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GEOCRES No. 316-54

DIST. 9 REGION

W.P. No.

CONT. No. MUNICIPAL

W. O. No. 72-11038

STR. SITE No. BRIDGE NO. 28

HWY. No.

LOCATION PRESCOTT + RUSSELL COUNTIES

CO. RD. NO. 8' OVER BEAR BROOK

No of PAGES -

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

OVERSIZE DRAWING

Mr. K. L. Kleinstieber,
Municipal Structural Engineer,
Design Services Branch,
West Bldg., Downsview.

Foundations Office,
Design Services Branch,
Central Bldg., Downsview.

March 20, 1972.

Prescott & Russell Counties, Bridge #28,
Co. Rd. No. 8 Over Bear Brook, W.O. 72-11038,
District No. 9 (Ottawa)

We have reviewed the preliminary bridge plan for the above-mentioned project together with the Foundation Report by Fondex Ltd. During our review we discussed certain matters by phone with Dr. J. D. Scott of Fondex, as a result of which further analyses were carried out. The results of these analyses are contained in a letter by Dr. Scott dated March 8, 1972, a copy of which was also sent to you. We have also consulted Dr. K. Y. Lo of the University of Western Ontario with regard to slope stability in the interim and final conditions and a copy of his report is attached to this memo.

Our comments relating to foundations are as follows:

- 1) In general, the scheme shown on the preliminary plan is acceptable.
- 2) The forward slopes of the structure approaches should be constructed together with the drainage system referred to in Dr. Scott's letter, prior to construction of either the piers or abutments.
- 3) The pier footings should be constructed within a sheeted and braced excavation prior to constructing the abutments.
- 4) The bridge plan does not indicate that flattening of existing slopes as recommended in 10.7, page 31 of the Foundation Report will be carried out. We assume that this recommendation will be followed.

KGS/ao
Attach.

K. G. Selby
K. G. Selby,
SUPERVISING FOUNDATION ENGINEER.

cc: Foundations Files ✓
Documents

Dr. K.Y. Lo
482 Village Green Avenue
London 64, Ontario

7 March 1972

Mr. K.G. Selby
Supervising Foundation Engineer
Department of Transportation and
Communications
Downsview 464, Ontario

Dear Ken:

I have submitted my short report on Bear Brook Crossing to Mr. Rutka. Enclosed herewith are all the materials of the project I received from you.

Best regards,

Yours sincerely,



K.Y. Lo

KYL:nd

encl.

Comments :

Excavation of sand & replacement by 930 A Material should be done by employing a dewatering scheme. The most effective sand method would be either interlocking sheet piles or caisson. Piles or caisson should be driven or advanced well into the underlying stiff clay stratum to seal out the water.

QUESTIONS TO BE ANSWERED

SLOPES

- (1) IS FINAL CONDITION SATISFACTORY?
WHAT IS SAFETY FACTOR?
- (2) ARE INTERIM CONDITIONS SAFE?

FOOTINGS

- (1) IS FOOTING DESIGN ADEQUATE OR
SHOULD WE BE USING PILES?
- (2) IS STATEMENT THAT SETTLEMENTS
WILL BE SMALL (I.E. < 1 INCH) JUSTIFIED?

$C' = 4000$ p.s.f.
 $\phi' = 25^\circ$

ABUTMENT LOADS (VERTICAL)

TOTAL 1150 K
1150000 lbs

<u>DEAD</u>	DECK	400	990 K
	ABUT	* 330	
	SOIL	<u>260</u>	

LIVE 160 K

* EXCLUDES WEIGHT OF FOOTING
(ASSUME 150 p.s.f. for footing wt.)

PIER LOADS (VERTICAL)

TOTAL 1315 K

<u>DEAD</u>	DECK	800K	1150 K
	PIER	* <u>350K</u>	
	TOTAL		

LIVE 165 K

* EXCLUDES WEIGHT OF FOOTING
(ASSUME 150 p.s.f. for footing wt.)

FOOT W/G

DIMENSIONS :-

ABUTMENT

62.5' x 9' x 4'

PIER

50' x 13' x 4'

1150

$$\text{area of abut} = 62.5 \times 9 = 562 \text{ SQ FT.}$$

$$\text{TOT LOAD} = 1150 \text{ K}$$

$$\text{unit load} = \frac{1150}{562} = 2.05 \text{ K} = 2050 \text{ PSF}$$

$$\begin{aligned} \text{load on one linear ft width} &= 9 \times 2050 + \overbrace{9 \times 4 \times 150}^{\text{footing}} = 18,500 + 5400 = \\ &= 23,900 = 23.9 \text{ K} \end{aligned}$$

$$\text{area on cross section} = 9 \times 14 = 126 + 12$$

$$\text{unit weight} = \frac{23,900}{138} = 173 \text{ PCF}$$

3.1.7

$$\begin{array}{r} 14 \times 173 \\ 982 \\ \hline 1422 \end{array}$$

PIERS

50' X 13'

= 650 SQ. FT.

unit load = 2020 PSF

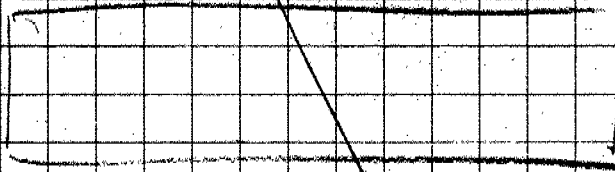
ABUT.

