



**THURBER** ENGINEERING LTD.

## **MEMORANDUM**

To: Christopher Schueler, P.Eng.  
URS Canada Inc.

Date: October 21, 2014

From: Keli Shi, P.Eng.  
Alastair Gorman, P.Eng.  
(Reviewed by P.K. Chatterji, P.Eng.)

File: 19-4406-20

### **PRELIMINARY FOUNDATION INVESTIGATION AND DESIGN SHELTER VALLEY CREEK CULVERT (SITE 21-272/C)**

#### **1. INTRODUCTION**

This memo presents a brief summary of the factual findings from a foundation review carried out for the existing Highway 401 Crossing at Shelter Valley Creek in the geographical township of Haldimand, Northumberland County, Ontario. It also presents preliminary geotechnical recommendations for use in assessment of the existing foundations and for preliminary design at the site. It is noted that the proposed structural alternatives are not yet defined.

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

The following reference numbers apply to this site:

- Current W.P. 4018-13-01
- Site No. 21-272/C
- GEOCRES No. 31C00-045
- Historic W.P. 55-57

#### **2. SITE DESCRIPTION**

The site is located on Highway 401 northeast of Grafton and 3.5 km east of Regional Road 23. Based on the historic General Arrangement (GA) drawing, the existing stream crossing structure is a single-span concrete arch culvert with a span of 15 m and a length of approximately 100 m across highway embankment. At the ends of the 8 m high arch structure, the lower 3.6 m is vertical with wingwall attached and the upper 4.4 m is inclined at approximately 1.5H: 1V to meet the embankment fill slope above the top of arch. The thickness of embankment fill above the top of arch is in the order of 11.6 m.



The site lies within the physiographical area of Iroquois Plain. Based on published information, this plain consists of sand and lacustrine clay deposited in glacial Lake Iroquois. The underlying bedrock consist of limestone of the Shadow Lake formation.

### 3. SUBSURFACE CONDITIONS

A foundation investigation report was completed by the Department of Highways Foundations Section in September 1957. Three boreholes (1, 2 and 3) were drilled in conjunction with Standard Penetration Tests (SPT) to depths of 6.7 to 15.7 m from the original ground surface. Dynamic cone penetration tests (DCPT) (4, 5 and 10) were advanced to practical DCPT refusal at depths ranging from 1.3 to 4.0 m. Borehole 1 and all DCPTs were completed in the vicinity of the creek crossing. The GEOCRE file is attached in Appendix A.

Topsoil was encountered only in Borehole 2 drilled approximately 0.8 km west of the creek. The thickness of the topsoil was 0.3 m.

A layer of dense to very dense gravelly sand to sand and gravel with occasional boulders was encountered from ground surface in Boreholes 1 and 3 and below the topsoil in Borehole 2, with SPT N-values ranging from 32 to 165 blows for 0.3 m of penetration. The layer was fully penetrated in Borehole 3 with the layer thickness of 2.7 m and the base of the layer at Elevation 129.3. Boreholes 1 and 2 were terminated within the layer at depths of 6.7 m and 15.7 m or Elevation 123.0 and 119.2. Natural moisture contents of the sand and gravel deposit ranged from 4 to 15% and typically from 13 to 15%.

The sand and gravel was underlain by a layer of dense to very dense sand in Borehole 3, with SPT N-values ranging from 38 to 110 blows for 0.3 m of penetration. The borehole was terminated in this layer at Elevation 119.4. Natural moisture contents of the sand samples ranged from 9 to 15% and typically from 12 to 15%.

Water level in the creek was reported at Elevation 128.1 in February 1954. The estimated high water level was at Elevation 131.5 approximately.

### 4. SITE OBSERVATIONS

Foundations engineering staff from Thurber visited the site to observe conditions related to the geotechnical performance.

There were no obvious signs of settlement or distress in the foundations.

The embankment slopes appeared to be stable, with no obvious signs of instability or bulging. There were multiple spots of minor water seepage on the interior face of the arch. Concrete spalling and exposed mesh wire reinforcement were noted on the east wingwall of the north end or inlet.

Photographs of the structure and the overlying embankment are attached in Appendix B.



## 5. EXISTING FOUNDATIONS

Based on the historic GA drawing for the structure, D-4111-1 dated May 1958, the arch structure and wingwalls are supported on spread footings.

The width and thickness of the arch footings vary along the length of the footing. The middle one third of the 100 m long footing or 33.5 m long middle section, has a constant base width of 4.7 m and a footing thickness of 2.4 m. The footing width decreases linearly from 4.7 m to 2.1 m at both ends, and the footing thickness decreases linearly from 2.4 m to 1.5 m at both ends. The top of footing is flat at Elevation 127.4 m or 418 ft.

The wing wall footings at the inlet and outlet are 2 m wide and 0.76 m thick with the top of footings located at the same elevation as the arch footings. Each wingwall is 3.7 m high and 7.3 m long.

Based on the recommendations provided in the GEOCRETS report, the footings were designed for an allowable bearing pressure of 3 tons/sq. ft. (working stress design). This is approximately equivalent to an SLS geotechnical resistance of 300 kPa. The highest founding elevation of the footing base was recommended to be 125.0 m, i.e. approximately 3 m below the stream bed, to minimize scouring hazards.

## 6. ASSESSMENT OF EXISTING FOUNDATIONS

Based on the soil conditions shown to exist at this site and the information contained on the historical GA, Limit State Design geotechnical resistances have been calculated in accordance with the requirements of the CHBDC. These values can be used in carrying out an assessment of the existing structure and for preliminary design of any modifications that may be necessary.

Based on the founding elevations provided on the historic GA and the soil conditions reported in the borehole logs, the recommended bearing resistances for footing assessment are as follows:

<b>Footing Width (m)</b>	<b>Footing Base Elevation (m)</b>	<b>SLS (kPa)</b>	<b>Factored ULS (kPa)</b>
2.0	126.6	300	450
2.0	125.9	400	600
3.0	125.4	400	600
4.5	125.0	400	600

The above bearing resistance values are computed for vertical concentric loading with the top of footing at or below the ground surface. For eccentric or inclined loading, the bearing resistances must be adjusted as per the CHBDC.

## 7. EXCAVATION AND ROAD WAY PROTECTION

If the selected rehabilitation strategy requires excavation above or beside the culvert, it is recommended that site investigation and field testing be carried out in order to characterize the fill and to select parameters for the design of the rehabilitation, roadway protection, shoring and dewatering. The number and depth of boreholes can be determined after the rehabilitation strategy has been selected.




## 8. CLOSURE

The factual subsurface information used in the preparation of this memorandum was taken from the report by the Department of Highways Foundations Section titled "Foundation Report on New Bridge at Highway 401 Crossing Shelter Valley Creek, about 2 miles North East of Grafton", W.J. F-57-27, W.P. 55-57 and dated September 30, 1957.

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


Thurber Engineering Ltd.

  
Oct 21/14

Keli Shi, P.Eng.  
Geotechnical Engineer

  
Oct 21/14

Alastair Gorman, P.Eng.  
Associate, Senior Foundation Engineer

  
Oct 21/14

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

Attachments



## Appendix A

### GEOCRES Report and Historic Drawings

## FOUNDATION REPORT

on

New Bridge at Highway 401  
Crossing Shelter Valley Creek,  
about 2 miles North East of Grafton.

Plan No: F-3133-4

Station No: 307/00

Distribution:

Mr. A. Toye  
Bridge Engineer (2)

Mr. H. Tregaskes  
Construction Engineer (1)

Mr. D. G. Ramsay  
Design Engineer (1)

Mr. H. D. Duff  
Dist.Eng. PORT HOPE (1)

Foundation Section (1)

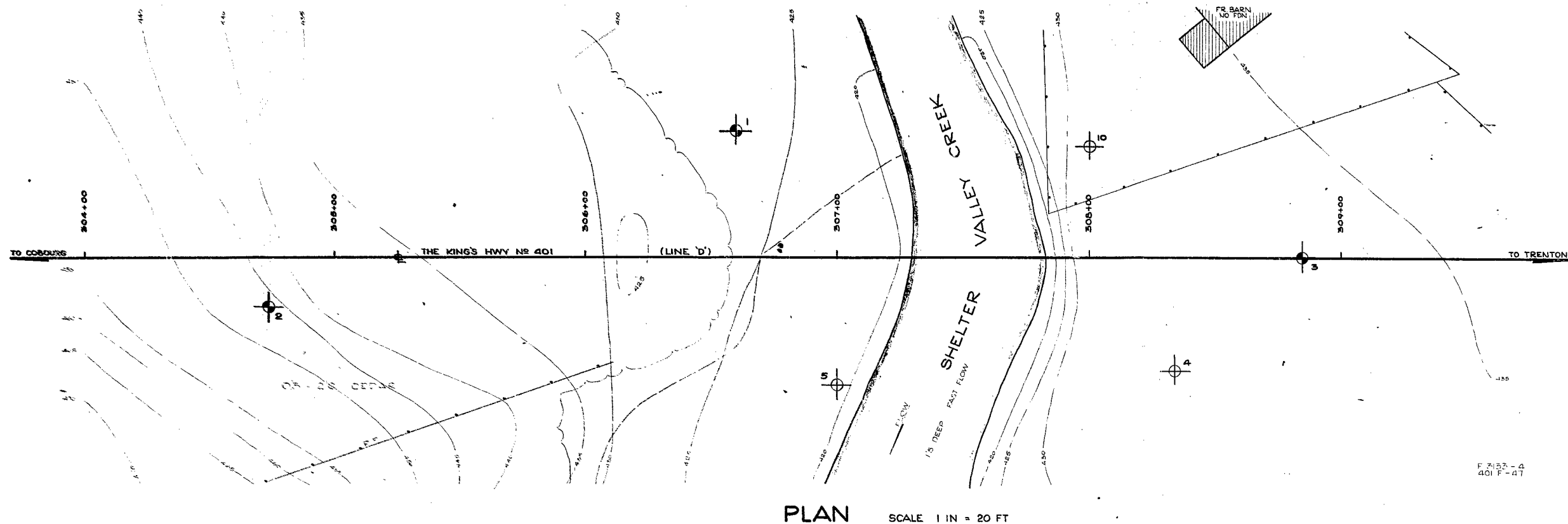
File (1)

