(RMH'D LAB DWG)

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

From: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

Attention: Mr. S. McCombie

Date: November 5, 1969

Our File Ref.

In reply to: NOV. 12, 1969

Subject:

FOUNDATION INVESTIGATION REPORT
For
Proposed Chester Creek Crossing
Hwy. 65 - New Liskeard Westerly
District No. 14 (New Liskeard)

W.J. 69-F-39 -- W.P. 39-67-02

Attached, please find our detailed foundation investigation report on the subsoil conditions existing at the above structure site.

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

AGS/MdeF
Attach.
cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Farren
W. McArthur
D. A. O. White
J. C. McAllister
E. P. Saint
B. A. Singh
Foundations Files
Gen. Files

TABLE OF CONTENTS

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District No. 14 (New Liskeard)
W.J. 69-F-39 -- W.P. 39-67-02

1. INTRODUCTION:

A request for a foundation investigation at the site of the proposed new crossing of Chester Creek and Hwy. 65, was contained in a memo from E.R.Saint dated June 4th.1969. Investigations on four possible lines designated "A","B","E", and "D" were requested to include the approaches to the structure as well as the structure foundations. At this stage information is required for functional planning purposes only in order to assist in selecting the most suitable time for the new revision of Hwy. 65, New Liskeard westerly.

A foundation investigation was carried out by this section to determine subsoil conditions at the abovementioned site. It is believed that sufficient information has been obtained for future design purposes as well as for functional planning purposes unless major changes are made in the proposed alignment. This report therefore contains specific recommendations relating to the foundations for the new bridge and to the slopes of the earth cuts and fills on the approaches.

2. DESCRIPTION OF SITE

The site is located some 2 miles northwest of the junction of Hwy.11 and Hwy.65. At this location Hwy.65 crosses Chester Creek on a 3 span bridge of total length 152.5 ft. The structure consists of a concrete deck on steel beams with a suspended centre portion of the mid-span. The abutments and piers are founded on timber pile bents. The condition of the bridge is generally poor the piles being split and decayed, the concrete deck being badly cracked, and the expansion joints being closed up tight. Chester Creek flows in a general south to north direction, the width at normal water level being about 30 ft. and the depth at the centre about 4 ft. The creek follows a somewhat meandering course through a valley some 40 to 50 ft. deep and about 400 ft. wide at the top. The average overall slope of the valley sides is approximately 4 horizontal to 1 vertical though a substantial number of partial slopes are about 3 horizontal to 1 vertical. A number of slope failures have occurred in the past and more recently a fairly large failure some hundred feet in width has occurred on the west side of the valley in the vicinity of the Line 'B'. Lines 'A','B', and 'E' are all within 500 ft. upstream of the existing bridge while line 'D' is about 1,500 ft. upstream.

Physiographically the site is located on the New Liskeard clay plain. Here the subsoil consists of deep deposits of varved clay overlying glacial till and limestone bedrock.

3. FIELDWORK:

Eight sampled boreholes and eight dynamic core penetration tests were carried out during the course of the fieldwork. The borings were concentrated in the area crossed by lines 'A', 'B', and 'E' only. Line 'D' was subjected to a visual inspection. Drilling was carried out using a continuous flight auger and a conventional diamond drill, adapted for soil sampling purposes. "Undisturbed" samples were recovered in 2 inch I.D. shelby tubes which were pushed manually into the soil. "Disturbed" samples were recovered in 2 inch O.D. split spoon samplers which were hammered into the soil utilising a free falling hammer with an energy of 350 ft.lbs. per blow. Dynamic cone penetration tests were performed using the same driving energy. Field Vane tests were performed in cohesive soils where possible at elevations 12 inches below the various sample depths. All samples were visually examined in the field upon recovery from the boreholes. Observations were made of ground water levels and seepage zones during and after drilling operations. The borings were surveyed in the field by personnel from New Liskeard District Construction Section. The locations and elevations of the borings are shown on Drawing 69-F-39-A which is contained in the appendix of this report.

4. LABORATORY TESTING:

All samples were carefully inspected in the laboratory, prior to testing and classified according to soil type. Tests were carried out on selected representative samples to determine the following physical properties, mainly as an aid to classification:-

Atterberg Limits

Moisture Content

Grain-Size Distribution

4. LABORATORY TESTING: (cont'd.) ...

The results of these tests are plotted on the Record of Borehole Sheets.

A number of unconfined compression tests and undrained triaxial compression tests were carried out on a selection of "undisturbed" samples to determine the undrained shear strength of the cohesive layers. Fig. 1 of the Appendix shows the results of these tests in the form of a plot of elevation versus undrained shear strength.

Five consolidation tests were carried out on undisturbed samples in order to obtain the parameters necessary for calculating settlements under the future fills and for obtaining information relating to the preconsolidation pressurers prevailing in the subsoil. The test results are plotted on Figures 2 and 3 contained in the Appendix. Four consolidated undrained triaxial compression stage tests were carried out on "undisturbed" samples from the cohesive layers to determine the effective stress parameters. C' and Ø'. The results of these tests are plotted on Figs.4 to 7 of the Appendix.

5. SOIL TYPES AND SOIL CONDITIONS:

Generally uniform subsoil conditions were found to prevail over the site areas of approximately equal ground surface elevation. In fact generally uniform subsoil conditions prevail at corresponding elevations everywhere except for the surficial alluvial layers in the valley floor and river bed. These surficial layers consist of deposits of sand and gravel with traces of silt and clay. Elsewhere the subsoil consists of a deep deposit of varved clay extending to a depth of at least 113 ft. below the river bed.

..... 5

5. <u>SOIL TYPES AND SOIL CONDITIONS</u>: (cont'd.) ...

The boundaries between the soil types encountered in the boreholes are shown on the attached Record of Borehole sheets. The estimated stratigraphical profiles of Draining #69-F-39-A are based upon this information. From ground level downward the various soil types are described in some detail as follows:-

<u>Alluvial Deposits</u>:

These deposits were found in the valley floor immediately below the topsoil, in areas where the ground surface is at or below approximate elevation 593.0. The lower boundary of the layer is approximately about 2 ft. below the river bed at its maxiumum depth. The average thickness of the layer is about 4 ft. The material consists of sand and gravel with traces of clay and silt and has probably been transported by the river from the outcropping glacial till stratum some distance to the south. The relative density may be classified as loose.

<u>Varved Clay</u>:

This is the predominant subsoil deposit at the site. It extends from the ground surface or from below the alluvial deposits to at least a depth of 113 ft. below the river bed. The material consists of layers of clay, silty clay and clayey silt in random order of occurence, and the thickness of the various layers, which are visible to the naked eye, ranges from about 1/8 inch to about 3 inches. In the upper portion of the deposit the material is dessicated through oxidation as evidenced by the brownish colour. Elsewhere the colour of the deposit is grey. The thickness of the dessicated zone ranges from about 2 ft. on the valley sides to about 8 ft. on the high ground above the valley.

..... 6

5. <u>SOIL TYPES AND SOIL CONDITIONS</u>: (cont'd.) ...

<u>Varved Clay</u>: (Cont'd.) ...

As mentioned above the material is classified as layers of clay, silty clay and clayey silt. Atterberg Limit tests and natural moisture content tests gave the following results: for material from the various layers:-

Separated Layers	Clay	Silty Clay	Clayey Silt
Liquid Limit %	51 to 75	36 to 48	27 to 35
Plastic Limit %	22 to 30	18 to 27	17 to 24
Moisture Content %	49 to 65	23 to 38	28 to 37

Typical Grain Size distribution curves are included in the Appendix of this Report. Figure: 8

In order to determine the undrained shear strength of the soil, certain tests, as mentioned previously, were carried out in the field and in the laboratory. The results of these various tests are summarized below:-

	El.630 - 590	El.590-520
Field Vane Test(p.s.f.)	1040 to 2,000	720 to 1,600
Unconfined Comp.Test(p.s.f.)	720 to 1,280	410 to 850
Triaxial Comp.Test(p.s.f.)	-------------	580 to 900
Sensitivity(Average)	4.3 TO	4.8

It will be noted that in the soil strata above the level of the valley floor (i.e. el.630-590) the average laboratory shear strength is about 500 p.s.f. lower than the vane test average whilst in the strata below the valley floor (i.e. el.590-520) the difference is about 400 p.s.f. It is believed that these differences are due in part to sample disturbance.

..... 7

5. <u>SOIL TYPES AND SOIL CONDITIONS</u>: (cont'd.) ...

<u>Varved Clay</u>: (Cont'd.) ...

Based on a review of all of the above test results it is estimated that the average undrained shear strength of the varved clay strata is as follows:-

El. 630 - 590	1,000	p.s.f.
El. 590 - 570	700	p.s.f.
El. 570 - 545	900	p.s.f.

These values are recommended to be used in stability analyses.

In order to provide information for stability analyses in the long term consideration, laboratory tests were performed to determine effective stress parameters C' and Ø'. The results of these tests are as follows:-

C'(p.s.f.)	56 to 462
Ø'	25° to 32°

For design purposes the following values are recommended

C' = 250 PSF

Ø' = 25°

The results of consolidation tests carried out on selected samples indicate that the preconsolidation pressure of the undessicated portion of the strata is approximately 2.0 to 5.0 t.s.f.

6. <u>DISCUSSION AND RECOMMENDATIONS</u>:

It is proposed to realign Hwy.#65 at this location in order to improve the present geometry and also to rebuild the bridge over Chester Creek which is in very poor condition. At present four lines designated 'A','B', 'E' and 'D' are proposed.

..... 8

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

Lines 'A','B' and 'E' are all within 500 ft. of the existing bridge and Line 'D' is about 1,500 ft. upstream. The new profile grade for all lines will be some 2 to 3 ft. higher than the grade at the existing bridge which will mean a height of about 27 ft. above the river bed. In addition to the bridge construction it will also be necessary to construct a culvert some 1,200 ft. west of the new bridge at approximate Sta.117 + 00. The size of the culvert required is appr. 4 ft. and the height of the embankment at this point will be about 25 ft. maximum. The engineering problems which can be foreseen at this time are, the structure foundations, the stability of the forward slopes of the structure approaches, the stability of the side slopes of the various cut and fill sections on the new alignment, and the settlements under the various fill sections. These various aspects are discussed below under the appropriate heading.

6. Structure Foundations: (All Lines)

6.1)

Regardless of which line is eventually chosen there appears to be only one suitable method of supporting the structure and that is by friction piles. Spread footings are ruled out because of the low undrained shear strength of the varved clay deposits and end bearing piles because of the very great depth to the hard soil strata (> 200 ft.) It is recommended therefore that the new bridge be supported on No.14 treated timber piles driven to the elevation necessary to achieve the required pile capacity.

..... 9

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.1) Structure Foundations (All Lines) (cont'd.) ...

In determining the safe capacity of a No.14 timber pile, the following equation may be used,

$$Q = 0.4\ L \text{ Tons}$$

where Q = safe capacity of one pile

L = embedded length in original ground in feet

The length of the new structure will be of course dependant on the height and dimensions of the forward slopes of the approach embankments. These are discussed below.

It is believed that the type of structure which would present the least construction problems would be a trestle type structure.

6.2) Culvert Foundations:

This culvert will be located some 1,200 ft. west of the new bridge on line 'A','B','E' and will be a 4 ft. DIA. C.I.P. The embankment height at this location will be about 23 ft. This height of fill will result in long term settlements and hence differential settlements of the culvert. It is estimated that settlements in the order of 18 inches will occur under the embankment at the centre. It is therefore recommended that the concrete structure be designed so as to be able to tolerate differential settlements of this magnitude or that a flexible pipe be used instead. In any event the culvert should be placed with a camber of 24".

6.3) Structure Approaches Lines 'A' and 'B':

Construction of the new alignment on Line 'A' or on Line 'B' will require both cut sections and fill sections. The most critical and most important parts are the immediate approaches

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.3) Structure Approaches Lines 'A' and 'B' :(cont'd.) ... to the new bridge and in particular the forward slopes of the approaches which determine the length of the bridge. Stability analyses in terms of total and effective stresses have been carried out for the fill sections and cut sections with the following assumptions:-

Fill Material		
Bulk Weight	γ	120 p.c.f.
Angle of Friction	ϕ	30°
Subsoil		
Bulk Weight	γ	115 p.c.f.
Undrained shear strength		
El. 625 - 590	C	1,000 p.c.f.
El. 590 - 570	C	700 p.s.f.
El. 520 - 545	C	900 p.s.f.
Effective angle of friction	ϕ'	25°
Effective cohesion intercept	C'	250 p.s.f.
Groundwater level		at ground surface

The results of these effective and total stress analysis indicated, that cuts up to 14 ft. deep, constructed with 3:1 slopes will be stable. It should be pointed out, that cut sections having slopes steeper than 3:1 could result in failures.

In the case of embankments a safe maximum height of 23 ft. provided with 2:1 sideslopes and 3:1 forward slope is recommended.

..... 11

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.3) Structure Approa s Lines 'A' and 'B': (cont'd.)

All the existing natural slopes should be trimmed to 3:1 within the construction area. Due to the compressibility of the subsoil, the expected settlement under the 23 ft. high fill, will be in the order of 18 inches. In view of this it is recommended that the fills be placed as long as possible in advance of the final construction stage.

6.4) Recommended Alignment:

Four lines (A,B,E,and D) were originally proposed for the Hwy.#65 revision. A field inspection revealed that lines B,E, and D would cross the valley at places where fai ly large failures have occured in the past and also recently. From the foundation point of view these areas are most unfavourable and if possible, should be avoided. Line 'A' therefore appears to be the most suitable for the proposed re-alignment.

7. MISCELLANEOUS:

The boring programme was carried out during the period of July 6 to July 23, 1969. Equipment used on the site was owned and operated by Dominion Soil Investigation Ltd. The field work was supervised directly by Mr.P.Payer, Project Foundation Engineer, who also prepared this report. The report was reviewed by K.G.Selby.

November 1969.

