DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Bldg.,

From: G. C. E. Burkhardt

Date: December 30, 1963.

Our File Ref.

In Reply to

Subject: Township of Lobo - Robinson Bridge
Lot 7, Con. II/III - County of Middlesex
Structure Site #20-219 - Our File No. B/ 1725

Attached please find one copy of the Foundation Report, by Dominion Soil Investigation Limited, and one copy of the Preliminary Plans for your comments.

We do not intend to approve the plans before the middle of January 1964, since we have to carry out a hydrology investigation. We would appreciate it very much, if we could have your comments on/or before Jan. 15th, 1964.

GCEB/bm

G. C. E. Burkhardt,
for K. L. Kleinsteiber,
Mun. Bridge Liaison Eng.

c.c. J. Walter

Regarding foundations - no comment.
Scour problem - hydraulogy should comment.
By phone to G.C.E.B.
A. Stermac

Dec 30. 1964.

BA 1725

MESSRS. A. M. SPRIET & ASSOCIATES
CONSULTING ENGINEERS
264 WELLINGTON STREET
LONDON ... ONTARIO

Report On

SOIL INVESTIGATION
For
ROAD BRIDGE
CONCESSIONS II and III, LOT 7
TOWNSHIP OF LOBO

by

DOMINION SOIL INVESTIGATION LIMITED
363 Queens Avenue
London Ontario
Reference No. 3-8-L2
August, 1963

CONTENTS

ENCLOSURES

SUMMARY

The Strata consist of a thin surface layer of sand covering a deep deposit of very stiff grey silty clay.

It is recommended that the structure should be supported on spread footings using a gross soil pressure of 4500 p.s.f. at El. 77 feet. Consolidation settlement will be small, so that a rigid-frame structure should perform satisfactorily.

No unusual construction problems are anticipated.

I. INTRODUCTION

In accordance with verbal authorization from Mr. A. M. Spriet a soil investigation has been carried out at a site in the Township of Lobo, where it is proposed to replace two adjacent road bridges with one new structure. The present bridges carry a gravel road across the Oxbow Creek which flows eastward to the Thames River.

The approximate positions of the new structure and of the boreholes were indicated to the writer by Mr. A. DeVos during a visit to the site on the 6th of August, 1963. It is understood that the new bridge will have a span of 65 to 70 feet.

The purpose of this investigation has been to reveal the sub-surface conditions and to determine the necessary soil properties for the design and construction of foundations.

II. PHYSIOGRAPHY

The site lies within the physiographic region known as the Caradoc Sand Plain, and close to its north-eastern extremity where the sand deposit is very thin. This area was previously a delta of the River Thames at the time of the glacial lake Whittlesey.

The clay deposits lying below the sand are very stiff and appear to be over-consolidated, so that they are assumed to be of glacial origin.

III. FIELD WORK

Field work was carried out on the 6th and 7th of August, 1963 and consisted of two boreholes at the locations shown on enclosure 2. The holes were advanced by washboring and lined with Bx (3-inch) casing.

Standard Penetration tests were made at frequent intervals of depth to obtain a measure of the consistency of the soil and to recover disturbed samples. Attempts were made to recover undisturbed samples in 2-inch diameter thin-walled tubes. Below the proposed footing elevation this was only partially successful, because it was necessary to drive the tubes into the very stiff clay. Insitu Vane Shear tests were performed using a 2-inch diameter 4-bladed vane.

The results of the field tests are recorded on geotechnical data sheets comprising enclosures 3 and 4. Elevations have been referred to the client's local reference datum, viz., a spike on a tree root, to the west of the more westerly existing structure (El. 100-0 feet).

IV. SUBSURFACE CONDITIONS

Details of the stratification at each borehole are given on the data sheets, and a general picture of the subsurface conditions is provided by the profile shown on enclosure 2.

A thin surface deposit of fine, brown,compact, silty sand covers the site at both borehole locations. At borehole I the sand is damp, but at borehole 2 it reaches to a depth of 2 feet below the prevailing water table (El. 84-4) and within this zone it is saturated.

Beneath the sand, the grey silty clay stratum is very stiff, and highly impervious. Granular particles are almost entirely absent, and the material is assumed because of its stiffness to be over-consolidated. Below about El. 65 feet, numerous silt seams up to several inches in thickness are interlayered with the silty clay.

At the time of this investigation the level of the water table was El. 84-4 feet.

