DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundation Eng.,
Materials & Research Section,
Lab. Building.

From: G.C.E. Burkhardt

Date: January 20, 1964.

Our File Ref.

In reply to

Subject: Township of Lobe
Edwards Bridge
Lot 12, Con.II/III
County of Middlesex
Structure Site No. 20-[illegible]6
Our File No. BA 1737

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 intend to approve the plans as soon as possible and we would appreciate it very much, if we could have your comments at your earliest convenience.

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

GCEB/kd
c.c. J. Walter

NOTE:
SHEETING SHOULD BE IMBEDED IN FOOTING SO AS TO PROVIDE POSITIVE SCOUR PROTECTION
GROSS SOIL PRESSURE TO BE 2.5 T/SQFT

BY PHONE JAN 22 1964 AGSTERMAC

BA-1737

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

Report on
SOIL INVESTIGATION
for
ROAD BRIDGE
CONCESSIONS II & III, LOT 12
TOWNSHIP OF LOBO

by
DOMINION SOIL INVESTIGATION LIMITED
363 Queens Avenue
LONDON - ONTARIO
Reference No. 3-8-L3
August 1963

CONTENTS

ENCLOSURES

SUMMARY

The main stratum is a stiff to very stiff grey silty clay containing many fine silt seams. There is a 3-foot thick band of predominantly silty material a short distance below the proposed footing elevation.

It is recommended that the structure should be supported on spread footings at El.76 feet. The gross soil pressure should be limited to 3000 p.s.f. or 4000 p.s.f. depending on which of two dewatering procedures is employed. The choice should be guided to some extent by local experience.

The structure should be simply supported to offset the effects of possible differential settlement.

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 an existing road bridge with a new structure. The present bridge carries a gravel road across the Oxbow Creek which is a tributary of the Thames River.

It is understood that the new bridge will have a span of 65 to 70 feet, and will be located approximately 75 feet to the west of the existing structure.

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

II PHYSIOGRAPHY

The site lies within the glacial spillway which follows the edge of the Lucan Moraine to the north-west. A thin deposit of gravel and sand encountered in the borings is probably the sediment of this glacial river. The underlying stratified clays and silts appear to belong to the Ekfrid Clay Plain which forms the substratum over a large area to the west of the site.

III FIELD WORK

Field work was carried out on the 8th and 9th 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. This was only partially successful, because it was necessary to drive the tubes into the very stiff soil by tapping with 140 lb. hammer. Insitu vane shear tests were performed using a 2-inch diameter 4-bladed vane.

A dynamic cone penetration test was performed adjacent to borehole 2 only. The results of this test in a stiff cohesive soil are of limited value so that no further such tests were made.

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 site (El.100.0 feet).

IV SUBSURFACE CONDITIONS

Details of the stratifications 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.

The upper layer of brown clayey silt fill is probably the local natural overburden which has been used to make up the road embankment. The clayey gravel and sand deposit which corresponds to the level of the creek bed is either the sediment of the present stream or, more likely, of the previous glacial river which covered the site.

The grey silty clay which comprises the principal stratum is in a stiff to very stiff condition. It contains numerous thin horizontal seams of silt, generally 1 or 2 millimetres in thickness, and a few seams of fine sand as indicated on the data sheets. The plasticity of the material is low and its permeability, at least in a vertical direction, is small. Insitu vane shear tests indicate a sensitivity of about 2.0.

In both boreholes near a depth of 20 feet, there is a 3-foot thick layer of mostly cohesionless silt, interlayered at random with horizontal clay seams up to 2 inches in thickness. The condition of the silt is compact to dense.

At the time of this investigation the average level of groundwater in the boreholes was El.87 (or 2 feet higher than the level of water in the creek).

V FOUNDATIONS

The soil is sufficiently strong to support the structure on spread footings, the only danger being that because of its high silt content it will be susceptible to disturbance during construction.

