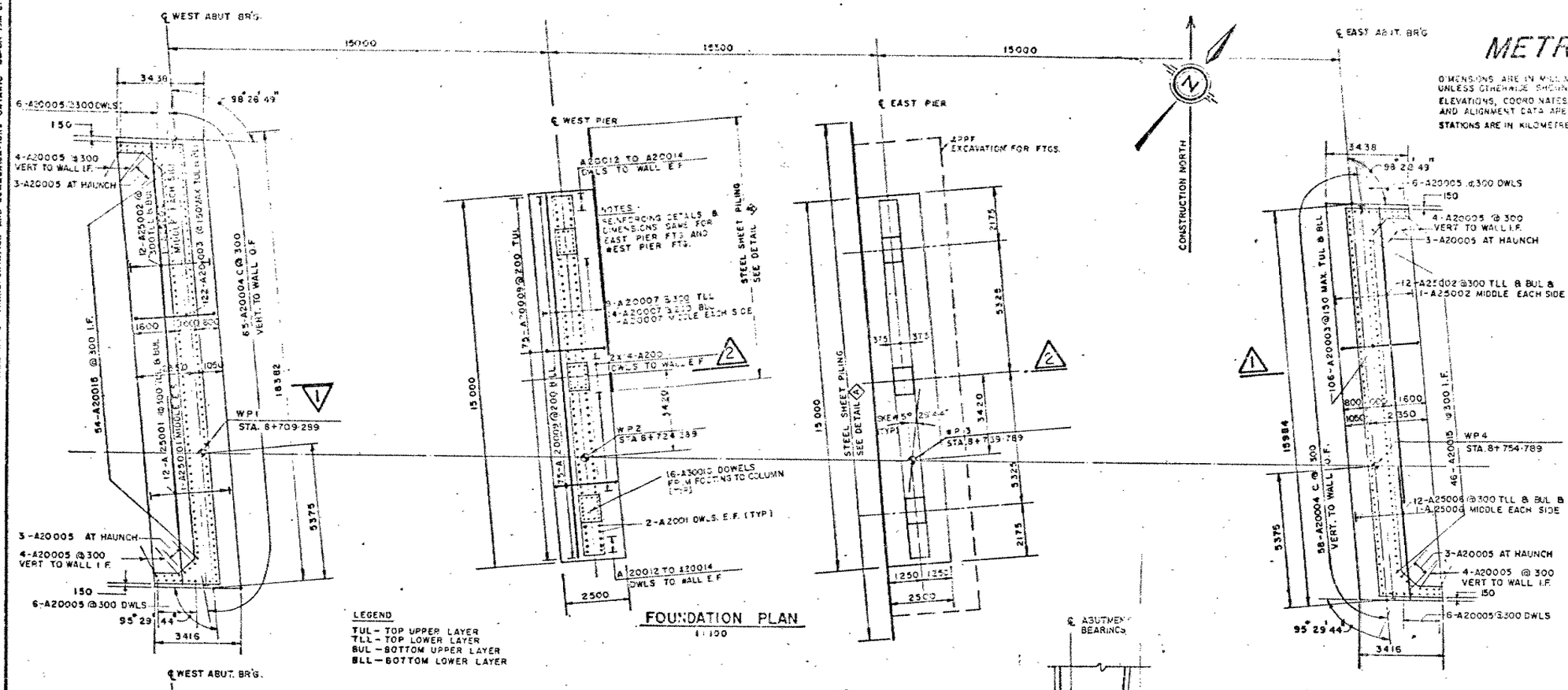
DIST No 7
CONT No
WP No 19-81-05

SHEET

CPR OVERHEAD HWY 7 W.B.L.
PETERBOROUGH BY-PASS
FOUNDATION

METRIC

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



FOUNDATION PLAN
1:100

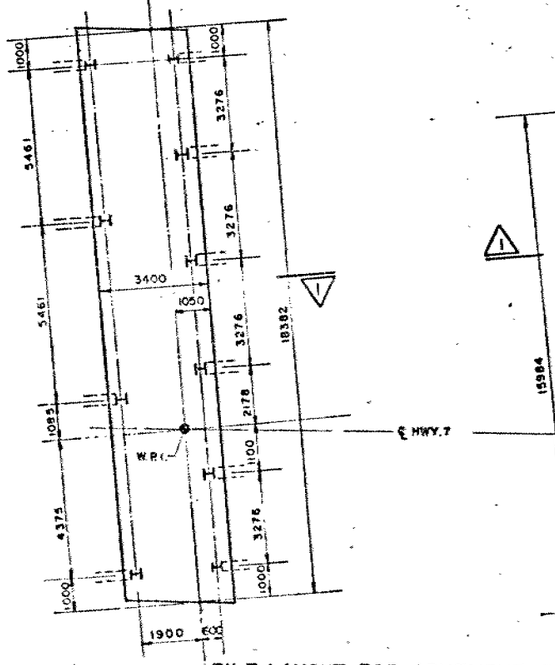
LEGEND
TUL – TOP UPPER LAYER
TLL – TOP LOWER LAYER
BUL – BOTTOM UPPER LAYER
BLL – BOTTOM LOWER LAYER

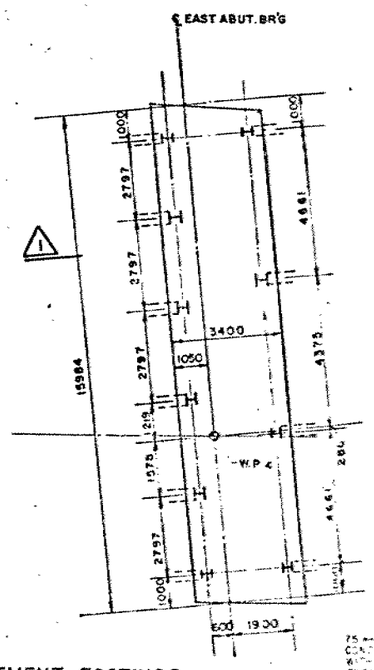
NOTES

1. E.F. DENOTES EACH FACE; I.F. DENOTES INSIDE FACE; O.F. DENOTES OUTSIDE FACE.
2. UNLESS OTHERWISE NOTED, MINIMUM LAPS FOR REINFORCING STEEL SHALL BE:
   15M – 690mm
   20M – 860mm
   25M – 1290mm
   30M – 1720mm
   35M – 2400mm
3. FOR ABUTMENTS AND WINGWALLS SEE DRAWINGS 4, 5 AND 6.
4. LAYOUT DIMENSIONS FOR PILES ARE GIVEN AT THE UNDERSIDE OF ABUTMENT FOOTINGS.
5. MOVE BARS ON BOTTOM OUT OF SPACING TO CLEAR PILES.
6. ALL PILES SHALL BE PROVIDED WITH REINFORCED TIPS IN ACCORDANCE WITH OD-3301. COBBLES AND BOULDERS ARE PRESENT WITHIN THE GLACIAL TILL.
7. PILES TO BE DRIVEN TO BEDROCK.

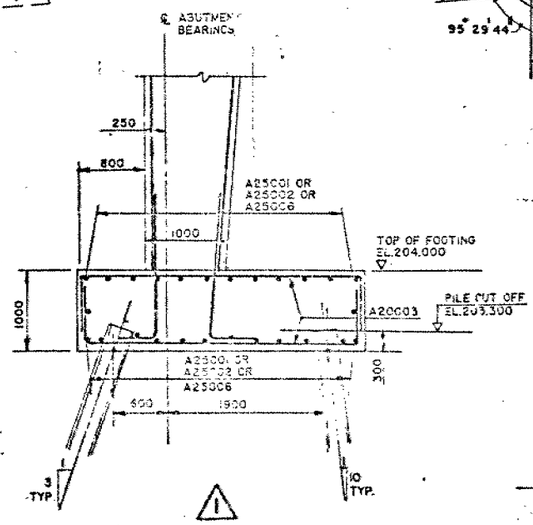
PILE DATA			
LOCATION	No. REQ'D	APPROX LENGTH (mm)	TYPE
WEST ABUTMENT	6 4	18200 17400	HP 310 X 110
EAST ABUTMENT	6 4	18200 17400	HP 310 X 110

LENGTHS SHOWN ARE THEORETICAL LENGTHS BELOW CUTOFF





PILE LAYOUT FOR ABUTMENT FOOTINGS
1:100



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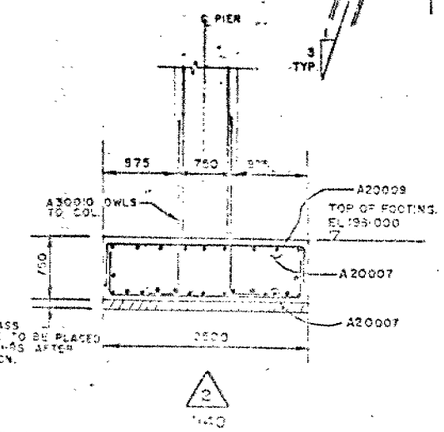

2
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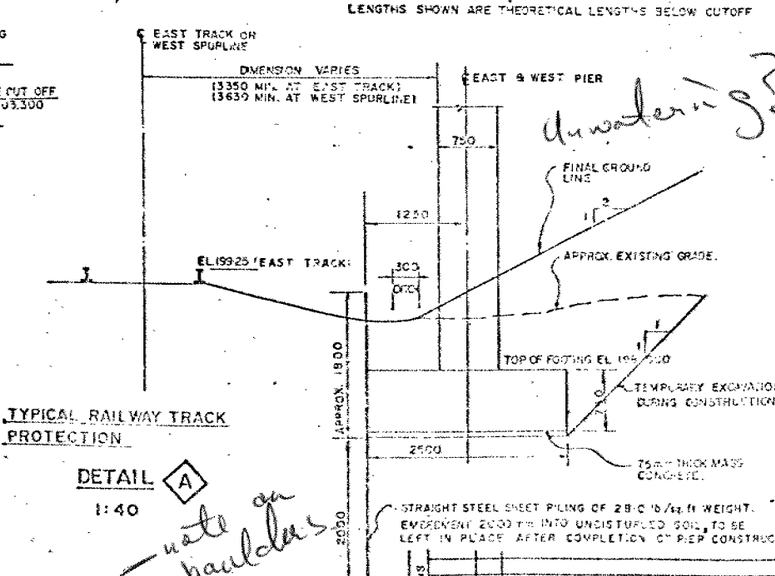

TYPICAL RAILWAY TRACK PROTECTION

DETAIL A
1:40

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN	CHECK	QUANTITIES	DATE
DRAWN	CHECK	SITE	DWG.

Ontario

Ministry of
Transportation and
Communications

foundation investigation and design report

ENGINEERING MATERIALS OFFICE
PAVEMENT & FOUNDATION DESIGN SECTION

WP 19-81-05 DIST 7

HWY 7 STR SITE 26-81

C. N. R. Overhead (W. B. L.)
on Peterborough Bypass

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GEOCRES 31D-282

DATE NOV 2 7 1981

FOUNDATION INVESTIGATION REPORT

For

C. N. R. Overhead (W. B. L.) on Peterborough Bypass
W. P. 19-81-05, Site 26-81
Highway 7, District 7, Port Hope

INTRODUCTION

This report contains the results of a foundation investigation that was performed at the above-mentioned site and provides recommendations to the structure foundations and related earthworks. The investigation was commenced on September 30, 1981 and continued to completion on October 6, 1981. Four boreholes were advanced to bedrock utilizing hollow stem continuous flight augers with two of the holes having bedrock cored. The boreholes ranged in depth from 13.4 metres to 18.5 metres with bedrock being cored for depths of 4.3 metres and 4.5 metres.