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

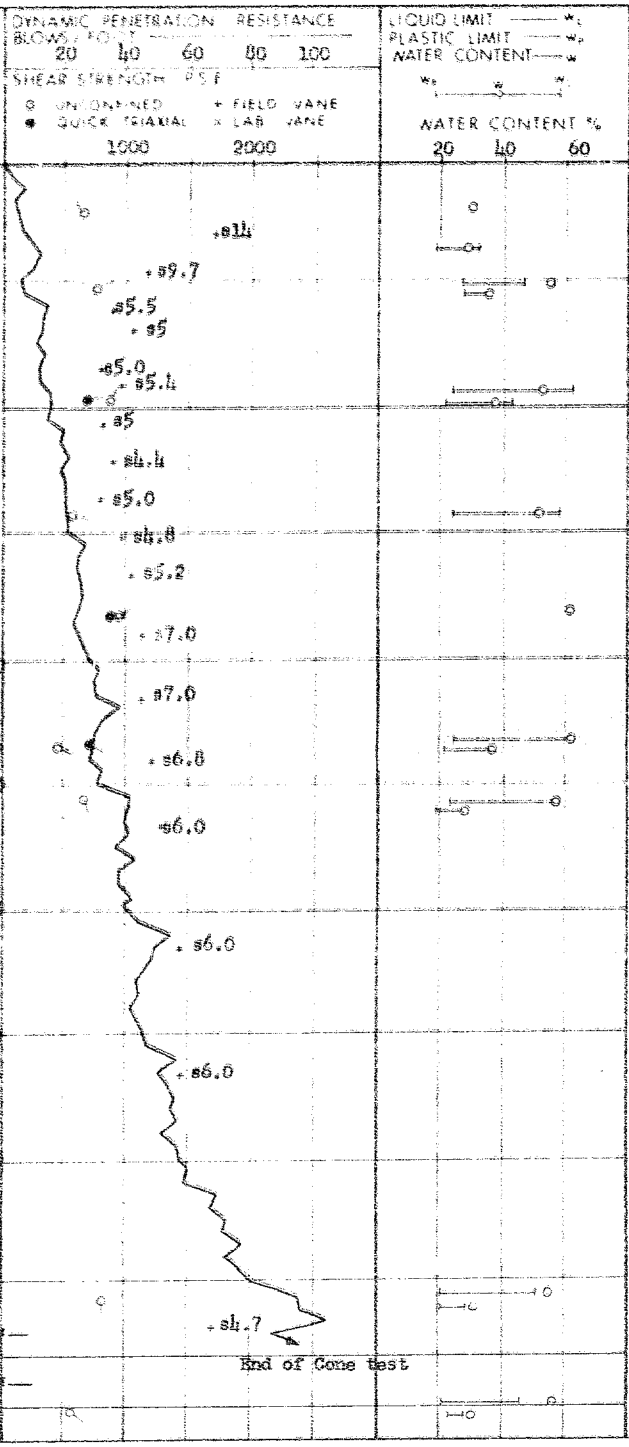
JOB	69-F-39	LOCATION	Co-ords. 62,450 N; 131,563 E.	ORIGINATED BY	FP
W.P.	39-67-01	BORING DATE	July 7, 1969	COMPILED BY	MV
DATUM	Geodetic	BOREHOLE TYPE	Cont. Flight Auger	CHECKED BY	[illegible]

SOIL PROFILE

ELEV DEPTH	DESCRIPTION
599.0	Ground Level
0.0	Clayey silt, Stiff to firm
592.5 / 6.5	Varved Clay. Layers of clay, silty clay & clayey silt. 1/8" - 3" thick. Firm to stiff
487.0 / 112.0	End of borehole

SAMPLES

NUMBER	TYPE	BLOWS/FOOT	BULK DENSITY γ (P.C.F.)	REMARKS GR.SA.SI.CL.
1	SS	6		Org. 0.5%
2	TW	PM	105.5	593.0 ▼
3	TW	PM	116	
4	TW	PM		
5	TW	PM	109 / 111	0 1 25 74 / 0 1 49 50
6	TW	PM		
7	TW	PM		
8	TW	PM	106	
9	TW	PM		
10	TW	PM	101.5 / 111	0 7 24 69
11	TW	PM		
12	TW	PM	106 / 106	0 1 18 81 / 0 0 63 37
13	TW	PM	109	
14	TW	PM		
15	TW	PM		
16	TW	PM	113	
17	TW	PM	113	0 1 28 71 / 0 1 84 15



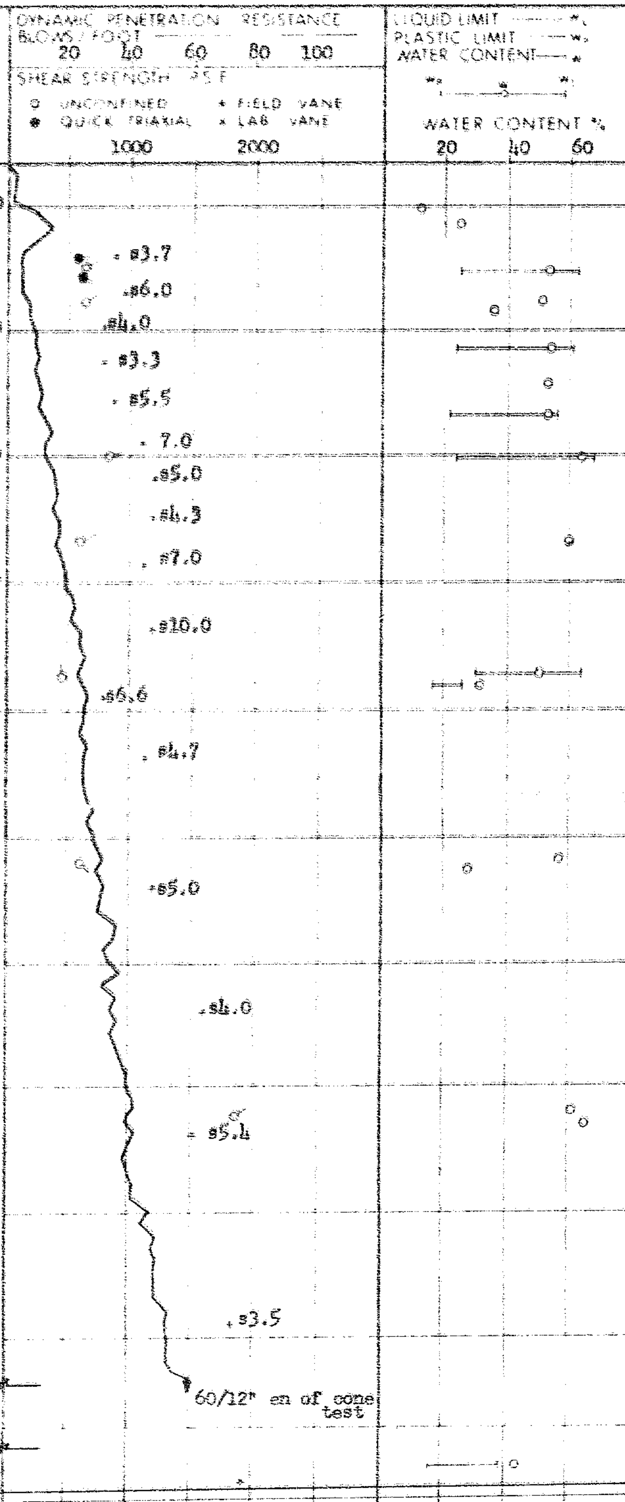
20
15 -○- 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-F-39	LOCATION	Co-ords. 62,452 N; 131,382 E.	ORIGINATED BY RP
W.P. 39-67-01	BORING DATE	July 8 - 9, 1969	COMPILED BY MV
DATUM Geodetic	BORE HOLE TYPE	Cont. Flight Auger & Washboring	CHECKED BY



ELEV / DEPTH	DESCRIPTION (SOIL PROFILE)	SAMPLE NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	SHEAR STRENGTH	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
593.4	Ground Level							
591.4	Topsoil							org. 0.9%
2.0	Sand and gravel	1	SS	6	590			589.9 ▼
587.4	Loose	2	SS	2				
6.0	Varved Clay	3	TW	PM		s3.7	105	
	layers of clay, silty clay & clayey silt					s6.0	102	
	1/8" - 3" thick	A	TW	PM			107	
	Firm to stiff				580	s4.0		
		B	TW	PM		s3.3		
		C	TW	PM		s5.5		0 0 17 83
		D	TW	PM				
		7	TW	PM	570	7.0	100	0 1 21 78
		8	TW	PM		s5.0		
						s4.3		
		9	TW	PM		s7.0	102	
		10	TW	PM	560	s10.0		
		11	TW	PM		s6.6	111	
		12	TW	PM	550	s4.7		
		13	TW	PM	540	s5.0	109	
		14	TW	PM	530	s4.0		
		15	TW	PM	520	s5.4	115	0 7 25 68 / 0 0 79 21
		16	SS	4	510	s3.5		
					500			
480.4 / 113.0	End of borehole				490 / 480			

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-33	LOCATION Co-ords. 62,308 N; 131,614 E.	ORIGINATED BY PP	
W.P. 39-67-01	BORING DATE July 10, 1969	COMPILED BY MV	
DATUM Geodetic	BOREHOLE TYPE Cont. Flight Auger	CHECKED BY	

ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.	WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL
629.7	Ground Level								
627.7 2.0	Topsoil								
	Varved Clay Layers of silty clay & clayey silt 1/8" - 3" thick Firm to stiff	1	SS	5		s3.8			org. 1.2%
		2	TW	TM	620	s4.0		116	620.7 ▼
		3	TW	TM		2000			
		4	TW	TM	610	s1.4		115	
		5	TW	TM		s2.0			
		6	TW	TM	600	s4.3		112	
		7	SS	7		s3.1			
		8	SS	8	590				
		9	SS	7	580	s6.4			
					570	End of cone test			
564.9		10	SS	6		7.0			0 2 20 78
63.0	End of Borehole				560				

DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100

SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 1000 2000

LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w

WATER CONTENT % 20 40 60

20 / 15 5 / 10 % STRAIN AT FAILURE

FORM OB-MS-26 (REV 1969)   OFFICE REPORT ON SOIL EXPLORATION

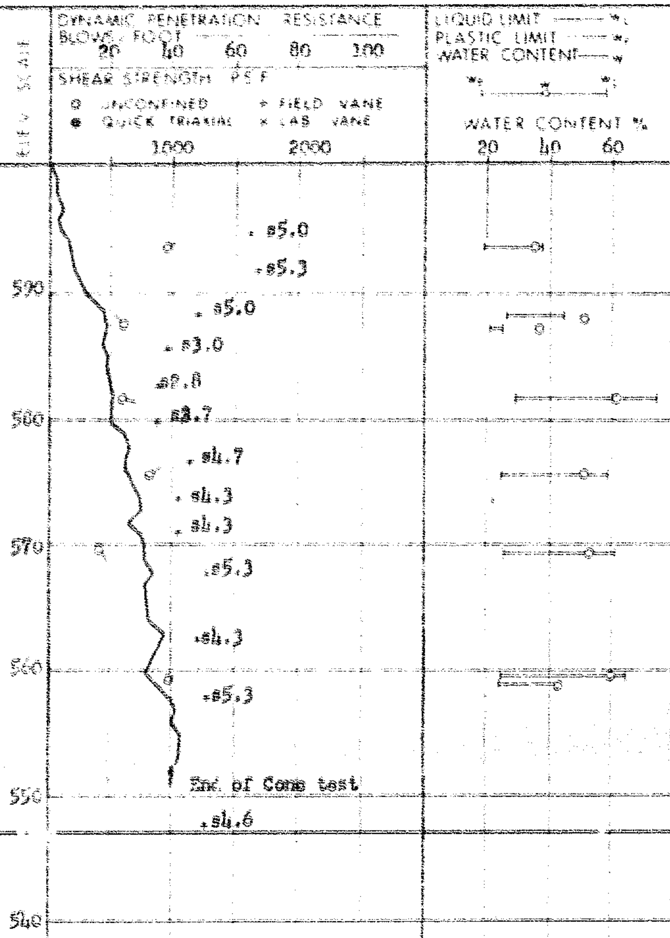
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 69-F-39   LOCATION Co-ords. 62,530 N; 131,347 E.   ORIGINATED BY PP
W P 39-67-01   BORING DATE July 14, 1969   COMPILED BY PP
DATUM Geodetic   BOREHOLE TYPE Cont. Flight Auger   CHECKED BY [illegible]

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	TYPE	BLOWS/FOOT	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
600.1	Ground Level					
598.1	Topsoil					597.1
2.0		1	SS	5		
		2	TW	PM	117	
		3	TW	PM		
		4	TW	PM	111.5	
		5	TW	PM		
	Varved Clay	6	TW	PM	103.5	0 1 17 82
	layers of clay, silty	7	TW	PM		
	clay & clayey silt	8	TW	PM	106	
		9	TW	PM		
	1/8" - 3" thick	10	TW	PM	104	
	Firm to stiff	11	TW	PM		
		12	TW	PM	104	
547.1		13	TW	PM		
53.0	End of Borehole					



20
15 -+- 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS · ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

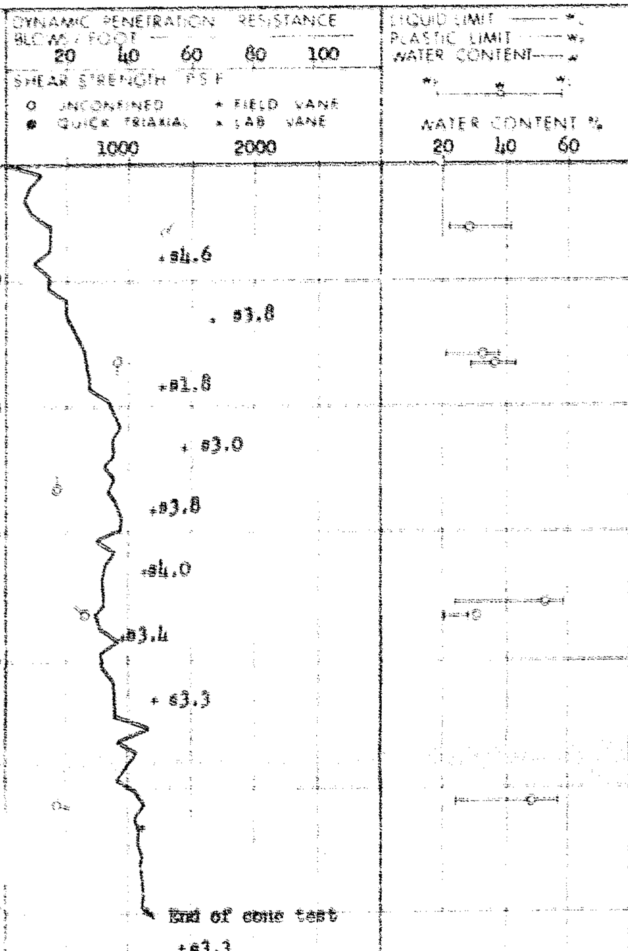
FOUNDATION SECTION

JOB 69-F-39
W.P. 39-67-01
DATUM Geodetic

LOCATION Co-ords. 62,610 N; 131,268 E.
BORING DATE July 14 & 15, 1969
BOREHOLE TYPE Cont. flight auger

ORIGINATED BY PP
COMPILED BY PP
CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	SHEAR STRENGTH (PSF)	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL
629.3	Ground Level							
627.3 2.0	Topsoil							
	Varved Clay layers of clay, silty clay & clayey silt 1/8" - 3" thick Firm to stiff	1	TW	PM		s4.6	119	620.8 ▼
		2	TW	PM	620	s3.8		
		3	TW	PM		s1.8	116	
		4	TW	PM	610	s3.0		
		5	TW	PM		s3.8	118	1 6 64 35
		6	TW	PM	600	s4.0		
		7	TW	PM		s3.4	111	
		8	TW	PM	590	s3.3		
		9	TW	PM	580		104	
		10	TW	PM	570	s3.3		
566.3 63.0	End of Borehole				560			



20
10 -+- 5 % STRAIN AT FAILURE
10

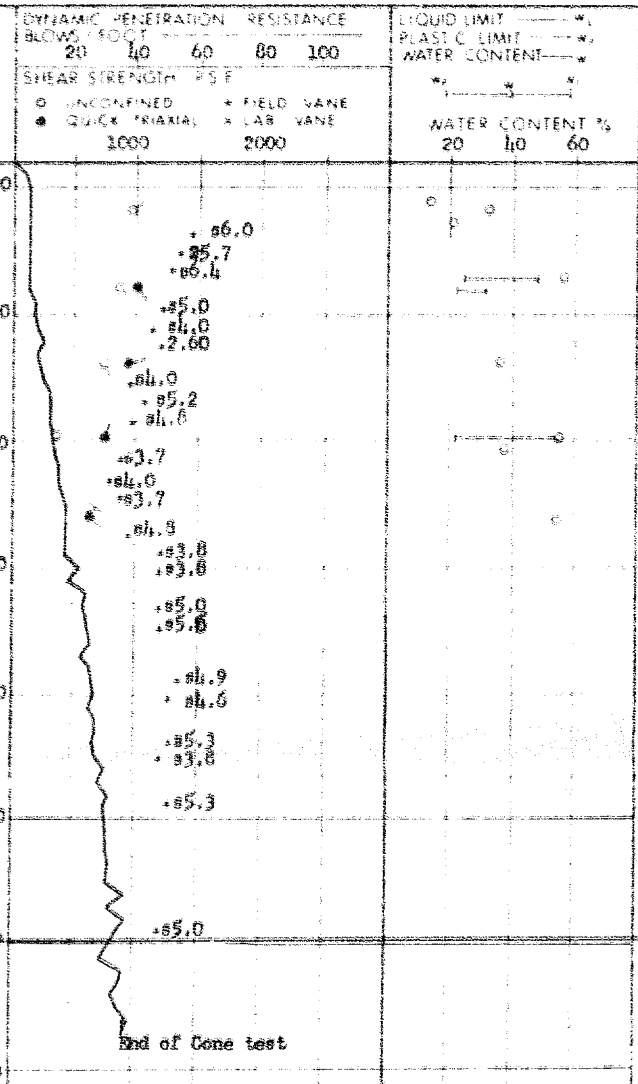
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 69-F-39 LOCATION Co-ords. 62,549 N; 131,511 E. ORIGINATED BY PP
W.P. 39-67-01 BORING DATE July 16, 1969 COMPILED BY PP
DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY [illegible]

