

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

Report on
SOIL INVESTIGATION
for
ROAD BRIDGE BRIDGES #748.
LOT 22, CONCESSION IX & X
TOWNSHIP OF CARADOC

Middlesex.

by
DOMINION SOIL INVESTIGATION LIMITED
363 Queens Avenue
LONDON ONTARIO
Reference No. 3-12-L8
December, 1963

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SUMMARY

The strata consist mainly of fine, cohesionless sand and sand-silt mixtures. The upper 15 to 20 feet of the deposit is quite loose and contains a considerable amount of compressible organic matter. The lower strata are in a compact to dense condition.

It is recommended that the structure should be supported on timber piles. Twelve inch diameter piles having a safe working load of 20 tons per pile are expected to reach a satisfactory set near El. 72 feet. Because of variations in the soil conditions, the depth at which the piles will set may vary appreciably, and it may be necessary to adjust the length or number of piles in the field as driving proceeds.

Some difficulty may be encountered in controlling the flow of groundwater and soil into an unsupported excavation for the pile caps. If this cannot be done effectively by pumping, it will be necessary to form an enclosure of timber or steel sheeting driven 6 or 7 feet below the level of excavation.

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 Caradoc where it is proposed to replace two adjacent road bridges with a single new structure. The bridges carry the gravel road dividing Concession IX and X across a tributary stream of the Sydenham River.

It is understood that the new structure will be located 150 feet to the east of the more westerly of the existing bridges.

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 the new foundations.

II PHYSIOGRAPHY

The site is located 3 to 4 miles east of the town of Strathroy in the physiographic region known as the Caradoc Sand Plains. This sand deposit is a delta of the early Thames River, formed at the time of the glacial lake Whittlesey which occupied the Erie Basin and that part of Southern Ontario to the west of London. The sand deposit covers most of the township, thinning out towards the west until the underlying clay appears at the surface. The area is generally flat except where it has been eroded by the tributary streams of the Sydenham River.

III FIELD WORK

Field work was carried out on the 18th and 19th of December, 1963 and consisted of 2 boreholes at the locations shown on enclosure The holes were advanced by washboring and lined with (3-inch) casing. Standard Penetration tests were made at frequent intervals of depth to determine the relative density of the soil and to recover disturbed samples. Dynamic cone penetration tests were made adjacent to each borehole to obtain a continuous record of penetration resistance. These tests enable the detection of abrupt changes in strata and give a qualitative indication of the resistance likely to be met by piling.

The results of the field tests are recorded on geotechnical data sheets comprising enclosures 3 and 4. Elevations have been referred to the centre of the deck of the existing 55 foot truss which is taken as El. 103.4 feet.

IV SUBSURFACE CONDITIONS

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

The strata are predominantly granular and cohesionless throughout the depth explored. Four to 5 feet of sand fill comprising the road embankment was encountered in both boreholes, covering the original topsoil. A very loose fine sand or sand-silt mixture extends to approximately 20 feet. Within this material there is much compressible organic matter, wood fragments, etc., in various stages of decomposition. The amount of organic matter present varies from an occasional fragment to seams up to 2-inches thick.

Around a depth of 20 feet there is no abrupt change, but the deposit becomes appreciably more dense and is mainly sand, with several feet of medium to coarse material appearing in borehole 2.

Below 35 feet the silt fraction appears again, and the strata consist of dense, cohesionless sand-silt mixtures in varying proportions.

The notes on the data sheets indicate appreciable differences in the stratification between the 2 boreholes. The penetration results also show considerable variation in the relationship of density v. depth. Further variations should be expected at points not explored by the borings.

V FOUNDATIONS

To construct spread footings in the loose sand strata would be extremely difficult and would involve very expensive dewatering procedures. On the other hand the soil conditions are ideally suited for the use of timber piling, and this type of foundation is recommended.