SITE DESCRIPTION AND GEOLOGY

The site is located approximately 4.5 kilometres east of the Highway 115 and Highway 7 intersection, 21 metres north of the existing Highway 7 C. N. R. bridge, in the City of Peterborough, County of Peterborough.

The existing bridge is a 47.5 metre long by 10 metre wide, 3 span steel girder structure. The two piers are supported on concrete footings founded on HP 310x79 steel 'H' piles driven to end bearing. The two abutments are perched within the approach fills and supported on concrete footings founded on HP 310x79 endbearing steel 'H' piles. The existing structure and earthworks exhibit no apparent signs of foundation distress.

The topography of the immediate site is generally flat and the vicinity of the proposed structure is poorly drained with a large amount

of shrubbery. Land use in this area is classified as rural-urban fringe.

Physiographically, the site is part of the Peterborough Drumlin Field Region which is described as a heavily drumlinized till plain. The drumlins are composed of highly calcareous sandy tills with varying quantities of angular limestone rubble and Precambrian boulders. In general, shallow overburden in this region is underlain by limestone bedrock of the Trenton Formation, which is highly fossiliferous and disintegrates readily upon weathering.

SUBSURFACE CONDITIONS

The predominate deposit across this site is a glacial stratum consisting of a heterogeneous mixture of silt, sand and gravel with traces of clay. This deposit is covered with a thin layer of topsoil and is in turn underlain by competent limestone bedrock.

The boundaries between the various soil types, insitu and laboratory test results, as well as ground water levels, are shown on the attached Record of Borehole Sheets. The locations and elevations of the borings, along with an estimated stratigraphical profile based on the borehole data, are shown on Drawing No. 198105-A.

The various subsoil types encountered across the site are briefly described in the following paragraphs.

Heterogeneous Mixture of Silt, Sand and Gravel with Traces of Clay (Glacial Till)

The predominate deposit, underlying a thin layer of topsoil and found consistently across the site, is a glacial till consisting of a silt and sand matrix with traces of clay and varying amounts of gravel

with cobbles and boulders throughout. This deposit was encountered to a maximum depth of 14.0 metres, i. e., elevation 186.0. In general, the composition of the material varies randomly with depth, however, the amounts of gravel, cobbles and boulders consistently become more frequent in occurrence towards the lower portion of the deposit.

Based on the interpretation of 'N' values obtained from the Standard Penetration Test, values ranging randomly from a low of 13 to a high of 100 blows per 0.3 metres, the relative density of this deposit can be described as compact to very dense.

Within the upper portion of this deposit, a thin layer of gravel was encountered at the western portion of the area investigated at a depth ranging from 2.0 to 3.5 metres. Difficulties were encountered while trying to advance borings through this layer due to the high gravel content. The denseness of this layer, as based on the interpretation of 'N' values and the difficulties encountered in trying to advance borings, can be assumed to be generally dense.

Within the lower portion of this deposit, a thin layer of sand was encountered at the extreme easterly and westerly portion of the area investigated at a depth of 11.0 to 12.0 metres. This layer consisted of a uniform fine sand with silt and traces of gravel and clay. The denseness of this layer, as based on the interpretation of 'N' values, can be assumed to be very dense.

Typical grain size distribution curves obtained in the upper portion of this deposit, are shown in envelope form on Figure 1. It should be noted tha the envelope does not include the gravel layer located at the western portion of the area investigated. These are shown on Figure 2.

Typical grain size distribution curves obtained in the lower portion of this deposit are shown in envelope form on Figure 1. This envelope, however, does not include the sand layer encountered in this deposit at the extreme east and west portion of the area investigated. These are shown on Figure 3.

Bedrock

Bedrock was proven by utilizing coring techniques to obtain BXL size core in two of the boreholes for penetrations of approximately 4.5 metres. The recovery was found to be greater than 90%. In addition, two borings were advanced to depths where augers met practical refusal and it was assumed that this elevation was the probable bedrock elevation.

Based on visual examination of the rock core and consistent rock core recovery rates of greater than 90%, bedrock is described as limestone, light grey, fine grained to lithographic, hard sound with irregular very thin seams of dark grey shale.

Depths to bedrock ranged from 13.4 metres (elevation 186.3) at the western portion of the area investigated to 14.0 metres (elevation 186.0) at the eastern portion of the area investigated.

In summary, bedrock was found to be generally flat across the site.

Groundwater Conditions

Groundwater levels as established, based on generally one week stabilized borehole water level observations, were approximately elevation 198.5 across the site.

DISCUSSION AND RECOMMENDATIONS

In order to accommodate the four laning of the Peterborough Bypass, it is proposed to twin the existing C. N. R. Overhead Bridge. The new W. B. L. structure will be located approximately 21 metres north of the present structure and will consist of 3 spans with approximate lengths of 15.0 metres, 15.5 metres and 15.0 metres. A profile elevation of approximately 207.7 is contemplated for the proposed bridge. This will necessitate maximum approach fill heights in the order of 8.0 metres above existing ground elevations.

In view of the competent glacial till overburden and sound bedrock across the site, recommendations pertaining to the structure foundations and related earthworks are as follows.

Structure Foundations

In consideration of the presence of the dense glacial till deposit at a relatively shallow depth, it is recommended that all abutment and pier elements be supported on shallow foundations as follows:

Perched type abutments can be supported on spread footings founded on compacted Granular 'A' as is shown on Figure 4. Footings constructed in such a manner can be designed with the following parameters:

Factored Capacity at U. L. S.	700 kPa
Capacity at S. L. S. Type II	300 kPa

Pier elements can be supported on spread footings founded as high as possible within the dense glacial till deposit but below elevation 198.0. Footings founded at or below elevation 198.0 can be designed with the following parameter:

Factored Capacity at U. L. S. 500 kPa

Some minor seepage into the excavation is anticipated, however, this flow of water can easily be controlled by employing conventional techniques such as pumping from sumps.

Pier footing excavations should be covered with a thin mat of lean concrete to act as a working pad, so as to prevent any loosening of the foundation material.

It should be noted that the design of shallow foundations in unyielding soil will not be governed by settlements since the loading required to produce detrimental settlements of the structure will normally be much larger than the factored capacity at ultimate limit states.

For frost protection purposes, the underside of the footings should have a minimum 1.25 metres of earth cover.

Other Considerations

Anticipated fill heights, for the approach embankments in the order of 8.0 metres, can be safely constructed with standard 2:1 slopes. All organic or softened material should be subexcavated for their full depth and replaced with well compacted earthfill within the planned limits of the embankment prior to embankment construction.

Earth pressures should be computed as per Subsection 6.6.1.2.2 of the O. H. B. D. C.

MISCELLANEOUS

The fieldwork for this investigation was carried out and written by Mr. N. Stea, Project Foundations Engineer and reviewed by Mr. M. Devata, Senior Foundations Engineer.

The equipment used for the investigation was owned and operated by Site Investigation Services Ltd., Peterborough, Ontario.

Nick Stea

N. Stea, P. Eng.,
Project Foundations Engineer

M. Devata, P. Eng.,
Senior Foundations Engineer

APPENDIX

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 1 METRIC

W P 19-81-05 LOCATION Co-ords N 4905 622.8; E 401 289.2 ORIGINATED BY N. S.
DIST 7 HWY 7 BOREHOLE TYPE Hollow Stem Continuous Flight Augers COMPILED BY N. S.
DATUM Geodetic DATE 81 09 30 CHECKED BY

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE	PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
199.7	Ground Surface										
0.0	Heterogeneous mixture of silt, sand and gravel with trace of clay		1	SS	13	▼					10 35 51 4
			2	SS	15		198				18 33 40 9
	(Glacial Till)		3	SS	27						35 32 27 6
			4	SS	23						
	Gravel with sand and trace of silt and clay		5	SS	48		196				62 33 4 1
	Brown Grey		6	SS	27						8 38 48 6
			7	SS	57		194				
	Compact to very dense										
191.2			8	SS	106		192				
8.5	Becoming more gravelly below elev. 191.2		9	SS	26						30 28 28 14
	with cobbles and boulders below elev. 189.3		10	SS	14		190				
							188				1 84 (16)
186.3	Uniform fine sand with traces of silt and clay. Grey		11	SS	75						
13.4	End of Borehole										
	Refusal to augering probable bedrock										
	Water level established on 81 10 06										

OFFICE REPORT ON SOIL EXPLORATION

$+^3$, $\times^5$: Numbers refer to Sensitivity

20
15 ◇ 5 (%) STRAIN AT FAILURE
10

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 2 METRIC

W P 19-81-05 LOCATION Co-ords N 4905 638.2; E 401 290.4 ORIGINATED BY N. S.

DIST 7 HWY 7 BOREHOLE TYPE Hollow Stem Continuous Flight Augers - BXL Rock Core COMPILED BY N. S.

DATUM Geodetic DATE 81 09 30 - 81 10 01 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
199.6	Ground Surface										
0.0	Heterogeneous mixture of silt, sand and gravel with traces of clay (Glacial Till)		1	SS	8	▼	198		○ N		12 28 55 5
			2	SS	33						41 34 20 5
	Gravel with traces of sand, silt & clay		3	SS	32						86 10 3 1
			4	SS	73		196				
	Brown Grey		5	SS	94						
			6	SS	60/8 cm		194		○H		1 11 73 15
192.4											
7.2	Becoming more gravelly below elev. 192.4		7	SS	81		192				
			8	SS	31						8 36 32 24
			9	SS	19		190				
	with cobbles and boulders below elevation 188.9										
	Compact to very dense		10	SS	70		188		○		58 27 12 3
186.3			11	SS	50/8 cm				○		
13.3	Limestone bedrock, light grey, fine grained to litho-graphic, hard sound with irregular very thin seams of dark grey shale		12	RC BXL	94% REC		186				
			13	RC BXL	99% REC		184				
181.8							182				
17.8	End of Borehole Water level established on 81 10 06										

+3, x5 : Numbers refer to Sensitivity

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

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 3

METRIC

W P 19-81-05 LOCATION Co-ords N. 4 905 650.3; E 401 312.2 ORIGINATED BY N. S.

DIST 7 HWY 7 BOREHOLE TYPE Hollow Stem Continuous Flight Augers COMPILED BY N. S.