W.P. 55-57

W.J. F-57-27

# 57-F-27  
W.P. # 55-57  
Hwy. # 401  
CROSSING  
SHELTER VALLEY  
CR. - 2 MI. N.E. OF  
GRAFTON

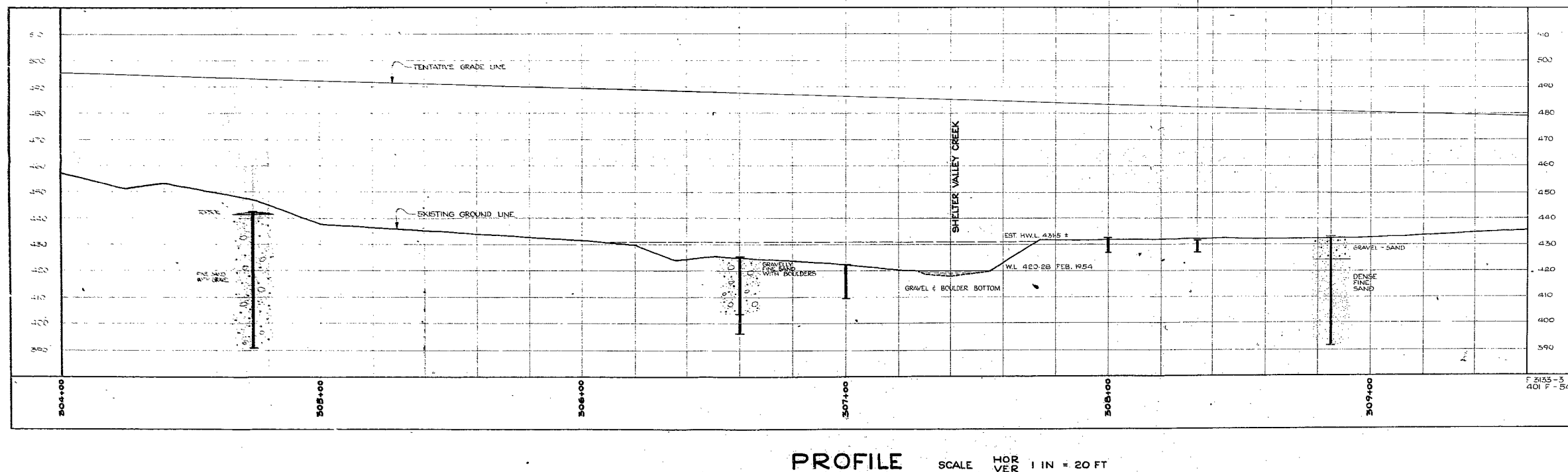
EDITED  
FOR MICROFILMING  
BY *LB* DATE *1/1/72*



LEGEND			
BORE HOLES			
PENETRATION HOLE			
BORE & PENETRATION HOLE			
HOLE NO.	ELEVATION	STATION	DISTANCE FROM #
1	425.65'	306+60'	50' LT
2	442.5'	304+74'	20' RT
3	437.25'	308+65'	4'
4	431.4'	308+34'	45' RT
5	422.5'	307+00'	51' RT
10	432.6'	308+00'	44' LT

— NOTE —

THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BORE HOLE LOCATIONS. BETWEEN BORE HOLES THE BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE AND MAY BE SUBJECT TO CONSIDERABLE ERROR.



DEPARTMENT OF HIGHWAYS - ONTARIO		
MATERIALS & RESEARCH SECTION - DOWNSVIEW		
<b>SHELTER VALLEY CREEK PROPOSED CROSSING 2 MILES N.E. OF GRAFTON</b> SHOWING POSITION & ELEVATION OF HOLES		
HWY. NO. 401 (LINE 'D')	W.P. 55 - 57	DIV. NO. 7
CO. NORTHUMBERLAND	LOT. 14	CON. 1
TWP. HALDIMAND		
SCALE AS SHOWN	SUBMITTED BY	DATE 30 SEPT. 57
DRAWN BY R.E.F.	APPROVED BY	DRAWING NO. F-57-27A





### Introduction:

A subsoil investigation was carried out to determine the bearing values of the layers for supporting the foundations of a proposed bridge and approach fills to the structure.

The location is where the new highway No. 401 crosses the Upper Valley Creek about 2 miles North East of Grafton, Haldimand Township. (Station 307+00, Profile F-3133-4).

The job started on July 23, 1957 and was completed on August 2, 1957.

### Procedure:

The subsoil investigations were carried out by means of a skid mounted coredrill machine. In the course of investigations one borehole with dynamic cone penetration (No. 1), and three dynamic cone penetrations (Nos. 4, 5, 10) were made separately to investigate for supporting the foundations. Also, two boreholes (Nos. 2 & 3) were made to investigate for approach fill stability.

The location of the boreholes is shown on drawing F-57-27A, and their elevations on log sheets under Appendix I.

### Subsoil Findings and Analysis:

In this area the topography is characterized by large drumlins, some with steep slopes, cut by deep stream valleys.

The terrain is spillway deposit, filled with sand and gravel and large boulders. The investigations all across the valley revealed the same subsoil stratigraphy.

Boreholes No. 1 & 2 on the west side of the creek were made by driving the casing by means of BX casing shoe. While borehole No. 3 on the eastern side of the creek was driven down by hammering. From the holes, samples were extracted and tested in the laboratory. During sampling standard Penetration tests were also registered.

In all the samples the soil was identified as gravelly sand. The standard penetration tests indicated the very dense nature of the layer. The natural moisture content of the layer was found to be 14%.

The eroded banks and the washed down large boulders in and around the streambed picture the impressive scouring action taking place along the valley during flood water times.

#### CONCLUSIONS AND RECOMMENDATIONS:

From the above discussion it will follow that:

1. The terrain is spillway deposit. The subsoil is uniform layer of gravelly sand with large boulders down to elevation 391 ft.
2. From the standard penetration tests the layer starting at elevation about 420 ft. and down can provide a bearing value of 2.5-3 T.s.f. to support the spread footing foundations.
3. However, the scouring hazards at this site constitute an important problem. From calculations developed by the Connecticut Highway Department, it is found that the footings should be placed some 10 ft. below the bottom of stream elevation. This gives a safety factor of 4 against scouring hazards at this crossing.

4. It will be convenient to support the structure on spread footing type foundations. These footings, while they may be placed at elevation 420 ft., should not be placed higher than elevation about 410 ft., due to scouring hazards mentioned in (3) above. At this elevation the layer can provide a conservative 3 T.s.f. bearing value.
5. The subsoil layer can provide sufficient bearing value to support the amount of fill anticipated for the approaches to the structure.

V. Korlu,  
Foundation Engineer.

APPENDIX I.

DRILL RIG 54-1 OPERATION BORI & PENIT'N JOB F-57-27 WP 55-57 BORING 1 STA. 306+60 (50' LT)  
CASING BX (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT SEPT 1957  
SAMPLER HAMMER WT. 250 LBS. DROP 19 INCHES COMPILED BY H.S. CHECKED BY A.L. DATE BORING 23 JULY 1957

## SAMPLE TYPES

### SAMPLE CONDITION

C.S. - CHUNK	S.S. - SLEEVE SAMPLE
D.O. - DRIVE OPEN	P.S. - PISTON SAMPLE
D.F. - DRIVE FOOT VALVE	W.S. - WASHED SAMPLE
T.O. - THIN WALLED OPEN	R.C. - ROCK CORE