The bed of the stream below the adjacent 55-foot truss is at El. 89 feet, indicating a probable elevation for the pile caps of El. 86 to 87 feet. Compact to dense conditions exist below El. 82 feet so that the piles will be mainly end-bearing. On the basis of the field penetration test results, it is estimated that 12-inch diameter timber piles having a safe working load of 20 tons each will find a satisfactory set within the following levels:

Borehole 1	Els. 72 to 67 feet
Borehole 2	Els. 77 to 72 feet

The foregoing is a purely theoretical prediction, and the piles should be driven to a satisfactory set in

accordance with some established dynamic pile driving formula such as the Hiley formula.

No appreciable settlement of the structure is anticipated.

Some difficulty may be encountered in dewatering the excavation for the pile caps. This will vary directly with the level of groundwater at the time of construction. Pumping alone may be sufficient to control the groundwater, although a very high yield should be expected. The loose unsupported sand will probably flow constantly into the excavation. In these conditions, speed of construction will be advantageous. If the water and soil cannot be controlled in this manner it will be necessary to form an enclosure of timber or steel sheet piling driven 6 to 7 feet below the level of excavation. This will restrain the movement of soil and enable the water table to be lowered sufficiently by pumping.

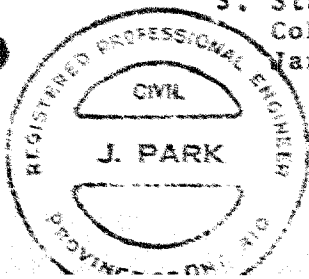
Attention is drawn to the variation in soil conditions as described in the preceding section of this report. The conditions at the two boreholes are not necessarily representative of the areas of the respective abutments, and allowance should be made for substantial adjustment of the length or number of the piles as driving proceeds. It is suggested that the length of piles should be chosen for the conditions at borehole 1, the least favourable of the two. In the even that poorer conditions are encountered, additional piles could be driven if necessary.

VI 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. Proceedings of the 4th International Conference on Soil Mechanics and Foundation Engineering (Research on Determining the Density of Sands by Spoon Penetration Testing - by H. J. Gibbs and W. G. Holtz of the United States Bureau of Reclamation) London, 1957.
4. Terzaghi and Peck: Soil Mechanics in Engineering Practice. John Wiley and Sons, New York 1948.
5. Standard Penetration Tests and Bearing Capacity of Cohesionless Soils, by G. G. Meyerhof, ASCE Paper 866, January 1956.

DOMINION SOIL INVESTIGATION LIMITED

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



LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.

BOULDER	COBBLE	GRAVEL		SAND			. LT	CLAY	ORGANICS	BEDROCK	GROUND WATER LEVEL	DEPTH OF CAVE-IN
		COARSE	FINE	COARSE	MEDIUM	FINE						
φ	> 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	OBSERVATIONS MADE WHILE CORING	Steady pressure	Washwater returns
"	pressure : p		No pressure	Washwater lost
"	tapping : t		Intermittent pressure	

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.

EXTRAPOLATED -N- VALUE

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

SYMBOL :



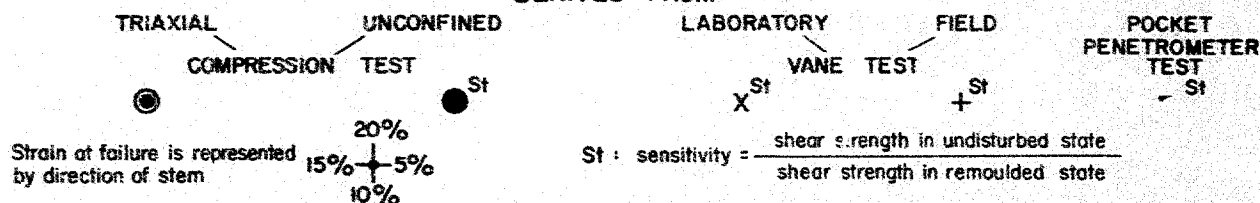
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SOIL PROPERTIES.