DATUM Geodetic DATE 81 10 02 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT WL — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
199.4	Ground Surface										
0.0	Heterogeneous mixture of silt, sand and gravel with traces of clay (Glacial Till) Brown Grey		1	SS	28	▼	198				12 39 38 11
			2	SS	30						
			3	SS	67		196				3 30 52 15
			4	SS	56						
			5	SS	63		194				0 17 68 15
			6	SS	60						
192.7											
6.7	Becoming more gravelly below elevation 192.7 Cobbles and Boulders		7	SS	22		192				25 30 30 15
			8	SS	42		190				
			9	SS	55						32 42 23 3
	Grey		10	SS	100/13 cm		188				6 23 53 18
186.0	Compact to very dense										
13.4	End of Borehole Refusal to augaring probable bedrock Water level established on 81 10 06										

$+^3$, $\times^5$: Numbers refer to Sensitivity

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

OFFICE REPORT ON SOIL EXPLORATION

Ministry of Transportation and Communications
Ontario

RECORD OF BOREHOLE No 4 METRIC

W P 19-81-05 LOCATION Co-ords N 4 905 666.3; E 401 311.9 ORIGINATED BY N. S.

DIST 7 HWY 7 BOREHOLE TYPE Hollow Stem Continuous Flight Augers - BXL Rock Core COMPILED BY N. S.

DATUM Geodetic DATE 81 10 05 - 06 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT Wp / NATURAL MOISTURE CONTENT W / LIQUID LIMIT W_L — WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
200.0	Ground Surface										
0.0	Heterogeneous mixture of silt, sand and gravel with traces of clay		1	SS	26	*					
	Boulder		2	SS	100/14 cm		198				
			3	SS	39						
	(Glacial Till)		4	SS	76						10 19 57 14
	Brown		5	SS	98		196				2 14 70 14
	Grey		6	SS	92						3 21 60 16
193.3			7	SS	67		194				
6.7	Becoming more gravelly below elevation 193.3 with cobbles and boulders throughout		8	SS	23		192				
			9	SS	28						35 32 29 4
	Grey		10	SS	100/20 cm		190				26 24 43 7
	Uniform fine sand with silt with traces of gravel and clay		~~11~~	~~SS~~	~~100~~/15 cm		188				3 62 32 3
	Dense to very dense		~~12~~	~~SS~~	~~100~~/14 cm		186				25 27 35 13
14.0	Limestone Bedrock light grey, fine grained to lithographic, hard sound with irregular very thin seams of dark grey shale		13	RC BXL	92% REC						
			14	RC	100%		184				
			15	RC BXL	100% REC						
181.4							182				
18.6	End of Borehole										

*Water level not established at time of investigation

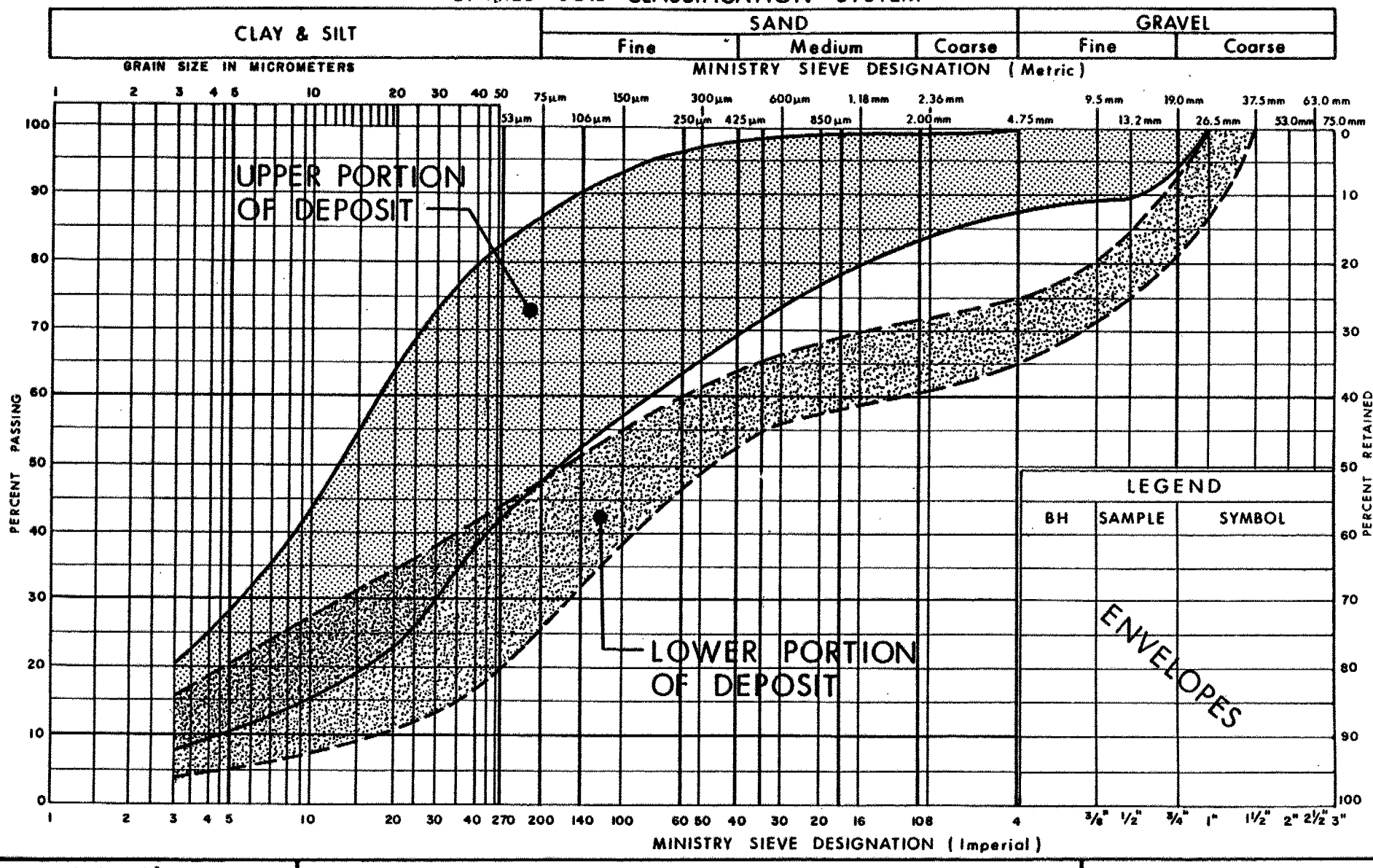
+3, ×5 : Numbers refer to Sensitivity

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

OFFICE REPORT ON SOIL EXPLORATION

78 12 M

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of Transportation and Communications
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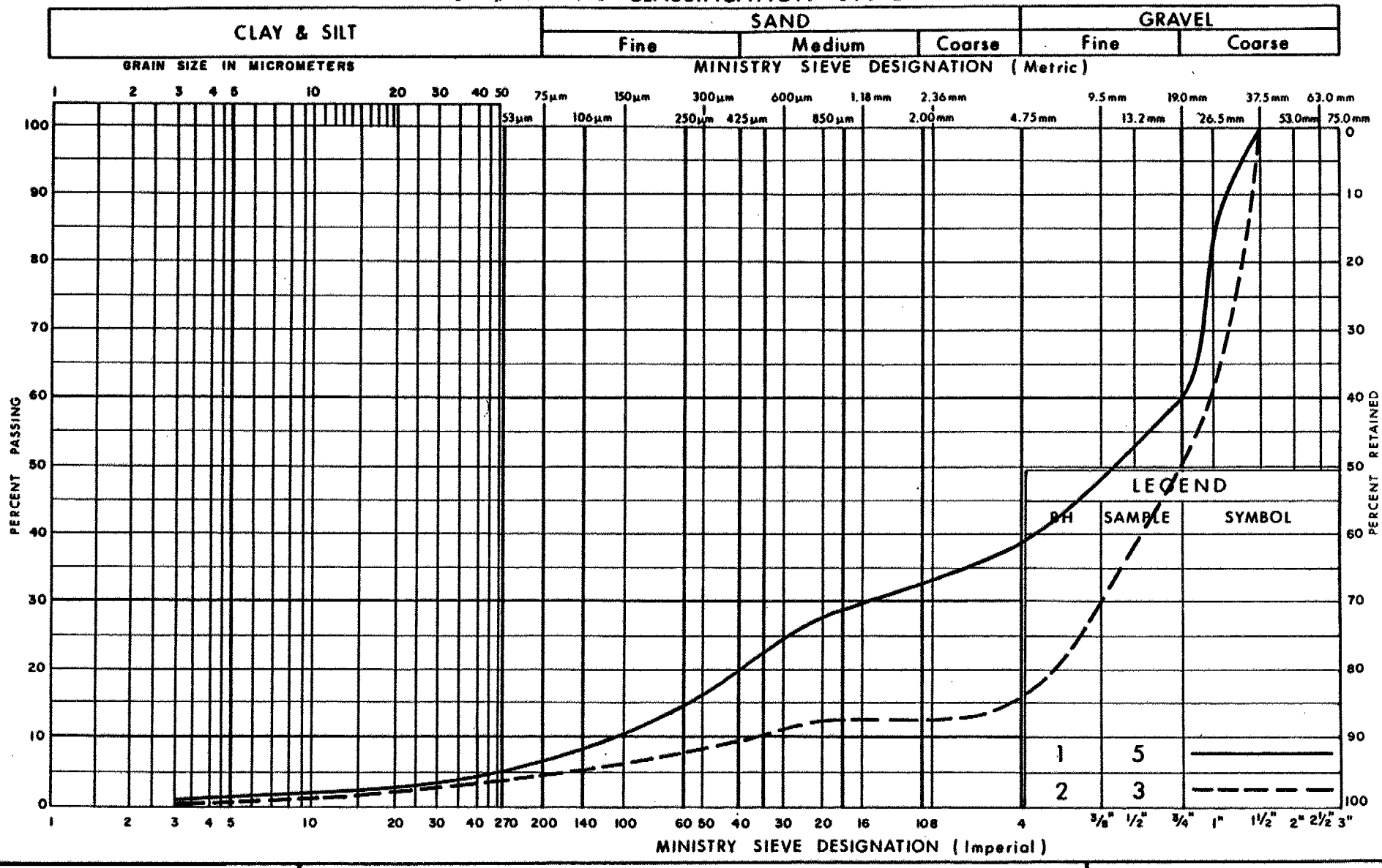
GRAIN SIZE DISTRIBUTION

HET MIXTURE OF
SILT, SAND & GRAVEL WITH TRACES OF CLAY (Glacial Till)