V. FOUNDATIONS

The level of the bed of the creek is approximately El. 82 feet. Allowing a 5-foot depth for scour, it is proposed that the structure should be supported on spread footings at El. 77. Below this elevation the average value of Vane Shear strength results at borehole 2 is 3760 p.s.f. (Such tests were not performed in the rather stiffer soil at borehole 1).

Foundations - continued

This value appears high in comparison to the recorded N-values of 15 and 18, so that a more conservative figure of 2500 p.s.f. has been used in calculating the bearing capacity of the soil.

Using Meyerhof's Theory, the ultimate bearing capacity of a footing 6 feet wide and 30 feet long is 13,500 p.s.f. Applying to this a factor of safety of 3, the allowable gross soil pressure is 4500 p.s.f.

Some settlement due to consolidation will occur under the dead load of the structure which is assumed to be of the order of 2500 p.s.f. Consolidation tests have not been performed because no truly undisturbed samples have been recovered from this very stiff material. However, experience in soils of similar consistency indicates that under the recommended loading, the consolidation settlement is unlikely to exceed 0.5 inch. Even assuming some error in this prediction, it can be taken that the total settlement due to consolidation will not exceed one-inch. On this basis a rigid-frame structure will perform quite satisfactorily.

VI. CONSTRUCTION

Excavations into the very stiff clay should encounter no special construction problems. Once the surface water has been diverted away from the site, the amount of seepage into the excavation through the clay stratum should be very small. Some seepage may be encountered through the sand layer which extends below the water table at borehole 2. This can be intercepted and carried away by a shallow trench dug outside the excavation.

Although the soil is not specially susceptible to disturbance, it is recommended that the footing grade should be protected with a thin layer of lean concrete as soon as it has been inspected and approved.

REFERENCES

1. The Physiography of Southern Ontario by L. J. Chapman and D. F. Putnam of the Ontario Research Foundation - University of Toronto Press 1951.

2. Procedures for Testing Soils, ASTM, April 1958. pp. 186 to 198. (Unified Soil Classification System - by A. A. Wagner)

3. Terzaghi and Peck: Soil Mechanics in Engineering Practice. John Wiley and Sons, New York 1948.

4. The Ultimate Bearing Capacity of Foundations by G. G. Meyerhof Geotechnique, Vol. II, 1950 and 1951.

DOMINION SOIL INVESTIGATION LIMITED

James Park, M. Sc., P. Eng.

REGISTERED PROFESSIONAL ENGINEER
CIVIL
J. PARK
PROVINCE OF ONTARIO

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.

BOULDER	COBBLE	GRAVEL		SAND			SILT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
		COARSE	FINE	COARSE	MEDIUM	FINE						

Ø > 8" 3" 3/4" 4.76mm 2.0 0.42 0.074 0.002 > NO SIZE LIMIT

U.S. Standard Sieve Size: No.4 No.10 No.40 No.200

SAMPLE TYPES.

AS	Auger sample	RC	Rock core	TP	Piston, thin walled tube sample
CS	Sample from casing	%	Recovery	TW	Open, thin walled tube sample
ChS	Chunk sample	SS	Split spoon sample	WS	Wash sample

SAMPLER ADVANCED BY static weight : w
" pressure : p
" tapping : t

OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittent pressure; Washwater returns; Washwater lost

PENETRATION RESISTANCES.

SYMBOL:

DYNAMIC PENETRATION RESISTANCE : to drive a 2"ø, 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot

STANDARD PENETRATION RESISTANCE, -N- : to drive a 2" outside dia, split spoon sampler 1 foot into the ground, expressed in blows per foot.

EXTRAPOLATED -N- VALUE

The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

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SOIL PROPERTIES.