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
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

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —



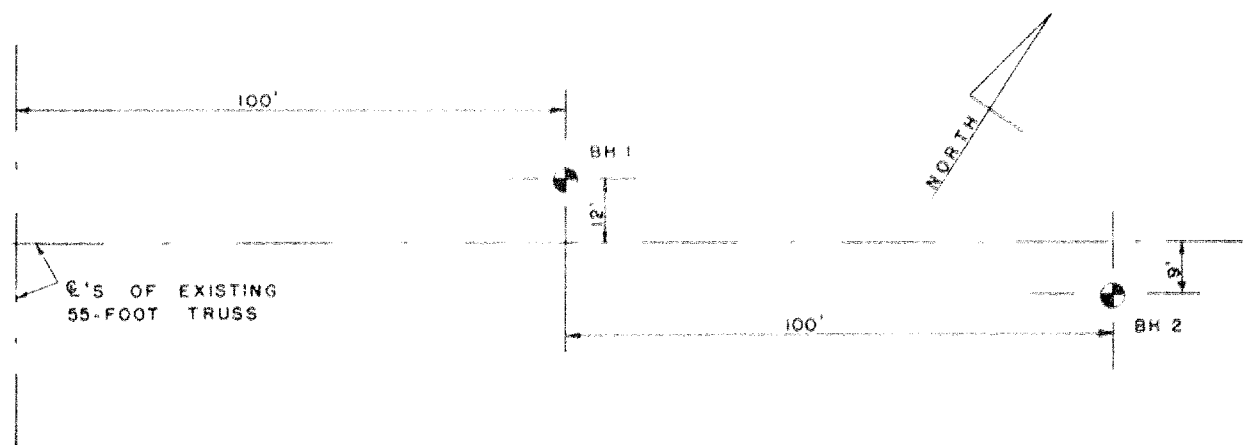
SOIL DESCRIPTION.

COHESIONLESS SOILS :

	RD :
Very loose	0 - 15 %
Loose	15 - 35 %
Compact	35 - 65 %
Dense	65 - 85 %
Very dense	85 - 100 %

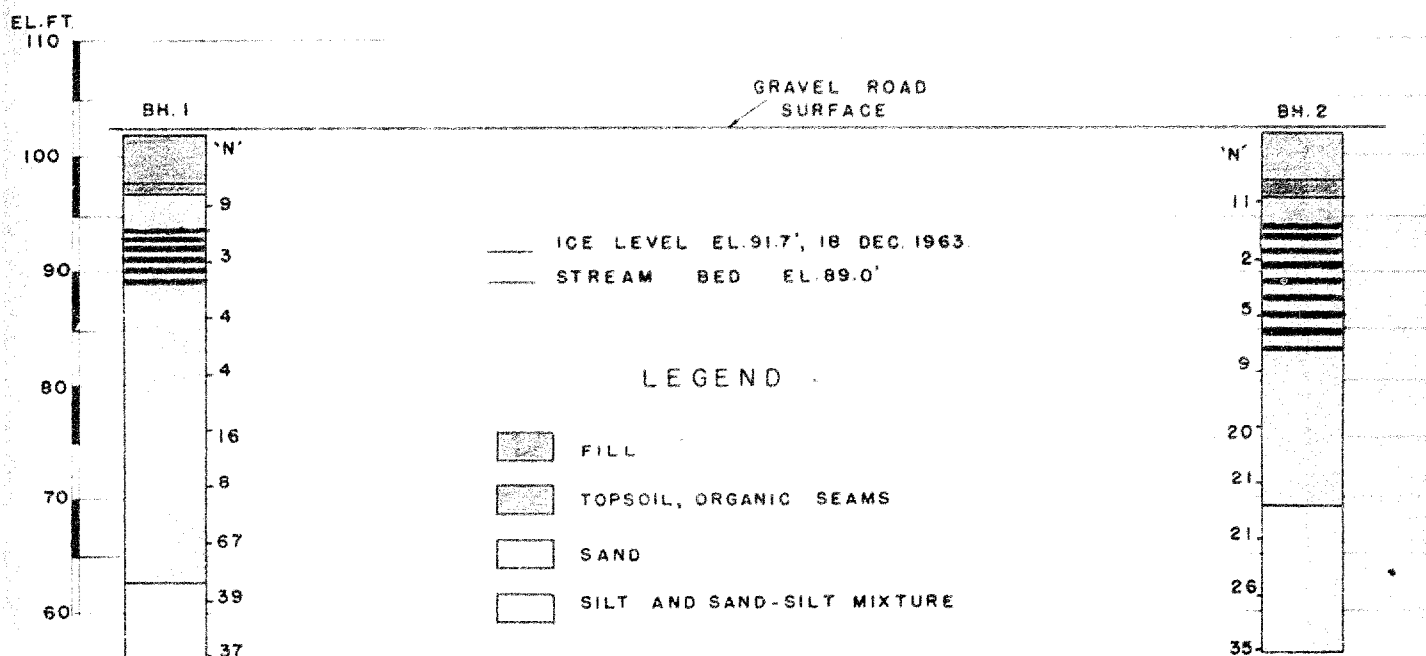
COHESIVE SOILS :