FIG No 1
W P 19-81-05

UNIFIED SOIL CLASSIFICATION SYSTEM



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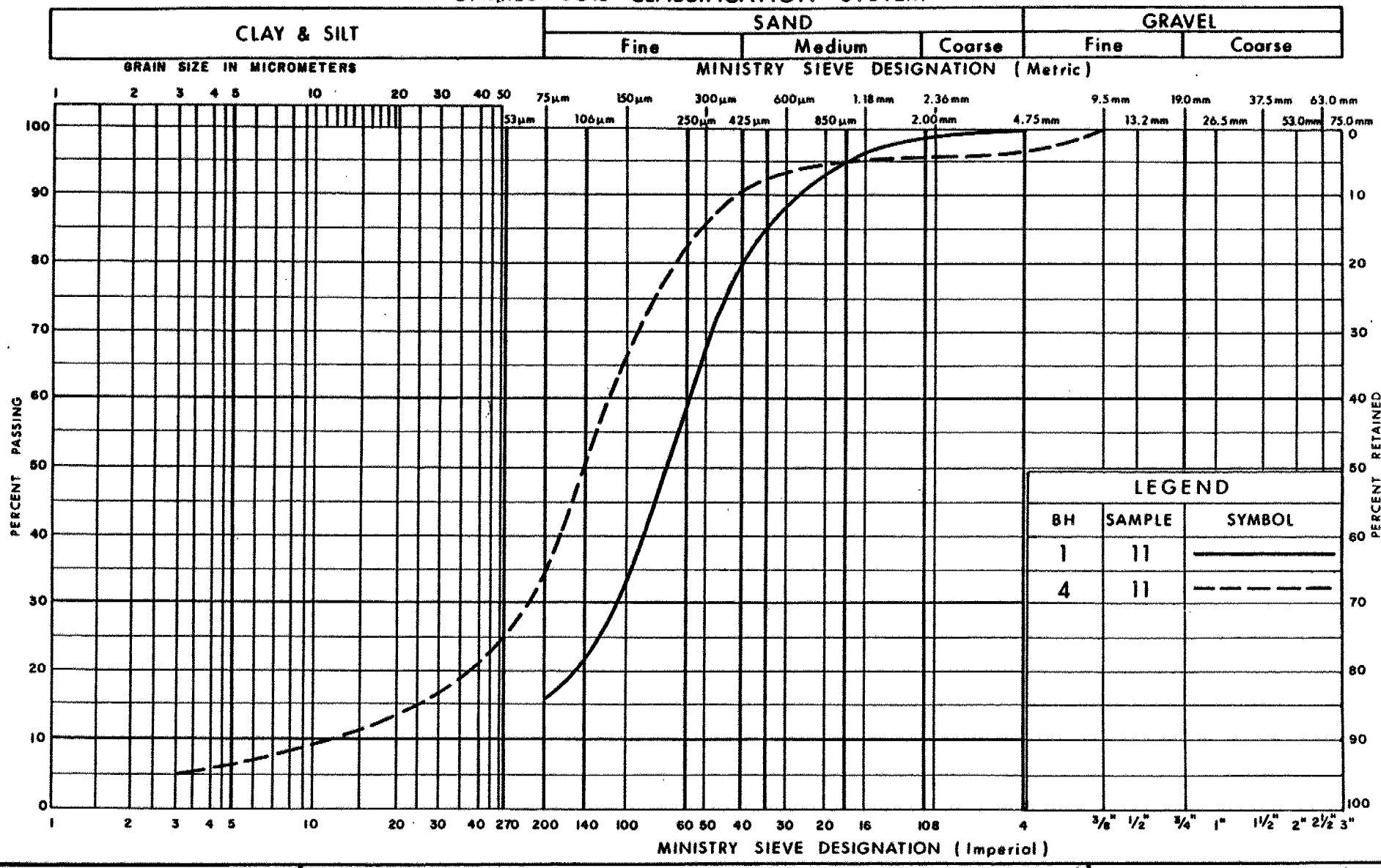
GRAIN SIZE DISTRIBUTION

GRAVEL LAYER

FIG No 2

W P 19-81-05

UNIFIED SOIL CLASSIFICATION SYSTEM



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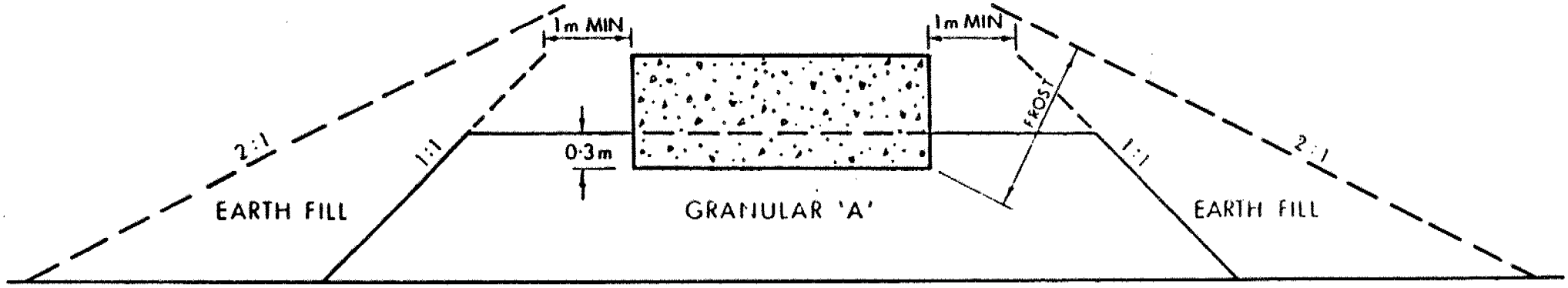
GRAIN SIZE DISTRIBUTION

SAND LAYER

FIG No 3

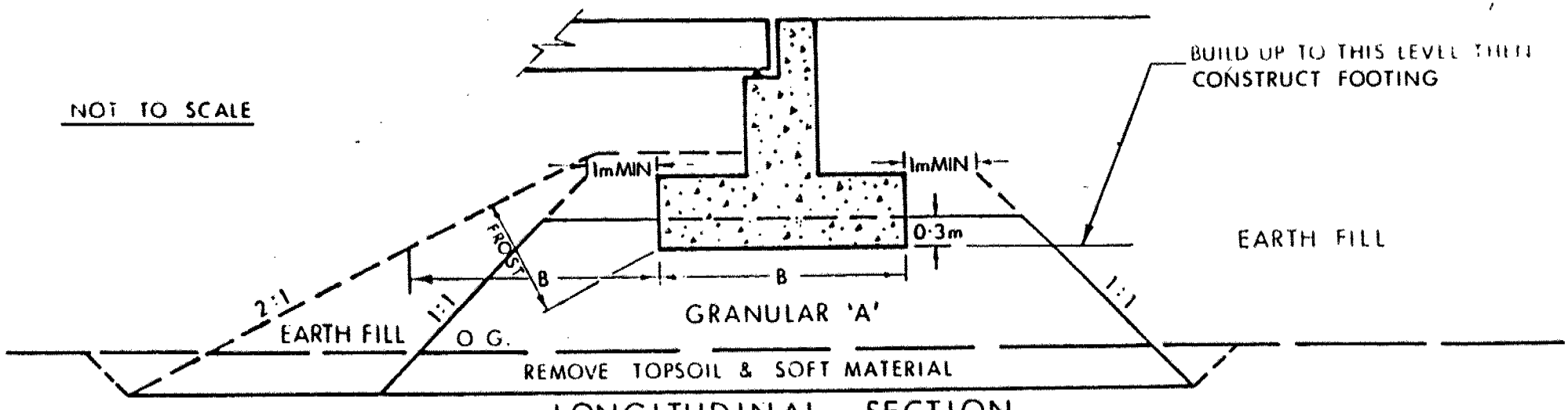
W P 19-81-05

ABUTMENT ON COMPACTED FILL SHOWING GRANULAR 'A' CORE



X SECTION

NOT TO SCALE



LONGITUDINAL SECTION

NOTES:

1 - REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.

2 - PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M.T.C. STANDARDS.

3 - CONSTRUCT CONCRETE FOOTING

4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED

FIG. 4

WP 19-81-05

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\bar{N}$.

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

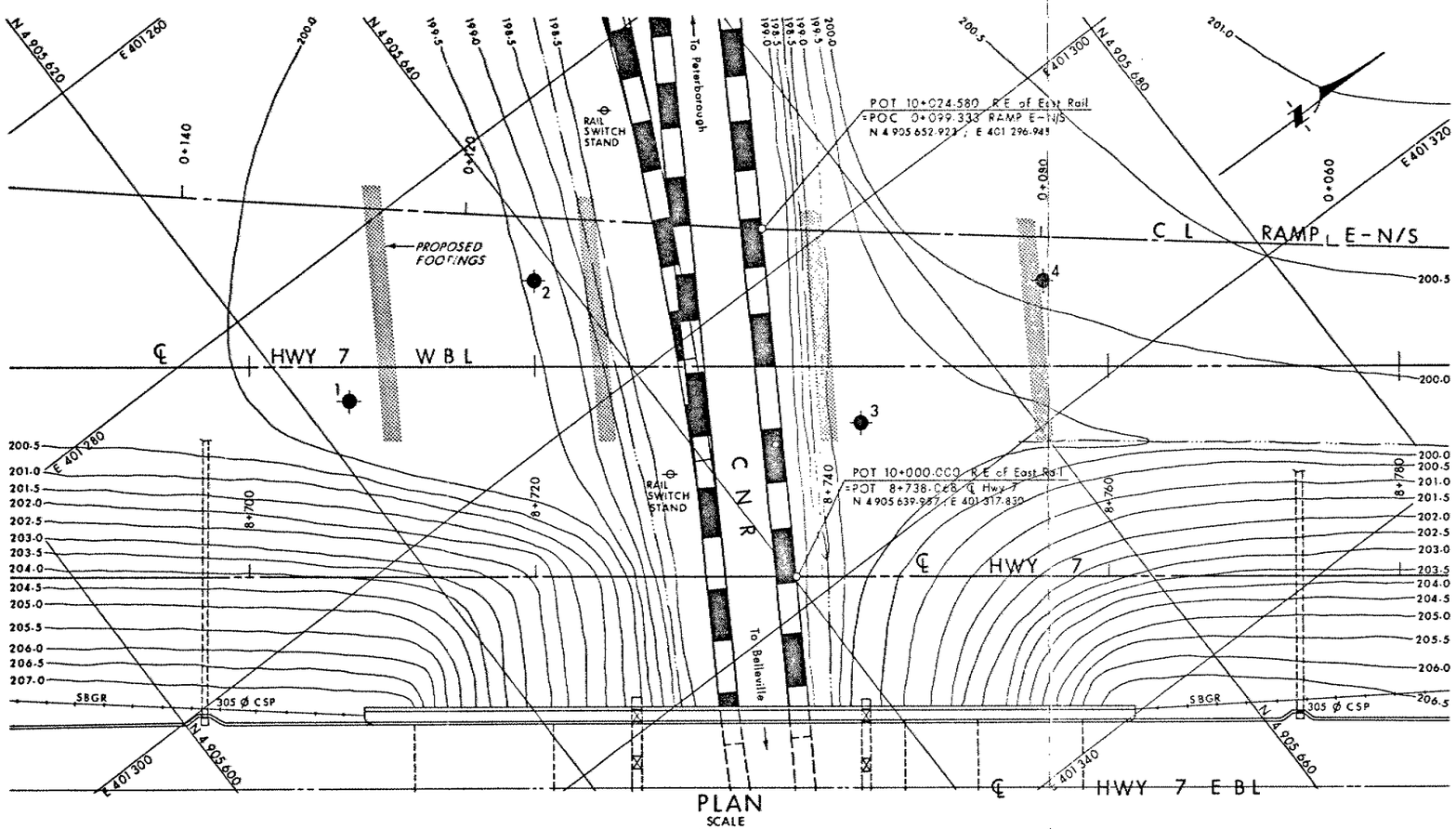
PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL

