

Mr. A. M. Tove,

April 24, 1961.

Bridge Engineer.

Materials and Research Section,

(Foundations Office)

Attention: Mr. K. L. Kleinstelber,
Municipal Bridge Liaison Engr.

Re: Carp River Bridge near Kinburn,
County of Carleton, Road #28,
District #9, W.J. 61-F-14.

At a meeting held in the Foundation Office on April 24, 1961, the following points were tentatively agreed upon pending a meeting with the bridge designer:-

1) A multi-span structure would be preferable to a single-span structure.

2) Footing support can be obtained by using timber piles with approximately 40 ft. of embedment.

3) A design load in the order of 10 tons per pile should be used, resulting in a pile grouping of approximately 15 ft. x 35 ft.

4) The settlement at each pile group would be in the order of six to eight inches.

L. G. Soderman,
PRINCIPAL FOUNDATION ENGR.

Per:

R. J. Salvas
(R. J. Salvas,
PROJECT FOUNDATION ENGR.)

RJS/MdeF

cc: Foundations Office
Gen. Files.

al

JOHN D. PATERSON, B.Sc., P.ENG.
CONSULTING ENGINEER AND GEOLOGIST
250 BESSERER STREET
OTTAWA 2, ONT.

31F-28

GEOCREs No.

STRUCTURE SITE No. 3-16

REPORT OF SOIL INVESTIGATION

SITE OF

PROPOSED NEW BRIDGE OVER CARP RIVER

COUNTY ROAD NO. 28, KINBURN

FOR

COUNTY OF CARLETON

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Report No. S 135 - 60

Ottawa, May 3rd, 1960.



1. Introduction:

At the request of Mr. A. J. Graham, County Engineer, County of Carleton, Ontario, a soil investigation was conducted at the site of a proposed new bridge where County Road 28 crosses the Carp River at Kinburn, Ontario.

The site is presently occupied by an old bridge about 40 years old. No other structures are in the immediate area.

2. Field Work Procedure:

The location of the test holes was governed somewhat by the rapid melting of the ice on the Carp River. Because of the accumulation of runoff water on the ice a cone probe only was driven at the approximate centre of the river channel adjacent to the bridge.

At Hole No. 2 the rising water of the river forced a move to a higher location for sampling after a cone probe was driven. Holes 3 and 4 were put down in a normal manner.

Four test holes were put down. At each hole a cone probe was driven and Hole No. 2 on the east bank and Hole No. 3 on the west bank were sampled to 127' and 74' respectively.

The equipment used for this investigation consisted of a diamond drilling rig mounted on skids and fully equipped for soil testing. The field work was supervised at all times by an engineer member of our staff. The Test Boring Plan included in this report shows the location of the boreholes.

3. Sampling and Testing:

Samples of the soils were obtained by means of thin-walled Shelby tubes. These were taken to the laboratory where the samples were tested for Unconfined Compressive Strength.

At Hole No. 2 the cone probe was driven to 150 feet which was not refusal. Cone probes were driven to 110 feet at Hole No. 1 and 100 feet at Holes 3 and 4 for comparison purposes.

The investigation was not carried to bedrock but information obtained from local sources indicated that the depth could be from 250 to 300 feet.

4. Observations:

(a) Soil Types

In Holes Nos. 2 and 3 there are 3 main soil types. The following descriptions will take into account the soil profiles of both holes.

0' to 10' -

0' to 10' - A fairly stiff weathered brown clay with minor amounts of organic material and some thin fine-grained sand lenses.

10' to 90' - This thick layer is essentially a silty soil which varies with depth with various amounts of clay. A further division of the soils is based on the inclusions of foreign material (i.e., white shells and pebbles found in the silt-clay interfaces. A more detailed division of the soils found from 10' to 90' feet is shown on the Soil Profile and Laboratory Test Sheets which accompany this report.

90' to 127' - A moderately sensitive stiff grey clay increasing in stiffness with depth.

No sampling was conducted in Holes 1 and 4. The soil profile of these two holes is based on a comparison of the cone blows with the cone blows of the sampled holes. The interfaces separate only broad features of the soils found at Holes Nos. 1 and 4.

(b) Ground Water

The ground water level can be considered to be the same elevation as that of the river surface.