	C lbs/sq.ft
Very soft	less than 250
Soft	250 - 500
Firm	500 - 1000
Stiff	1000 - 2000
Very stiff	2000 - 4000
Hard	over 4000



LOCATION OF BOREHOLES

SCALE: 1 INCH TO 25 FEET



SUBSURFACE PROFILE

SCALE: 1 INCH TO 12 FEET

GEOTECHNICAL DATA SHEET FOR BOREHOLE 11111

OUR REFERENCE NO 5-12-L8

CLIENT: Messrs. A. M. Spry & Associates
PROJECT: Road Bridge
LOCATION: Caradoc Township
DATUM ELEVATION: 100.0' (centre of deck of existing 55' truss)

METHOD OF BORING: Washboring
DIAMETER OF BOREHOLE: 8x (3-inch)
DATE: December, 1963

ENCLOSURE NO 5

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE				CONSISTENCY				REMARKS
				NUMBER	TYPE	N ₆₀ or Adm. Consist. of Soil	20	40	60	80	100	PI	W	LI	
101.9	0	Ground Surface													
		Brown sand fill.													
	5	Organic sandy topsoil.													
95		Fine brown silty sand, compact, damp.		1	SS	9									
10		Seams of decaying organics		2	SS	3									
90															
15		loose		3	SS	4									
85		compact													
20		Fine grey sand, silty		4	SS	4									
80															
25				5	SS	16									
75															
30		compact		6	SS	8									
70		dense		7	WS										
35				8	SS	67									
65				9	WS										
40		Dense grey silt.		10	SS	39									
60		sandy													
45				11	SS	37									
65		End of borehole													

2" cone

Level of ice in creek El. 91.7
18 Dec. 1963.

GEOTECHNICAL DATA SHEET FOR BOREHOLE 2

OUR REFERENCE NO. 5-12-18

CLIENT: Messrs. A. M. Spriet & Associates
 PROJECT: Road Bridge
 LOCATION: Caradoc Township
 DATUM ELEVATION: 100.0' (centre of deck of existing 55' truss)

METHOD OF BORING: Washboring
 DIAMETER OF BOREHOLE: 3 x (3-inch)
 DATE: December, 1963

ENCLOSURE NO. 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES			PENETRATION RESISTANCE blows per foot					CONSISTENCY water content %			REMARKS
				NUMBER	TYPE	IN- ADVANCEMENT of Sampler	20	40	60	80	100	PI	W	LI	
101.9	0	Ground Surface													
		Brown sand fill.													
	5	Organic sandy topsoil.													
95		Fine brown silty sand, compact, damp.		1	SS	11									
	10														
90		Grey fine sand-silt mixture, many seams of soft organic matter, wet, loose.		2	SS	2									
	15														
85				3	SS	5									
	20														
80		medium to coarse fine, silty		4	SS	9									
	25														
75		Grey sand, compact to dense.		5	SS	20									
	30														
70				6	SS	24									
	35														
65				7	SS	21									
	40														
60		Grey sand-silt mixture, dense.		8	SS	26									
	45														
55				9	SS	35									
		End of borehole													