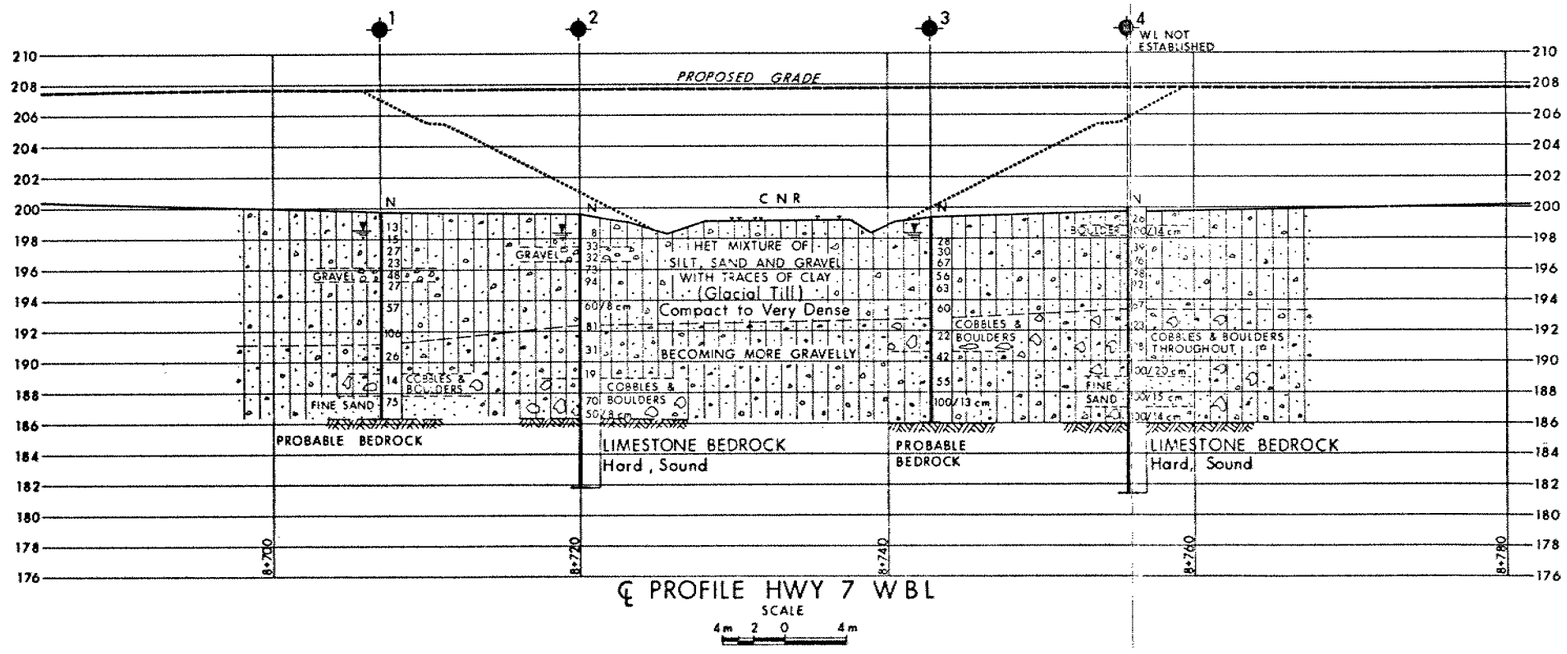
e	1,%	VOID RATIO
n	1,%	POROSITY
w	1,%	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_p	%	PLASTIC LIMIT
w_s	%	SHRINKAGE LIMIT
I_p	%	PLASTICITY INDEX = $w_L - w_p$
I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	1,%	VOID RATIO IN LOOSEST STATE

e_{min}	1,%	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO 08-MT-308M 8-78



PLAN
SCALE
4m 2 0 4m



℄ PROFILE HWY 7 WBL
SCALE
4m 2 0 4m

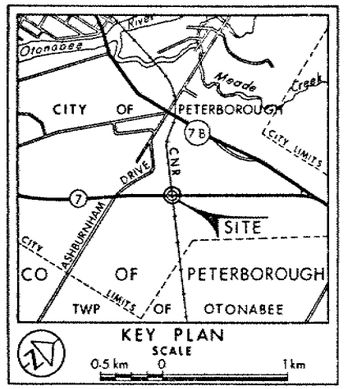
METRIC

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

CONT No
WP No 19-81-05

C N R OVERHEAD
(WEST BOUND LANE)
BORE HOLE LOCATIONS & SOIL STRATA

SHEET



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- WL at time of investigation 1981 10
  WL Not Established in B H ## 4

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	199.7	4 905 622.8	401 289.2
2	199.6	4 905 638.2	401 290.4
3	199.4	4 905 650.3	401 312.2
4	200.0	4 905 666.3	401 311.9

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

REVISIONS

DATE	BY	DESCRIPTION

Geocres No 31D-282

HWY No 7			DIST 7
SUBMD'N'S	CHECKED	DATE 1981 11 24	SITE 26-81
DRAWN	CHECKED	APPROVED	DWG 198105-A

REF No DELCAN 01-1377 Dwg 11 ; 1981 11 20

THURBER

Appendix B

Site Photographs

Photo 1 Looking North at West Approach

Photo 2 Looking North at East Approach

Photo 3 Looking South at West Forward Slope (Rock Protection)

Photo 4 Looking East at East Median Slope

THURBER ENGINEERING LTD.

Appendix C

Archived Drawings

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

PLATE No

CONT No. 83-57

WP No 19-81-01

CONSTRUCTION

STA. 8+625 TO STA. 8+975

SHEET 56

DeLCan DE LEUW CATHER CANADA LTD
CONSULTING ENGINEERS AND PLANNERS

N 4 905 600 E 401 200 N 4 905 700 E 401 300 N 4 905 800 E 401 400 E 401 500

C.N.R.

DD-901 0·3m INSIDE R.O.W.

END DD-905-A

DD-901 TO REPLACE EXISTING FENCE

MH

0+200

0+210

0+100

0+000

8+625

8+975

RAMP E - NS

DD-913-A

DD-912-C

DD-909-A

DD-912-B

DD-909-B

DD-642

DD-601-B

DD-602-L

2·5

3·5

4·75

1·25

HWY 7 WB

HWY 7 EB

22·10

8·95

3·75

3·75

11·00

STEEL BEAM GUIDE RAIL

CABLE GUIDE RAIL

300 mm CSP

1050 mm CSP

DD-905-A

DD-912-B

20 21 22 23

8+700 8+800 8+900

CB

SIGN

PVI. 8+731·000
EL 211·535

END DD-901

QUANTITIES

EC m³
St m³
ED m³
ME m³
MBE m³
EF m³
RC m³
Sh m³
RD m³
MBR m³
RF m³
GB t
GSB t

Sta

C WEST PIER C EAST PIER

K=-90
L=522

C.N.R.

TP ℄ WBL

SUBGRADE

GL

205

200

8+625 8+700 8+800 8+900 8+975

SCALES

5m 0 10m Horizontal

0·5m 0 1·0m Vertical

DIST. No 7
CONT No 83-57
WP No 19-81-05

SHEET 301

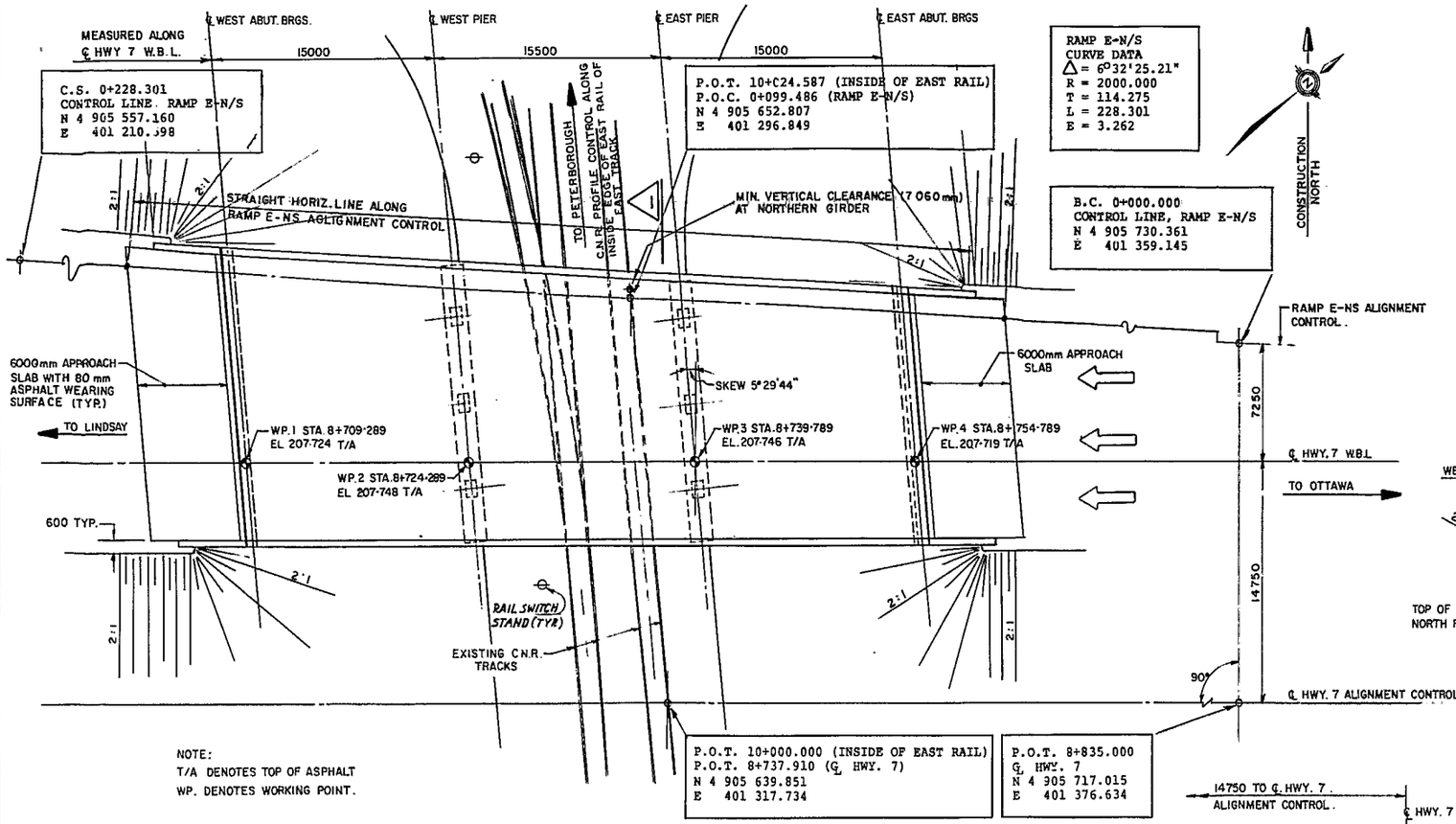
CNR OVERHEAD HWY 7 W.B.L.
PETERBOROUGH BY-PASS
GENERAL ARRANGEMENT

Morrison, Hershfield, Burgess & Huggins, Limited
Consulting Engineers

MHBH

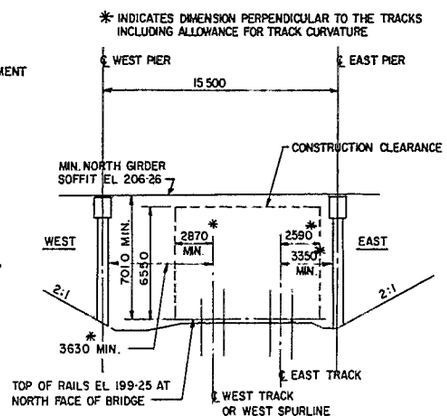
METRIC

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



NOTE:
T/A DENOTES TOP OF ASPHALT
WP. DENOTES WORKING POINT.