(c) Test Results

The results of the unconfined compressive strength tests were as follows:

<u>Hole No.</u>	<u>Sample No.</u>	<u>Depth</u>	<u>Comp. Strength</u>	<u>Tons/ Sq.Ft.</u>
2	(TW 1	5 - 6 $\frac{1}{2}$	0.58	(Consider disturbed)
2	(TW 2	10 - 11 $\frac{1}{2}$	0.21	
2	(TW 4	20 - 21 $\frac{1}{2}$	0.50	
2	(TW 5	35 - 36 $\frac{1}{2}$	0.63	
2	(TW 6	50 - 51 $\frac{1}{2}$	0.46	
3	(TW 12	5 - 6 $\frac{1}{2}$	0.87	
3	(TW 13	15 - 16 $\frac{1}{2}$	0.38	
3	(TW 14	25 - 26 $\frac{1}{2}$	0.51	
3	(TW 15	30 - 31 $\frac{1}{2}$	0.47	
3	(TW 17	50 - 51 $\frac{1}{2}$	0.58	
3	(TW 19	72 $\frac{1}{2}$ - 74	0.70	

It is to be noted that although the band of soils between 10 and 90 feet varies somewhat in physical properties between Holes 2 and 3 the average compressive strength over this interval for both holes is 0.53 tons per square foot. (Omit Value of TW 2).

5. Conclusions & Recommendations

5. Conclusions & Recommendations:

The results of this investigation indicate that a pile foundation will be necessary for the new bridge. Information obtained locally has revealed that the existing bridge is founded on piles but the length of the piles is not known. The existence and location of these piles should be kept in mind when designing the new bridge.

Analysis of Pile Loading

The safe load on a friction pile driven into clay soil can best be determined by means of a static load test. However, load tests on piles are relatively expensive and for a small bridge the cost may be considered prohibitive. It is estimated that the cost of a load test will be from \$1,500.00 to \$2,000.00 at this site.

An alternative to the load test is to compute the safe load on a pile by means of pile-driving formulas but experience has shown that erroneous results can be expected when the soil consists of clay. In this case the soils contain sufficient clay size to warrant rejection of this method.

A further alternative to the load test is to compute the bearing capacity on the basis of laboratory tests on soil samples using the unconfined compressive strength. Experience has shown that the bearing capacity of a friction pile is approximately proportioned to its length. For cylindrical piles the ultimate bearing capacity is approximately equal to the product of the shearing resistance of the soil and the area of the embedded portion of the pile. The shearing resistance is equal to one-half the unconfined compressive strength. This relationship has been found to be more satisfactory than the pile-driving formulas.

Proceeding on this basis it has been found by laboratory tests that the average shearing resistance of the soil at this site to a depth of 60 feet is 550 lbs. per square foot. Considering the case of a 60-foot timber pile with a diameter of 12 inches at the butt and 6 inches at the tip the calculated ultimate bearing capacity is 38.8 tons. Allowing for a factor of safety of 3 the safe loading becomes 12.9 tons. This is considered to be a conservative figure and is well within the generally specified maximum loading of 20 tons for a timber pile.

Recommendations

(1) If obtainable drive 60-foot timber piles making sure that the spacing between piles is not less than three times the pile diameter. The piles should be driven continuously once started since the strength regain properties of this soil will make it extremely difficult to resume driving if any length of time elapses. The calculated safe loading on these piles will be 12.9 tons per pile.

(2) If 60-foot piles are not obtainable or are considered to be prohibitive in price then we would recommend that a test pile of the longest obtainable length be driven and test loaded. Assuming that timber piles 40 feet long are obtainable and that a total of 30 piles will be needed then the saving in cost due to shorter length and depth driven will approximately offset the cost of the load test — providing, of course, that the 40-foot pile can be safely loaded to 12.9 tons, the same as the calculated safe load on a 60-foot pile.

If a load test is decided upon we would appreciate having the opportunity to be present and assist in this undertaking. It is imperative that a period of not less than 3 days elapse after the test pile has been driven before loading is commenced.


J. D. Paterson, P. Eng.

NO 4
195.4
- 106.0 = 89.4

NO 2 (BORE)
191.7 - 106.0 = 85.7

NO 2 (CAVE)
191.2
- 106.0 = 85.2

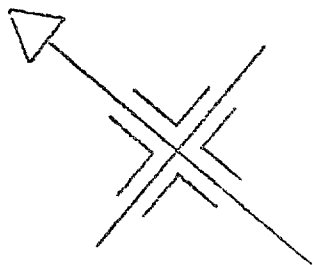
COUNTY OF CARLETON
Book 27 P. 24

16+00 - 22.94.0

15+00 - not read

14+00 - 93.8

12+00 - 93.6



BM & ROAD
∴ correction to ASSUMED 200.0'
this report = -106.0 Read 94.0

← CARP RIVER

NO. 1
191.2 - 106.0 = 85.2
chainage 14+70

TEST BORING PLAN
PROPOSED NEW BRIDGE
CARLETON COUNTY
ROAD NO. 28
KINBURN, ONT.