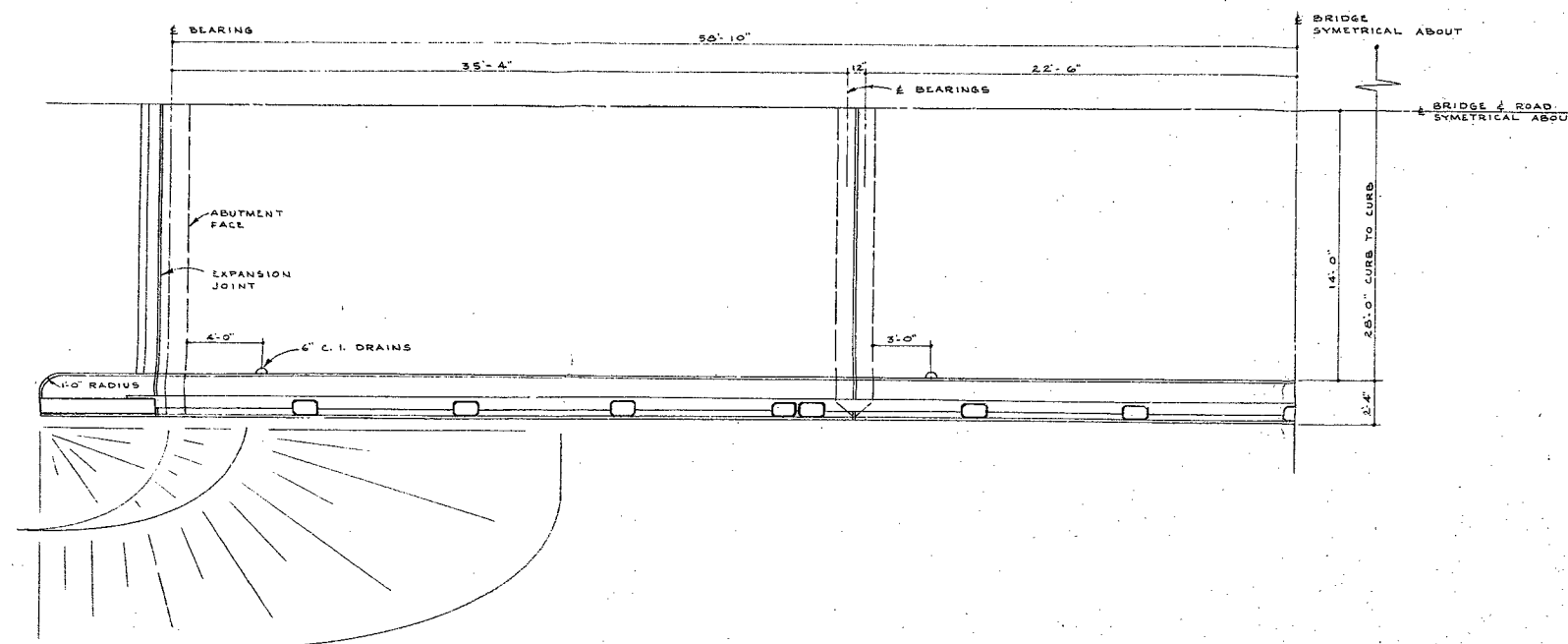
level of
 ice in
 creek E1.917
 18 Dec. 1963