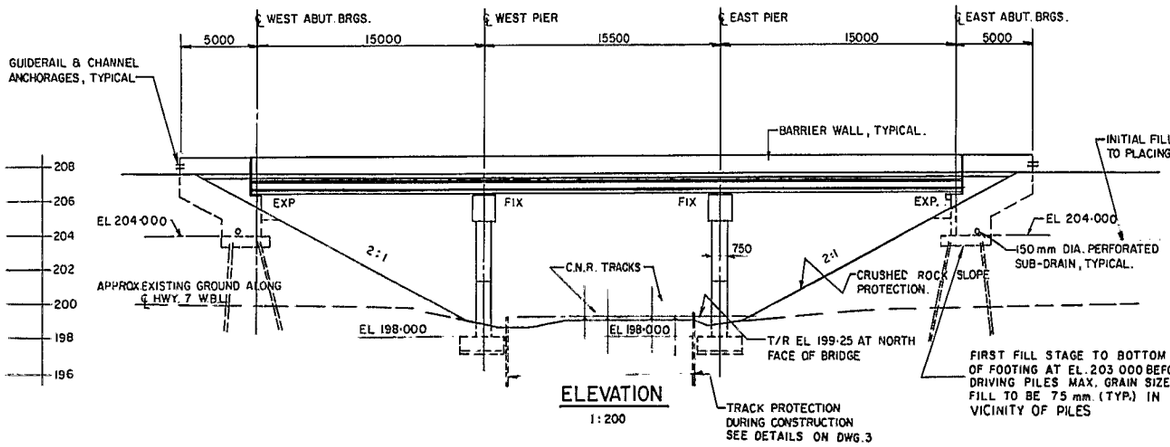
PLAN
1 : 200



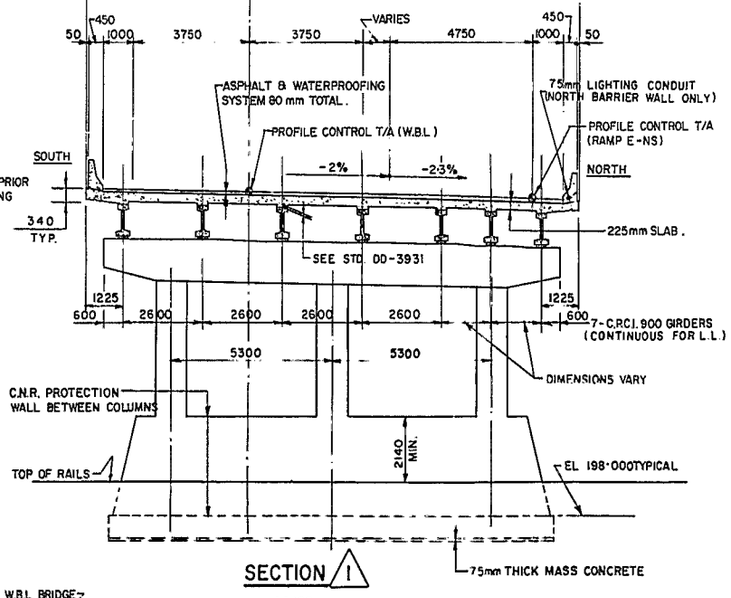
RAILWAY CLEARANCE DIAGRAM
N.T.S.

GENERAL NOTES:

1. CLASS OF CONCRETE:
   - PRESTRESSED GIRDERS - 35MPa.
   - DECK, DIAPHRAGMS, PIERS, ABUTMENTS AND BARRIER WALLS - 30 MPa.
   - APPROACH SLABS, FOOTINGS AND REMAINDER - 20 MPa.
2. CLEAR COVER TO REINFORCING STEEL:
   - FOOTINGS 100 mm ± 25 mm.
   - PIERS, CNR PROTECTION WALLS, ABUTMENTS AND WINGWALLS FRONT SURFACES 80 mm ± 20 mm.
   - BOTTOM OF DECK 40 mm ± 10 mm.
   - REMAINDER 70 mm ± 20 mm UNLESS OTHERWISE NOTED.
3. - REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED.
   - BARS MARKED WITH THE SUFFIX 'C' SHALL BE COATED BARS.
4. CONSTRUCTION NOTES:
   - THE CONTRACTOR SHALL FINISH THE BEARING SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS TO A TOLERANCE OF ± 3 mm.
5. CONCRETE QUANTITIES:
   CONCRETE QUANTITIES LISTED BELOW ARE FOR THE APPROPRIATE LUMP SUM TENDER ITEMS.
   - CONCRETE IN PIERS, ABUTMENTS AND WINGWALLS 261m³
   - CONCRETE IN DECK AND DIAPHRAGMS 213m³
   - CONCRETE IN BARRIER WALLS 28m³
   - CONCRETE IN APPROACH SLABS 49m³



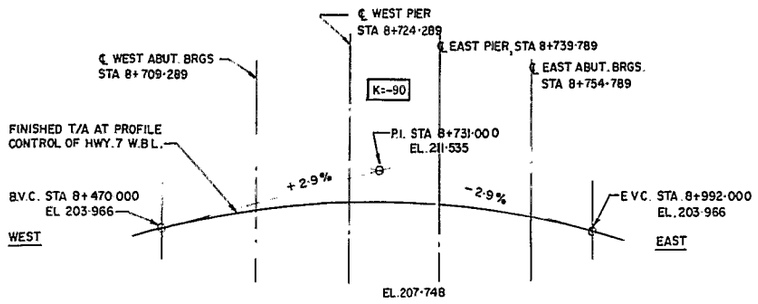
ELEVATION
1 : 200



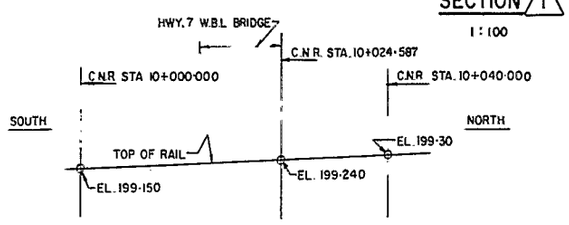
SECTION 1
1 : 100

LIST OF DRAWINGS:

26-1545-81-1	GENERAL ARRANGEMENT
-2	BOREHOLE LOCATIONS & SOIL STRATA
-3	FOUNDATIONS
-4	WEST ABUTMENT
-5	EAST ABUTMENT
-6	WINGWALL DETAILS
-7	WEST PIER
-8	EAST PIER & BEARING DETAILS
-9	DECK LAYOUT AND SCREED ELEVATIONS
-10	PRESTRESSED GIRDERS
-11	DECK REINFORCEMENT & DIAPHRAGM DETAILS
-12	BARRIER WALL
-13	6000mm APPROACH SLAB
-14	EXPANSION JOINTS & SLOPE PROTECTION DETAILS
-15	BRIDGE DATE & SITE NUMBER DATA
-16	AS CONSTRUCTED ELEVATIONS & DIMENSIONS
-17	ELECTRICAL EMBEDDED WORK



PROFILE OF HWY. 7 W.B.L.
N.T.S.

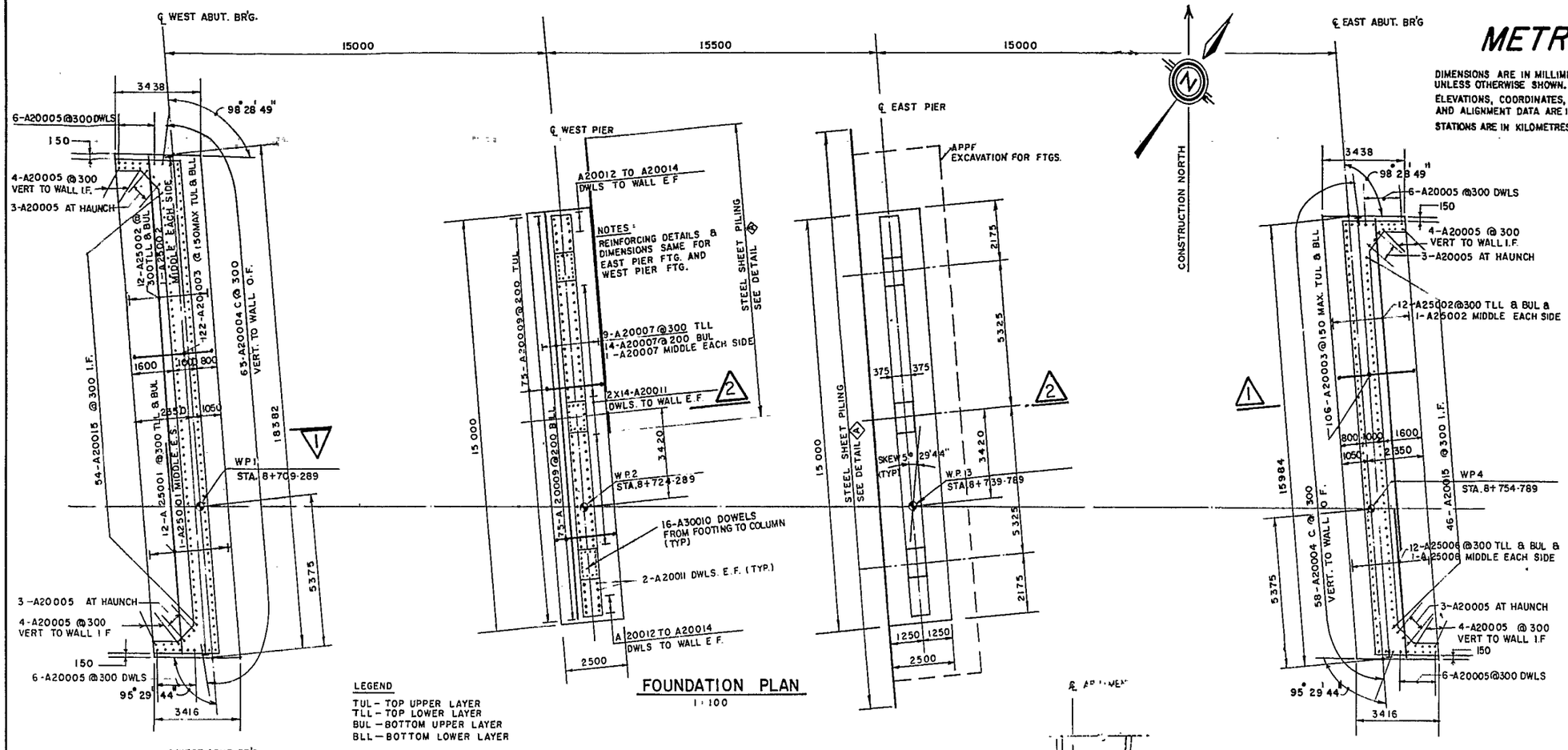


PROFILE OF C.N.R. EAST RAIL OF EAST TRACK
N.T.S.