The level of the bed of the creek is approximately El.81.6 feet, so that allowing 5 to 6 feet for scour protection, it is proposed that the footings should bear at El.76.0 feet. The vane shear strength values in this stratum vary from 3050 p.s.f. to 4575 p.s.f. These values are probably influenced to some extent by the many silt seams. If it is assumed that the soil has a cohesive strength of 3000 p.s.f., the ultimate bearing capacity of a footing 30 ft.x6 ft. calculated according to Meyerhof is 16,200 p.s.f. Applying to this a factor of safety of 3, the allowable gross soil pressure would be 5400 p.s.f. - 2.7 T/sq ft

Because of the susceptibility of the silty soil to disturbance, it is felt that a lower figure should be used for the soil pressure, and that this figure should depend on the dewatering procedure which is employed. Two alternative methods will be discussed.

(a) Open excavation

The head of water above the proposed footing elevation (76.0 feet) was 9 feet at the time of the site investigation. This pressure may tend to heave the floor of the excavation if no measures are taken to relieve it, particularly in view of the high silt content between elevations 72 and 76. The particle size of the silt stratum is probably too small to be effectively dewatered by vacuum well-points. It is suggested that auxilliary excavations in the form of sumps or trenches should be dug on either side of the excavation to a depth of 1 to 2 feet below the footing grade. The water table can then be lowered by continuous pumping. Some disturbance may occur in spite of this measure, and its effect is not calculable. To reduce the effect to a minimum the following procedure is recommended:

(i) The footings should be designed for a gross soil pressure *not exceeding 3000 p.s.f.*

(ii) Construction of the footings should proceed as *rapidly* as possible after the grade has been exposed and approved.

(iii) The structure should be *simply supported* to allow for possible differential settlement.

The magnitude of immediate settlement will depend on the amount of disturbance of the grade. Long-term consolidation settlement is not expected to exceed *one inch*.

(b) Closed excavation

The water pressure can be controlled by lining the excavation with interlocking steel sheet piles. These should be driven to a depth of 9 feet below the footing grade, i.e. to El.67, for the prevailing water level of El.85. (In this case fluctuations in the water table will not seriously affect the required depth of piling. A margin of safety is provided by the low permeability and cohesion of the clay layers below El.72). Seepage water should be collected in a sump dug below the footing grade and removed by pumping.

For this method of construction, a soil pressure of 4000 p.s.f. is recommended. As in the previous case the construction should proceed as rapidly as possible. Although long-term consolidation settlement is not expected to exceed *one inch*, the effects of possible disturbance cannot be foreseen, and as a precaution against differential settlement the structure should be *simply supported*.

Of the two foregoing proposals (a) and (b) the latter is the more sound, and probably also the more expensive. Local experience should be used to judge which method strikes the best balance between economy and effectiveness. If any doubt exists the latter method involving the sheet pile enclosure should be used.

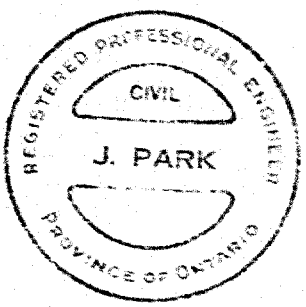
VI REFERENCES

1. The Physiography of Southern Ontario by L. J. Chapman and D. F. Putman 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 & 1951.

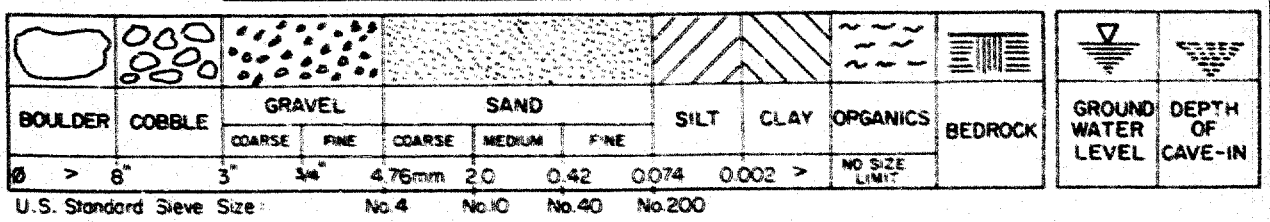


DOMINION SOIL INVESTIGATION LIMITED

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

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.



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

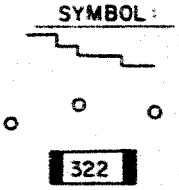
OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittent pressure; Washwater returns; Washwater lost

PENETRATION RESISTANCES.