ELEV DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL
601.8	Ground Level						
599.8 2.0	Topsoil				600		
		1	TW	PM		124	
		2	TW	PM	590	111 110	
	Varved Clay	3	TW	PM		116 118	586.3 (water level)
	Layers of clay, silty clay and clayey silt	4	TW	PM	580	108 107	
	1/8" - 3" thick	5	TW	PM		104 104	
	Firm to stiff				570		
					560		
					550		
540.3 61.5	End of Borehole				540		
					530		



20
15 -+- 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 69-F-39 LOCATION Co-ords. 63,162 N; 130,590 E. ORIGINATED BY PP
W.P. 39-67-01 BORING DATE July 17, 1969 COMPILED BY PP
DATUM Geodetic BOREHOLE TYPE Cont. Flight Auger CHECKED BY [illegible]

ELEV DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	SHEAR STRENGTH / DYNAMIC PENETRATION	WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
609.5	Ground Level									
607.5 / 2.0	Topsoil									
			1	TW	PM				151	
							s2.5			
			2	TW	PM	600				
							s3.0, s6.0, s5.5			
			3	TW	PM		s4.0, s4.0		117	
						590	s3.3			
	Varved Clay layers of clay, silty clay & clayey silt 1/8" - 3" thick Firm to stiff		4	TW	PM		s4.8, s4.0, s4.8		102	
			5	TW	PM	580	s4.7, s4.3		105	
						570	s4.0			
						560	s4.3			
548.0						550	s4.6			
61.5	End of Borehole									
						540				

Legend: DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100; SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 1000 2000; LIQUID LIMIT, PLASTIC LIMIT, WATER CONTENT; WATER CONTENT % 20 40 60

20 / 15 5 / 10 % STRAIN AT FAILURE

DEPARTMENT OF HIGHWAYS · ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

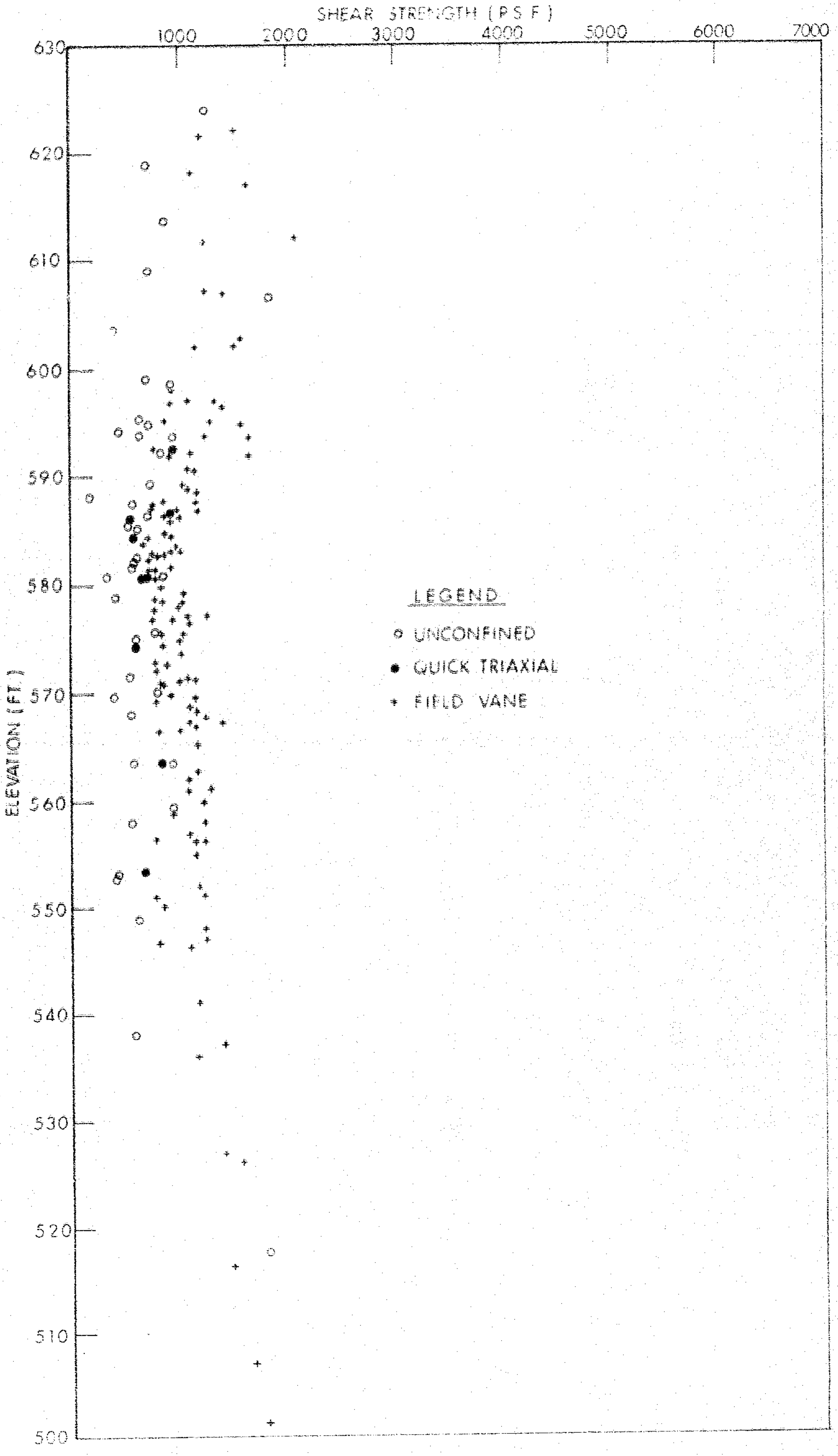
FOUNDATION SECTION

JOB 69-F-39 — LOCATION Co-ords. 62,200 N; 131,260 E. — ORIGINATED BY PP
W.P. 39-67-01 — BORING DATE July 18 & 21, 1969 — COMPILED BY PP
DATUM Geodetic — BOREHOLE TYPE Cont. flight auger — CHECKED BY

ELEV. / DEPTH	SOIL PROFILE DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.	BULK DENSITY γ P.C.F.	REMARKS GR SA SI CL
598.5	Ground Level							
596.5 / 2.0	Topsoil	1	TW	PM			92	
593.0 / 5.5	Sand and gravel Loose	2	TW	PM				38 56 (6)
590.5 / 8.0		3	TW	PM	590			590.5 ▼
	Varved Clay	4	TW	PM		s5.0	106	
	Layers of clay, silty clay and clayey silt					s6.0, s4.0, s5.0		
	1/8" - 3" thick	5	TW	PM	580	s5.2, s4.0, s6.5		
	Firm to stiff	6	TW	PM		s6.7, s5.5, s5.5		
		7	TW	PM	570	s3.3		
		8	TW	PM	560	s4.0	114.5	
		9	TW	PM	550	s4.0		
545.5 / 53.0	End of Borehole				540			

DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 20 40 60 80 100
SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 1000 2000
LIQUID LIMIT, PLASTIC LIMIT, WATER CONTENT — WATER CONTENT % 20 40 60