- DISTURBED
- FAIR
- GOOD
- LOST

SOIL PROFILE				ELEVATION SCALE	WATER CONTENT W %		CASING BLOWS (ACTUAL)	SAMPLES					
ELEVATION DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT PLOT		0 - NAT. □ - P.W. Δ - L.W.			OTHER TESTS	CONDITION	TYPE	NO.	PENETRATION RESISTANCE	ELEV. RECOV. %
					PENETRATION TEST RESISTANCE BLOWS PER FOOT AT STANDARD ENERGY ( 4200 IN. LBS. PER BLOW )								
				D. CONE PEN. X-----X-----X	STAND. PEN. •-----•-----•								
425.05 435.65		GROUND LEVEL		435 425			BY CASING SHOT						425.65 435.65
435.65 440.00		GRAVELLY FINE SAND WITH BOULDERS		435 425									420.65 435.65
440.00 445.00			435 425										415.65 425.65
445.00 450.00			435 425										410.65 420.65
450.00 455.00			435 425										405.65 415.65
455.00 460.00		END OF BOREHOLE		435 425									400.65 410.65
460.00 465.00			435 425										395.40 405.40
465.00 470.00			435 425										390.40 400.40
470.00 475.00			435 425										385.40 395.40
475.00 480.00				435 425									380.40 390.40
480.00 485.00				435 425								375.40 385.40	
485.00 490.00				435 425								370.40 380.40	
490.00 495.00				435 425								365.40 375.40	
495.00 500.00				435 425								360.40 370.40	
500.00 505.00				435 425								355.40 365.40	
505.00 510.00				435 425								350.40 360.40	
510.00 515.00				435 425								345.40 355.40	
515.00 520.00				435 425								340.40 350.40	
520.00 525.00				435 425								335.40 345.40	
525.00 530.00				435 425								330.40 340.40	
530.00 535.00				435 425								325.40 335.40	
535.00 540.00				435 425								320.40 330.40	
540.00 545.00				435 425								315.40 325.40	
545.00 550.00				435 425								310.40 320.40	
550.00 555.00				435 425								305.40 315.40	
555.00 560.00				435 425								300.40 310.40	
560.00 565.00				435 425								295.40 305.40	
565.00 570.00				435 425								290.40 300.40	
570.00 575.00				435 425								285.40 295.40	
575.00 580.00				435 425								280.40 290.40	
580.00 585.00				435 425								275.40 285.40	
585.00 590.00				435 425								270.40 280.40	
590.00 595.00				435 425								265.40 275.40	
595.00 600.00				435 425								260.40 270.40	
600.00 605.00				435 425								255.40 265.40	
605.00 610.00				435 425								250.40 260.40	
610.00 615.00				435 425								245.40 255.40	
615.00 620.00				435 425								240.40 250.40	
620.00 625.00				435 425								235.40 245.40	
625.00 630.00				435 425								230.40 240.40	
630.00 635.00				435 425								225.40 235.40	
635.00 640.00				435 425								220.40 230.40	
640.00 645.00				435 425								215.40 225.40	
645.00 650.00				435 425								210.40 220.40	
650.00 655.00				435 425								205.40 215.40	
655.00 660.00				435 425								200.40 210.40	
660.00 665.00				435 425								195.40 205.40	
665.00 670.00				435 425								190.40 200.40	
670.00 675.00				435 425								185.40 195.40	
675.00 680.00				435 425								180.40 190.40	
680.00 685.00				435 425								175.40 185.40	
685.00 690.00				435 425								170.40 180.40	
690.00 695.00				435 425								165.40 175.40	
695.00 700.00				435 425								160.40 170.40	
700.00 705.00				435 425								155.40 165.40	
705.00 710.00				435 425								150.40 160.40	
710.00 715.00				435 425								145.40 155.40	
715.00 720.00				435 425								140.40 150.40	
720.00 725.00				435 425								135.40 145.40	
725.00 730.00				435 425								130.40 140.40	
730.00 735.00				435 425								125.40 135.40	
735.00 740.00				435 425								120.40 130.40	
740.00 745.00				435 425								115.40 125.40	
745.00 750.00				435 425								110.40 120.40	
750.00 755.00				435 425								105.40 115.40	
755.00 760.00				435 425								100.40 110.40	
760.00 765.00				435 425								95.40 105.40	
765.00 770.00				435 425								90.40 100.40	
770.00 775.00				435 425								85.40 95.40	
775.00 780.00				435 425								80.40 90.40	
780.00 785.00				435 425								75.40 85.40	
785.00 790.00				435 425								70.40 80.40	
790.00 795.00				435 425								65.40 75.40	
795.00 800.00				435 425								60.40 70.40	
800.00 805.00				435 425								55.40 65.40	
805.00 810.00				435 425								50.40 60.40	
810.00 815.00				435 425								45.40 55.40	
815.00 820.00				435 425								40.40 50.40	
820.00 825.00				435 425								35.40 45.40	
825.00 830.00				435 425								30.40 40.40	
830.00 835.00				435 425								25.40 35.40	
835.00 840.00				435 425								20.40 30.40	
840.00 845.00				435 425								15.40 25.40	
845.00 850.00				435 425								10.40 20.40	
850.00 855.00				435 425								5.40 15.40	
855.00 860.00				435 425								0.40 10.40	
860.00 865.00				435 425									
865.00 870.00				435 425									
870.00 875.00				435 425									
875.00 880.00				435 425									
880.00 885.00				435 425									
885.00 890.00				435 425									
890.00 895.00				435 425									
895.00 900.00				435 425									
900.00 905.00				435 425									
905.00 910.00				435 425									
910.00 915.00				435 425									
915.00 920.00				435 425									
920.00 925.00				435 425									
925.00 930.00				435 425									
930.00 935.00				435 425									
935.00 940.00				435 425									
940.00 945.00				435 425									
945.00 950.00				435 425									
950.00 955.00				435 425									
955.00 960.00				435 425									
960.00 965.00				435 425									
965.00 970.00				435 425									
970.00 975.00				435 425									
975.00 980.00				435 425									
980.00 985.00				435 425									
985.00 990.00				435 425									
990.00 995.00				435 425									
995.00 1000.00				435 425									
1000.00 1005.00				435 425									
1005.00 1010.00				435 425									
1010.00 1015.00				435 425									
1015.00 1020.00				435 425									
1020.00 1025.00				435 425									
1025.00 1030.00				435 425									
1030.00 1035.00				435 425									
1035.00 1040.00				435 425									
1040.00 1045.00				435 425									
1045.00 1050.00				435 425									
1050.00 1055.00				435 425									
1055.00 1060.00				435 425									
1060.00 1065.00				435 425									
1065.00 1070.00				435 425									
1070.00 1075.00				435 425									
1075.00 1080.00				435 425									
1080.00 1085.00				435 425									
1085.00 1090.00				435 425									
1090.00 1095.00				435 425									
1095.00 1100.00				435 425									
1100.00 1105.00				435 425									
1105.00 1110.00				435 425									
1110.00 1115.00		</											

DRILL RIG 54-1 OPERATION BORING PINETON JOB F-57-27 W.P. 55-57 BORING 2 STA. 304+74 (20' BT)  
CASING BK (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT SEPT 1957  
SAMPLER HAMMER WT. 250 LBS. DROP 19 INCHES COMPILED BY \_\_\_\_\_ CHECKED BY AL DATE BORING 25 JULY 1957

## SAMPLE TYPES

**SAMPLE CONDITION**

C.S. - CHUNK	S.S. - SLEEVE SAMPLE
D.O. - DRIVE OPEN	P.S. - PISTON SAMPLE
D.F. - DRIVE FOOT VALVE	W.S. - WASHED SAMPLE
T.O. - THIN WALLED OPEN	R.C. - ROCK CORE



- DISTURBED
- FAIR
- GOOD
- LOST

[illegible]

DRILL RIG 541 OPERATION BORE & PENETIN JOB F 57-27 W.P. 55 57 BORING 3 STA. 308 +85 ON 4  
CASING BA (standard samplers to fit unless noted) DATUM GEODINIC DATE REPORT SEPT. 1957  
SAMPLER HAMMER WT. 350 LBS. DROP 40 INCHES COMPILED BY H.S. CHECKED BY M.L. DATE BORING 31 JULY 1957

## SAMPLE TYPES

### SAMPLE CONDITION

V - INSITU VANE SHEAR TEST	Q - TRIAXIAL QUICK	K - PERMIABILITY	C.S. - CHUNK	S.S. - SLEEVE SAMPLE
M - MECHANICAL ANALYSIS	S - TRIAXIAL SLOW	C - CONSOLIDATION	D.O. - DRIVE OPEN	P.S. - PISTON SAMPLE
U - UNCONFINED COMPRESSION	WL - WATER LEVEL IN CASING	CA - CASING	D.F. - DRIVE FOOT VALVE	WS - WASHED SAMPLE
Q <sub>c</sub> - TRIAXIAL CONSOLIDATED QUICK	WT - WATER TABLE IN SOIL	γ - UNIT WEIGHT	T.O. - THIN WALLED OPEN	R.C. - ROCK CORE



- DISTURBED
- FAIR
- GOOD
- LOST

## SAMPLES

ELEVATION DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT PLOT	ELEVATION SCALE	WATER CONTENT W %			PENETRATION TEST RESISTANCE BLOWS PER FOOT AT STANDARD ENERGY ( 4200 IN. LBS. PER BLOW )			CASING BLOW (ACTUAL)	OTHER TESTS	CONDITION	TYPE	NO.	PENETRATION RESISTANCE	ELEV. RECOV. %
					0 - NAT	0 - PW	0 - LW	D. CONE PEN. X	STAND. PEN.								
433.25 433.25		GROUND LEVEL														433.25 433.25	
3.5		GRAVEL - SAND														428.25 430.25	
5.5	424.25 431.25 9.3'															423.25 432.25	
13.5																	
18.5																418.25 420.25	
23.5		DENSE FINE SAND														413.25 423.25	
28.5																408.25 410.25	
33.5																403.25 415.25	
38.5	391.75 401.25 41.5'	END OF BOREHOLE														393.25 400.25	



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH BRANCH - FOUNDATIONS SECTION - DOWNSVIEW  
**OFFICE REPORT ON SOIL EXPLORATION**

DRILL RIG 5- OPERATION PENETRATION JOB F-37-27 W.P. 55-57 BORING 4 STA. 308+34.45 (RT.)  
CASING 3" (standard samplers to fit unless noted) DATUM GIODITIC DATE REPORT SEPT 1957  
SAMPLER HAMMER WT. 25 LBS. DROP 19 INCHES COMPILED BY 4.5 CHECKED BY 4.1 DATE BORING 30 JULY 1957

**ABBREVIATIONS**

V - INSITU VANE SHEAR TEST Q - TRIAXIAL QUICK K - PERMIABILITY  
M - MECHANICAL ANALYSIS S - TRIAXIAL SLOW C - CONSOLIDATION  
U - UNCONFINED COMPRESSION WL - WATER LEVEL IN CASING CA - CASING  
QC - TRIAXIAL CONSOLIDATED QUICK WT - WATER TABLE IN SOIL  $\gamma$  - UNIT WEIGHT

**SAMPLE TYPES**

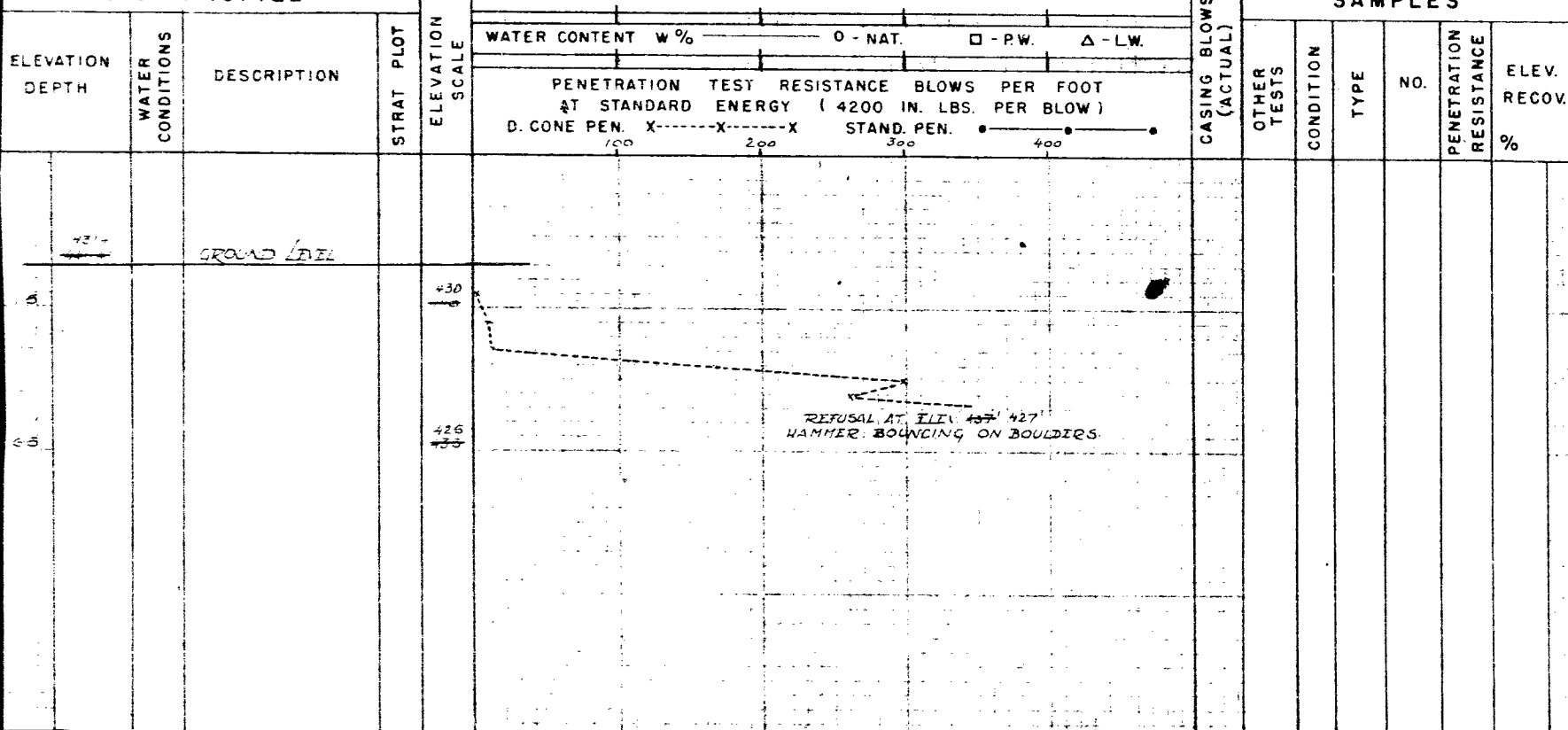
C.S. - CHUNK S.S. - SLEEVE SAMPLE  
D.O. - DRIVE OPEN P.S. - PISTON SAMPLE  
D.F. - DRIVE FOOT VALVE W.S. - WASHED SAMPLE  
T.O. - THIN WALLED OPEN R.C. - ROCK CORE