DYNAMIC PENETRATION RESISTANCE : to drive a 2"ϕ, 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.

SYMBOL :



EXTRAPOLATED -N- VALUE

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

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 ● St

LABORATORY VANE TEST X St — FIELD VANE TEST + St

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

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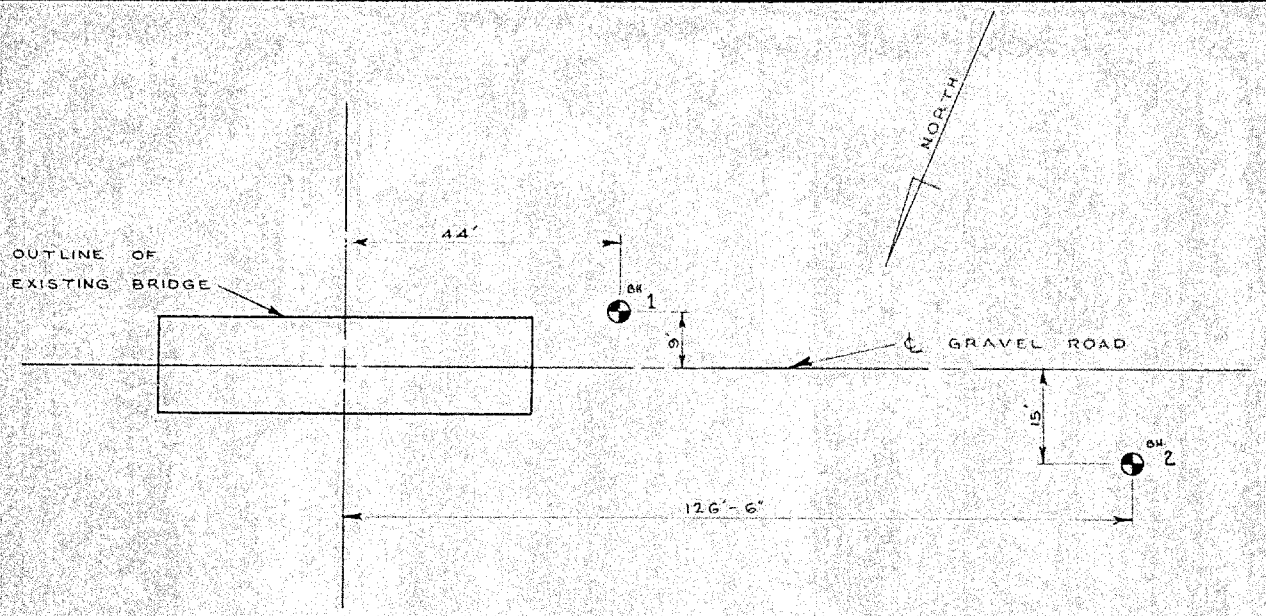
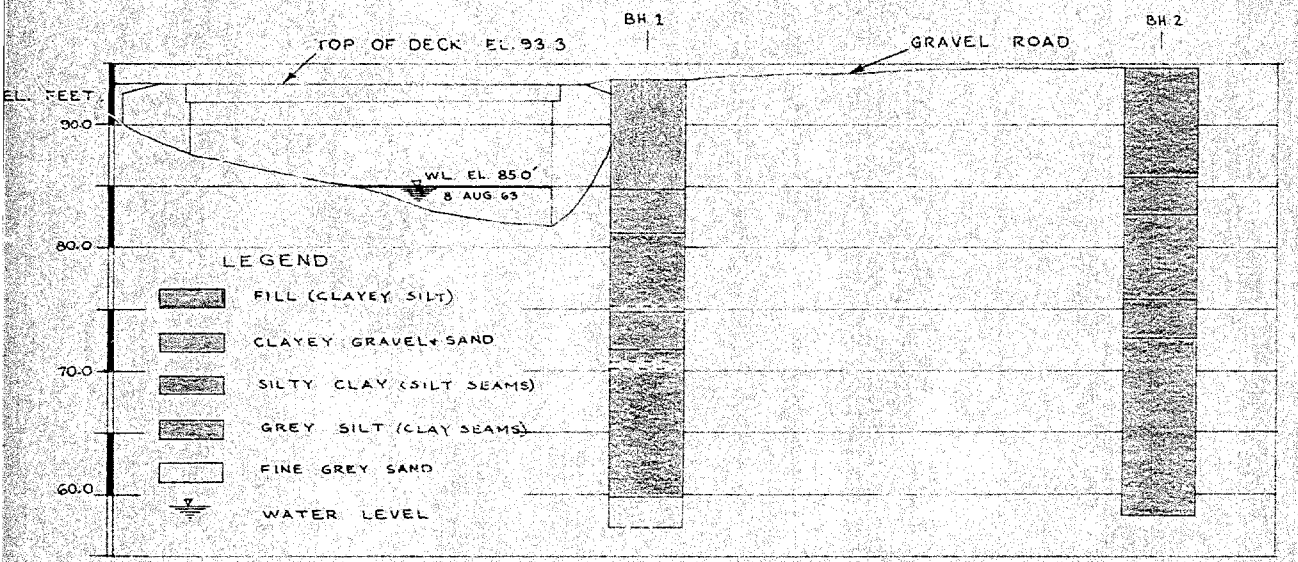