20
15 -○- 5 % STRAIN AT FAILURE
10



SHEAR STRENGTH vs DEPTH

FIG 1

FIG. 1

VOID RATIO – PRESSURE CURVES

JOB NO. 69-F-39

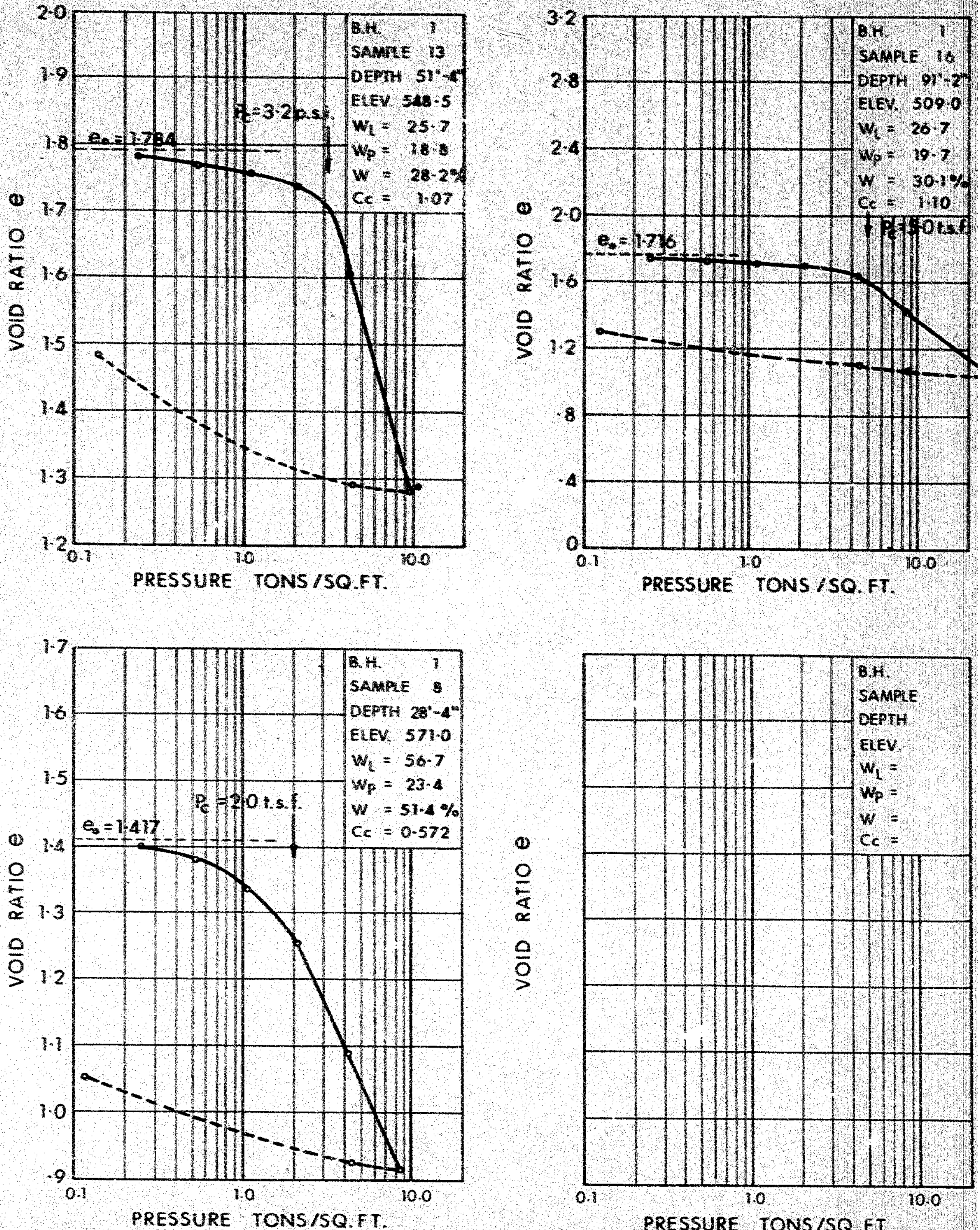


FIG. 2

VOID RATIO–PRESSURE CURVES

JOB NO. 69-F-39

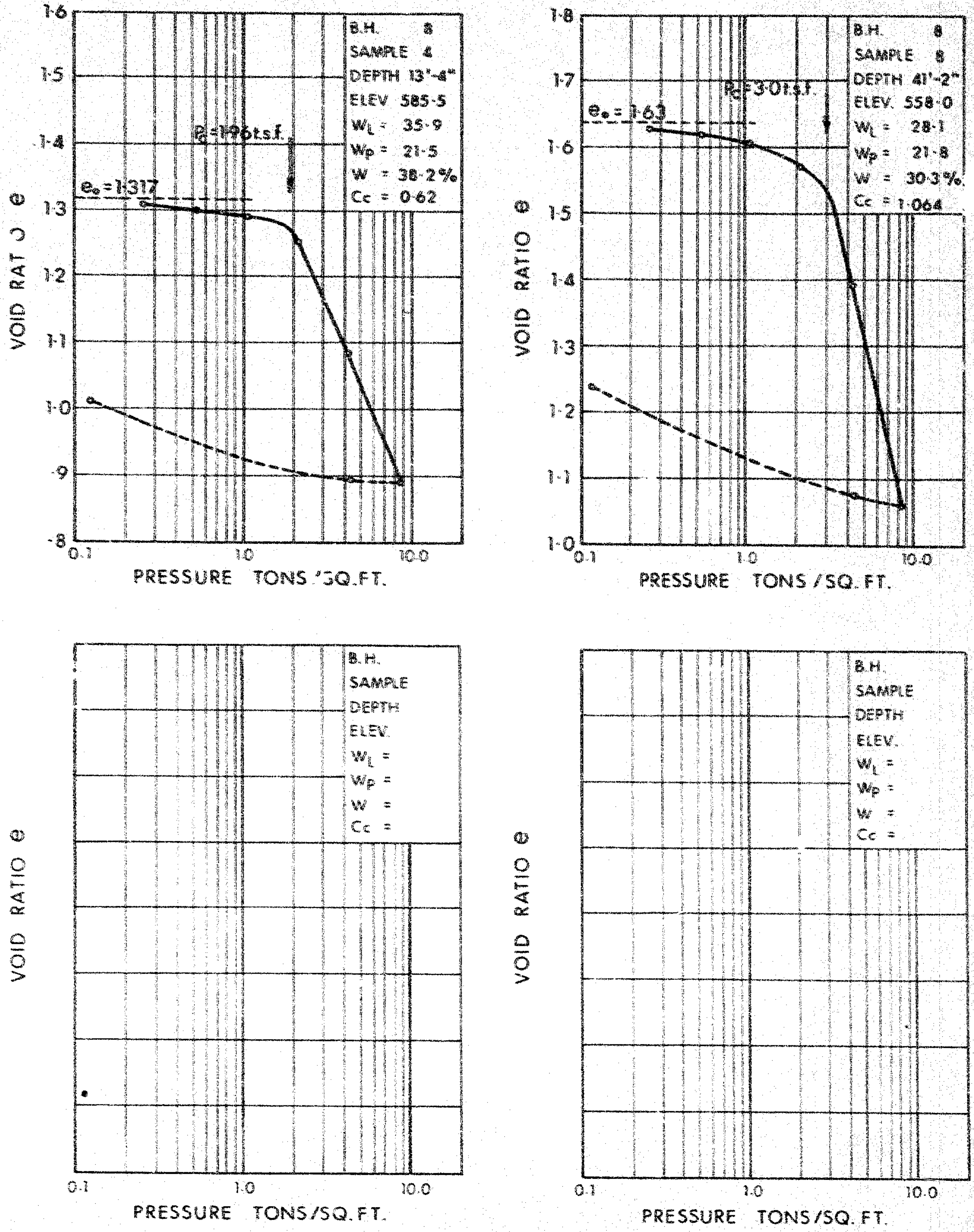


FIG. 3

EFFECTIVE STRESS PARAMETERS

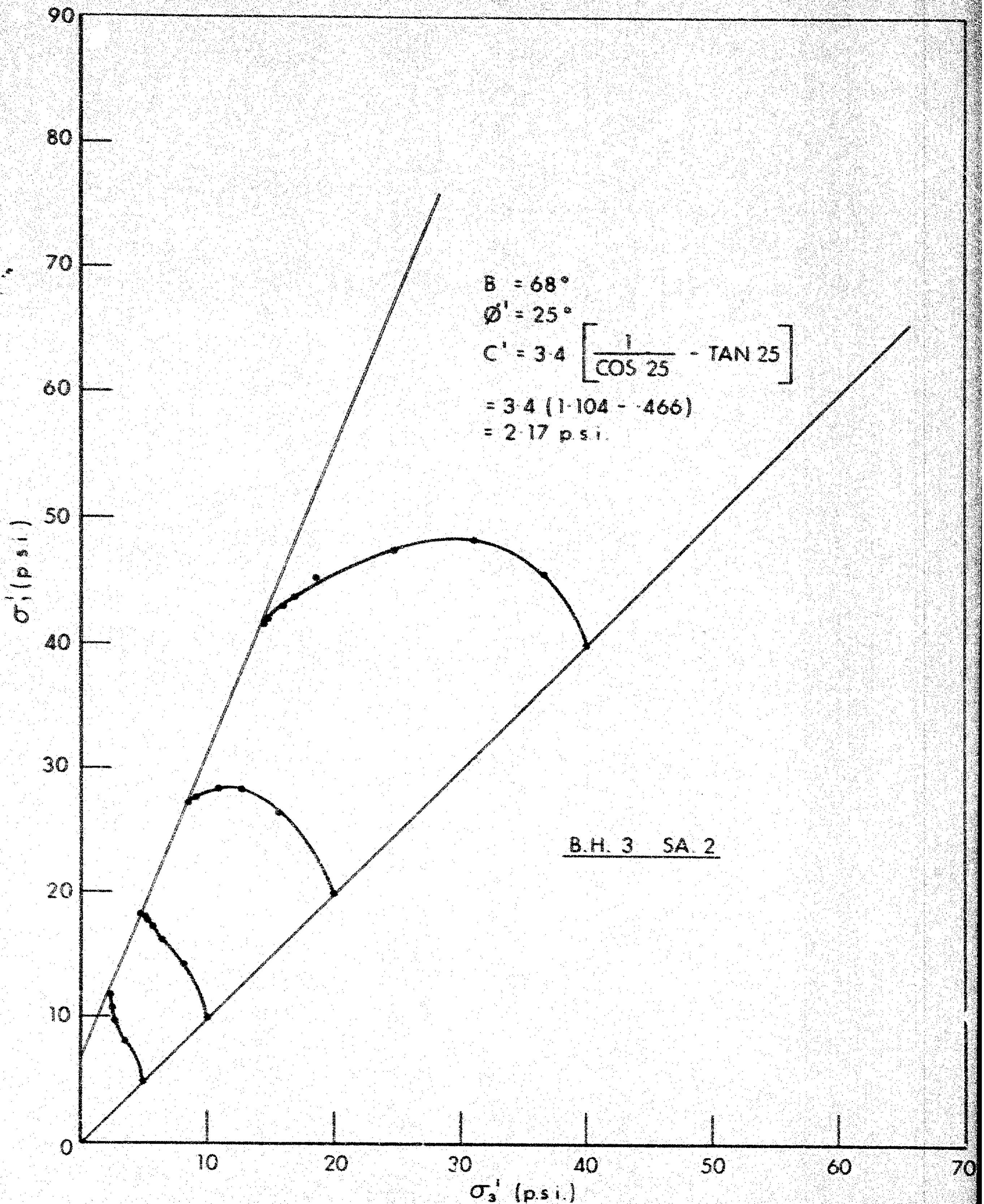


FIG. 4

EFFECTIVE STRESS PARAMETERS

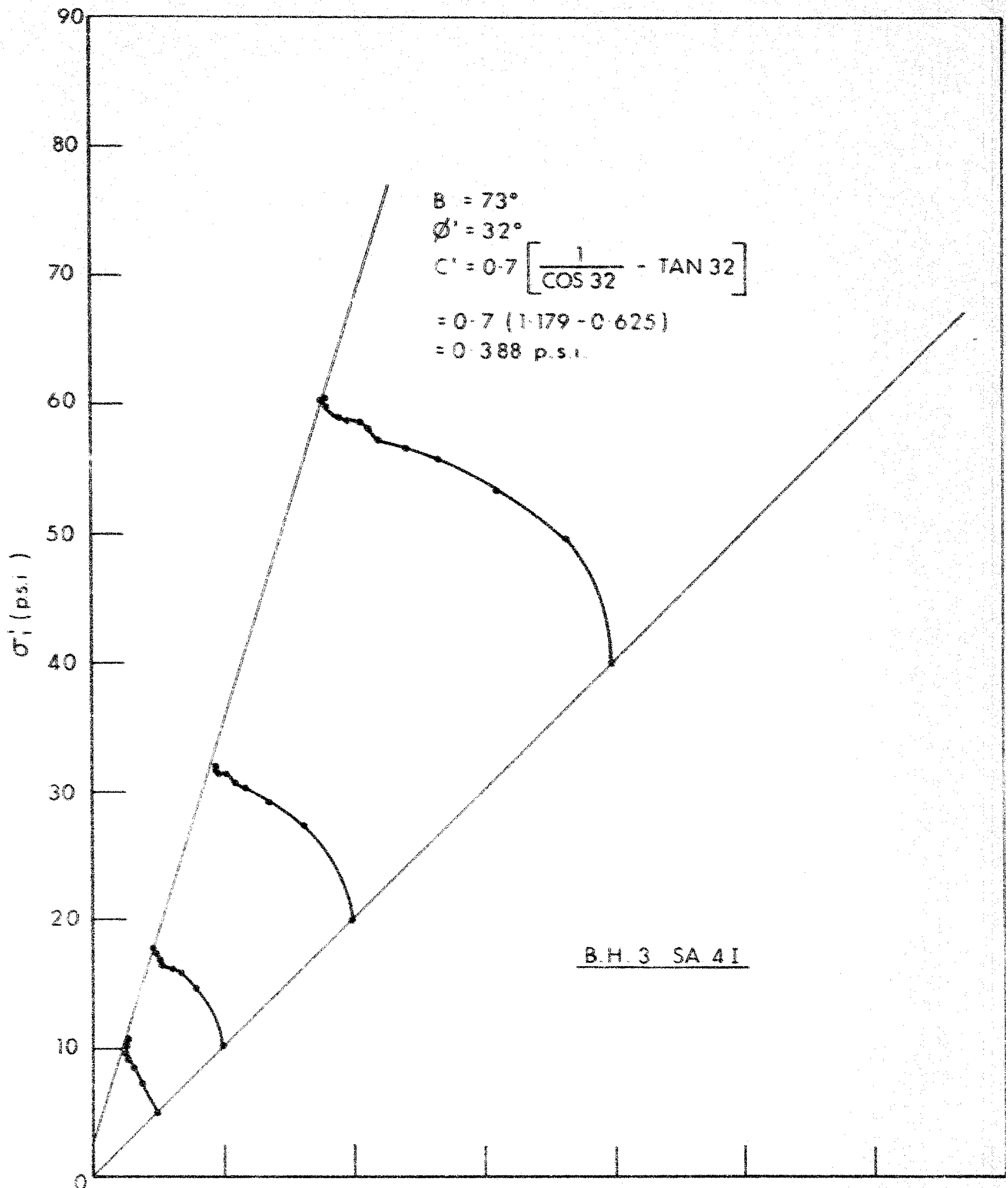


FIG. 5

EFFECTIVE STRESS PARAMFTERS

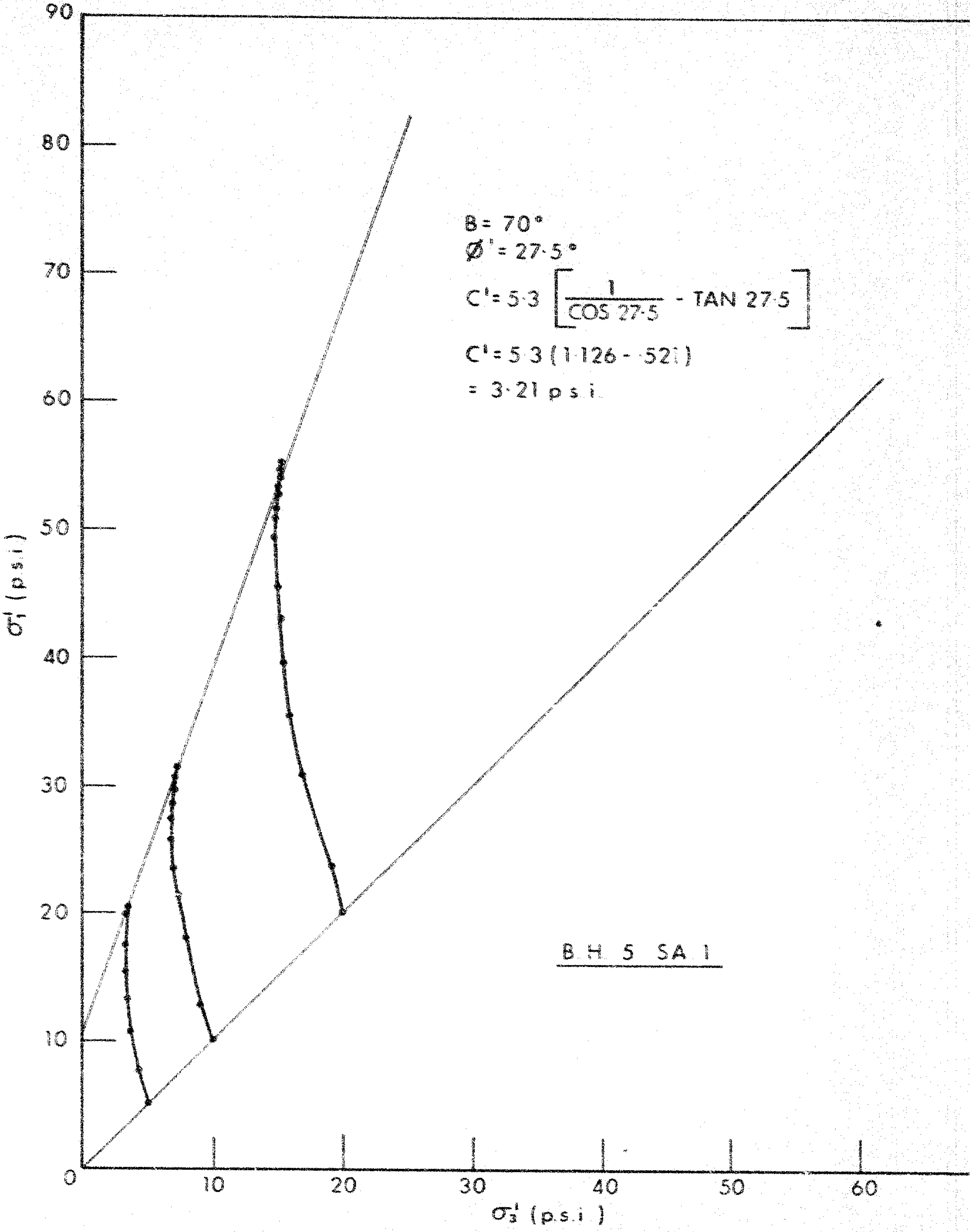


FIG. 6

EFFECTIVE STRESS PARAMETERS

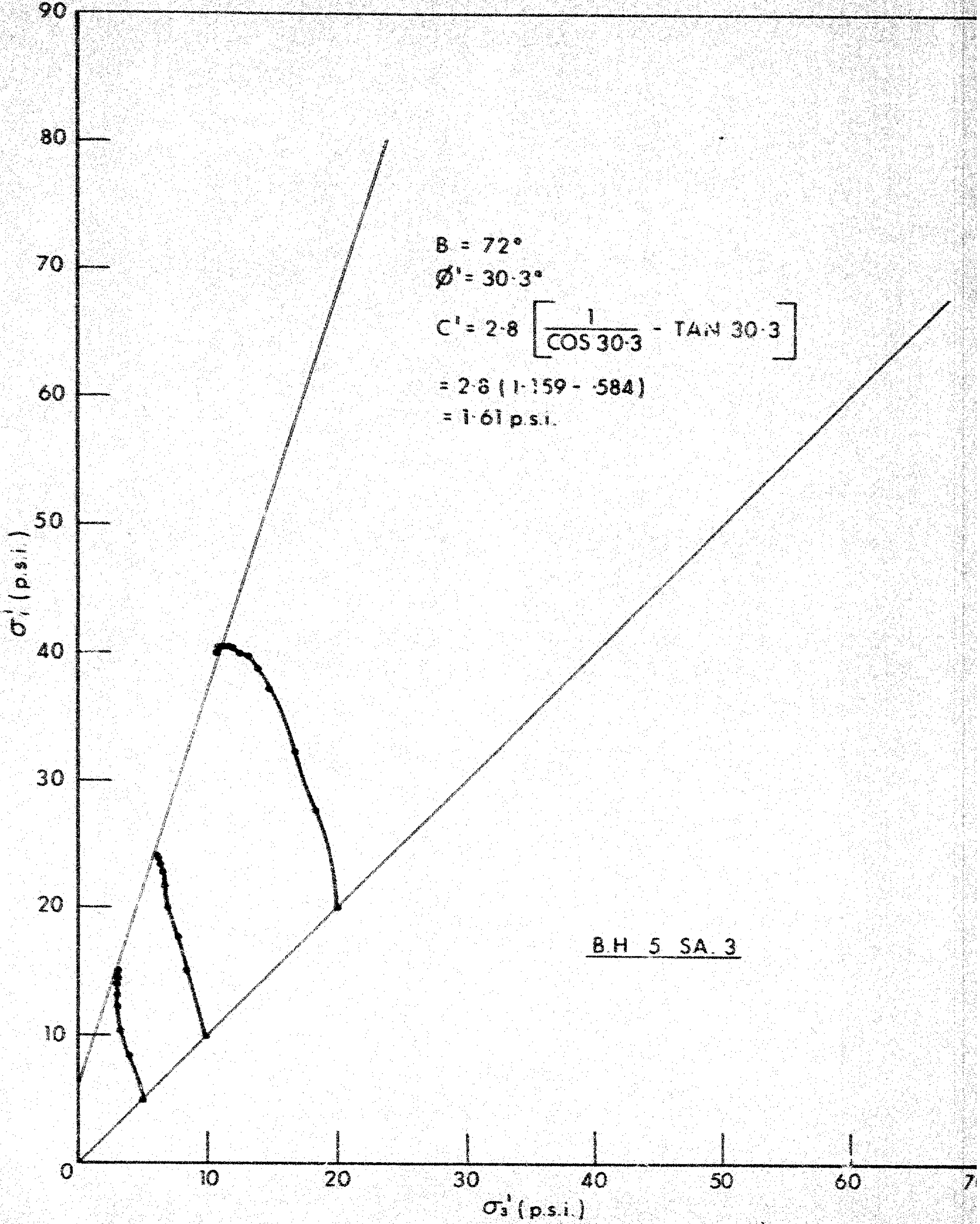
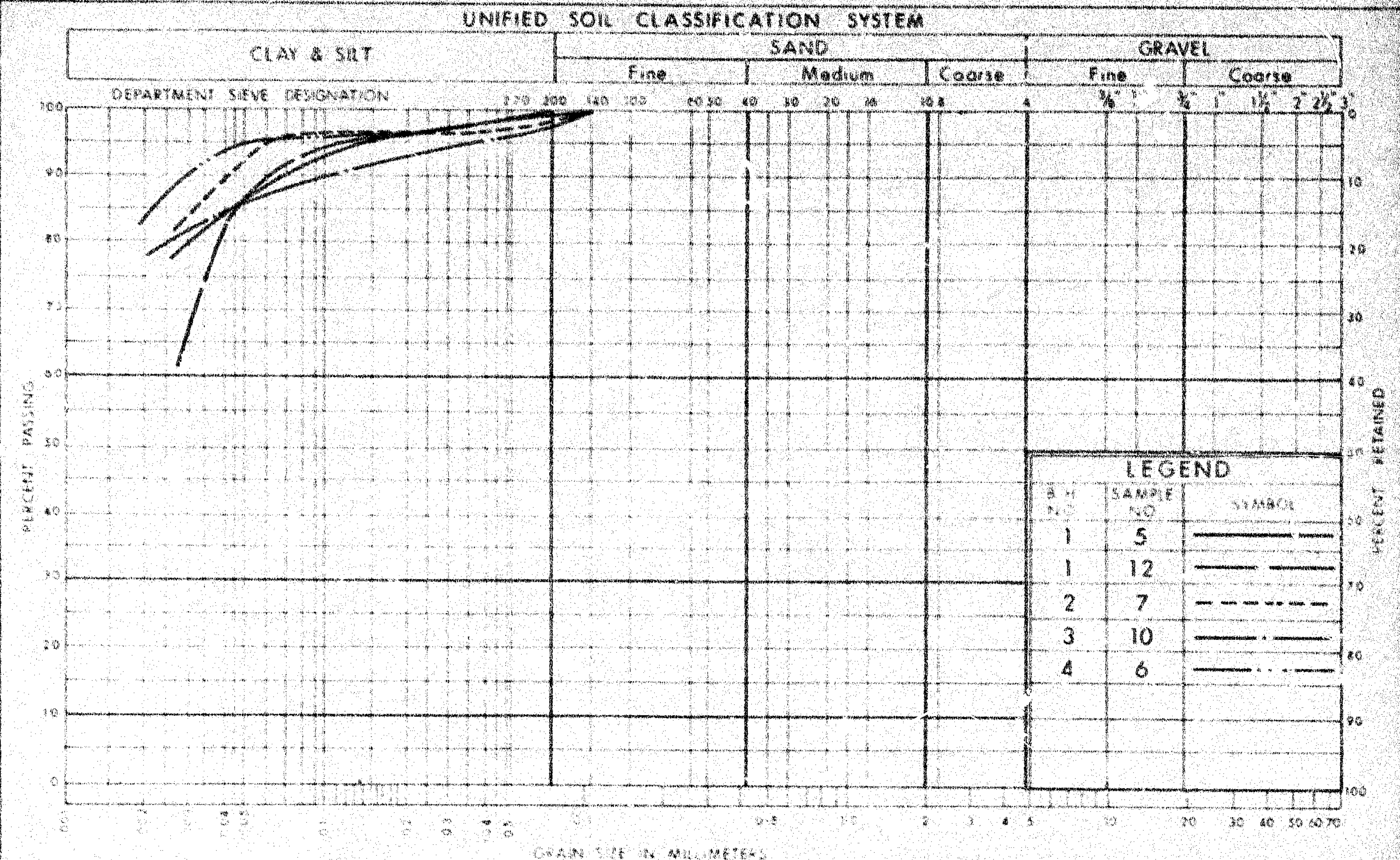