**SAMPLE CONDITION**



- DISTURBED  
- FAIR  
- GOOD  
- LOST

**SOIL PROFILE**



DEPARTMENT OF HIGHWAYS - ONTARIO  
 MATERIALS & RESEARCH BRANCH - FOUNDATIONS SECTION - DOWNSVIEW  
**OFFICE REPORT ON SOIL EXPLORATION**

DRILL RIG 54-1 OPERATION PENETRATION JOB F-57-27 W.P. 53-57 BORING 5 STA. 307+00 (51' BT.)  
 CASING BX (standard samplers to fit unless noted) DATUM GEODETIC DATE REPORT SEPT. 1957  
 SAMPLER HAMMER WT. 250 LBS. DROP 19 INCHES COMPILED BY H.S. CHECKED BY A.I. DATE BORING 29 JULY 1957

## ABBREVIATIONS

V - INSITU VANE SHEAR TEST Q - TRIAXIAL QUICK K - PERMIABILITY  
 M - MECHANICAL ANALYSIS S - TRIAXIAL SLOW C - CONSOLIDATION  
 U - UNCONFINED COMPRESSION WL - WATER LEVEL IN CASING CA - CASING  
 QC - TRIAXIAL CONSOLIDATED QUICK WT - WATER TABLE IN SOIL γ - UNIT WEIGHT

## SAMPLE TYPES

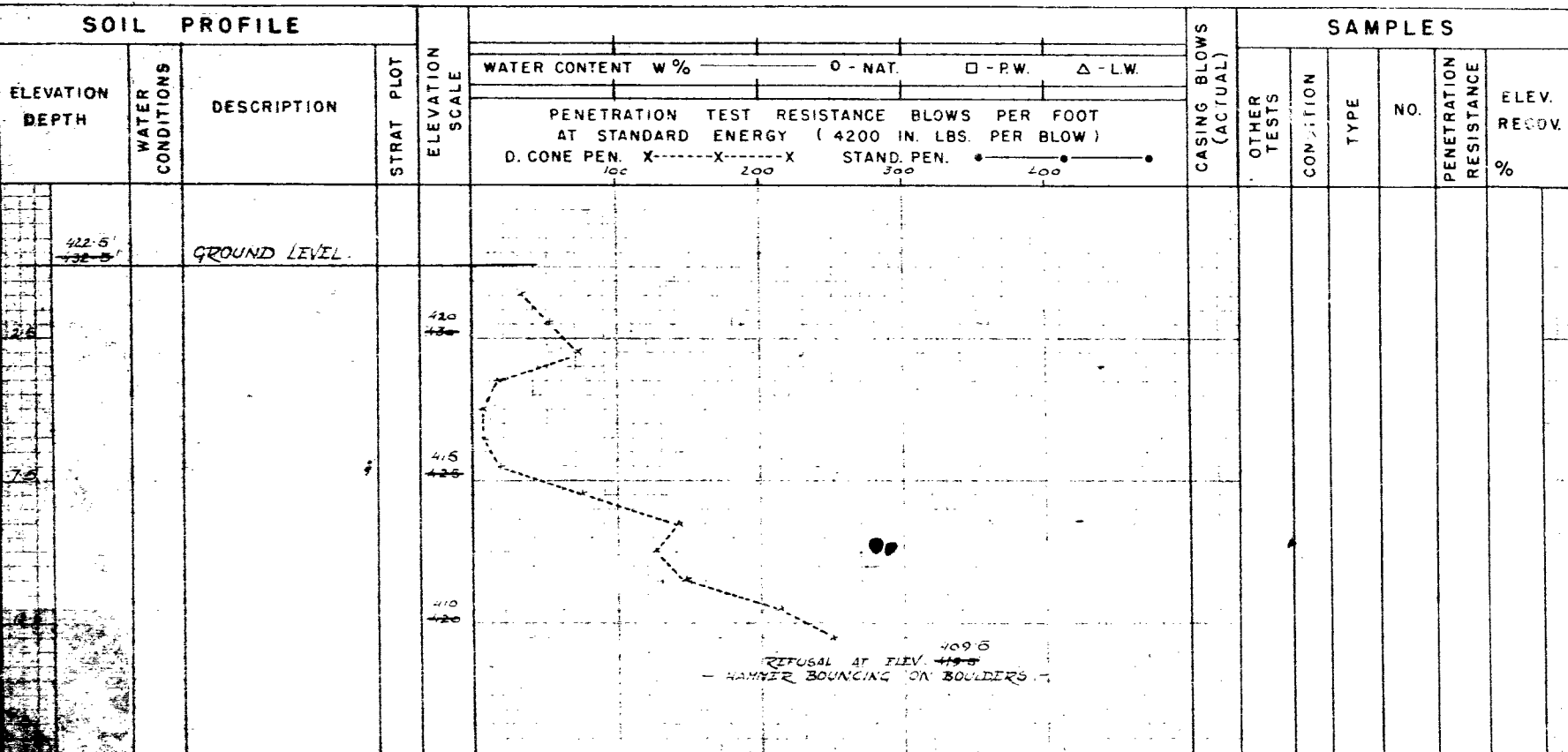
C.S. - CHUNK SS - SLEEVE SAMPLE  
 D.O. - DRIVE OPEN PS - PISTON SAMPLE  
 D.F. - DRIVE FOOT VALVE WS - WASHED SAMPLE  
 T.O. - THIN WALLED OPEN R.C. - ROCK CORE

## SAMPLE CONDITION



- DISTURBED  
 - FAIR  
 - GOOD  
 - LOST

## SOIL PROFILE



DEPARTMENT OF HIGHWAYS - ONTARIO  
MATERIALS & RESEARCH BRANCH - FOUNDATIONS SECTION - DOWNSVIEW  
OFFICE REPORT ON SOIL EXPLORATION

DRILL NO. 54-1 OPERATION PENETRATION  
CASING BK (standard samplers to fit unless noted)  
SAMPLER HAMMER WT. 350 LBS. DROP 19 INCHES

JOB F-57-27 W.P. 55-57  
 DATUM GEODETIC  
 COMPILED BY H.S. CHECKED BY A.L.

BORING 10 STA. 308+00 (44' LT.)  
DATE REPORT SEPT. 1957  
DATE BORING 14 AUG. 1957

## ABBREVIATIONS

V - INSITU VANE SHEAR TEST      Q - TRIAXIAL QUICK      K - PERMIABILITY  
 M - MECHANICAL ANALYSIS      S - TRIAXIAL SLOW      C - CONSOLIDATION  
 U - UNCONFINED COMPRESSION      WL - WATER LEVEL IN CASING      CA - CASING  
 QC - TRIAXIAL CONSOLIDATED QUICK      WT - WATER TABLE IN SOIL       $\gamma$  - UNIT WEIGHT

## SAMPLE TYPES

C.S. - CHUNK	S.S. - SLEEVE SAMPLE
D.O. - DRIVE OPEN	P.S. - PISTON SAMPLE
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T.O. - THIN WALLED OPEN	R.C. - ROCK CORE