W %	Water content	γ	Natural bulk density (unit weight)	k	Coeff. of permeability
LL %	Liquid limit	e	Void ratio	C	Shear strength — in terms of total stress
PL %	Plastic limit	RD	Relative density	ϕ	Angle of int. friction — in terms of total stress
PI %	Plasticity index	C_v	Coeff. of consolidation	C'	Cohesion — in terms of effective stress
LI	Liquidity index	m_v	Coeff. of volume compressibility	ϕ'	Angle of int. friction — in terms of effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL COMPRESSION TEST — UNCONFINED TEST — LABORATORY VANE TEST — FIELD VANE TEST — POCKET PENETROMETER TEST

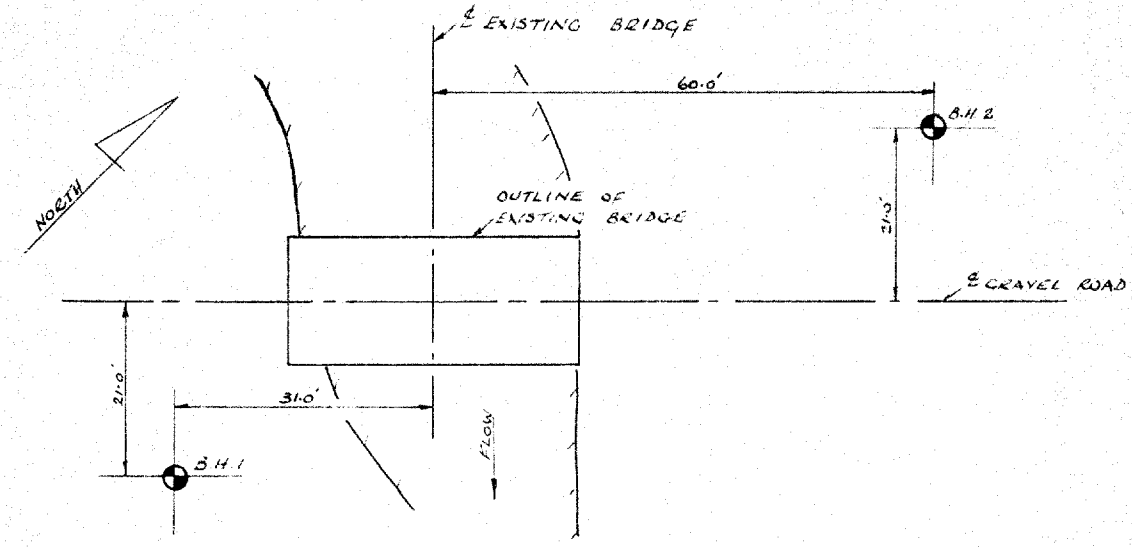
St

Strain at failure is represented by direction of stem: 20%, 15%, 5%, 10%

St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

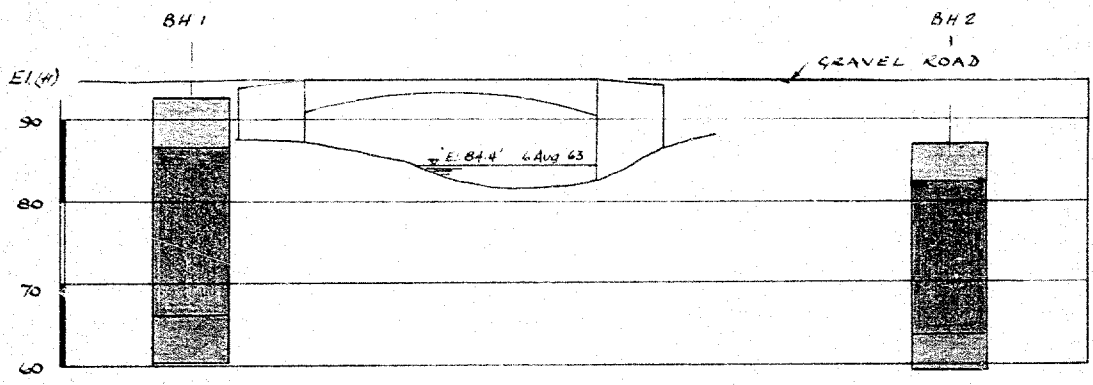
SOIL DESCRIPTION.

COHESIONLESS SOILS :	RD :	COHESIVE SOILS :	C lbs/sq ft
Very loose	0 – 15 %	Very soft	less than 250
Loose	15 – 35 %	Soft	250 – 500
Compact	35 – 65 %	Firm	500 – 1000
Dense	65 – 85 %	Stiff	1000 – 2000
Very dense	85 – 100 %	Very stiff	2000 – 4000
		Hard	over 4000



LOCATION OF BOREHOLES

SCALE - 1 INCH TO 15 FEET



LEGEND

- SILTY SAND
- VERY STIFF SILTY CLAY
- STIFF SILTY CLAY WITH SILT SEAMS
- WATER LEVEL

SUBSURFACE PROFILE

SCALE: 1" TO 15'