FIG. 7



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

W.P. No. 39-67-02

JOB No. 69-F-39

FIG. 8

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N' :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

CONSISTENCY	'N' BLOWS / FT.	c LB. / SQ. FT.	DENSENESS	'N' BLOWS / FT.
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

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

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

Q_u	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V.	FIELD VANE
Q_{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q_d	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta \sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT — IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION — IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION — IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION — IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	$= 3.1416$
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ or $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ or $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

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

EARTH PRESSURE

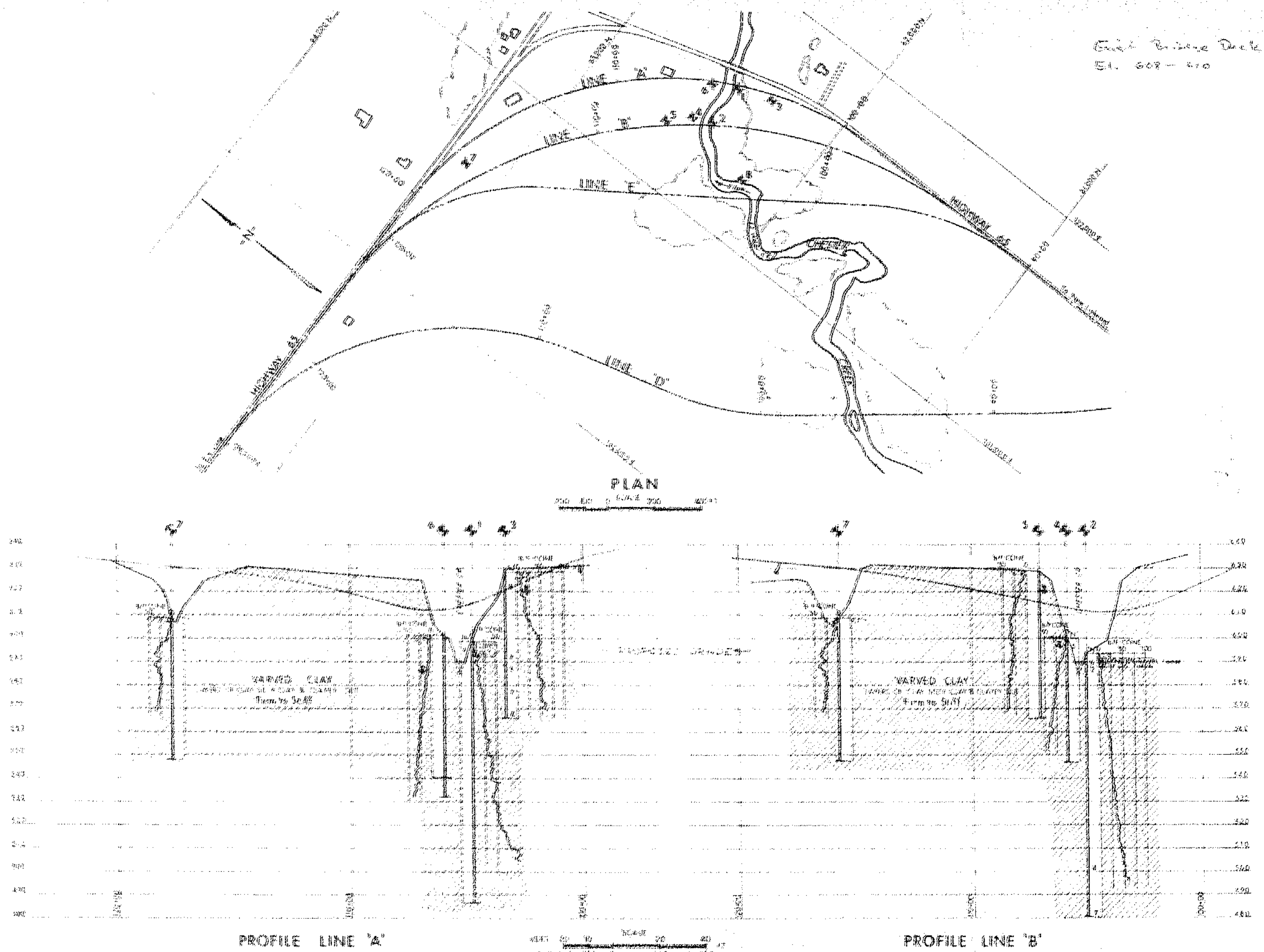
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

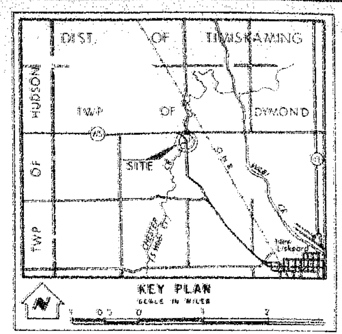
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND CO[illegible] ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

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



Guide Bridge Deck
El. 608 – 610



LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. JULY 1969

NO	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	599.0	62,450	131,563
2	593.4	62,452	131,382
3	629.7	62,308	131,614
4	600.1	62,530	131,547
5	629.3	62,610	131,268
6	601.8	62,549	131,511
7	609.5	63,162	130,990
8	598.5	62,200	131,760

– NOTE –

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence and may be subject to considerable error.

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

CHESTER CREEK
(SOUTH WABI CREEK)

KING'S HIGHWAY NO. 65 LINE 'A' 'B' 'E' & 'D' DIST NO. 14
DIST OF TIMISKAMING
TWP. DYMOND LOT ____ CON. ____

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D P.P.	CHECKED	W.P. NO. 29-67-02	M.B.T. DRAWING NO. 69-F-39A
DRAWN S.O.	CHECKED	JOB NO. 69-F-39	
DATE 18 SEPT 1969		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT NO.	

cc: Gen. Files W.P. 39-67

RE: Comments re: Chester Creek Crossing on Hwy. Dist. 14 W.O. 69-

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. T. G. Smith, Regional Functional Planning Engineer, NORTH BAY, Ontario.

From: Foundation Section, Materials & Testing Office, Room 107, Lab. Bldg.

Attention: Mr. Bruce Schoales, Project Planning Engr.

Date: September 2, 1970

Our File Ref:

In reply to

Subject: Chester Creek Crossing on Hwy. 65
W.O. 69-11039 -- W.P. 39-67-02
District No. 14 (New Liskeard)

We have recently reviewed Profile #C-304-13 for the above mentioned project. We would like to draw your attention to the following:

(1) The height of the proposed approach fill to the structure is 39 ft., whereas the safe height recommended in the Foundation Report is 23 ft. It should be noted that the height of the fill is the difference in elevation between profile grade and the stream bed.

(2) In order to comply with the recommendations in the Foundation Report, the bridge deck level should be at or below El. 610.

The present design will undoubtedly result in an unstable approach embankment. We suggest, therefore, that you review your proposals and initiate the necessary changes. We would be pleased to be of any further assistance we can in this matter.

K. G. Selby

KGS/MdeF

K. G. Selby,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. H. McArthur
T. A. Sharpe
Foundations Files
Gen. Files

al

DEFECTS IN NEGATIVE DUE TO
CONDITION OF ORIGINAL DOCUMENT

cc: FOUNDATIONS – RM. 110 LAB. BLDG.

A68

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. T. G. Smith,
Regional Functional Planning Engineer,
NORTH BAY, Ontario.

ATTENTION: Mr. B. Schoales,
Project Planning Engr.

OUR FILE REF.

FROM: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

DATE: February 4, 1971

IN REPLY TO

SUBJECT: Chester Creek Crossing on Hwy. #65
W.O. 69-11039 -- W.P. 39-67-02
District No. 14 (New Liskeard)

We have recently reviewed Profile #C-304-13, which was revised by your Office following our review in September, 1970.

Since the new grade involves cuts of 20 ft. depth at Station 204+00± and fills of 30 ft. at Station 194+50±, we have carried out stability analyses to determine suitable slopes at these locations. Our recommendations are as follows:

(1) Fill Section -- Stations 192+00 - 196+00:

Where the fill height is more than 23 ft., stabilizing berms will be required. For 30-ft. high fills, 1/2 height berms of length 30 ft. should be constructed. Slopes should be 3 horizontal to 1 vertical.

(2) Cut Section -- Stations 196+00 - 205+40:

Where the depth of cut is more than 14 ft., benches will be required. For 20-ft. deep cuts, mid-height benches of length 10 ft. should be constructed. Slopes should be 3 horizontal to 1 vertical.

If further information is required, please contact this Office.

KGS/MdeF

K. G. Selby
SUPERVISING FOUNDATION ENGINEER
For:
A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

cc: Messrs. H. McArthur
T. A. Sharpe
S. McCombie
J. C. McAllister
E. R. Saint
Foundations Files
Gen. Files

Department of Highways Ontario
Copy for the information of

Foundation Office
~~Mr. A. Stermac,~~
Principal Foundation Engineer,
Room 107, Lab. Bldg.

C.S. Grebski,
Bridge Office

March 30, 1971

Chester Creek Bridge (South Wabi River)
W.P. 39-67-02, Site No. 47-49
Highway 65, District No. 14

69-F-39

Attached herewith we are submitting the final bridge drawings which show the foundation design for this structure.

Kindly give us your comments at your earliest convenience.

C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Office

COMMENTS: (1) Note for pile driving should read:"#14 treated timber piles driven to tip elevations as shown:

(Mention of design load might imply use of Hiley Formula, which is not valid for this site.)

N. Abutment	--	El. 551
N. Pier	--	El. 540
S. Pier	--	El. 542
S. Abutment	--	El. 552"

(2) Suggested construction note: ~~"Excavations for pier~~
"Excavations for pier foundations may precipitate failures of the existing varved clay slopes unless adequate precautions are taken"

11 May 71

K. G. Selby
K. G. Selby,
SUPERVISING FOUNDATION ENGR.

April 15, 1971

cc. C. Grebski.
A. Radkowski
Fdn. Report
A. McKim

Ke[illegible] Sept. 30

Message from Ev. Saint (N. Bay)

Re: Chester Ck. - New Liskeard

110 ft. West of existing structure on the North side, there is bad erosion in the stream bed and 160 ft. West of the existing structure, big slide failure on top of slope. Erosion is at the easterly toe of the failure slide. The District checked it out.

389-2021

389-2021

EMBANKMENT FAILURE AT CUMBERLAND

Approximately one mile west of the village of Cumberland on T.C.H. Hwy. #17, a failure occurred on the north side of the highway where the terrain slopes erratically from the edge of the highway down to the Ottawa River some 40' below. This failure took palce on the 1st of May, 1962 when a section of the hillside some 100' long and 60' wide slid down into the river leaving a very steep slope only about 30' from the highway ditch. Prior to this failure, a steep slope in the order of 1:1, was existing on the upper portion of the hill face and the area was heavily wooded right to the edge of the slope. This failure has been preceded by various other failures in the same vicinity, the last occurring immediately to the west on the spring of 1960.

At the west end of the D.H.O. park another fialure occurred on May 1st, 1962 when a section of hillside in front of, and including about 15' of, the park slid down into the river. The length of this section was about 60' Tension cracks are now visible about 8' back from the present edge of the slope. The boundary fence of the park has been moved to a line just south of these tension cracks. The slope at the east end of the park is very steep - in the order of 1:1.

69-F-39

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac
Principal Foundations Eng.
Downsview

Att: Mr. K. Selby

From: Materials & Testing Office
Northern Region

Date: June 4, 1969

Our File Ref.

In reply to

Subject:

Re: W.P. 39-67-01 Hwy. #65 New Liskeard W'ly
W.P. 39-67-02 Chester Creek Structure

The above noted structure and approaches are located on the New Liskeard clay plain. Four alternate lines are proposed and an assessment of the foundation and stability problems at the locations is necessary to finalize the alignment. Prints of the plan indicating the proposed lines and profiles of lines A, B, and D are being forwarded to your office along with a copy of the vane tests carried out to date. Duplicates of the above will be available in this office for the field Engineer to pick up on his way to the site. The fill 1000 feet north-west of the creek should also be checked for stability on all lines.

E.R. Saint
Regional Materials Engineer

ERS/ef
c.c. G.A. Wrong
File

Steel beams with suspended centre portion of main span
Founded on timber pile bents
Concrete deck
152' 6"
43-6
65-6
43-6
piles are rotted
poor condition
exp. joints closed up

AGS

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A.G. Stermac
Principal Foundation Eng.
Downsview

From: Materials & Testing Office
Northern Region

Attention:

Date: August 5, 1970

Our File Ref.

In reply to

Subject:

Re: W.P. 39-67-01 & 02
Hwy. #65 New Liskeard westerly
and Chester Cr. St.

A Foundation Report (W.J. 69-F-39) dated November 5, 1969 was prepared by your office based on preliminary profiles and a proposed grade.

The alignment has now been finalized and the grade revised. The proposed fill heights at the structure Station 217+ and culvert at Station 205+50 have been increased by as much as ten feet. (See attached profile C-304-13).

Could you review your recommendations for the above areas based on the revised conditions. If more detail is required please contact this office.

E.R. Saint
Regional Materials Engineer

ERS/ps
c.c. T.G. Smith
H. McArthur
T.A. Sharpe
File (2)

SAFE FILL HEIGHT: 23 FT.
PROPOSED " " 35 FT.

A48.

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: M. T. G. Smith,
Regional Functional Planning Engineer,
NORTH BAY, Ontario.

From: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

Attention: Mr. Bruce Schoales,
Project Planning Engr.

Date: September 2, 1970

Our File Ref.

In reply to

Subject: Chester Creek Crossing on Hwy. 65
W.O. 69-11039 -- W.P. 39-67-01
District No. 14 (New Liskeard)

We have recently reviewed Profile #C-304-13 for the above mentioned project. We would like to draw your attention to the following:

(1) The height of the proposed approach fill to the structure is 39 ft., whereas the safe height recommended in the Foundation Report is 23 ft. It should be noted that the height of the fill is the difference in elevation between profile grade and the stream bed.