63-F-248M

BRIDGES 7+8

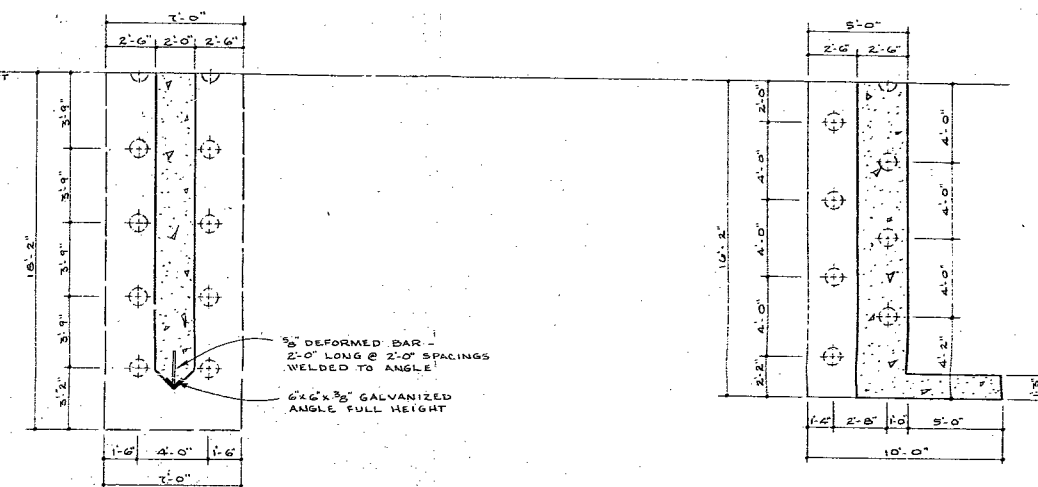
LOT 22, CON. 9+10

CARADOC

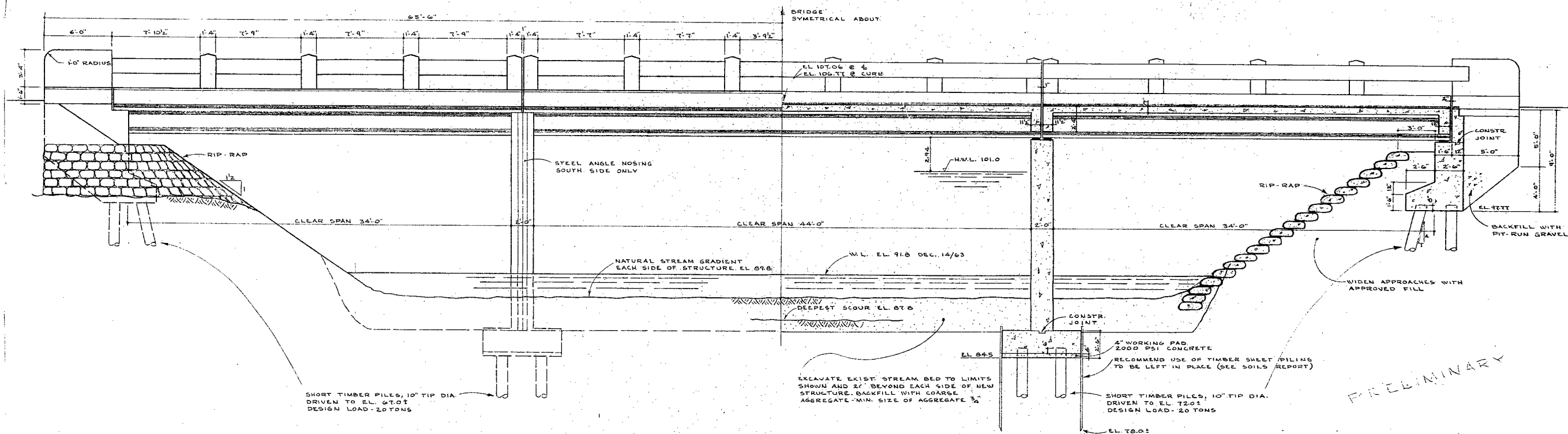


Q U A R T E R P L A N

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

QUARTER SECTION

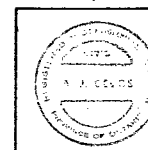
SCALE $\frac{1}{4}'' = 1' - 0''$



HALF ELEVATION

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