GEOTECHNICAL DATA SHEET FOR BOREHOLE 1

OUR REFERENCE NO. 3-8-L2

CLIENT: Messrs A.M. Spriet & Associates
PROJECT: Road bridge
LOCATION: Township of Lobo
DATUM ELEVATION: 100.0' (spike on tree)

METHOD OF BORING: Washboring
DIAMETER OF BOREHOLE: 3"
DATE: 6 Aug 63

PROFILE NO. 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES No. of Advancement of Sampler	PENETRATION RESISTANCE blows per foot 20 40 60 80 100 / SHEAR STRENGTH lbs/sq ft 3000 6000	CONSISTENCY water content % PL W LL	REMARKS
92.3	0	Ground surface							
		Clayey topsoil							
		Fine brown silty sand							
	5			1	SS	15			
86.3									
	10			2	TW				
				3	SS	13			
					vane		St=2.1		
	15			4	TW				Proposed footing elevation 77.0'
		Very stiff grey silty clay		5	SS	21			
	20			6	SS	22			
	25			7	SS	20			
66.3		Stiff grey clay with interlayered silt seams							
	30			8	SS	13			
60.8		End of borehole							

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: MC CH'D: JP

OUR REFERENCE NO. 3-8-L2

GEOTECHNICAL DATA SHEET FOR BOREHOLE . . 2 . . .

CLIENT: Messrs A.M.Spriet & Associates
PROJECT: Road bridge
LOCATION: Township of Lobo
DATUM ELEVATION: 100.0' (spike on tree)

METHOD OF BORING: Washboring
DIAMETER OF BOREHOLE: 3"
DATE: 7 Aug 63

ENCLOSURE NO. 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N-or Advancement of Sampler	PENETRATION RESISTANCE blows per foot (20 40 60 80 100) / SHEAR STRENGTH lbs/sq ft (1000 3000 5000)	CONSISTENCY water content % (PL W LL)	REMARKS
		Ground surface							
86.9	0	organics							
		Fine brown silty sand							
82.4	5			1	SS	20			
	10			2	SS	18			Proposed footing elevation 77.0'
					vane		St=1.4		
	15	Very stiff grey silty clay		3	SS	15			
					vane		St=2.2		
				4	TW				
	20			5	SS	22			
							St=2.2		
63.9		Stiff grey clay with interlayered silt seams							
	25			6	SS	23			
59.4		End of borehole							