(2) In order to comply with the recommendations in the Foundation Report, the bridge deck level should be at or below El. 610.

The present design will undoubtedly result in an unstable approach embankment. We suggest, therefore, that you review your proposals and initiate the necessary changes. We would be pleased to be of any further assistance we can in this matter.

K. G. Selby

KGS/MdeF

K. G. Selby,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. H. McArthur
T. A. Sharpe
Foundations Files ✓
Gen. Files

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To:

Mr. A. G. Stermac
Principal Foundations Engr.
Downsview

From:

Materials & Testing
Northern Region

Attention:

Date: January 18, 1971

Our File Ref.

In reply to

Subject:

W.P. 36-67-01, Highway 65,
Chester Creek Crossing
District 14; Foundations
Report No. 69-11039

In a memo dated September 2, 1970, from Mr. Ken Selby to Mr. T. G. Smith, you indicated additional requirements for the approach fills to Chester Creek. Your recommendations at that time have now been incorporated into the new profile. (See attached copy). On reviewing your original report and the revised grade line some clarification is, however, requested in the following areas and for the following reasons:

1. Cut - Stations 202 to 205
The cut depth in this area is greater than the 14 ft indicated in the original report for stable cut slopes at 3:1. What terms would you suggest - granular sheeting or benching through this area.

2. Culvert - Station 194+55
Due to an error in the original ground line the proposed fill at this location is now in the order of 30 ft; would you recommend flattening of the fill slopes or berms in this area. Treatment would probably only be required on the south side as the existing road is located immediately north and could probably be used as a berm.

Road Design is presently working on the property requirements and an early reply would be appreciated so that this can be finalized.

E. R. Saint
Reg. Materials Engr.

cc: J. C. McAllister
H. McArthur
T. G. Smith

Cont 72-110

ERS/gm

69-F-39

TOTAL STRESS :

LINE 'A', LEFT BANK, PARTIAL SLOPE FS: 1.6

JOB TITLE: WABI RIVER 'A'
FIGURE (1) (RED LINE) FS. = 1.64

LINE 'A', RIGHT BANK - FINAL GRADE

FS:

JOB TITLE : WABI RIVER 'B'
FIGURE (2) (RED LINE) FS. = 2.40

EFFECTIVE STRESS:

LINE 'A', LEFT BANK, PARTIAL SLOPE

JOB TITLE : WABI RIVER 'C' FS:
FIGURE (1) (RED LINE)

LINE 'A', RIGHT BANK - FINAL GRADE

JOB TITLE: WABI RIVER 'D'
FIGURE (2) RED FS:

CUT SECTION

JOB TITLE: WABI RIVER CUT SECTION 1 } TOTAL STRESS FS: 2.70
FIGURE (4) WABI RIVER CUT SECTION 2 } FS: 3.03
FS:
WABI RIVER CUT SECTION 3 - EFFECTIVE STRESS.

SAFE MAXIMUM HEIGHT
FIGURE 3 AND FIGURE 3A

OVERALL SLOPES:

LEFT BANK
FIGURE 1 (PENCIL LINE) FS:

RIGHT BANK
FIGURE 2 (PENCIL LINE) FS:

$\gamma H = 115 \times 16$

$= 1840$

Putting $\frac{c'}{\gamma H} = 0.05$ $\underline{c' = 90 \text{ PSF}}$

$D = 1.5$

$\phi' = 25^\circ$

$\underline{\text{Slope} = 3:1}$

From Table A - 6

$m = 2.467$

$n = 2.179$

$F = m - n r_u$

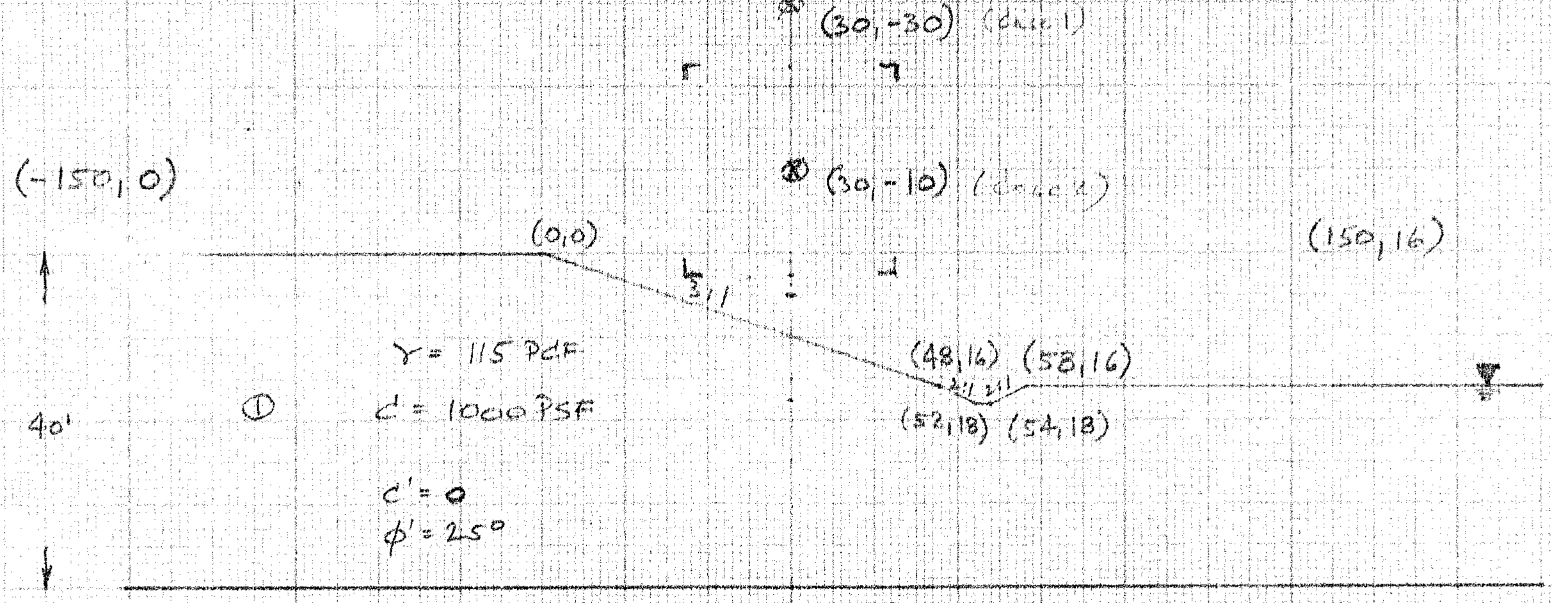
$= 2.467 - 2.179 \times 0.6$

$= 2.467 - 1.307$

$= \underline{1.16}$ $\underline{\text{SAFE}}$

CUT SLOPES

				R	x_c	y_c
TOTAL STRESS	CUT SEC 1 –	F.S.	2.699	80	25	-30
	2 –		3.527	48.5	25	-22.5



②

γ = 115 PCF
c = 700 PSF

c' = 0
ϕ' = 25°

NOTE: WABI RIVER, CUT SECTION 1 } TOTAL
" " " " 2 }
" " " 3 Effect.

FIGURE ④

CUT 20 FT.

CHESTER CREEK

69 - 11039

	$c = 1000$ $c = 700$	$c' = 250$ $\phi' = 25°$	$c' = 0$ $\phi' = 25°$	$c' = 50$ $\phi' = 25°$
3:1 Slope	2.43	1.70	0.72	0.95
20' Bench	2.84	2.12	0.94	1.36

CHESTER CREEK. FILL. 69-11039

	Fill c = 1000 soil c = 700 (Prog. 33)	Fill ϕ = 30 soil c = 700 (Prog. 33)	Fill ϕ = 30 soil c = 700 (Prog 32)
3:1 slope	1.213	1.076	1.154
20' Berm	1.282	1.158	1.231
30' Berm	1.322	1.204	1.275
40' Berm (extrapolated)	1.36	1.25	1.31

Berms to be provided = 30 ft.