**SAMPLE CONDITION**



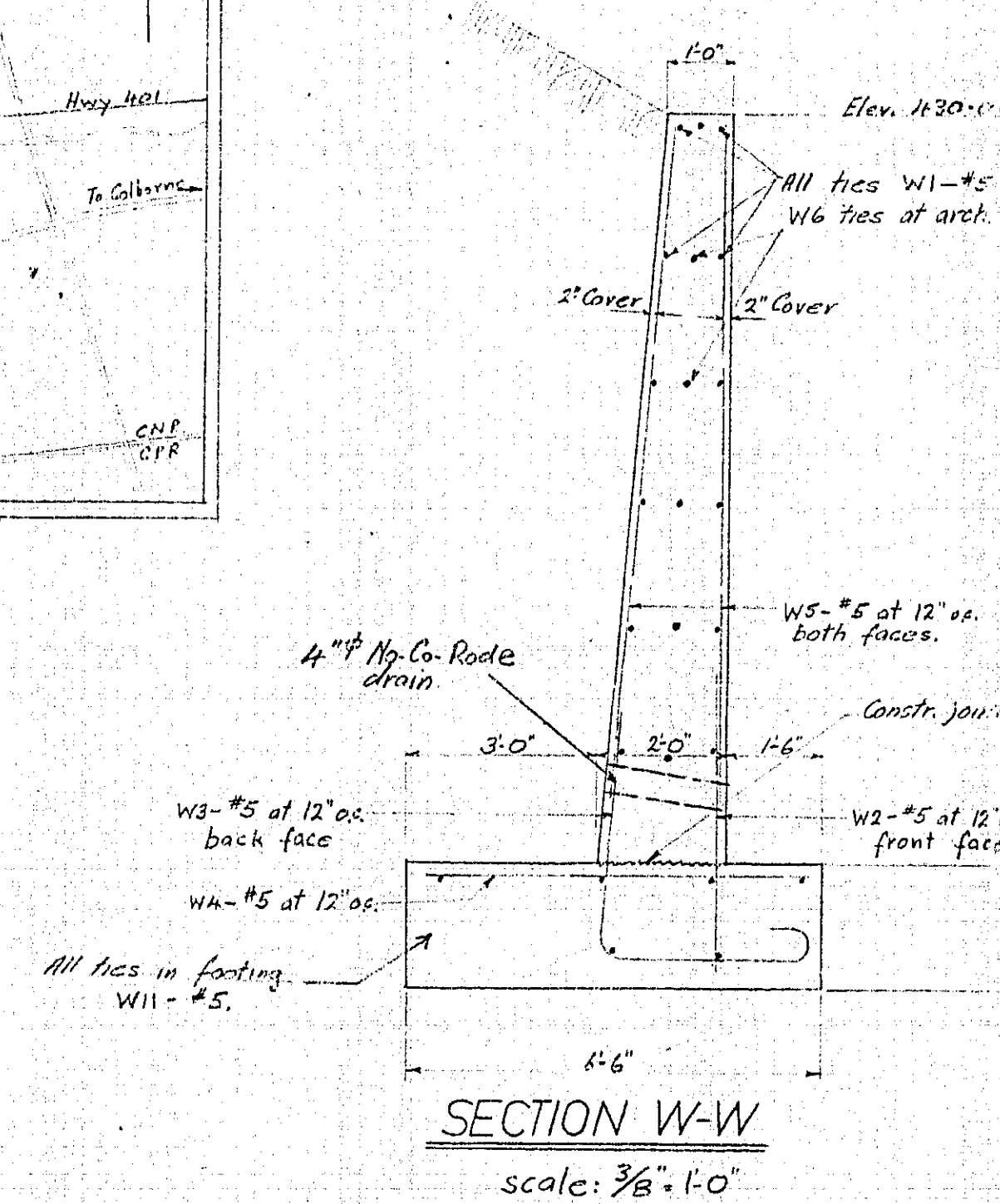
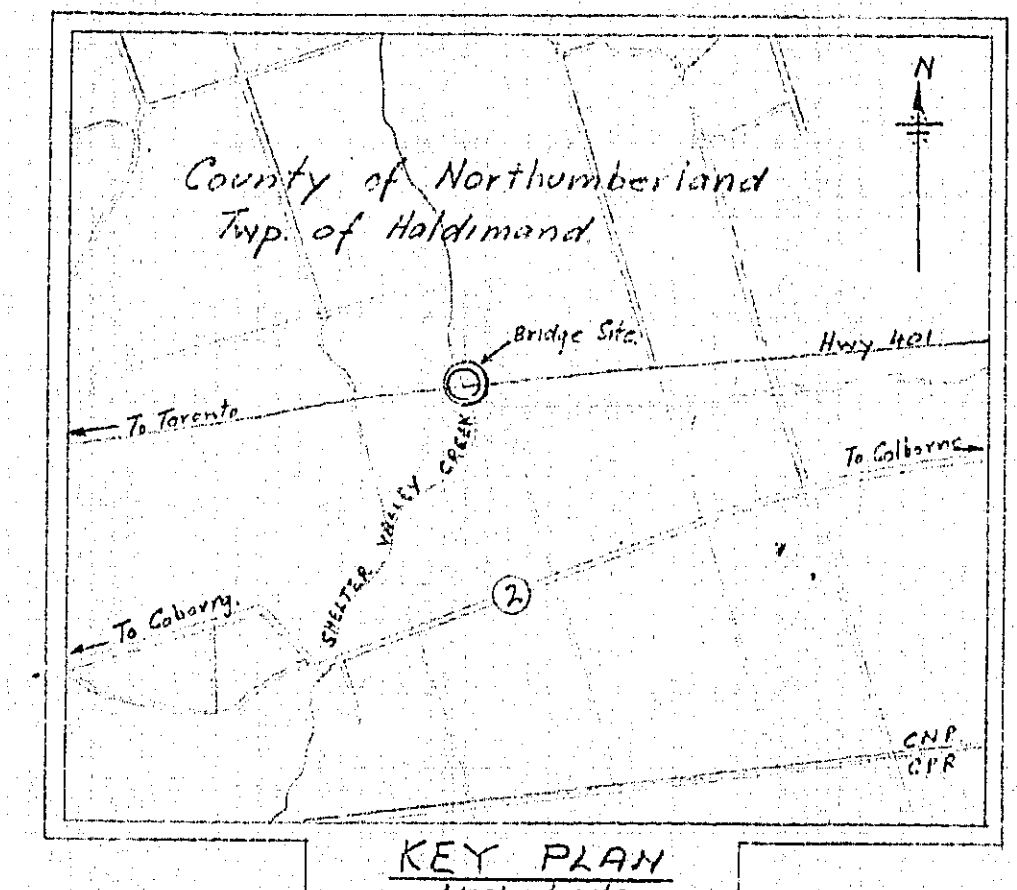
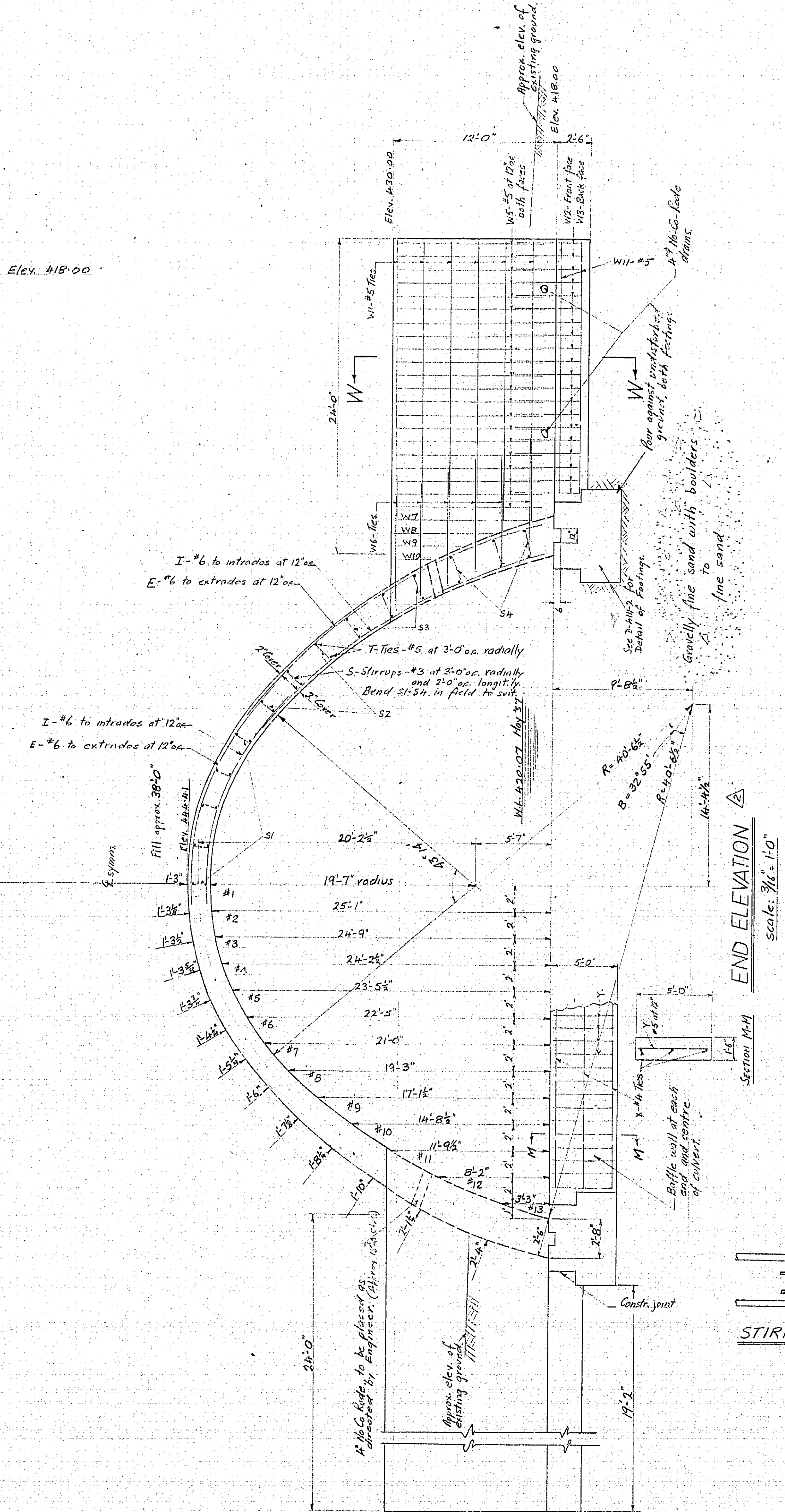
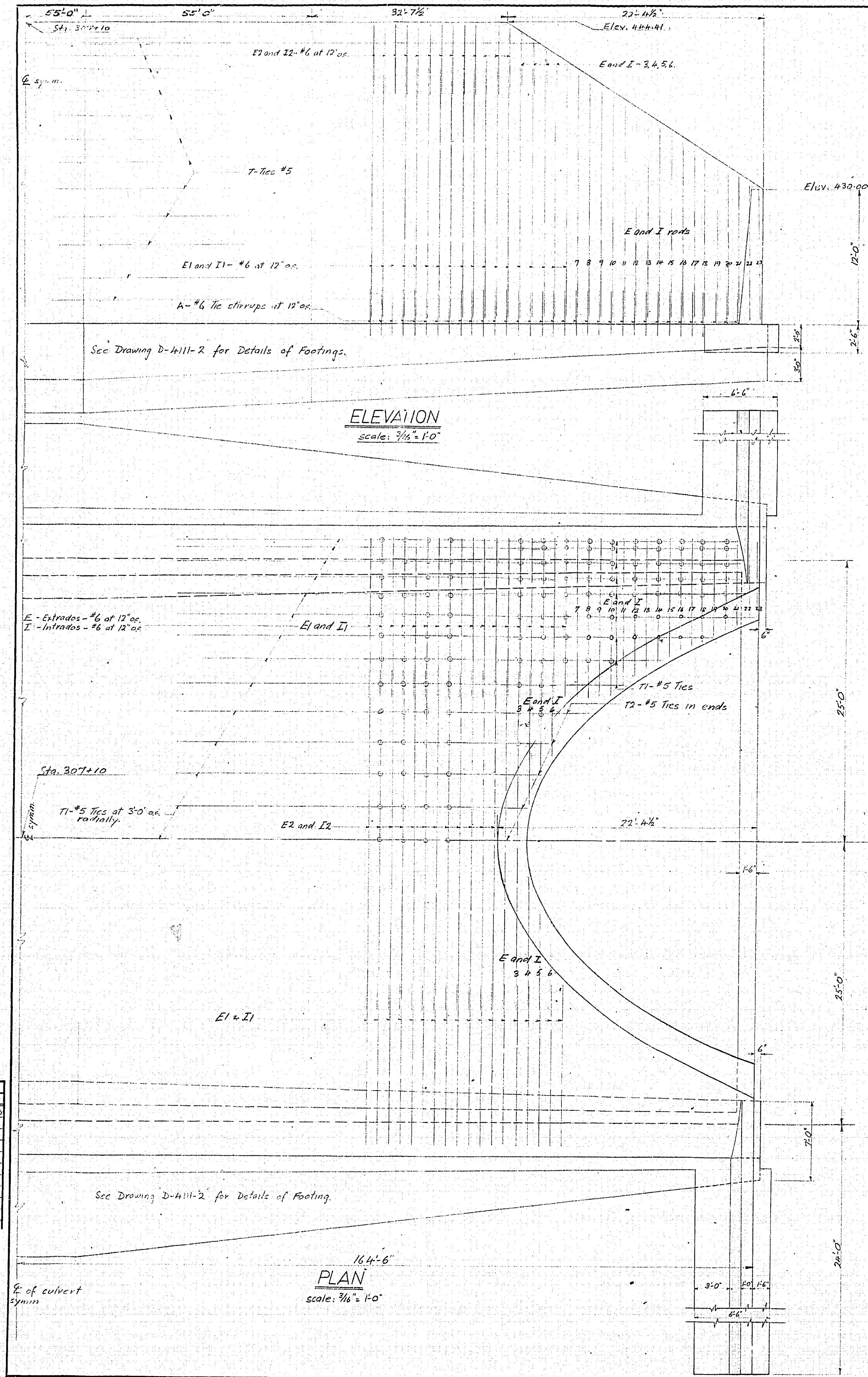
- DISTURBED
- FAIR
- GOOD
- LOST