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS			
DATE	BY	DESCRIPTION
83/08/23	J.S.	RAIL SWITCH STANDS ADDED, NOTE RE; FIRST FILL STAGE REVISED, LIST OF DRAWINGS REVISED

DESIGN D.R.	CHECK A.C	LOADING OHBDC-A-79	DATE NOV., 82
DRAWING BWM	CHECK A.T.	SITE No 26-1545-81	DWG 1



LEGEND

TUL – TOP UPPER LAYER
TLL – TOP LOWER LAYER
BUL – BOTTOM UPPER LAYER
BLL – BOTTOM LOWER LAYER

FOUNDATION PLAN
1:100

METRIC

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

DIST No 7
CONT No 83-57
WP No 19-81-05

CNR OVERHEAD HWY 7 W.B.L.
PETERBOROUGH BY-PASS
FOUNDATION

SHEET 303

Morrison, Hershfield, Burgess & Huggins, Limited
Consulting Engineers

MHBH

REGISTERED PROFESSIONAL ENGINEER M. T-M. CHAN PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER A. TOMK 181-350 PROVINCE OF ONT.

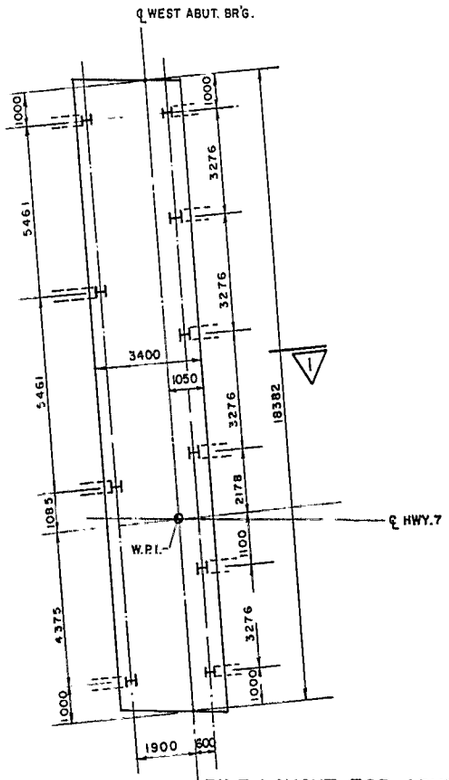
NOTES

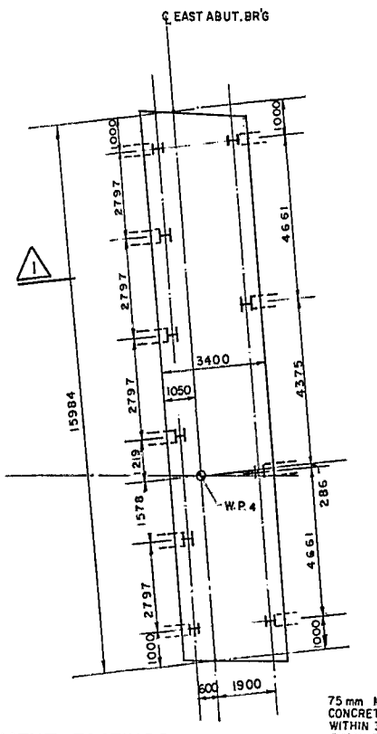
1. E.F. DENOTES EACH FACE; I.F. DENOTES INSIDE FACE; O.F. DENOTES OUTSIDE FACE.
2. UNLESS OTHERWISE NOTED, MINIMUM LAPS FOR REINFORCING STEEL SHALL BE:
   15M – 650mm
   20M – 800mm
   25M – 1200mm
   30M – 1700mm
   35M – 2400mm
3. FOR ABUTMENTS AND WINGWALLS SEE DRAWINGS 4, 5 AND 6.
4. LAYOUT DIMENSIONS FOR PILES ARE GIVEN AT THE UNDERSIDE OF ABUTMENT FOOTINGS.
5. MOVE BARS ON BOTTOM OUT OF SPACING TO CLEAR PILES.
6. ALL PILES SHALL BE PROVIDED WITH REINFORCED TIPS IN ACCORDANCE WITH DD-3301. COBBLES AND BOULDERS ARE PRESENT WITHIN THE GLACIAL TILL.
7. PILES TO BE DRIVEN TO BEDROCK.

PILE DATA

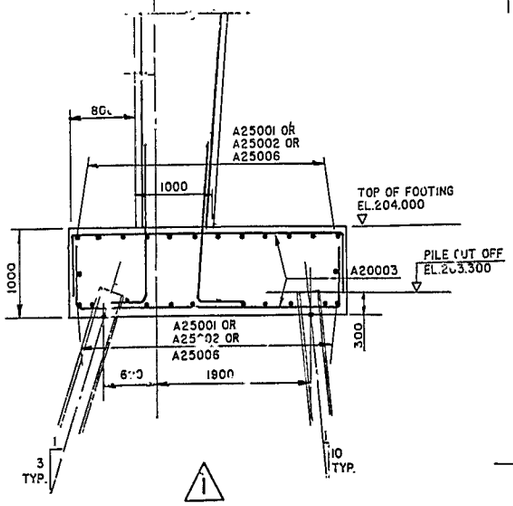
LOCATION	No. REQ'D	APPROX. LENGTH (mm)	TYPE
WEST ABUTMENT	6 4	18200 17400	HP 310 X 110
EAST ABUTMENT	6 4	18200 17400	HP 310 X 110

LENGTHS SHOWN ARE THEORETICAL LENGTHS BELOW CUTOFF

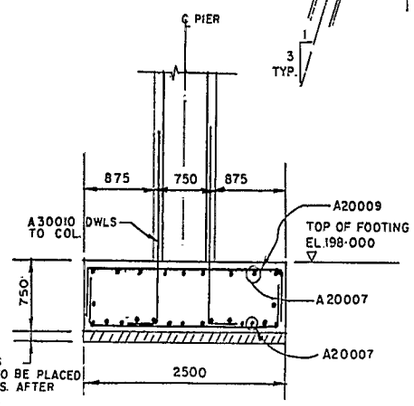




PILE LAYOUT FOR ABUTMENT FOOTINGS
1:100



1:40

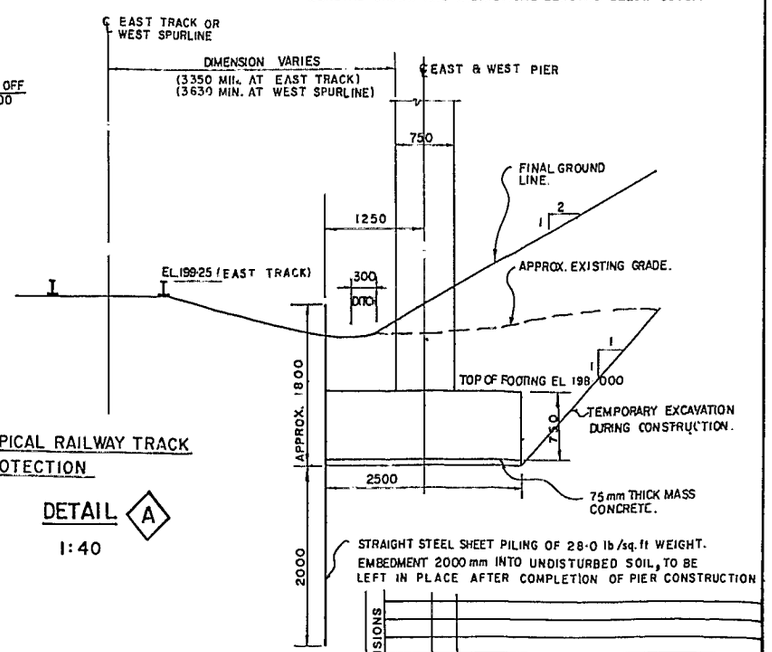


75 mm MASS CONCRETE TO BE PLACED WITHIN 3 HRS. AFTER EXCAVATION.

2
1:40

NOTE

SHEET PILES NOT DESIGNED TO PENETRATE COBBLES OR BOULDERS, REMOVAL OF COBBLES OR BOULDERS MAY BE NECESSARY PRIOR TO DRIVING PILES



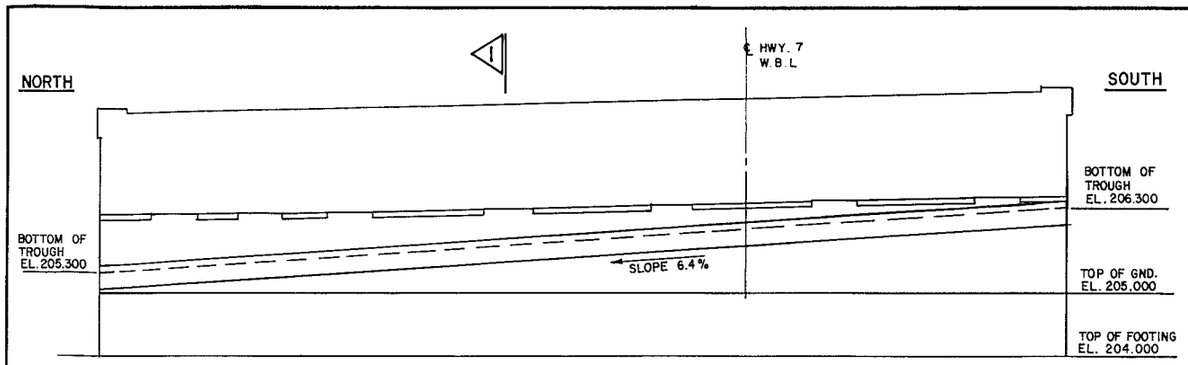
TYPICAL RAILWAY TRACK PROTECTION

DETAIL A
1:40

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

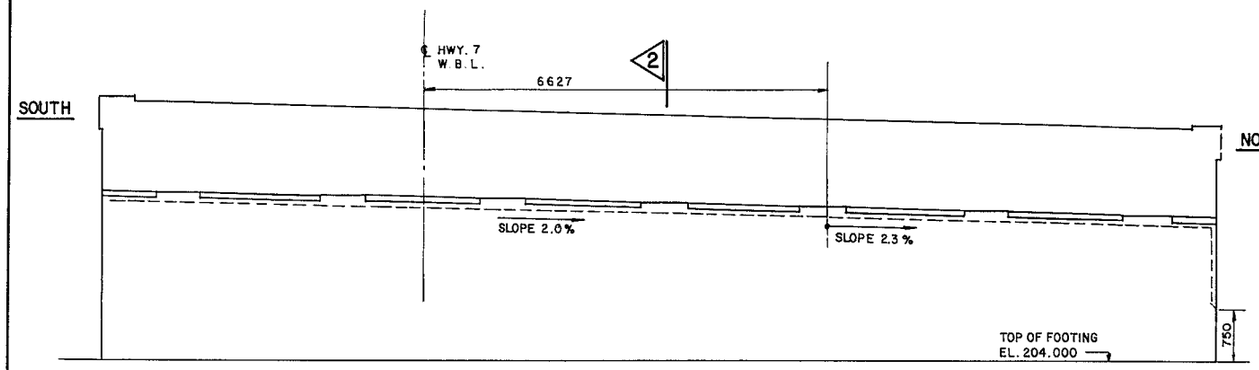
REVISIONS		
DATE	BY	DESCRIPTION
83/02/28	J.S.	NOTE RE; SHEET PILES ADDED