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

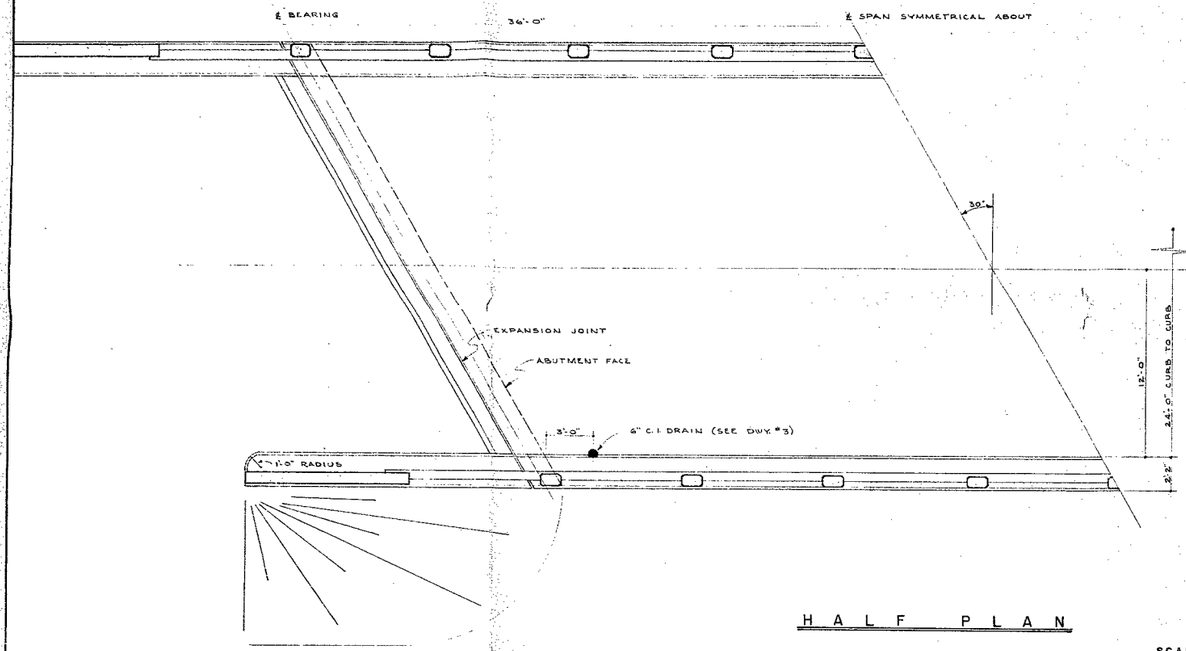
MADE: MC CH'D: JP

63-F-256M

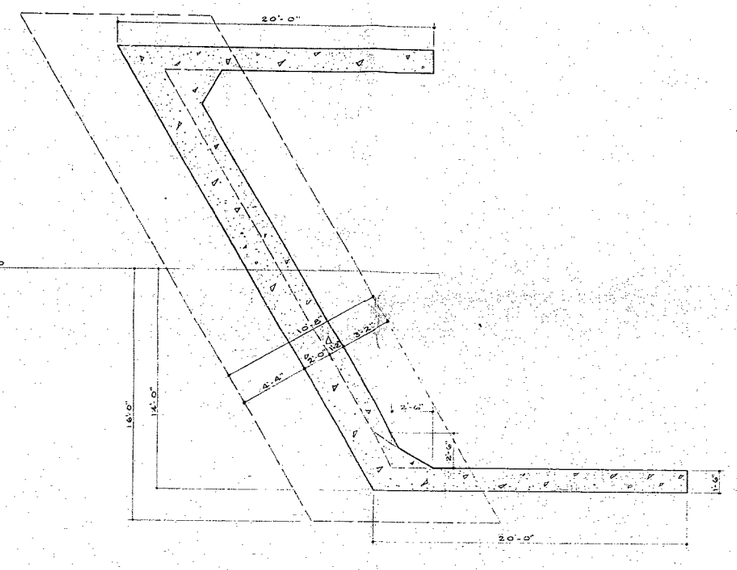
ROBINSON BRIDGE

LOT 7, CON. II / III

LOBO TWP.