62.5' X 9'

= 562 SQ. FT.

Q = 2040 PSF

4' THICK



OVERSIZE DRAWING

3000 3000

Leftmost beneath abutment footing

Trailing 14' below ground

BOUSSINESQ FORMULA

$\mu = 0.33$

$b =$

4.5

$Q = 1 \text{ TON}$

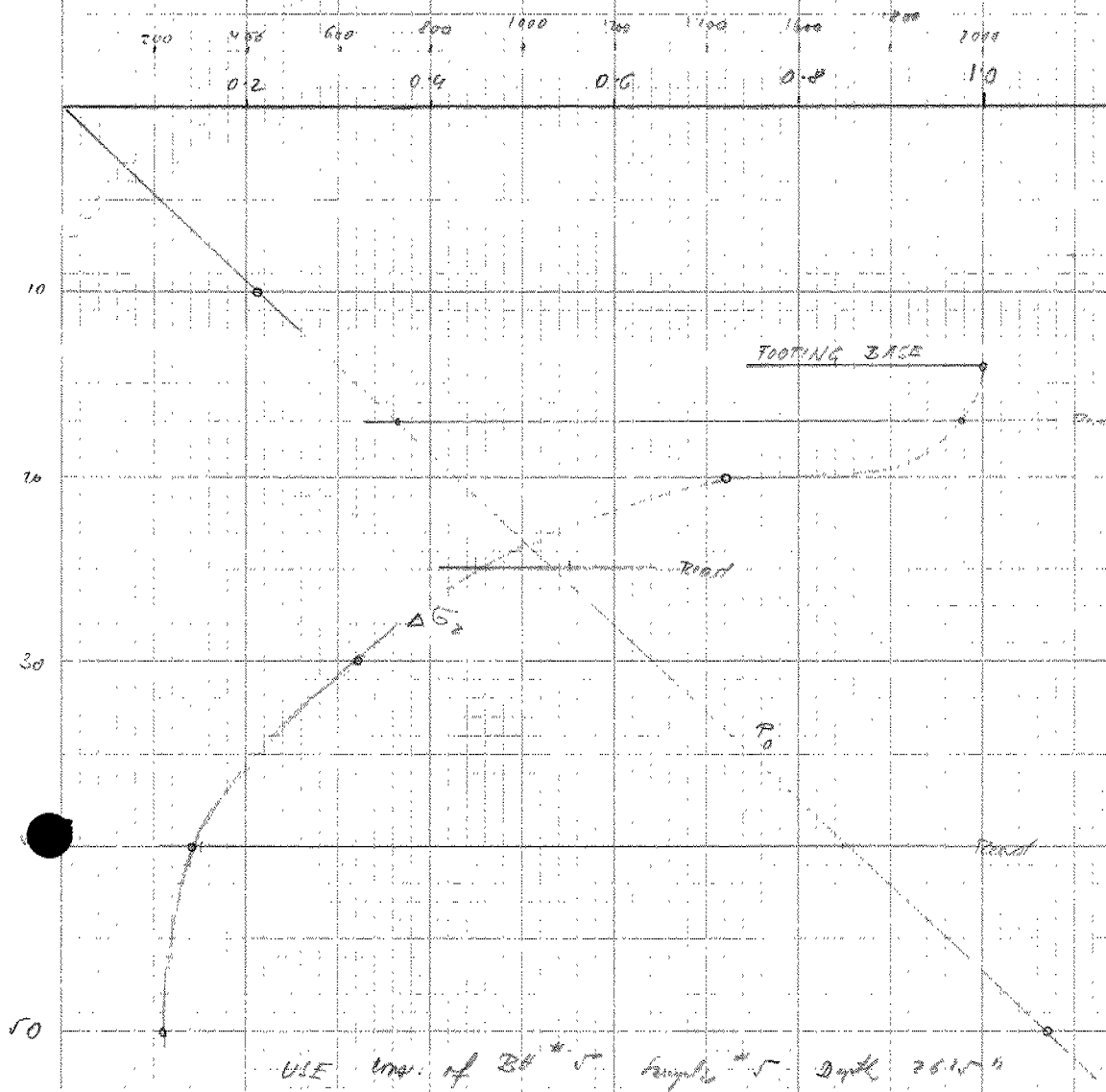
$W_L = \text{ground}$

Depth below ground	z (ft)	$m = \frac{Q}{z}$	$n = \frac{b}{z}$	f_B	$G_z = 4 \times Q \times f_B$ (TSF)
20	6	1.3	0.75	0.18	0.72
30	16	2	0.28	0.08	0.32
40	26	1.2	0.17	0.05	0.14
50	36	0.9	0.125	0.029	0.11