SCALE 1" = 20'

APRIL 1960

NO. 3
195.7
- 106.0
= 89.7
chainage 13+58

TO KINBURN

correct all el readings - 106.0

JOHN D. PATTERSON
CONSULTING ENGINEER
OTTAWA CANADA

SOIL PROFILES
&
LABORATORY TESTS

Location: County of Carleton, Road 28.
Kinburn, Ontario

ELEVATION (Zero Depth). 191.2

Remarks: Cone Test only. Classification based on penetration of
cone.

Sheet No.
1 of 4

Bore No.
1

Borings by: F. E. Johnston Drilling Company Date: March 30, 1960

BLOWS PER FOOT Cone	SOIL DESCRIPTION	Samples	Max. Comp. Strength in Tons/Sq. Ft.	Depth in Feet	ELEV.	MOISTURE CONTENT PER CENT.				
						30	40	50	60	70
	River Surface			0	191.2					
	Water	4	81.2		(85.2)					
1										
2	Muck & Soft Clay	10		10	181.2					
4										
3										
4	Clayey Silt			20	171.2					
7										
5										
7		30		30	161.2					
16										
13	Interbedded Silt and									
14	Clayey Silt with Sand			40	151.2					
22	Lenses and Shells									
17										
15		50		50	141.2					
25										
23	Stiff Clay with Black									
21	Organic Streaks and			60	131.2					
38	some Pebbles									
31										
23				70	121.2					
58										
30										
26		80		80	111.2					
68										
47										
37	Stiff Clay			90	101.2					
50										
41										
49				100	91.2					
103										
90										
71				110	81.2					

JOHN D. PATTERSON
CONSULTING ENGINEER
OTTAWA CANADA

SOIL PROFILE
&
LABORATORY TESTS

Location: Carleton County Road 28,
Kinburn, Ontario

ELEVATION (Zero Depth): Cone 191.2; Bore Hole 191.7.

Remarks: Cone Test and Test Boring

Sheet No. 2 of 4

Hole No. 2

Borings by: F. E. Johnston Drilling Co. Date: March 31st & April 1 & 4, 1960.

BLOWS PER FOOT	SOIL DESCRIPTION	Sample	Pen. Comp. Strength in Tons/Sq. Foot	Depth in Feet	ELEV.	MOISTURE CONTENT PER CENT.				
						30	40	50	60	70
Cone	Ground Surface			0	191.7					
1	Stiff Brown Weathered Clay	TW 1	0.58							
2	with Minor Organic In-	TW 2	0.21	10	181.7					
3	clusions	TW 3	(Sample Lost)							
2	Sensitive Pinkish Grey									
2	Silty Clay with an odd									
2	pebble	TW 4	0.50	20	171.7					
6	Interbedded clay									
6	Grey Silt & Silt with									
6	fine-grained Sand Lenses			30	161.7					
10	& small White Shells.	TW 5	0.63	40	151.7					
9										
9										
18	Medium stiff moderately									
16	sensitive interbedded									
16	Pink Silt & Grey residual	TW 6	0.46	50	141.7					
26	Clay									
24										
19				60	131.7					
38										
29										
24	Sensitive Grey Clay with			70	121.7					
100	Black Organic Streaks & an									
51	odd Pebble.	TW 7	(Sample Lost)							
42		TW 8	(Sample	80	111.7					
43			disturbed)							
46										
44				90	101.7					
57		TW 9	Not tested.							
50										
41	Moderately sensitive, Grey			100	91.7					
52	Clay grading to stiff Grey									
44	Clay with depth.	TW 10	Not tested.							
44				110	81.7					
65										
56				120	71.7					
50										
67										
72		TW 11	Not tested.							
62				130	61.7					
127										
97				140	51.7					
67										
71										
70										
63				150	41.7					



Ground Water
Level 6".

JOHN D. PATRICKSON
CONSULTING ENGINEER
OTTAWA CANADA

SOIL TESTING
&
LABORATORY TESTS

Location: Carleton County Road 28,
Kinburn, Ontario.