## SOIL PROFILE

SOIL PROFILE						SAMPLES						
ELEVATION DEPTH	WATER CONDITIONS	DESCRIPTION	STRAT PLOT	ELEVATION SCALE	WATER CONTENT W% ———— PENETRATION TEST RESISTANCE BLOWS PER FOOT AT STANDARD ENERGY ( 4200 IN. LBS. PER BLOW ) D. CONE PEN. X-----X-----X STAND. PEN. ●————●————●	CASING BLOWS (ACTUAL)	OTHER TESTS	CONDITION	TYPE	NO.	PENETRATION RESISTANCE	ELEV. RECOV. %
		GROUND LEVEL		432.6								
25				430								
75				426	REFUSAL AT ELEV. 437.1 HAMMER BOUNCING ON BOULDERS							



PRINT RECORD		
NO.	FOR	DATE
9	F.S.D.	8-5-58
11	F.S.D.	2-6-59
30	TRACED	8-10-58
32	REVISED	4-23-59



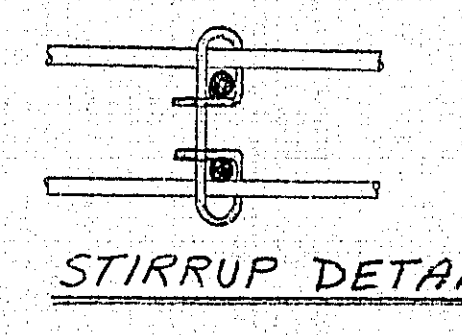
**NOTE TO DISTRICT ENGINEER.**  
Concrete work on this structure must not be commenced until monuments to fix control points have been erected and checked by the District Engineer.

**NOTE TO CONTRACTOR.**  
Structure to be built in accordance with Form No. 2, revised March 1957 and the Special Provisions, extra copies of which may be obtained from the District Engineer. All construction joints must be approved by the Bridge Engineer. Particular attention is to be given to the expansion joints, see D-4111-2.

**CONCRETE MIX.**  
All concrete in footings to be 2500 p.s.i. at 28 days. Arch and wing wall concrete to be 3000 p.s.i. at 28 days. Maximum size of aggregate to be 3/4".

**BORING DATA.**  
The complete soil report BA 673 may be examined at the D.H.O. Bridge Design Office, 380 Davenport Road, Toronto. The Dept. does not guarantee the accuracy of this report or the abridged version shown on these plans.

**REINFORCING STEEL.**  
Clear cover in footings to be 3" and is noted. Clear cover elsewhere to be 2". All exposed edges of concrete to be chamfered 1".



WP 55-57

DEPARTMENT OF HIGHWAYS, ONTARIO  
BRIDGE OFFICE - TORONTO

SHELTER VALLEY CREEK  
HALDIMAND TWP. BRIDGE NO. 14

THE KING'S HIGHWAY NO. 401 DIST. NO. 7  
CO. Northumberland Sta. 307+10  
TWP. Haldimand LOT CON.