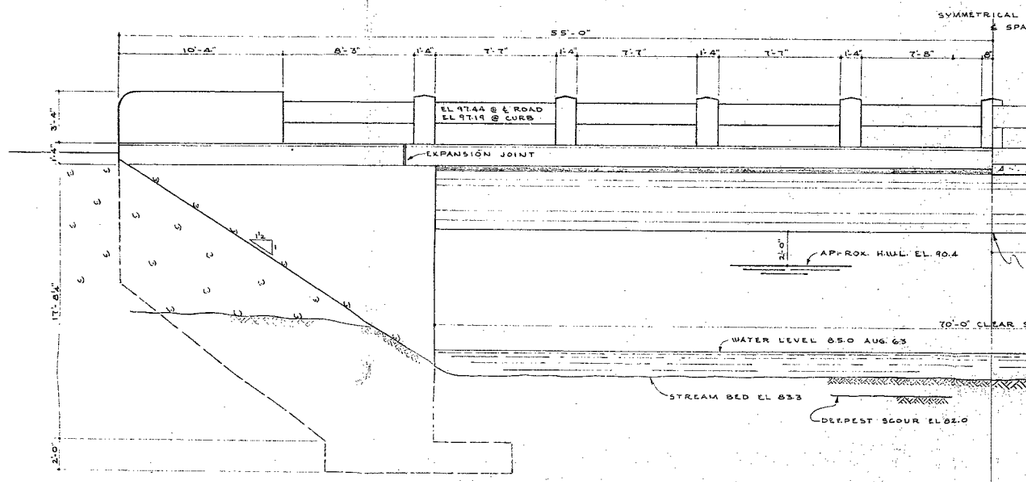


HALF PLAN

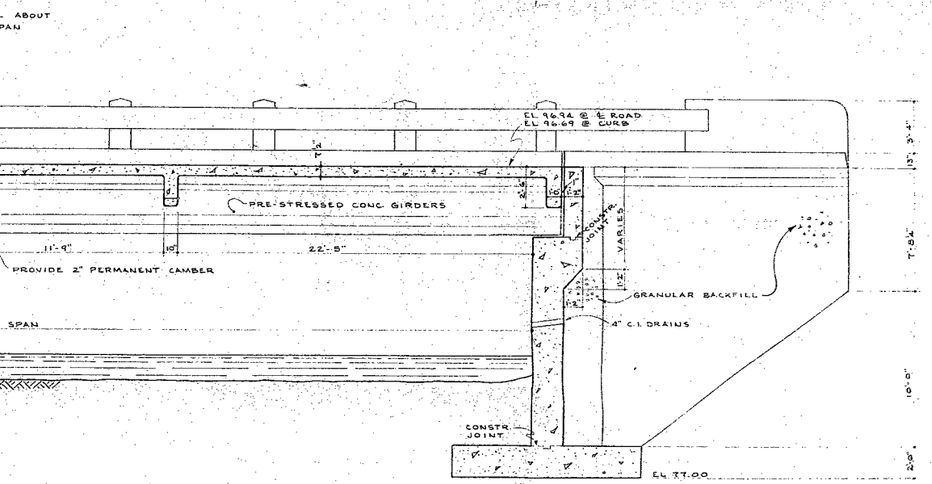


HALF SECTION

SCALE $\frac{1}{4}$" = 1'-0"



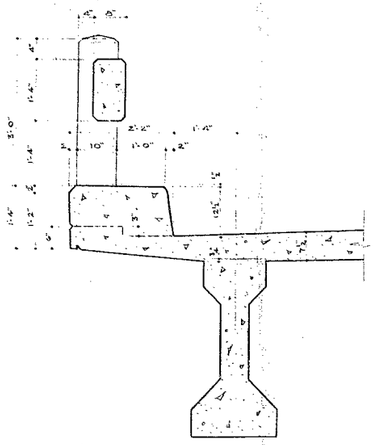
HALF ELEVATION



HALF SECTION

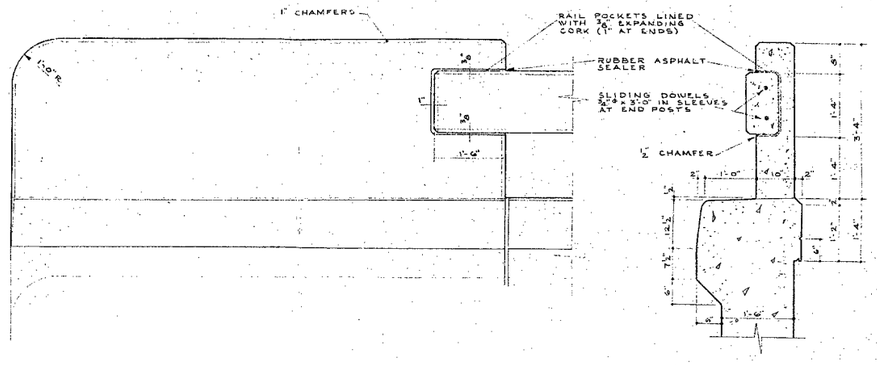
SCALE $\frac{1}{4}$" = 1'-0"

ROBINSON BRIDGE TOWNSHIP OF LOBO			
SCALE: AS NOTED DATE: 10-12-63	APPROVED BY:	JOB NO 6339	DRAWN BY A.J.D. REVISED
PLAN, SECT., & ELEV.			
			DRAWING NUMBER 2



CURB & RAIL DETAIL

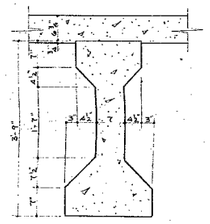
SCALE $\frac{3}{4}$" = 1'-0"



END POST DETAIL

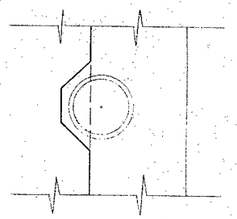
SECTION A-A

SCALE $\frac{3}{4}$" = 1'-0"