LOCATION OF BOREHOLES

SCALE : 1" TO 20'



SUBSURFACE PROFILE (LOOKING SOUTH)

VERT. SCALE : 1" TO 10'

GEOTECHNICAL DATA SHEET FOR BOREHOLE . . 1 . . .

OUR REFERENCE NO. 3-8-L3

CLIENT: Messrs. A.M. Sprict & Assocs.
PROJECT: Lobo Township Road Bridge
LOCATION: Concessions II & III, Lot 12
DATUM ELEVATION: 100.0' (Spike on tree root west of site)

METHOD OF BORING: Wash Boring
DIAMETER OF BOREHOLE: Bx(3")
DATE: 8 Aug 63

ENCLOSURE NO. 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	SOIL SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS PER FOOT	REMARKS
100.0	0	Ground Surface					
		Gravel fill (6")					
	5	Firm brown clayey silt fill		1	SS	6	6' 10" 9 Aug.63
94.6	10	Black clayey organic gravel and sand		2	SS	21	
81.0		Grey silty clay with many thin silt seams		3	SS	16	St=2.0
	15				vane		
		sandy					
74.6	20	Grey silt with thin clay seams		4	SS	56	
71.6		sandy					
	25	Grey silty clay with many thin silt seams		5	TW	P/C	
				6	SS	21	St=1.9
					vane		
	30	trace of gravel		7	SS	28	
59.6	35	Fine grey sand		8	SS	15	
57.1		End of borehole					

SHEAR STRENGTH lbs/sq ft: 1000 2000 3000 4000 5000

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

MADE: MC CHK'D: JP

GEOTECHNICAL DATA SHEET FOR BOREHOLE . . 2 . . .

OUR REFERENCE NO. 3-8-L3

CLIENT: Messrs. A.M. Spriet & Assocs.
PROJECT: Lobo Township Road Bridge
LOCATION: Concessions II & III, Lot 12
DATUM ELEVATION: 100.0'(Spike on tree root west of site)

METHOD OF BORING: Wash Boring
DIAMETER OF BOREHOLE: Bx(3")
DATE: 9 Aug 63

ENCLOSURE NO. 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: No. OF BLOWS/FOOT OR PRESSURE	PENETRATION RESISTANCE: Blows per foot (20 40 60 80 100) / SHEAR STRENGTH psf (1000 2000 3000 4000 5000)	CONSISTENCY: water content % (PL, W, LL)	REMARKS
94.7	0	Ground Surface							
		Organics							
		Brown clayey sandy silt fill		1	SS	10			WL 7'9" 9 Aug.63
85.7	10	Brown clayey gravel & sand		2	SS	11			
82.7	15	Grey silty clay with many thin silt seams		3	SS	24			
75.7	20	Grey silt with thin clay seams		4	SS	21			
72.7	25	Grey silty clay with many thin silt seams		5	SS	12			
					vane		St=1.7		
	30			6	TW	P/t			
				7	SS	15			
					vane		St=2.3		
	35			8	SS	11			
58.2		End of borehole							

VERTICAL SCALE: 1 IN. TO 5 FT.