DESIGN D.R.	CHECK A.C.	LOADING OHBDC-A79	DATE NOV., 82
DRAWING P.M.	CHECK A.T.	SITE 26-1545-81	DWG 3



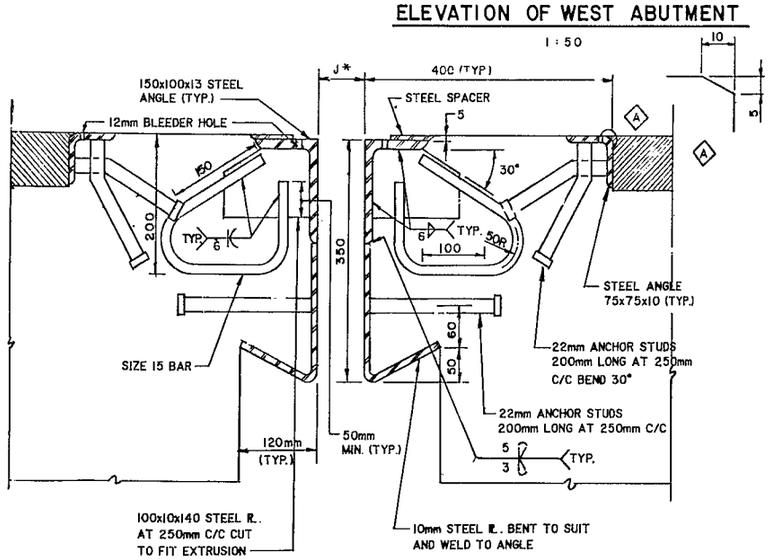
ELEVATION OF EAST ABUTMENT

1 : 50



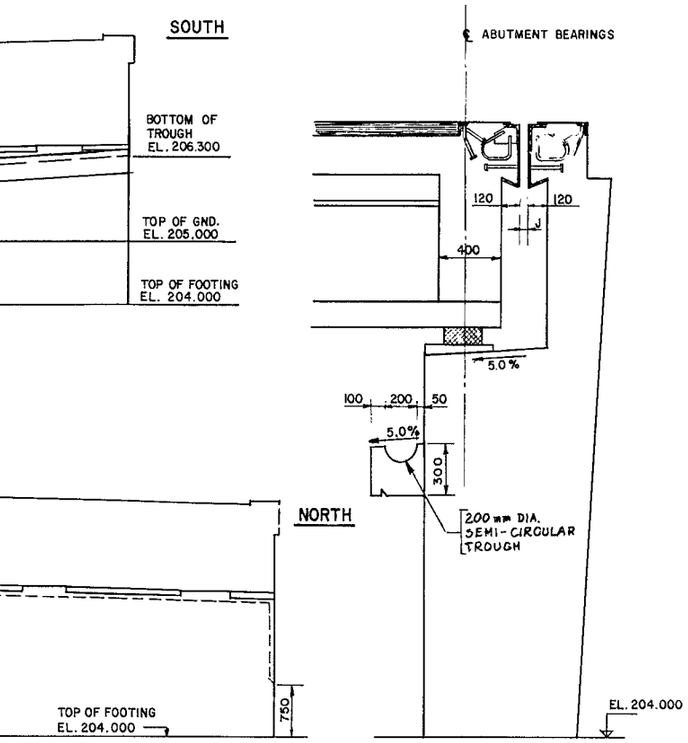
ELEVATION OF WEST ABUTMENT

1 : 50

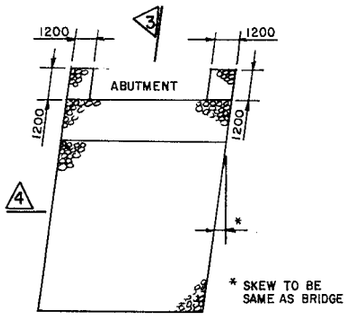


EXPANSION JOINT DETAIL

1 : 5

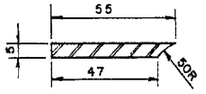


1
1 : 20



SLOPE PROTECTION LAYOUT

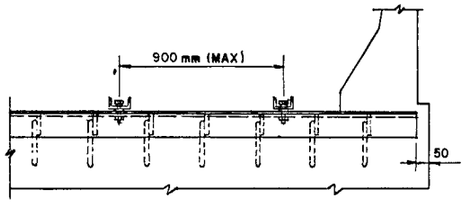
N.T.S.



STEEL SPACER AND DAM

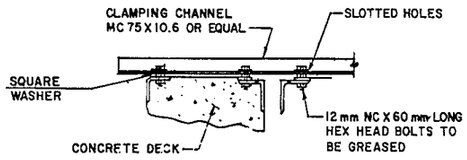
N. T. S.

DIM			INSTALLATION TEMPERATURE					
mm	MIN	MAX	5°C	10°C	15°C	20°C	25°C	30°C
J	50	70	64	62	60	58	56	54



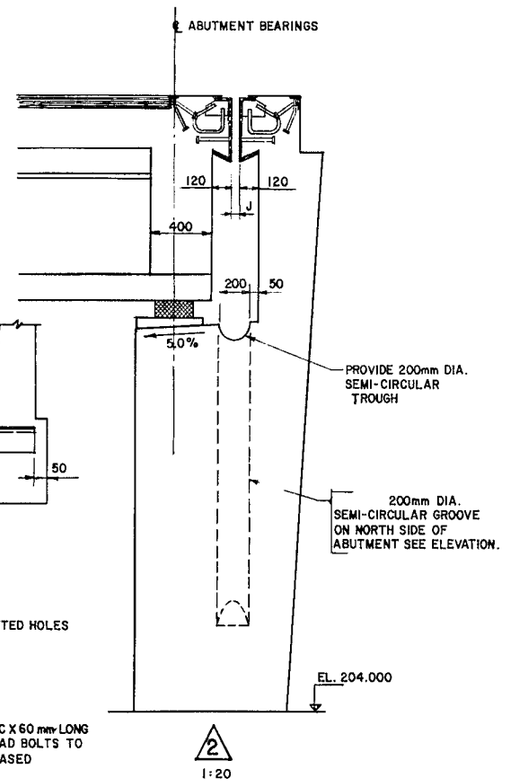
DETAIL AT BARRIER WALL

N.T.S.

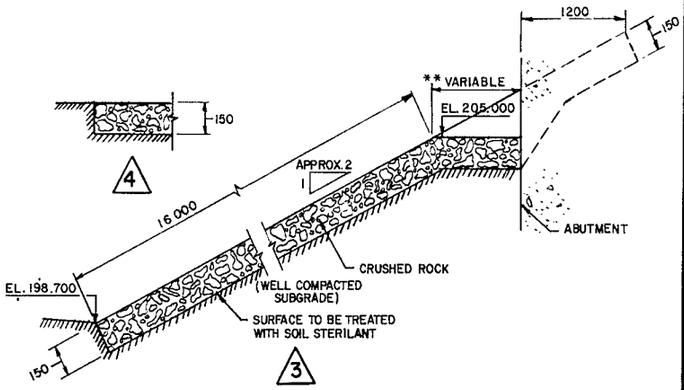


CLAMPING DEVICE

N. T. S.



2
1 : 20



** VARIES TO MAINTAIN SLOPE OF ROADWAY CUT THROUGH THE BRIDGE

CRUSHED ROCK SLOPE PROTECTION

N.T.S.

NOTES

1. MANUFACTURER'S SHOP DRAWINGS SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL AT LEASTS 4 WEEKS PRIOR TO FABRICATION.
2. STEEL SHALL BE IN ACCORDANCE WITH CSA STANDARD G40.21-M GRADE 300W OR EQUAL.
3. STEEL EXTRUSIONS SHALL BE IN ACCORDANCE WITH CSA STANDARD G40.21-M GRADE 230G MINIMUM.
4. ALL STEEL SURFACES SHALL BE HOT DIP GALVANIZED IN ACCORDANCE WITH CSA STANDARD G164 OR METALLIZED IN ACCORDANCE WITH CSA STANDARD G189 AFTER FABRICATION AND INSTALLED IN ONE CONTINUOUS PIECE.
5. JOINT ASSEMBLY SHALL BE FABRICATED TO SUIT THE SKEW OF THE BRIDGE AND SHALL BE COMPLETELY SHOP ASSEMBLED AND PRESET TO DIMENSION 'J' FOR 15° C TEMPERATURE PRIOR TO SHIPMENT.
6. REINFORCING STEEL SHALL BE IN ACCORDANCE WITH CSA STANDARD G30.12-M GRADE 400.
7. STUDS SHALL BE 'NELWELD' OR 'KSM' OR EQUAL USING FUSION WELD PROCESS.
8. WELDING SHALL BE OF A LOW HYDROGEN CLASSIFICATION. MANUAL ELECTRODES SHALL BE E7016 OR E7018. ALL WELDING SHALL BE IN ACCORDANCE WITH CSA STANDARD W59.
9. JOINT ASSEMBLY SHALL BE INSTALLED 5mm BELOW ELEVATION AND GRADE OF BRIDGE DECK.
10. FINAL WIDTH ADJUSTMENT SHALL BE MADE AND CLAMPING CHANNELS TIGHTENED JUST PRIOR TO PLACING OF CONCRETE IN BALLAST WALL.
11. AFTER REMOVAL OF CLAMPING CHANNELS AND SPACER DAM, BOLT AND BLEEDER HOLES TO BE FILLED WITH AN APPROVED EPOXY GROUT.
12. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN.
13. INSTALLATION TEMPERATURE SHALL BE TAKEN AS THE MEAN SHADE AIR TEMPERATURE PRIOR TO JOINT INSTALLATION AT THE STRUCTURE AS FOLLOWS: FOR CONCRETE STRUCTURES - 48 HOURS, FOR STEEL STRUCTURES - 24 HOURS.
14. J = CLEAR GAP BETWEEN EXTREME METAL FACES.

METRIC

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

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

DIST. No 7
CONT No 83-57
WP No 19-81-05

CNR OVERHEAD HWY. 7 W.B.L.
PETERBOROUGH BY-PASS
EXPANSION JOINTS AND SLOPE PROTECTION DETAILS

SHEET 314

Morrison, Hershfield, Burgess & Huggins, Limited
Consulting Engineers
MHBH

LED PROFESSIONAL ENGINEER A. T-H. CHAN PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER A. TORK 181-350 PROVINCE OF ONTARIO

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN D.R.	CHECK A.C.	LOADINGOHBDC-A79	DATE NOV., 82
DRAWING S.L.	CHECK A.T.	SITE 26-1545-81	DWG 14