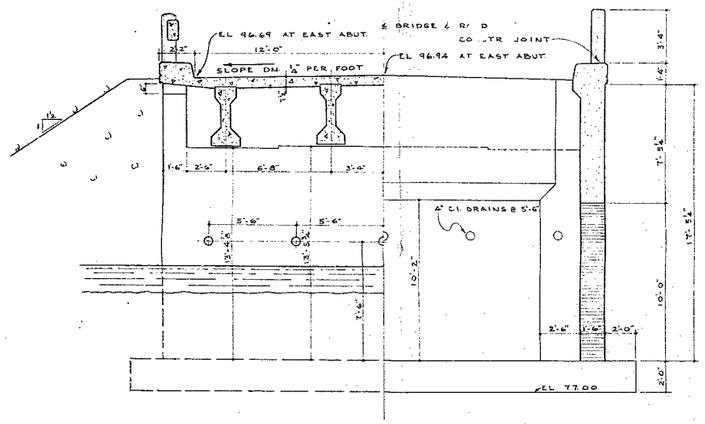


PRECAST GIRDER DETAIL

SCALE $\frac{3}{4}$" = 1'-0"

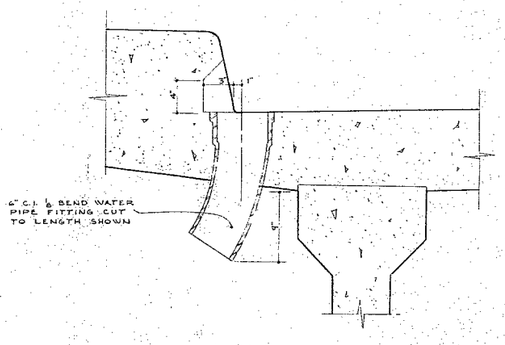


PLAN



HALF CROSS SECT. HALF END VIEW

SCALE $\frac{1}{4}$" = 1'-0"



DRAIN DETAIL

4 REQ'D

SCALE $1\frac{1}{2}$" = 1'-0"

GENERAL NOTES

1. Structure designed for H-20 [illegible]

2. Work on the structure must not be commenced in the vicinity of the contract plans have been checked and checked by the [illegible].

3. Structure to be built in accordance with O.H.C. Spec. [illegible] and the Highway Specifications for the Bridge Con. [illegible]

4. The complete soil investigation report by Dominion Soil Research [illegible] is filed and is contained at the Consulting Engineers' office. The Consulting Engineers [illegible] the meaning of this report.

5. Footing depths subject to revision by Engineer. Footing designed for a maximum soil pressure of 4,000 lbs. per sq. ft.

6. Footings to be finished in the most dimensional and the concrete shall be poured against undisturbed material where practicable.

7. No concrete shall be placed in the footings before the character of the soil and excavation for footings has been approved by the Engineer.

8. Concrete Mix
   (a) Minimum strength at 28 days 3000 psi. except the precast prestressed beams.
   (b) All concrete except in footings shall include an approved air entraining agent.
   (c) Maximum size of aggregate shall be 3/4 in. in deck slab, curb and guardrail; 1½ in. footings and 1 in. elsewhere or as specified.
   (d) Concrete Mix 1-2-4

9. All exposed edges to be chamfered 1" unless otherwise noted. All re-entrant angles shall be filleted as indicated.

10. No concrete to be poured before materials, men, formwork, falsework and reinforcing have been checked by the Engineer.

11. Deck falsework shall not be struck until all backfill has been placed and compacted behind the abutments, to the satisfaction of the Engineer. In case of girders and beams, all backfill to be placed before girders are erected and secured.

12. Backfill behind abutments to be brought up simultaneously at both ends.

13. Construction joints not shown on plans must be approved by the Engineer.

14. Reinforcing Steel to be Hi-Bond. Clear cover unless otherwise noted: 3" in footings and all surfaces in contact with earth or water; 1½" in bottom of decks; ¾" elsewhere.

15. Precast Prestressed Concrete Beams
    Concrete Strengths (a) On stressing 4,000 p.s.i.
    (b) At 28 days 5,000 p.s.i.

16. Work to be performed by others
    (a) Grading of approaches shall be by the Township.

17. Estimated Quantities:
    (a) Reinforcing Steel 18.0 TONS
    (b) Concrete 304.3 C.Y.

18. Notify O.H.C. prior to stressing Conc. Beams. Submit prestressed Shop Drawings.

ROBINSON BRIDGE TOWNSHIP OF LOBO			
SCALE: AS NOTED	APPROVED BY:	JOB NO. 6339	DRAWN BY A.J.D.
DATE: 10-12-63			REVISED
ELEV., SECT., & DETAILS			
CONSULTING ENGINEERS LONDON, ONT.			DRAWING NUMBER 3