DOMINION SOIL INVESTIGATION LIMITED

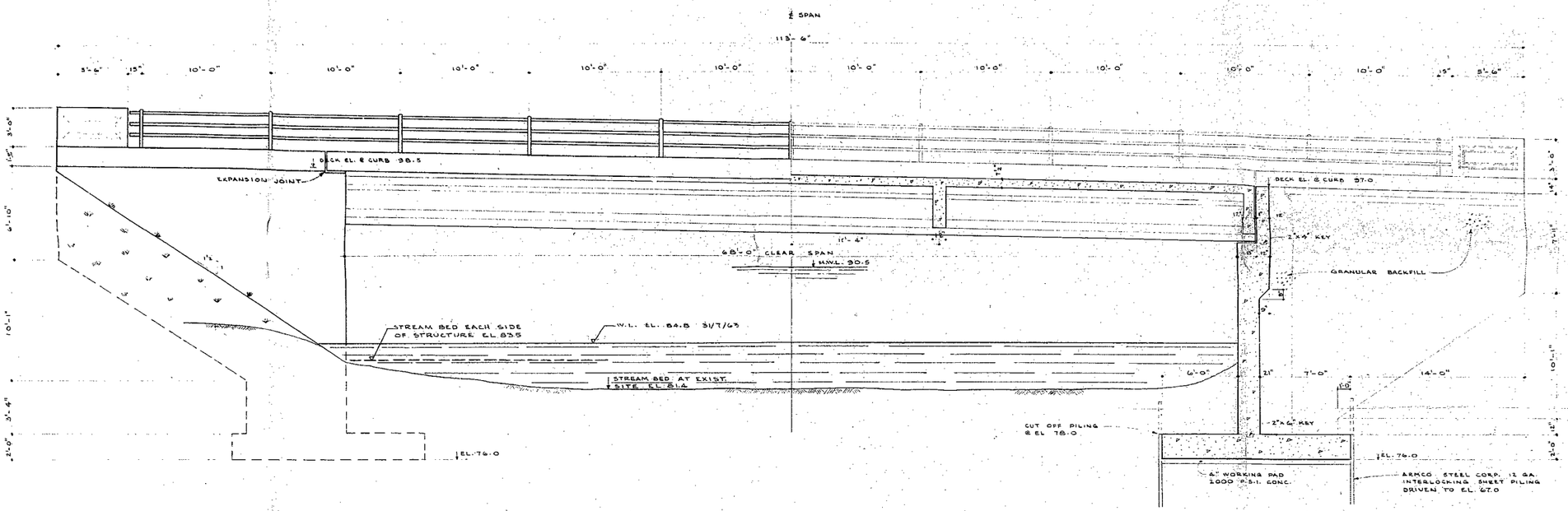
MADE: MC CHD: JP

#63-F-255 M

EDWARDS BRIDGE

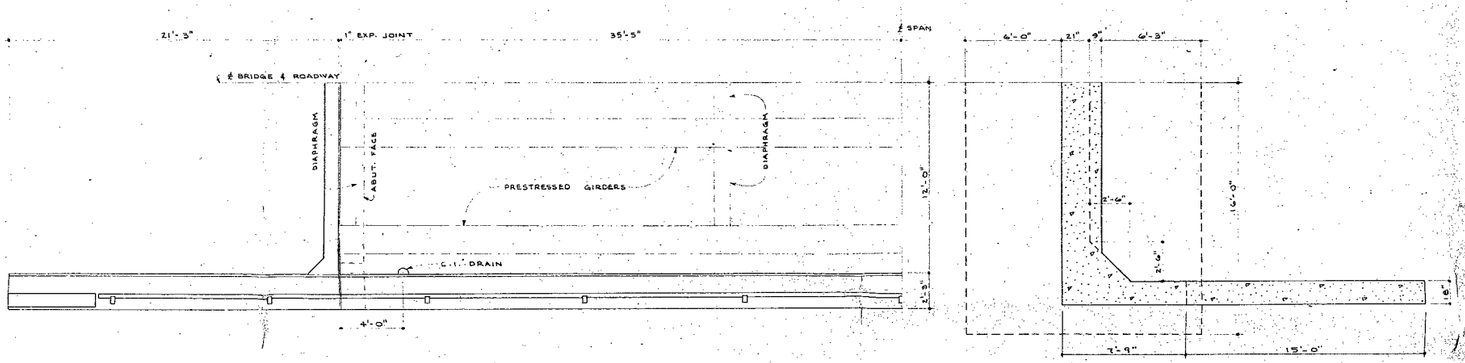
LOT 12, CON. II /III

LOBO TWP.