GENERAL PLAN

APPROVED *Paul L. ...* DESIGN ENGINEER

BRIDGE ENGINEER

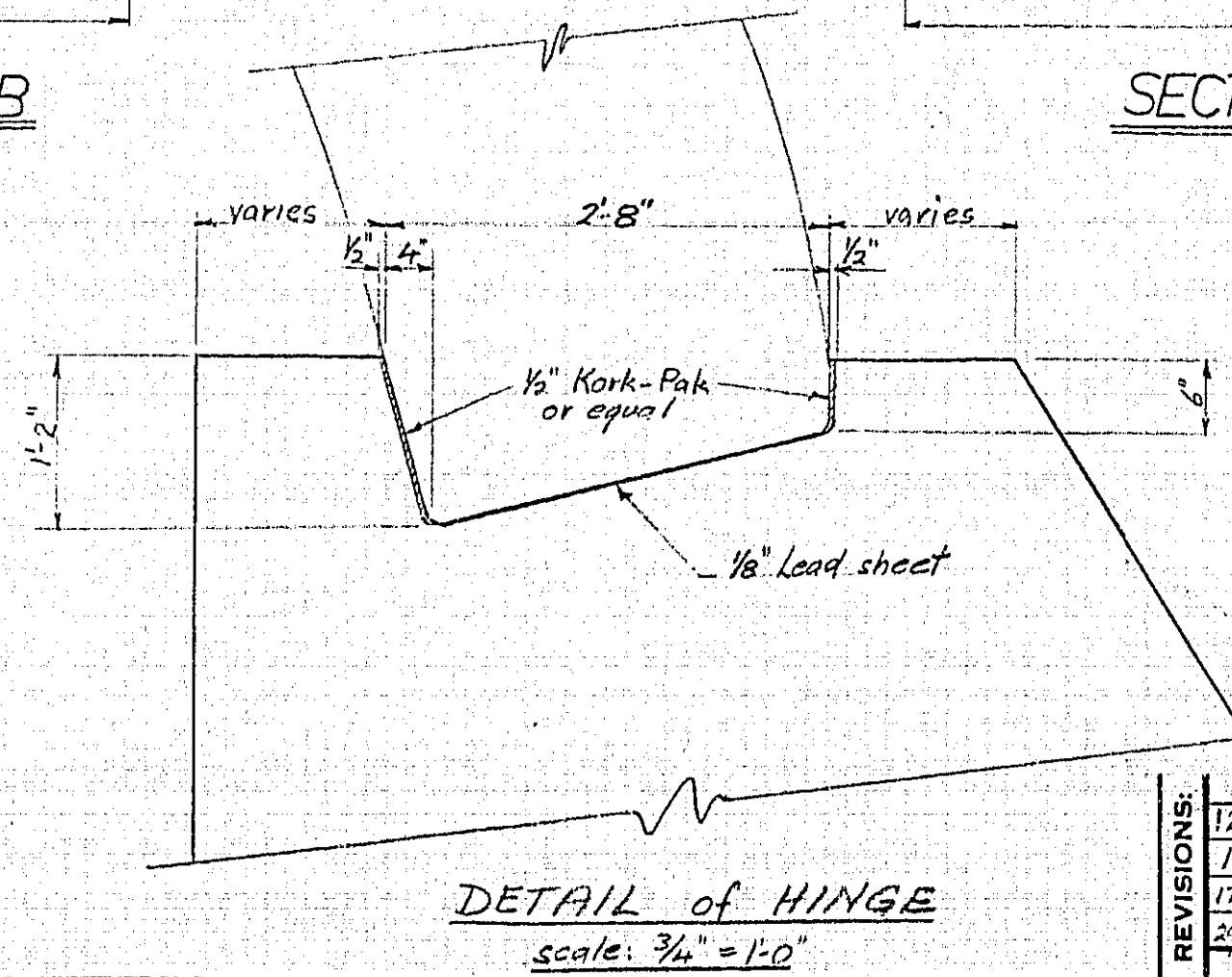
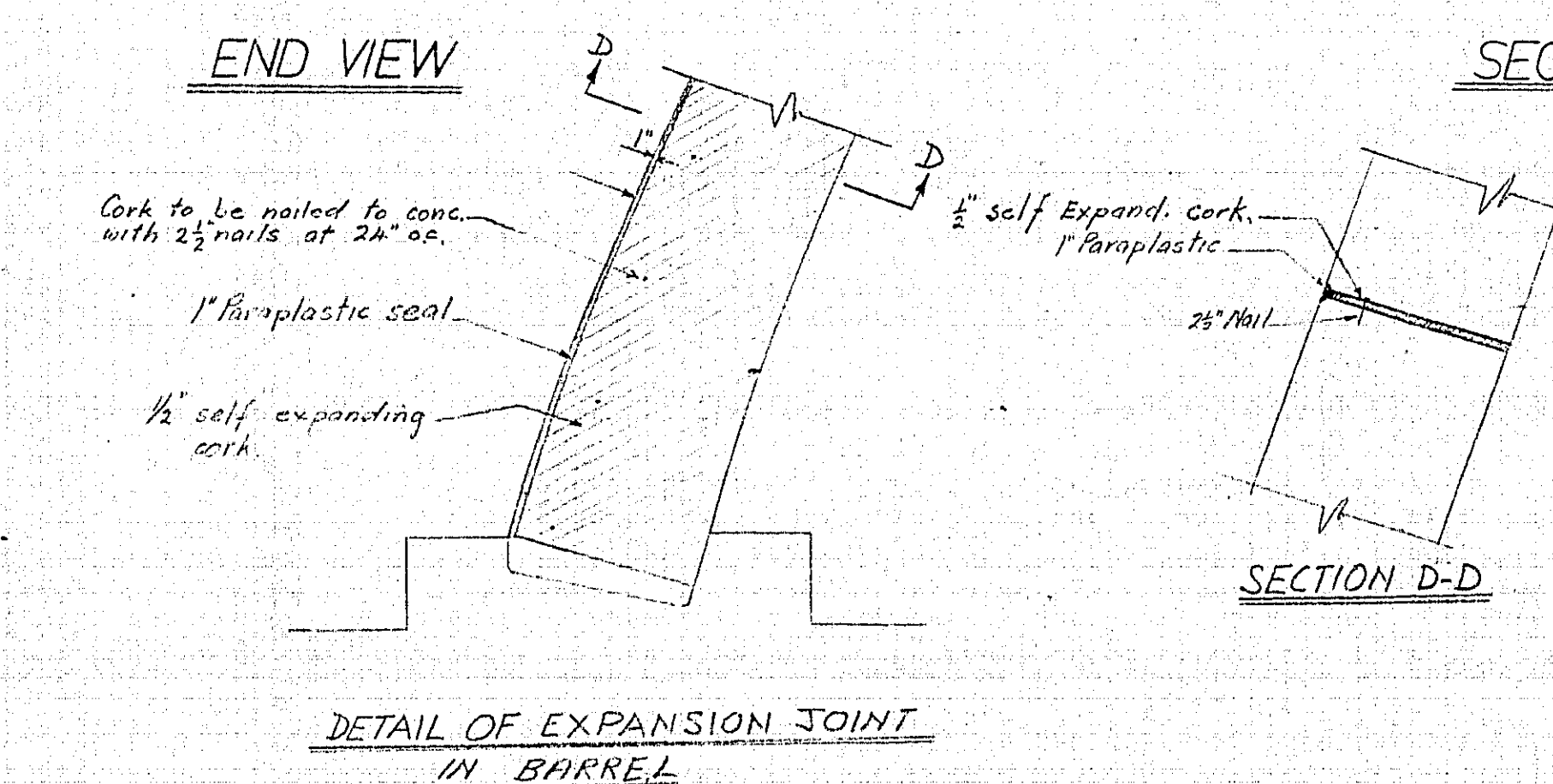
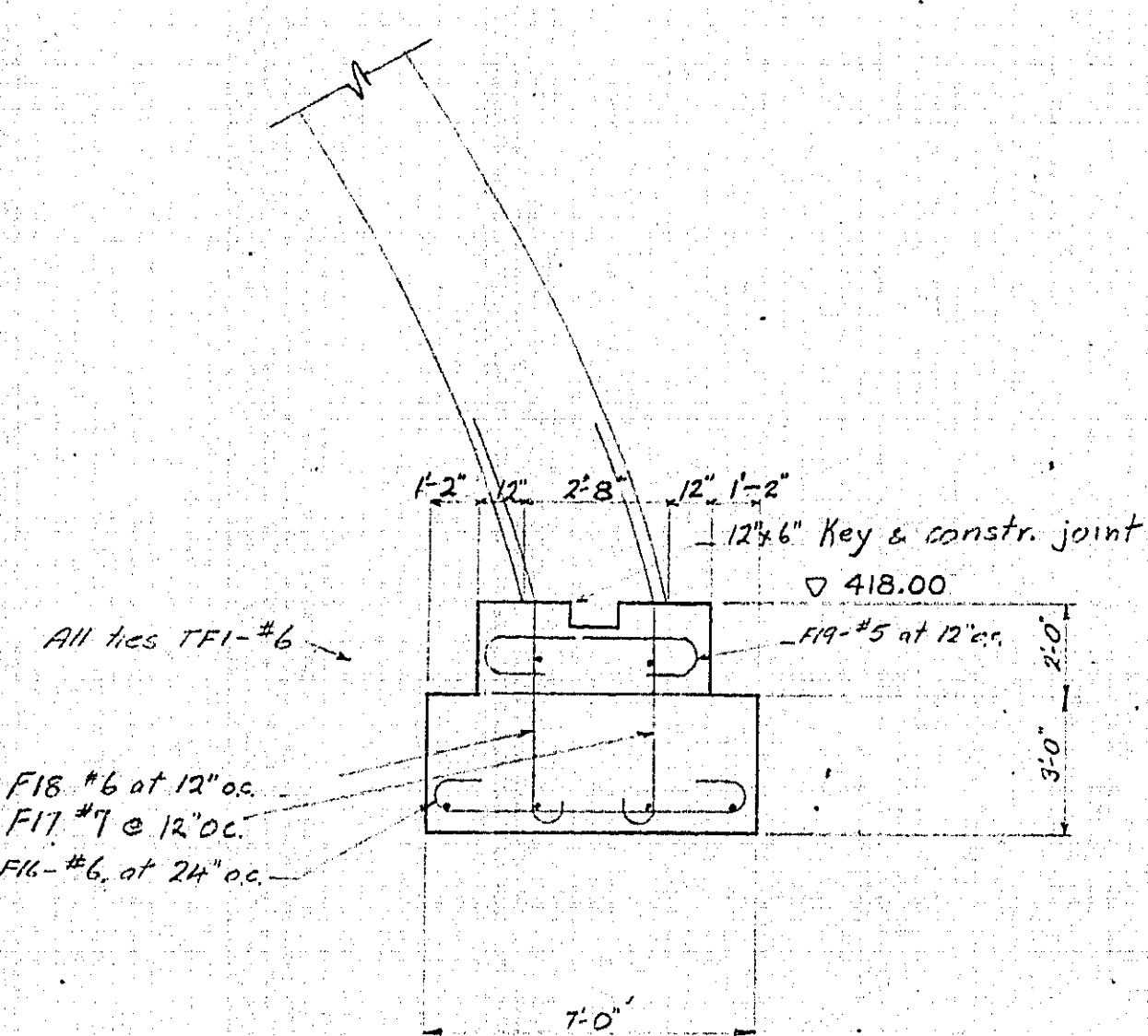
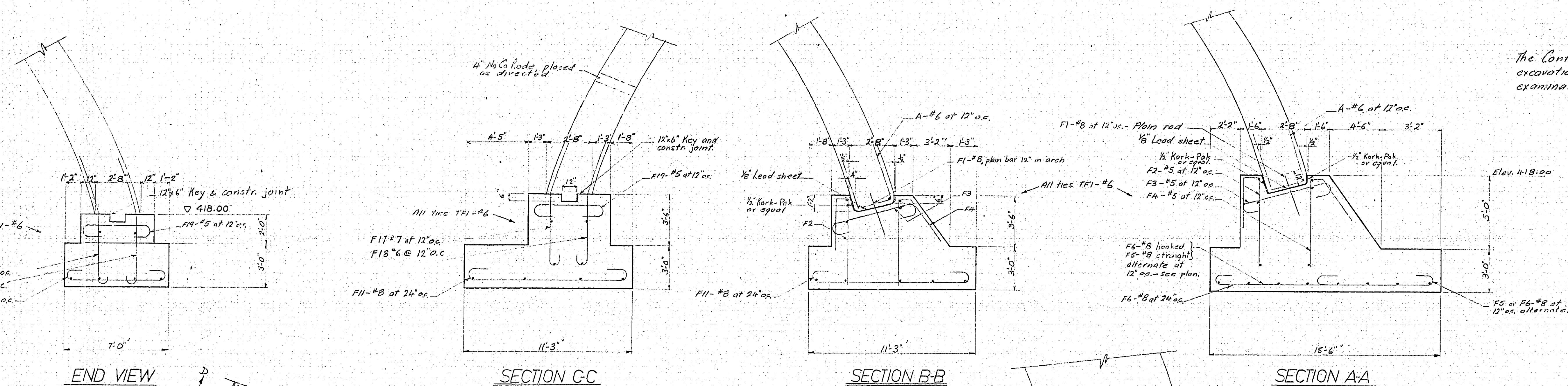
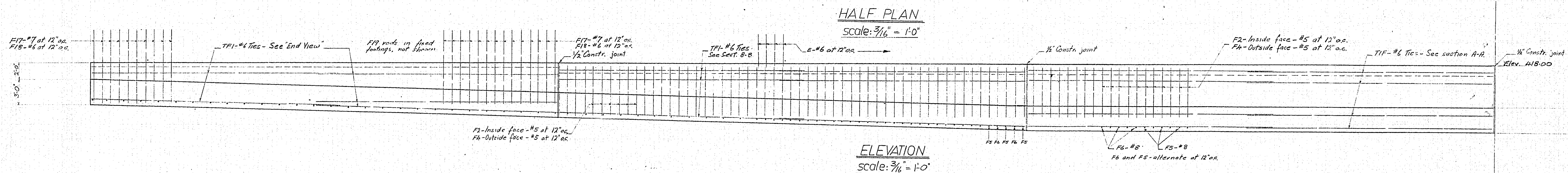
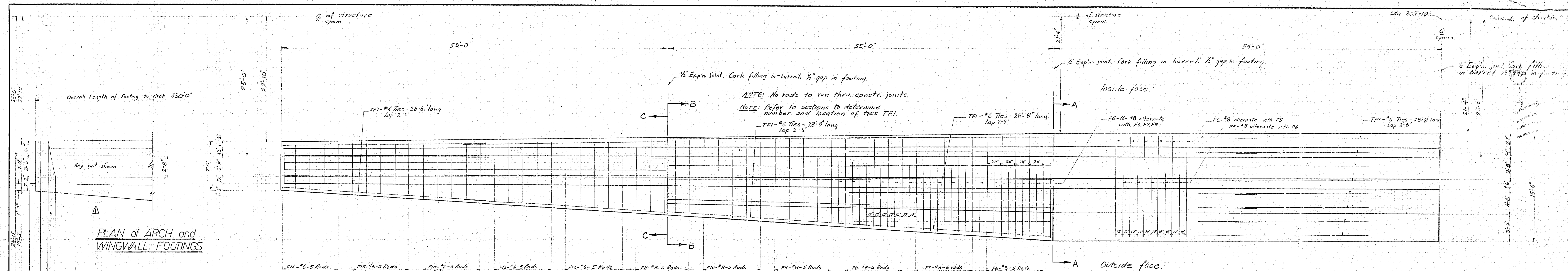
DESIGN ENGINEER

DESIGN: H.D. 100% CHECK: W.T.H. CONTRACT NUMBER: 5-3-291  
DRAWING: H.S. CHECK: J.G.H. LOADING: 5-3-291  
TRACING: - CHECK: - DRAWING NUMBER: D-4111-1  
DATE: MAY 1958 H20-516

REVISIONS	DATE	BY	DESCRIPTION
12-7-63	J.G.G.		ADDITIONAL INFORMATION TO END ELEVATION.
2-6-68	H.S.		Design Revision (REV. NO. OF CORR.)