ELEVATION (Zero Depth) 195.7
Remarks: Cone Test and Test Boring.

Sheet No.
3 of 4
Hole No.
3

Borings by: F.E. Johnston Drilling Company Date: April 5 & 6, 1960

ELEVATION PER FOOT	SOIL DESCRIPTION	Sample	Unconsolidated Strength Tons/Sq. Ft.	Depth in Feet	SLR	MOISTURE CONTENT PER CENT.				
						30	40	50	60	70
Cone	Ground Surface			0	195.7					
2	Stiff Brown Weathered Clay	TW 12	0.87							
8	with Silt-Sand Lenses									
8	10									
13				10	185.7					
13	Grey Clayey Silt	TW 13	0.38							
10	20									
15				20	175.7					
15	Sensitive Pinkish Grey	TW 14	0.51							
13	Silty Clay with Sand									
21	Lenses.	TW 15	0.47	30	165.7					
15	Interbedded Silt and Clay									
13	with Sand Lenses and									
17	Small White Shells.	TW 16	Sample	40	155.7					
13	Sensitive Grey Clayey									
14	Silt, some pebbles.		disturbed.							
17	Stiff Grey Clay sensitive	TW 17	0.58	50	145.7					
15	to 70 feet containing									
12	an odd pebble and Black									
18	Organic Streaks, approxi-	TW 18	Sample	60	135.7					
15	mately 60' - 70'.									
13			disturbed							
20		TW 19	0.70	70	125.7					
16										
15				80	115.7					
23										
21										
21	90			90	105.7					
35	Probably Grey Clay in-									
41	creasing in stiffness with									
36	depth.			100	95.7					

Ground Water
Level 3'

JOHN D. PATTERSON
CONSULTING ENGINEER
OTTAWA CANADA

SOIL PROFILE

LABORATORY TESTS

Location: County of Carleton Road 28,
Kinburn, Ontario.

ELEVATION (Zero Depth): 195.4

Sheet No. 4 of 4
Hole No. 4

Remarks: Cone Test only. Classification based on penetration of cone.

Borings by: F.E. Johnston Drilling Company Date: April 6 & 7, 1960

BLOWS PER FOOT	SOIL DESCRIPTION	Sample	Unconf. Strength in Tons/Sq. Ft.	Depth in Feet	ELEV.	MOISTURE CONTENT PER CENT.				
Cone						30	40	50	60	70
5	Ground Surface			0	195.4					
8	Stiff Brown Clay	5								
13				10	185.4					
15										
10	Clayey Silt			20	175.4					
9										
9										
13				30	165.4					
13										
16				40	155.4					
16	Interbedded Silt and									
14	Clayey Silt with Sand			50	145.4					
23	Lenses and Small White									
17	Shells			60	135.4					
16										
26				70	125.4					
19										
17				80	115.4					
28										
23	Stiff Clay with Black			90	105.4					
23	Organic Streaks and									
35	some pebbles			100	95.4					
28										
29										
36										
36	Stiff Clay									
34										
64										
52										
44										



Ground Water
Level 3'.