HALF SECTION



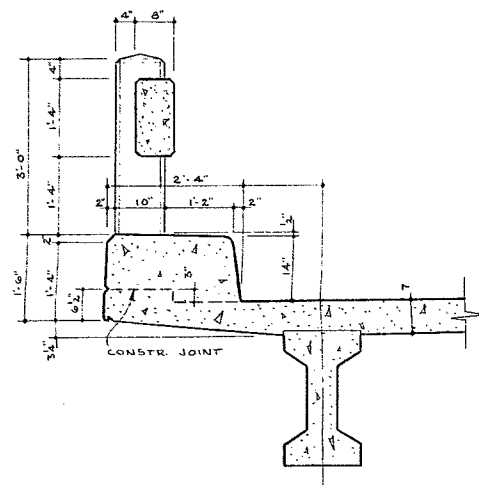
BRIDGES NO.s 6 & 7

TOWNSHIP OF CARADOC.			
SCALE: AS NOTED	APPROVED BY:	JOB NO.	DRAWN BY A. J. D.
2.1-1-64		8358	

PLAN, SECT. & ELEV.

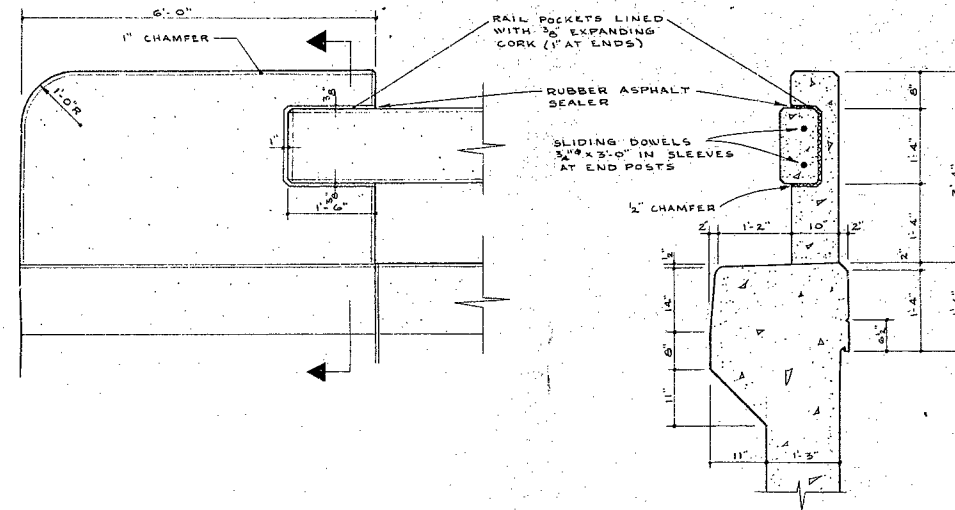
[illegible]

DRAWING NUMBER	2
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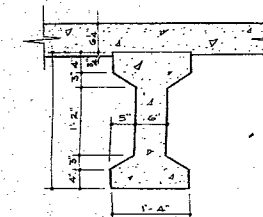
CURB & RAIL DETAIL