HALF ELEVATION

HALF SECTION



QUARTER PLAN

QUARTER SECTION

GENERAL NOTES

1. Structure designed for H20-S16 loading.
2. Work on the structure must not be commenced until monuments to fix control points have been erected and checked by the Engineer.
3. Structure to be built in accordance with D.H.O. Form 9 Revised and the Engineers specifications for the Edwards Bridge, Concession II and III, Lot 12.
4. The complete soil investigation report by Dominion Soil Investigation Limited may be examined at the Consulting Engineer's office. The Consulting Engineer does not guarantee the accuracy 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 to the neat dimensions and the concrete shall be poured against undisturbed material where applicable.
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 1-2½-3½
9. All exposed edges to be chamfered 1" unless otherwise noted. All acute angles shall be filleted as indicated.
10. No concrete to be poured before materials, mesh, formwork, falsework and reinforcing have been checked by the Engineer.
11. Deck falsework shall not be struct until all backfill has been placed and compacted behind the abutments, to the satisfaction of the Engineer. In case of girders and beams, no 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; 2" 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 OUTSIDE OF LIMITS SHOWN.
17. Estimated Quantities:
    (a) Reinforcing Steel 20.0 TONS
    (b) Concrete 291.8
18. Notify D.H.O. prior to stressing Conc. Beams. Submit prestressed Shop Drawings.

REGISTERED PROFESSIONAL ENGINEER — CIVIL — G. D. VALLEE — PROVINCE OF ONTARIO

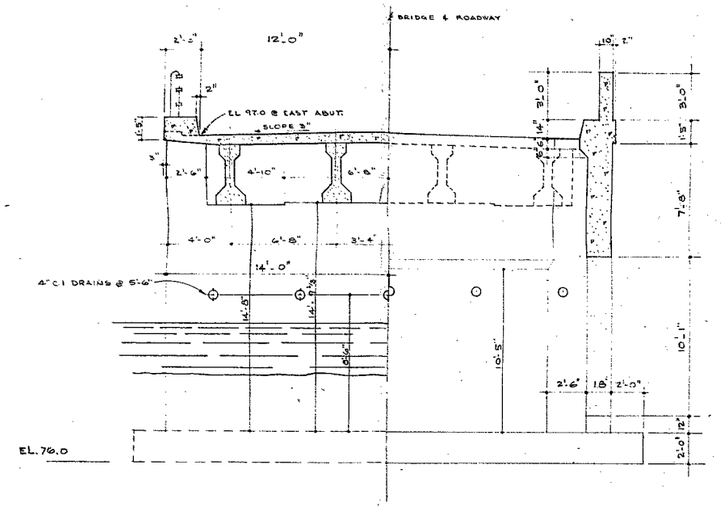
THE EDWARDS BRIDGE
TOWNSHIP OF LOBO

SCALE: 1/4"=1'-0"	APPROVED BY:	JOB NO. 6336	DRAWN BY G.D.V.
DATE: 30-12-63			REVISED

PLANS, SECTIONS AND ELEVATIONS

A. M. GRIECT & ASSOCIATES
CONSULTING ENGINEERS
LONDON & SIMCOE

DRAWING NUMBER 2



HALF CROSS SECTION **HALF END VIEW**

SCALE ¼" = 1'-0"

PRINTED ON NO. 1000H CLEARPRINT

G. D. VALLEE — CIVIL — REGISTERED PROFESSIONAL ENGINEERS — PROVINCE OF ONTARIO

THE EDWARDS BRIDGE

TOWNSHIP OF LOBO

SCALE: AS SHOWN	APPROVED BY:	JOB NO.	DRAWN BY G.D.V
DATE: 30-12-65		6336	REVISED

SECTIONS & DETAILS

A. M. SPRIET & ASSOCIATES
CONSULTING ENGINEERS
LONDON & SIMCOE

DRAWING NUMBER 3