69-T-39

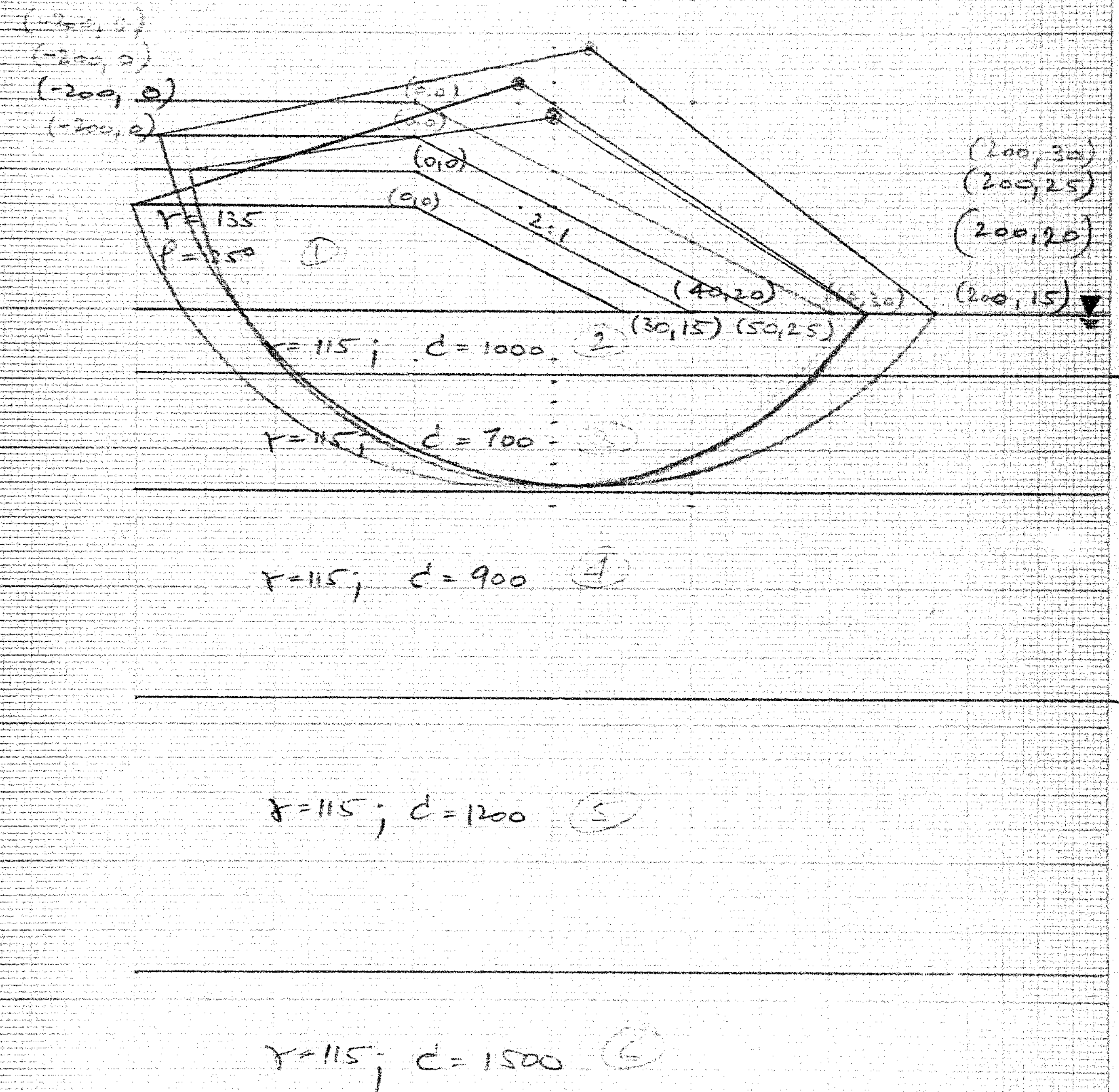


FIGURE 3

WABI RIVER

69-F-39

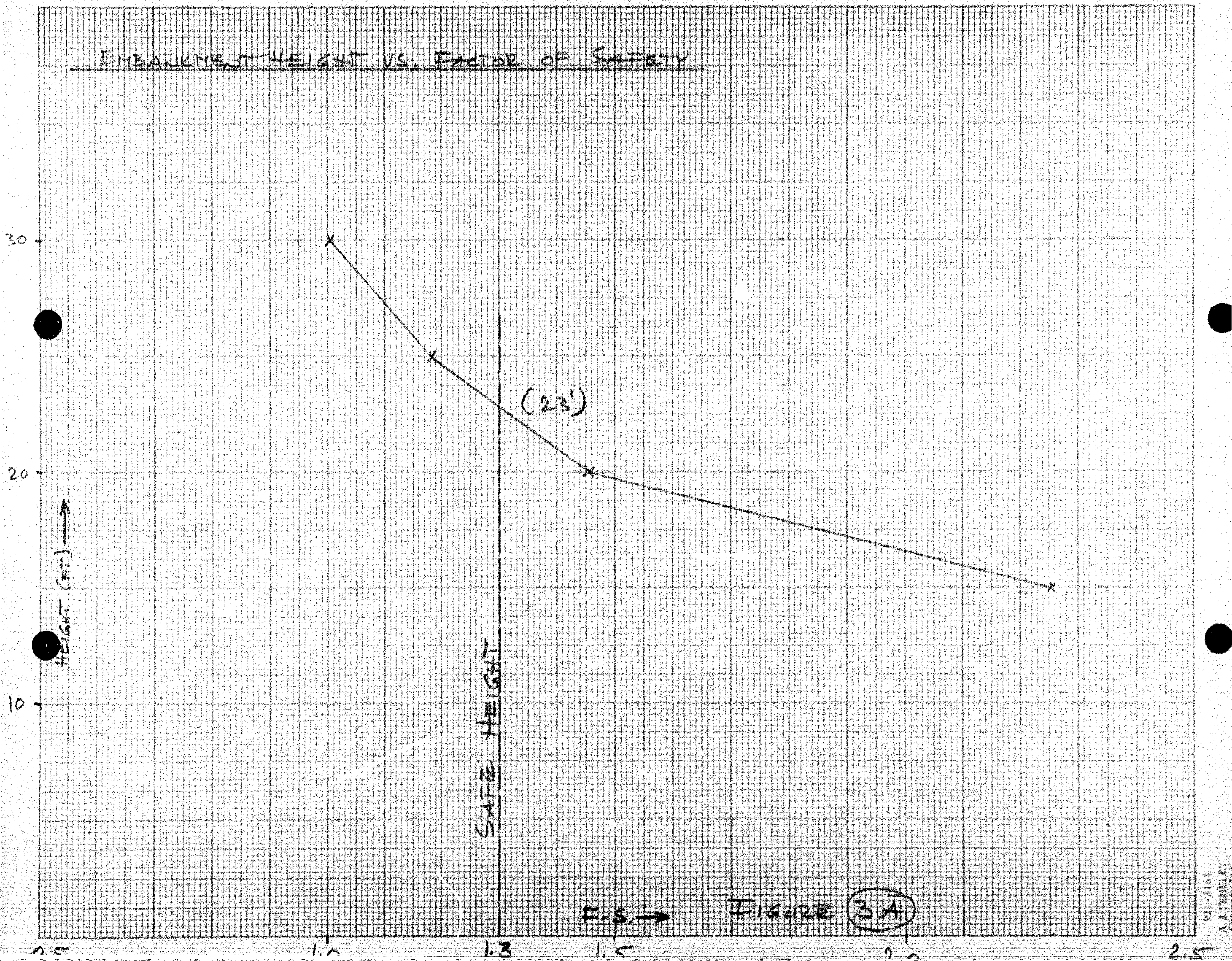


FIGURE 3A

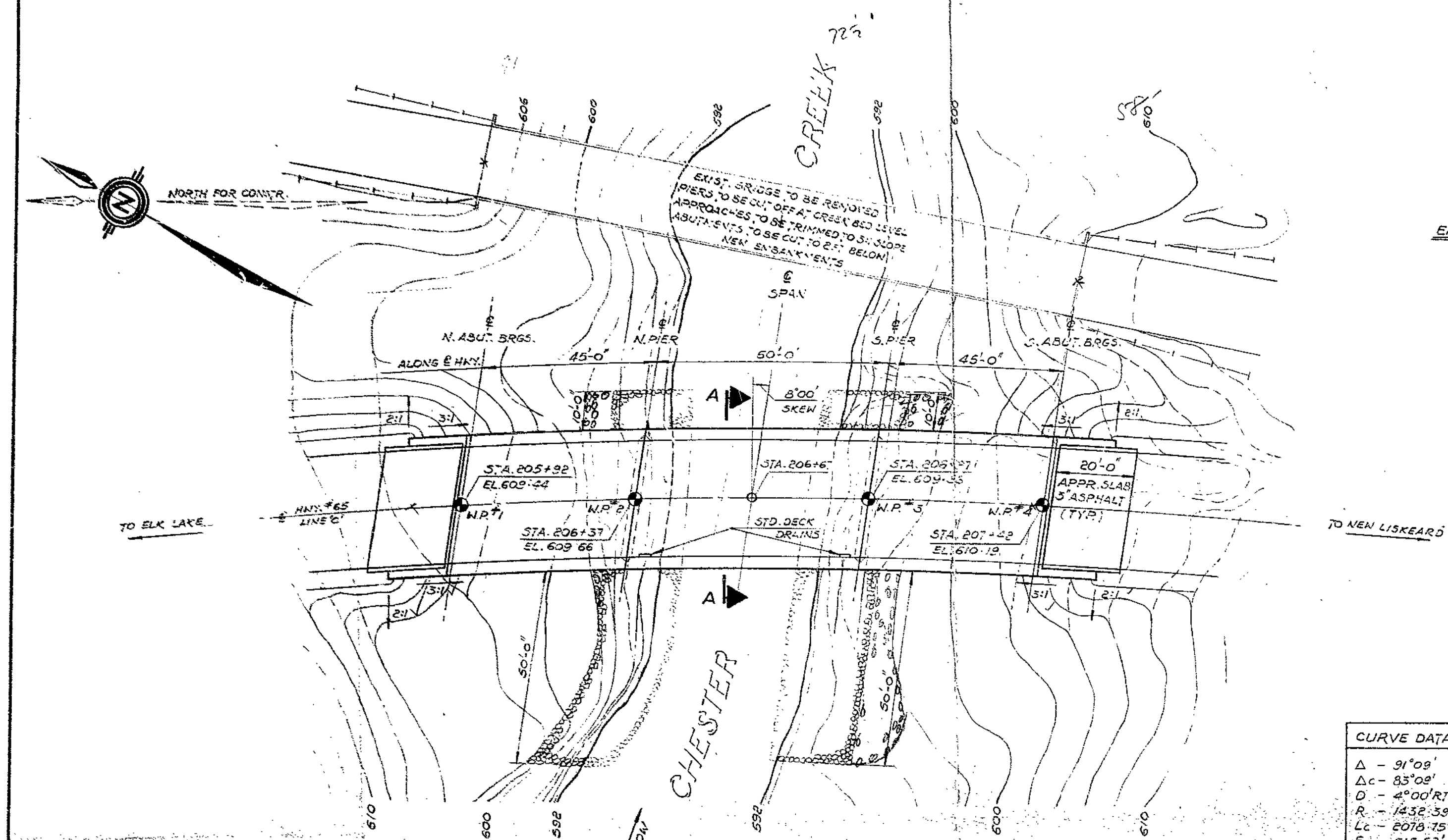
69-F-39

W.P. 39-67-02

H.W.Y. 65

LINE "A", "B" "E" AND "D"

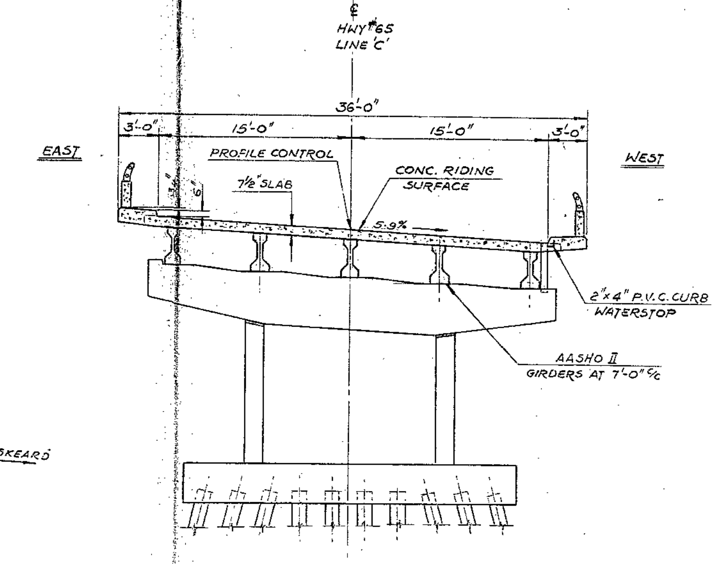
CHESTER CREEK



PLAN

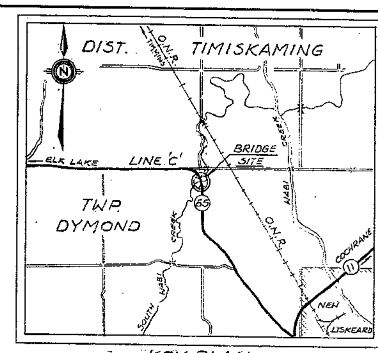
SCALE: 1"=20'-0"

CURVE DATA
Δ - 91°09'
Δc - 83°08'
D - 4°00' RT.
R - 1432.39'
Lc - 2078.75'
Es - 615.62'



SECTION A-A

SCALE: 1"=6'-0"



KEY PLAN

SCALE: 1 IN. = 0.8 MI.

NOTES

CLASS OF CONCRETE

DECK, CURBS OVER DECK & PARAPET WALLS __ 4,000 P.S.I.
REMAINDER ____________________ 3,000 P.S.I.
FOR PRESTRESSED GIRDERS SEE D-6994-7

CLEAR COVER ON REINFORCING STEEL.

FOOTINGS, ABUTMENTS & PIERS __ 3"
DECK TOP ____________ 1½"
DECK BOTTOM ____________ 1"
CURBS ____________ 2"
AND/OR AS NOTED.

CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARINGS SEATS DEAD LEVEL TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ±1/8".

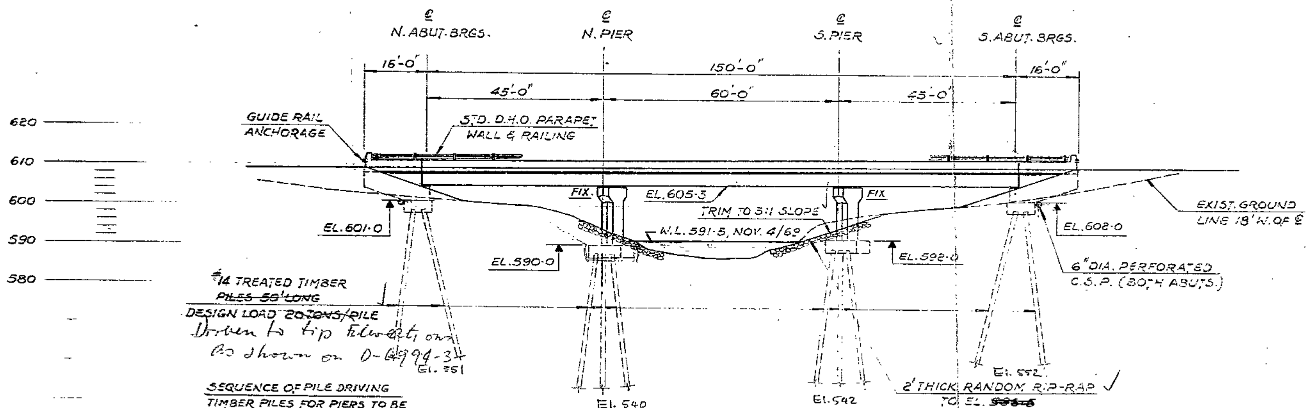
UNLESS SHOWN OTHERWISE NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

LIST OF DRAWINGS

D-6994-1 GENERAL LAYOUT
-2 BORE HOLE LOCATIONS & SOIL STRATA
-3 FOOTING LAYOUT
-4 N. ABUTMENT
-5 S. ABUTMENT
-6 PIERS
-7 PRESTRESSED GIRDERS & BEARINGS
-8 DECK, DIAPHRAGMS & SCREED ELEVATIONS
-9 APPROACH SLABS
-10 PARAPET WALL DETAILS
-11 STANDARD STEEL PARAPET RAIL
-12 STANDARD DETAILS I
-13 STANDARD DETAILS II

REGISTERED PROFESSIONAL ENGINEER
C. F. FARRELL
PROVINCE OF ONTARIO

PRINT RECORD		
No.	FOR	DATE

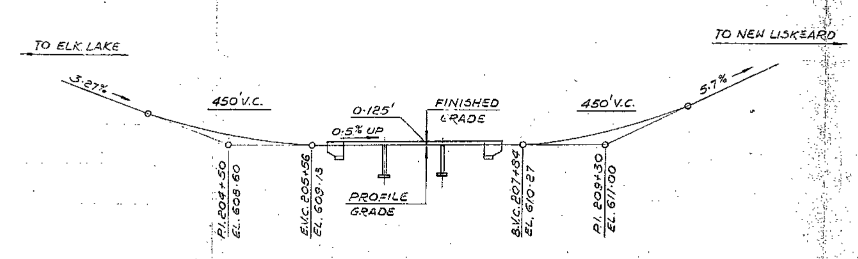


#14 TREATED TIMBER ~~PILES 50' LONG~~
DESIGN LOAD ~~20 TONS~~/PILE
Driven to tip elevations as shown on D-6994-3

SEQUENCE OF PILE DRIVING
TIMBER PILES FOR PIERS TO BE DRIVEN PRIOR TO DRIVING PILES FOR ABUTMENTS.

WEST ELEVATION

SCALE: 1"=20'-0"



PROFILE GRADE @ ℄ HWY. #65, LINE 'C'

N.T.S.

B.M. EL. 629.57
GEODETIC DATUM
N.&W. IN N. ROOT 1.1' BIR.
211' RT. 208+43

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE OFFICE

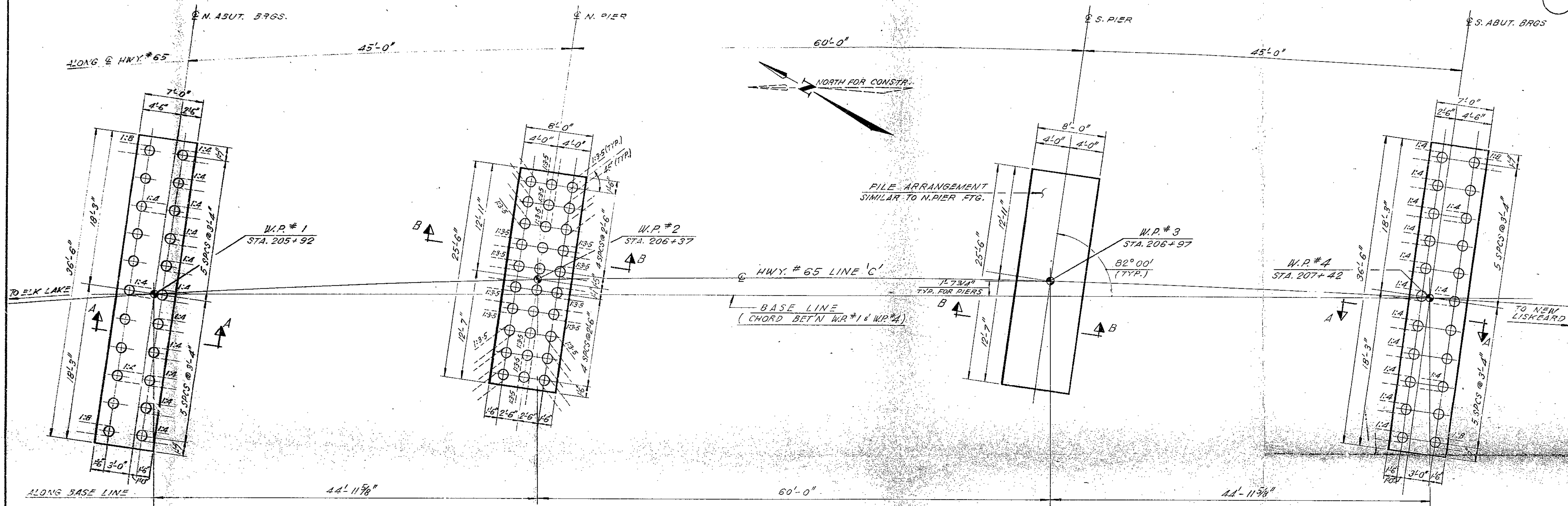
69-F-39

CHESTER CREEK BRIDGE
(SOUTH WABI RIVER)
(2.0 MI. N.W. OF JCT. HWY. #11)

KING'S HIGHWAY No. 65 — DIST. No. 14
DIST. OF TIMISKAMING
TWP. OF DYMOND — LOT 4 — CON. 3

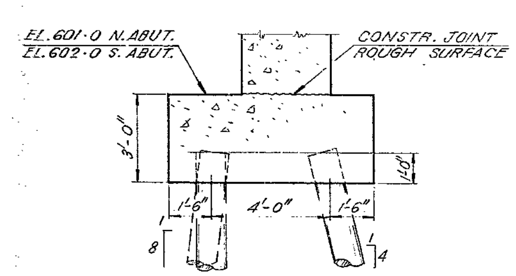
GENERAL LAYOUT

APPROVED ____ BRIDGE ENGINEER				SITE No. 47-49	W.P. No. 39-67-02
DESIGN	C.F.F.	CHECK	P.O.L.	CONTRACT Nos.	
DRAWING	H.N.	CHECK	C.F.F.	DRAWING No.	D-6994-1
DATE	MAR./71	LOADING	HS20-44		



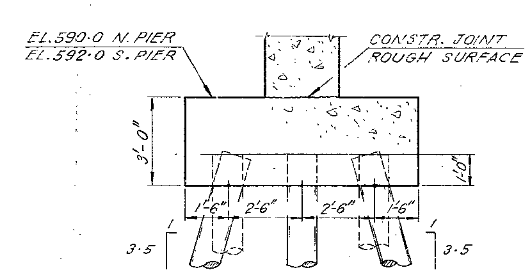
FOOTING LAYOUT

SCALE: 3/16" = 1'-0"



SECTION A–A

SCALE: 3/8" = 1'-0"



SECTION B–B

SCALE: 3/8" = 1'-0"

LIST OF #14 TREATED TIMBER PILES			
LOCATION	Nº REQ'D	LENGTH	CUT OFF ELEV.
N. ABUTMENT	22 ✓	50'	599·0
N. PIER	30 ✓	50'	588·0
S. PIER	30 ✓	50'	590·0
S. ABUTMENT	22 ✓	50'	600·0

PRINT RECORD

No.	FOR	DATE

REGISTERED PROFESSIONAL ENGINEER C. F. FARRELL PROVINCE OF ONTARIO

FOR REDUCED PLAN

USE SCALE BELOW

0 1 2 3

3 INCHES ON ORIGINAL PLAN

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO

BRIDGE OFFICE

69-F-39

CHESTER CREEK BRIDGE

(SOUTH WABI RIVER)

(2·0 MI. N.W. OF JCT. HWY. # 11)