61-F-14

ROAD 28 &

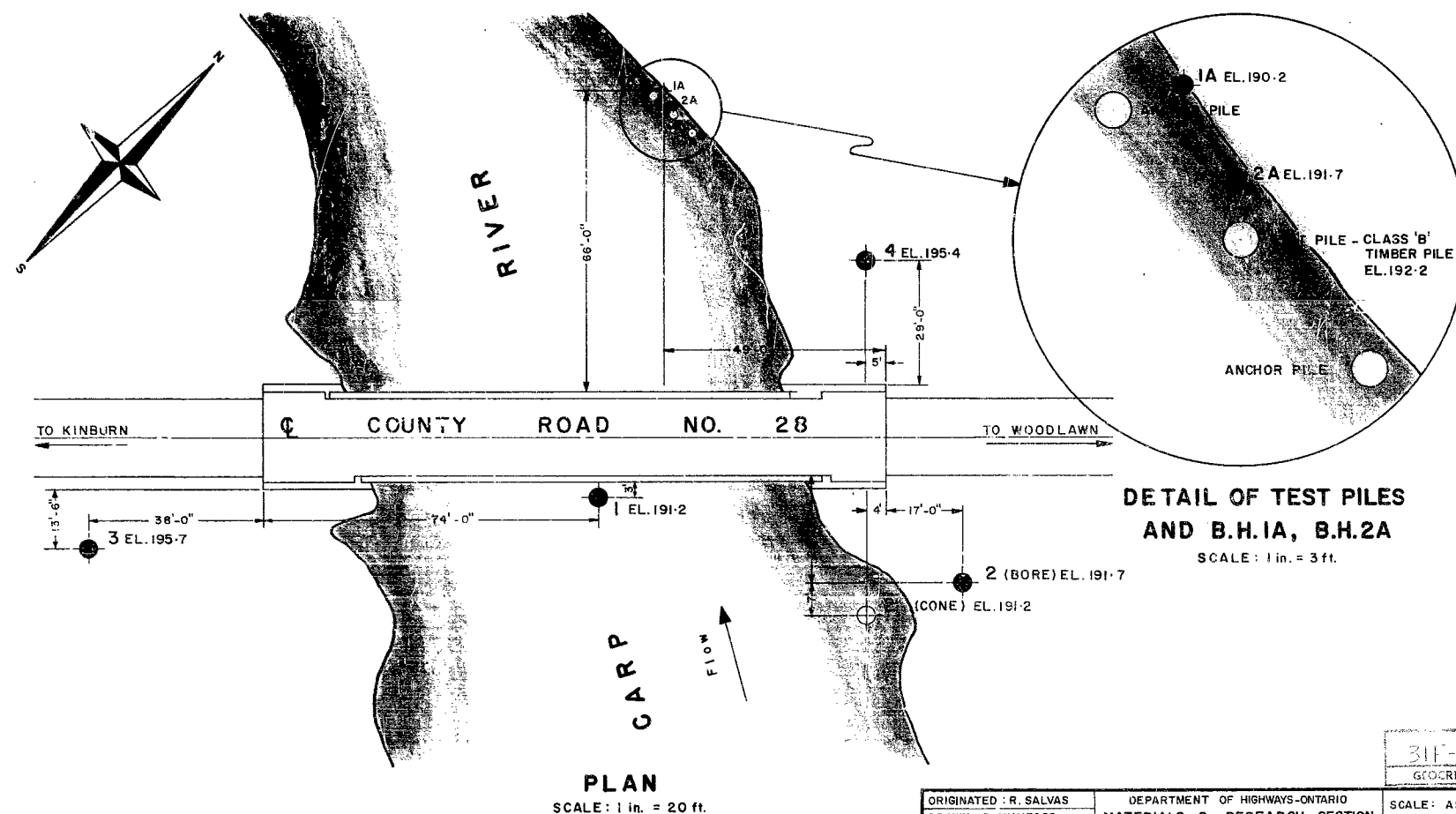
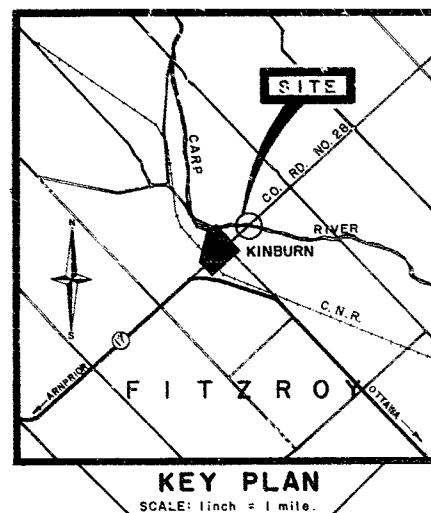
CARP RIVER

NEAR KINBURN

31F-28

NOTES

1. ALL BOREHOLES EXCEPT B.H. 1A & B.H. 2A WERE CARRIED OUT BY J.D. PATTERSON, OTTAWA, ONTARIO.
2. ALL ELEVATIONS ARE REFERED TO THE ELEVATION OF $\frac{1}{2}$ OF ROAD AT MIDDLE OF EXISTING BRIDGE WHICH WAS TAKEN AS 200.0'



ORIGINATED: R. SALVAS
DRAWN: D. MUMFORD
CHECKED: *[Signature]*
APPROVED: *[Signature]*
DATE: 29 MARCH 1961

DEPARTMENT OF HIGHWAYS-ONTARIO
MATERIALS & RESEARCH SECTION
LOCATION OF TEST PILE & BOREHOLES
CARP RIVER BRIDGE
CARLETON COUNTY, ROAD NO. 28

31F-28
GEOCRES No.
SCALE: AS SHOWN
W. P. NO:
JOB NO: 61-F-14
DWG. NO: 61-F-14A