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



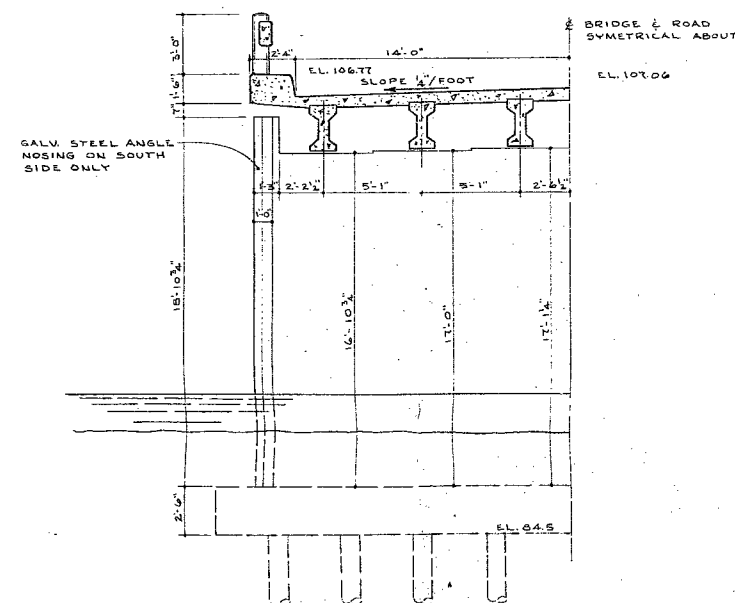
END POST DETAIL

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



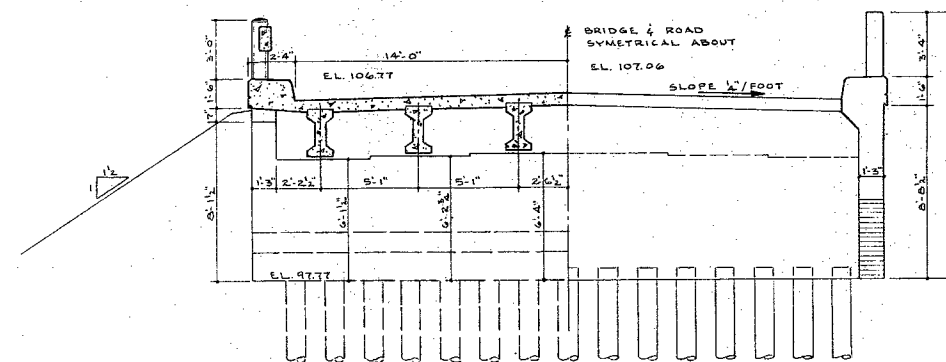
PRECAST GIRDER DETAIL

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



HALF CROSS SECTION - PIER

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



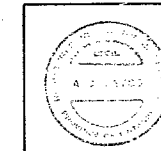
HALF CROSS SECTION

HALF END VIEW

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

PRELIMINARY

- GENERAL NOTES**
- Structure designed for H20-S16 loading.
 - Work on the structure must not be commenced until work to fix control points have been erected and checked by the Engineer.
 - Structure to be built in accordance with D.H.C. Form 9 Revised and the Engineers specifications for the Bridges No. 6 & 7.
 - The complete soil investigation report by Dominion Soil Investigation Limit may be examined at the Consulting Engineer's office. The Consulting Engineer does not guarantee the accuracy of this report.
 - Pile Foundations
Type--Short timber piles, 10" tip dia.
Design load--20 Ton per pile
Length of pile--EAST PIER - 16' WEST PIER - 21'
EAST ABUT - 24' WEST ABUT - 34'
 - Footings to be finished to the neat dimensions and the concrete shall be poured against undisturbed material where applicable.
 - No concrete shall be placed in the footings before the character of the soil and excavation for footings has been approved by the Engineer.
 - 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; 1 1/2 in. footings and 1 in. elsewhere or as specified.
(d) Concrete Mix 1-24-34
 - All exposed edges to be chamfered 1" unless otherwise noted. All acute angles shall be filleted as indicated.
 - No concrete to be poured before material, men, formwork, falsework and reinforcing have been checked by the Engineer.
 - 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.
 - Backfill behind abutments to be brought up simultaneously at both ends.
 - Construction joints not shown on plans must be approved by the Engineer.
 - Reinforcing Steel to be Hi-Bond. Clear cover unless otherwise noted: 3" in footing and all surfaces in contact with earth or water; 1 1/2" in bottom of decks; 2" elsewhere.
 - Precast Prestressed Concrete Beams
Concrete Strengths
(a) On stressing 4,000 p.s.i.
(b) At 28 days 5,000 p.s.i.
 - Work to be performed by others
(a) Roadwork and grading of approaches within limits shown shall be by the contractor.
(b) Roadwork and grading outside limits shown shall be by the Township.
 - Estimated Quantities:
(a) Reinforcing Steel 12.0 TONS
(b) Concrete 311.9 CU. YDS.
 - Notify D.H.C. prior to stressing Conc. Beams. Submit prestressed Shop Drawings.



BRIDGES NO.s 6 & 7			
TOWNSHIP OF CARADOC			
SCALE AS NOTED	APPROVED BY:	JOB NO.	DRAWN BY A.J.D.
DATE: 21-1-64		6356	REVISED
ELEVATIONS & DETAILS			
A. J. D. 1952			DRAWING NUMBER
			3