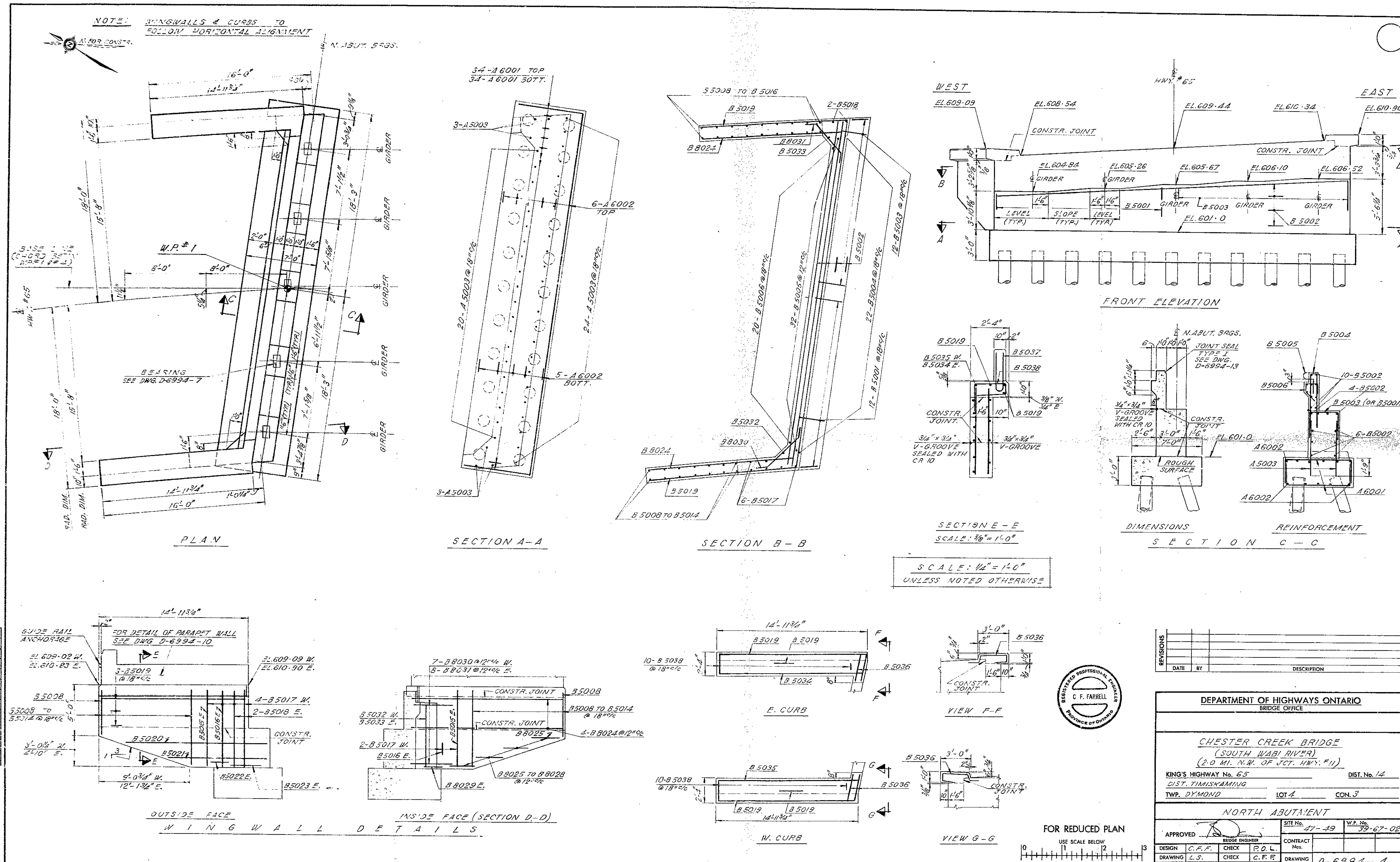
KING'S HIGHWAY No. 65 DIST. No. 14

DIST. TIMISKAMING

TWP. DYMOND LOT 4 CON. 3

FOOTING LAYOUT

APPROVED	BRIDGE ENGINEER			SITE No. 47-49	W.P. No. 39-67-02
DESIGN	C.F.F.	CHECK	R.O.L.	CONTRACT Nos.	
DRAWING	L.S.	CHECK	C.F.F.	DRAWING No.	D-6994-3
DATE	MAR./71	LOADING	HS20-44		



PRINT RECORD		
No.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

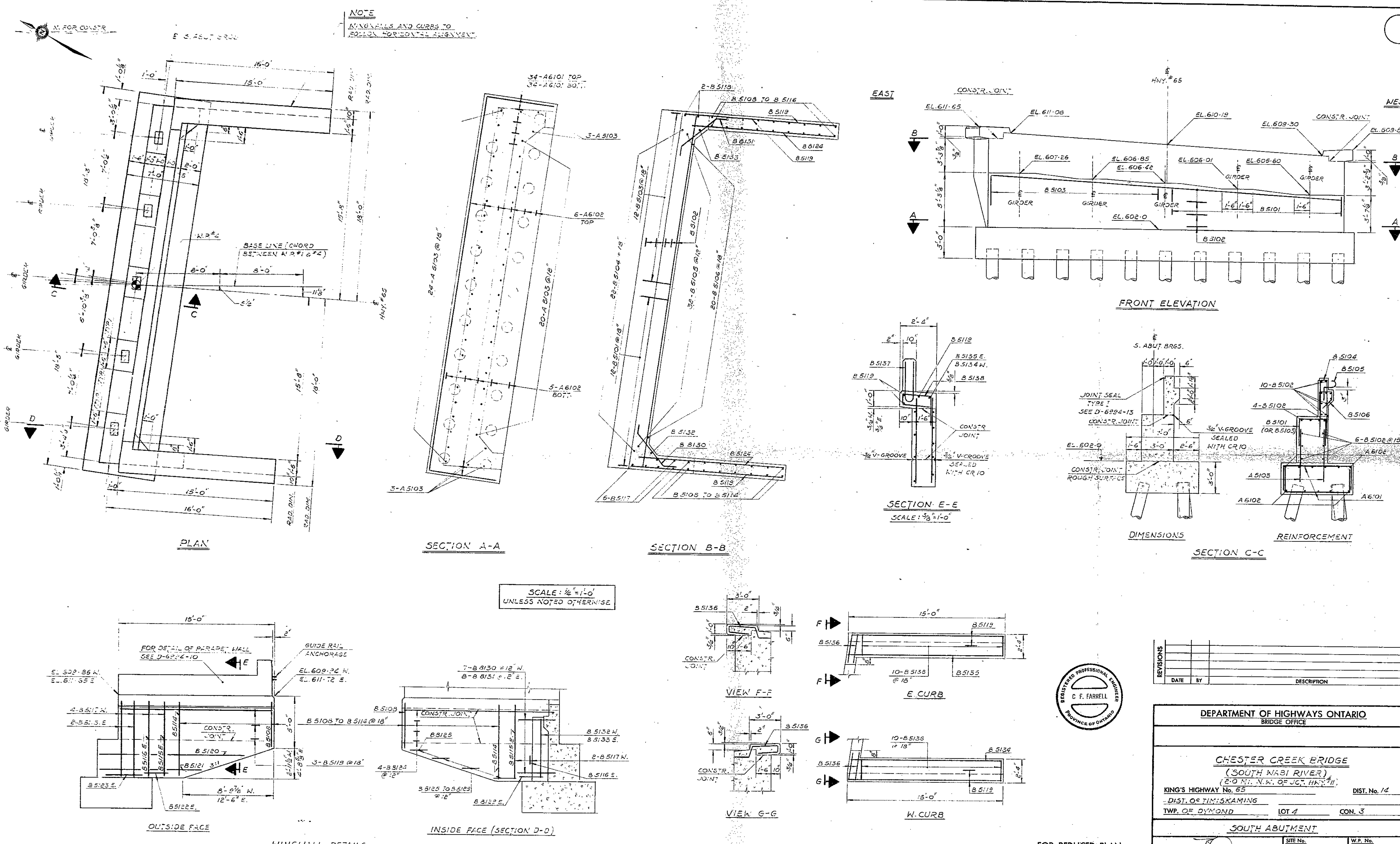
DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE OFFICE

CHESTER CREEK BRIDGE
(SOUTH WABI RIVER)
(2.0 MI. N.W. OF JCT. HWY. #11)

KING'S HIGHWAY No. 65 DIST. No. 14
DIST. TIMISKAMING
TWP. DYMOND LOT 4 CON. 3

NORTH ABUTMENT

APPROVED (BRIDGE ENGINEER)				SITE No. 47-49	W.P. No. 39-67-02
DESIGN	C.F.F.	CHECK	P.O.L.	CONTRACT Nos.	
DRAWING	L.S.	CHECK	C.F.F.	DRAWING No.	D-6994-4
DATE	MAR./71	LOADING	HS 20-44		



PRINT RECORD		
No.	FOR	DATE

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

REGISTERED PROFESSIONAL ENGINEER
C. F. FARRELL
PROVINCE OF ONTARIO

REVISIONS		
DATE	BY	DESCRIPTION

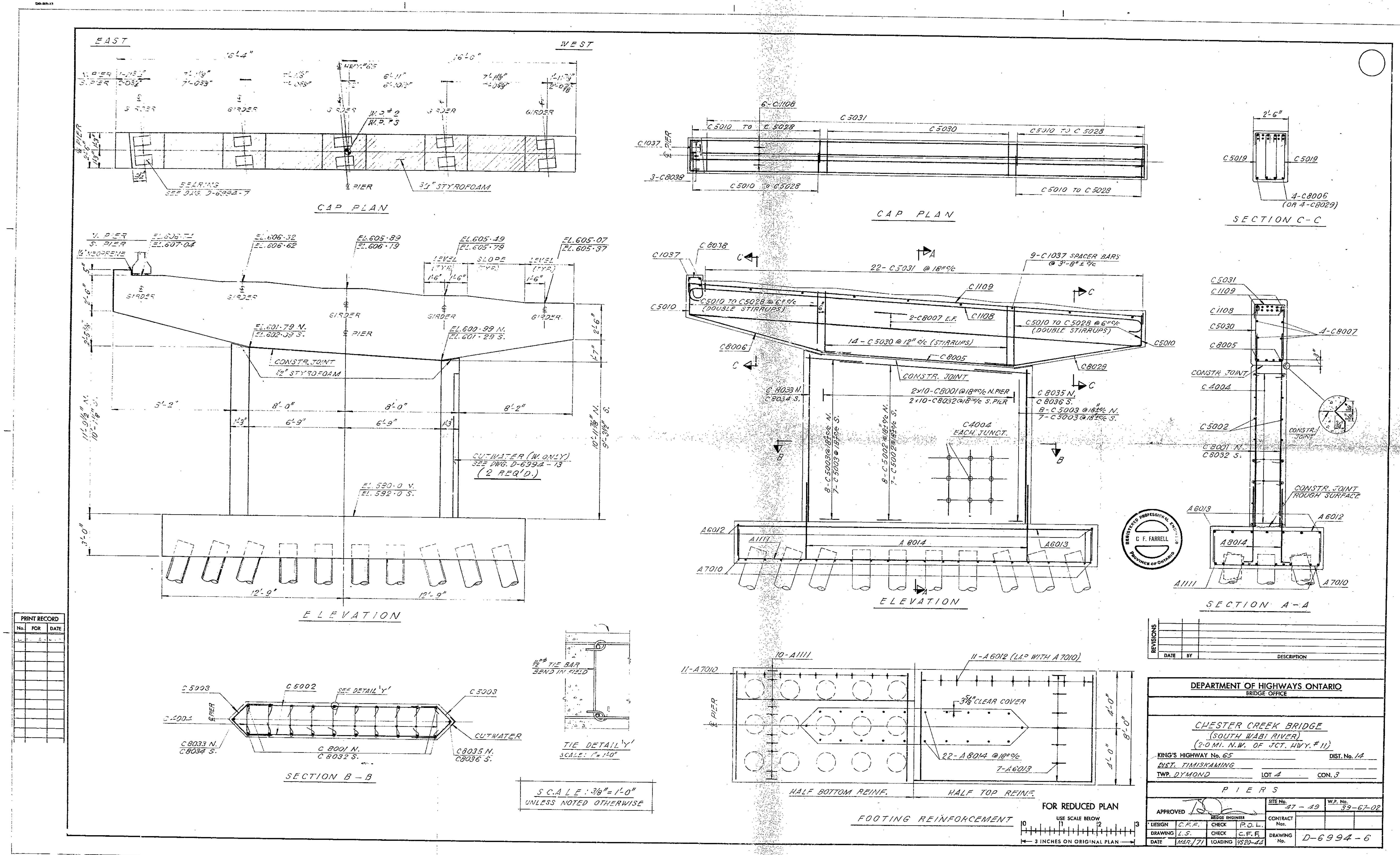
DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE OFFICE

CHESTER CREEK BRIDGE
(SOUTH WABI RIVER)
(2.0 MI. N.W. OF JCT. HWY. #11)

KING'S HIGHWAY No. 65 DIST. No. 14
DIST. OF TIMISKAMING
TWP. OF DYMOND LOT 4 CON. 3

SOUTH ABUTMENT

APPROVED	BRIDGE ENGINEER			SITE No. 47-49	W.P. No. 39-67-02
DESIGN	C.F.F.	CHECK	P.O.L.	CONTRACT Nos.	
DRAWING	H.N.	CHECK	C.F.F.	DRAWING No.	D-6994-5
DATE	MAR./71	LOADING	HS 20-44		


EAST
WEST
CAP PLAN
BEARING SEE DWG. D-6994-7
℄ PIER
3/4" STYROFOAM
GIRDER
6-C1108
C5031
C5010 TO C5028
C5030
C1037
3-C8038
C5019
4-C8006 (OR 4-C8029)
SECTION C-C
EL.605·89 EL.606·19
EL.605·49 EL.605·79
EL.605·07 EL.605·37
EL.606·32 EL.606·62
EL.601·79 N. EL.602·09 S.
EL.600·99 N. EL.601·29 S.
1/4" NEOPRENE
LEVEL (TYP.)
SLOPE (TYP.)
CONSTR. JOINT
1/2" STYROFOAM
CUTWATER (W. ONLY) SEE DWG. D-6994-13 (2 REQ'D.)
EL.590·0 N. EL.592·0 S.
ELEVATION
22-C5031 @ 18" c/c
9-C1037 SPACER BARS @ 3'-8" ± c/c
C1109
C5010 TO C5028 @ 6" c/c (DOUBLE STIRRUPS)
2-C8007 E.F.
C1108
14-C5030 @ 12" c/c (STIRRUPS)
C8005
C8006
C8029
C8033 N. C8034 S.
2×10-C8001 @ 18" c/c N. PIER
2×10-C8032 @ 18" c/c S. PIER
C8035 N. C8036 S.
8-C5003 @ 18" c/c N.
7-C5003 @ 18" c/c S.
C4004 EACH JUNCT.
A6012
A1111
A8014
A6013
A7010
ELEVATION
C4004
C5002
C8001 N. C8032 S.
CONSTR. JOINT ROUGH SURFACE
4-C8007
SECTION A-A
C5003
C5002
SEE DETAIL 'Y'
C8001 N. C8032 S.
CUTWATER
SECTION B-B
1/2" Ø TIE BAR BEND IN FIELD
TIE DETAIL 'Y' SCALE: 1" = 1'-0"
SCALE: 3/8" = 1'-0" UNLESS NOTED OTHERWISE
11-A7010
10-A1111
11-A6012 (LAP WITH A7010)
3/8" CLEAR COVER
22-A8014 @ 18" c/c
7-A6013
HALF BOTTOM REINF.
HALF TOP REINF.
FOOTING REINFORCEMENT
FOR REDUCED PLAN USE SCALE BELOW
3 INCHES ON ORIGINAL PLAN
C. F. FARRELL
REGISTERED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO
PRINT RECORD
No. FOR DATE
REVISIONS
DATE BY DESCRIPTION
DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE OFFICE
CHESTER CREEK BRIDGE
(SOUTH WABI RIVER)
(2·0 MI. N.W. OF JCT. HWY. #11)
KING'S HIGHWAY No. 65
DIST. No. 14
DIST. TIMISKAMING
TWP. DYMOND
LOT 4
CON. 3
PIERS
APPROVED
BRIDGE ENGINEER
SITE No. 47-49
W.P. No. 39-67-02
DESIGN C.F.F.
CHECK P.O.L.
DRAWING L.S.
CHECK C.F.F.
DATE MAR/71
LOADING HS20-44
CONTRACT Nos.
DRAWING No. D-6994-6