TWP# 9-272-1-A 1 to 4





The Contractor to notify the Design Engineer of this structure when excavation of footings is to be completed, in order that an examination may be made before any concrete is poured.

[illegible]

7-2-58

DEPARTMENT OF HIGHWAYS: ONTARIO  
BRIDGE OFFICE: TORONTO

SHELTER VALLEY CREEK  
HALDIMAND TWP. BRIDGE NO. 14.

THE KING'S HIGHWAY No. 401 DIST. No. 7  
Co. Northumberland Sta. 307+10  
TWP. Haldimand LOT          CON.         

FOOTING DETAILS

APPROVED Am L.  
BRIDGE ENGINEER

DESIGN <u>SLB</u>	CHECK <u>SLB</u>	CONTRACT NUMBERS
DRAWING <u>148</u>	CHECK <u>SLB</u>	
TRACING	LOADING	
DATE <u>MAY 1958</u>	<u>401</u>	

Twp# 9-25-2-1-A



25.1.1

MARK	NO. BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	O	R	SHAPE	LOCATION
E2	290	#6	33'-8"	9			30'-5"					6'-4"					21'-1 1/2"	Extrados of arch at 12' o.c.
E3	4		10'-10"				10'-8 1/2"					8"						ditto
E4	4		8'-9"				8'-5"					5 1/2"						ditto
E5	4		6'-6"				6'-8 1/2"					3 1/2"						ditto
E6	4	#6	5'-0"	9			4'-11 1/2"					2"					21'-1 1/2"	ditto
I2	290	#6	32'-4"	9			28'-10"					6'-3"					19'-9 1/2"	Intrados of arch at 12' o.c.
I3	4		32'-4"				28'-10"					5"						ditto
I4	4		8'-3"				8'-2"					3"						ditto
I5	4		6'-0"				5'-11 1/2"					1 1/2"						ditto
I6	4	#6	4'-6"	9			4'-5 1/2"					1 1/2"					19'-9 1/2"	ditto
E1	600	#6	26'-3"	9			25'-9"					1'-10"					42'-6"	Extrados of arch at 12' o.c.
E7	4		26'-0"				25'-6 1/2"					1'-11 1/2"						ditto
E8	4		25'-6"				25'-0 1/2"					1'-10 1/2"						ditto
E9	4		24'-1"				23'-8 1/2"					1'-8 1/2"						ditto
E10	4		23'-3"				22'-10 1/2"					1'-7"						ditto
E11	4		22'-1"				21'-9"					1'-5"						ditto
E12	4		21'-5"				21'-1 1/2"					1'-4"						ditto
E13	4		20'-4"				20'-0 1/2"					1'-2 1/2"						ditto
E14	4		19'-9"				19'-5"					1'-1 1/2"						ditto
E15	4		18'-8"				18'-5 1/2"					1'-0 1/2"						ditto
E16	4		17'-10"				17'-7 1/2"					11"						ditto
E17	4		16'-11"				16'-8 1/2"					10 1/2"						ditto
E18	4		16'-2"				16'-0"					9 1/2"						ditto
E19	4		15'-3"				15'-1 1/2"					8 1/2"						ditto
E20	4		14'-6"				14'-4 1/2"					7 1/2"						ditto
E21	4		13'-10"				13'-9"					6 3/4"						ditto
E22	4		13'-0"				12'-11"					6"						ditto
E23	4	#6	12'-6"	9			12'-5"					5 1/2"					42'-6"	Intrados of arch at 12' o.c.
I1	600	#6	24'-9"	9			24'-5"					1'-10"					40'-9"	Intrados of arch at 12' o.c.
I7	4		26'-6"				25'-11 1/2"					2'-2"						ditto
I8	4		26'-0"				25'-6"					2'-1"						ditto
I9	4		24'-9"				24'-3 1/2"					1'-10 1/2"						ditto
I10	4		23'-9"				23'-4 1/2"					1'-8 1/2"						ditto
I11	4		22'-9"				22'-5 1/2"					1'-7"						ditto
I12	4		22'-0"				21'-8 1/2"					1'-5 1/2"						ditto
I13	4		21'-0"				20'-8 1/2"					1'-4 1/2"						ditto
I14	4		20'-3"				20'-0"					1'-3 1/2"						ditto
I15	4		19'-3"				19'-0 1/2"					1'-1 1/2"						ditto
I16	4		18'-6"				18'-3 1/2"					1'-0 1/2"						ditto
I17	4		17'-6"				17'-3 1/2"					11 1/2"						ditto
I18	4		16'-9"				16'-7"					10 1/2"						ditto
I19	4		15'-9"				15'-7 1/2"					9 1/2"						ditto
I20	4		15'-0"				14'-10 1/2"					8 1/2"						ditto
I21	4		14'-6"				14'-4 1/2"					8"						ditto
I22	4		14'-0"				13'-10 1/2"					7 1/2"						ditto
I23	4	#6	13'-6"	9			13'-5"					6 3/4"					40'-9"	ditto
X	18	#4	23'-6"	Str.													Lap 1'-6" Min.	Ties in buffer wall, lap 1'-6" in buffer wall at 12' o.c.
Y	135	#5	4'-6"	Str.														
A	444	#6	10'-2"	4	4'-0"	2'-2"						4'-0"						Bottom of arch at footing at 12' o.c.

MARK	NO. BARS	SIZE	LENGTH	TYPE	A	B	C	D	E	F	G	H	J	K	O	R	SHAPE	LOCATION
T1	262	#6	28'-8"	Str.														Ties in footing lap 2'-0"
F1	444	#5	3'-0"	Str.														In hinge at footing at 12' o.c. as shown
F2	444	#5	10'-3"	5	3'-6"	9"	6'-0"											In footing at 12' o.c. as shown
F3	444	#5	6'-6"	1	7'	5'-4"												ditto (hooked)
F4	444	#5	10'-6"	6	6'-0"	1'-0"	3'-6"											ditto
F5	176	#8	9'-0"	1	1'-1"	6'-10"												In bottom of footing all with P.E. at 12' o.c.
F6	132	#8	16'-8"	1	1'-1"	14'-6"												In bottom of footing all with P.E. at 12' o.c.
F7	20	#8	15'-8"	1	1'-1"	13'-6"												In bottom of footing all with P.E. at 12' o.c.
F8	20	#8	14'-8"	1	1'-1"	12'-6"												In bottom of footing all with P.E. at 12' o.c.
F9	20	#8	14'-0"	1	1'-1"	11'-10"												In bottom of footing all with P.E. at 12' o.c.
F10	20	#8	13'-2"	1	1'-1"	11'-0"												In bottom of footing all with P.E. at 12' o.c.
F11	20	#8	12'-5"	1	1'-1"	10'-3"												ditto
F12	20	#6	10'-10"	1	8"	9'-6"												ditto
F13	20	#6	10'-1"	1	8"	8'-9"												ditto
F14	20	#6	9'-4"	1	8"	8'-0"												ditto
F15	20	#6	8'-7"	1	8"	7'-3"												ditto
F16	20	#6	7'-10"	1	8"	6'-6"												ditto
F17	220	#7	9'-4"	11	4'-0"	4'-6"												In footing & arch extrados at 12' o.c.
F18	220	#6	9'-2"	12	4'-0"	4'-6"												In footing & arch intrados at 12' o.c.
F19	220	#5	6'-2"	1	7"	5'-0"												In footing at 12' o.c.
W1	48	#5	21'-0"	Str.														Ties in wing-wall as shown
W2	80		4'-9"	Str.														In wing-wall at 12' o.c. front face
W3	80		8'-4 1/2"	14	4'-3"	2'-9"	9 1/2"											In wing-wall at 12' o.c. back face
W4	80		6'-0"	Str.														In wing-wall at 12' o.c.
W5	168	#5	11'-6"	Str.														In wing wall of 12' o.c. front & back faces
W6	24	#6	9'-0"	2	6"	8'-6"												Ties in wing wall as shown
W7	8	#5	10'-3"	Str.														In wing-wall near arch, as shown
W8	8		7'-4"	Str.														ditto
W9	8		5'-0"	Str.														ditto
W10	8	#5	2'-9"	Str.														ditto
W11	24	#5	19'-3"	Str.														6 IN EACH FTNG. AS SHOWN
T1	960	#5	19'-8"	Str.														Ties in barrel as shown
T2	40	#5	12'-0"	Str.														Ties in ends lap to suit with T1, minimum 2'-0"

ALL STEEL PLACED IN ARCH.  
ALEX. M. CRAE

1. All dimensions are cut to out of bar.

2. "J" dimension on 180° hooks to be shown only where necessary to restrict hook size, otherwise standard hooks to be used.

3. Where "J" is not shown, "J" will be kept equal to or less than "H", where "J" is shown, "H" should be shown.

4. "K" dimension on stirrups to be shown where necessary to restrict hooks.

5. Where bars are to be bent more accurately than standard bending tolerances, bending dimensions which require close working should have limits indicated.

6. Figures in circles show types.

ENLARGED VIEW SHOWING BAR BENDING DETAILS

11. 12. 13. 14.

ALL BARS TO BE DETAILED AS PER A.C.I. SPECIFICATIONS

ALL STEEL TO BE HARD GRADE & HIGH BOND EXCEPT AS NOTED

WP 55-57

DEPARTMENT OF HIGHWAYS - ONTARIO

BRIDGE - OFFICE - TORONTO

SHELTER VALLEY CREEK

HALDIMAND TWP. BR. NO. 14

THE KING HWY. NO. 221 DIV. NO. 12

CO. Northumberland Sta. 307+10

TWP. Haldimand LOT CON.

REINFORCING STEEL SCHEDULE

WEIGHT OF STEEL 163.456 LBS

CONTRACT NUMBER R 35127

DRAWING NUMBER D-4111-3

DATE MAY 1958

TWP # 9-272-3-A









Appendix B  
Site Photographs





North End of Shelter Valley Creek Culvert



South End of Shelter Valley Creek Culvert





South End of Shelter Valley Creek Culvert showing Hwy 401 Embankment



Interior of Shelter Valley Creek Culvert