$P_0 = 105 - 62 = 43 \times \text{depth}$
2000

$10' = 0.21$

$50' = 1.07$



Depth	P_0	P_1	e_0	e_1	Δe	$H \frac{\Delta e}{1+e_0}$	Δ in
14 - 20 72"	720	720 + 1560 2280	1.25	1.17	0.08	72 $\frac{0.08}{2.25}$	2.5
20 - 30 120"	1050	1050 + 920 1970	1.22	1.19	0.02	120 $\frac{0.02}{2.22}$	1.1
30 - 50 225"	1700	1700 + 290 1990	1.2	1.18	0.02	240 $\frac{0.02}{2.2}$	2.2

TOT $\Delta = 5.8"$

If Schmestmann construction of e by p curve is assumed to be valid no settlement will occur.

March 8th, 1972.

Mr. K.G. Selby,
Supervising Foundation Engineer,
Department of Transportation
and Communications,
Downsview 464, Ontario.

RE: Foundation Conditions for Proposed Bridge at
Crossing of County Road No. 8 and Bear Brook.

File No. 3069-S

Dear Mr. Selby:

As requested, we have reviewed several points regarding the foundations and slopes for the proposed bridge at the crossing of County Road No. 8 and Bear Brook. These items could not be analyzed at the time the original report was written because the locations and loads of the piers and abutments had not been determined.

This letter reports on the following studies:

1. The stability of the south slope at the bridge site when the clay slope is subjected to the stresses from the abutment founded on a spread footing in the clay.
2. The resistance to sliding of the piers when they are founded on spread footings in the clay at the base of the slopes.

The locations and elevations of the abutments and piers were determined from a Preliminary Drawing of the General Plan dated January 17, 1972 obtained from McNeely, Lecompte & Associates, Ltd. The live and dead loads of these structural elements were obtained from Mr. P. Proulx of the same firm.

Figure 1 attached shows the factor of safety of the south slope at the bridge site when the full live and dead loads are acting on the abutment and the groundwater table is close to the surface. The factors of safety are given for an undrained shear strength value for the clay of 1700 psf and for a range of effective stress shear strength parameters varying between $\phi' = 25^\circ$, $c' = 400$ psf and $\phi' = 35^\circ$, $c' = 290$ psf.

...2

The factors of safety for the effective stress condition are close to unity and cannot be regarded as sufficient. Figure 2 shows the same conditions but with the ground water table drawn down by drains in the vicinity of the abutment. The factors of safety have increased to 1.2 and 1.3. Although these values would normally be regarded as low, the shear strength values as explained in our original report are conservative and these values for the factor of safety can be considered to be satisfactory.

It is recommended therefore that the south abutment be founded on a spread footing at the shown location with drainage tiles installed both upslope and downslope of the abutment. The drainage system should be designed to prevent freezing and must be able to discharge at all times of the year.

The loads from the south pier have not been taken into consideration in analyzing the above slope as the pier is not located on the same slope section as the abutment because of the angle at which the bridge crosses the river. It is recommended also, however, that a tile drainage system be installed on the upslope side of the pier as an aid in lowering the ground water pressures in the slope.

The resistance to sliding of the piers when they are founded on spread footings at the base of the slope has been analyzed for a number of conditions. It was assumed that no passive pressure resistance acted on the downslope side of the pier and that only the dead load was on the pier. The table below shows the shear strength parameters for the clay in the slope and at the bottom of the footing used in the analyses and the results obtained.

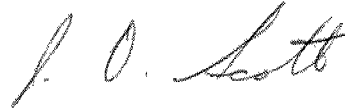
Case	Shear Strength Parameters	Factor of Safety Against Sliding
1	$\phi = 0$, $c = 1500$ psf	Infinity. No active pressure.
2	$\phi' = 25^\circ$, $c' = 400$ psf r_u in slope = 0.48	Infinity. No active pressure.
3	$\phi' = 35^\circ$, $c' = 290$ psf r_u in slope = 0.48	Infinity. No active pressure.
4	$\phi = 0$, $c = 450$ psf	2.0

March 8th, 1972

As can be seen in the above results no problem exists with respect to the sliding resistance of the pier foundations. The fairly flat clay slope of two horizontal to one vertical above the piers only requires a small value of cohesive strength to prevent active pressures from building up on the pier. The cohesion required to give a factor of safety of 2.0 is shown in case 4. This value of 450 psf is sufficiently small that it is not anticipated that long term yielding of the clay slope causing movement of the pier will occur.

If any further information is required on the foundation conditions at this site please contact us at any time.

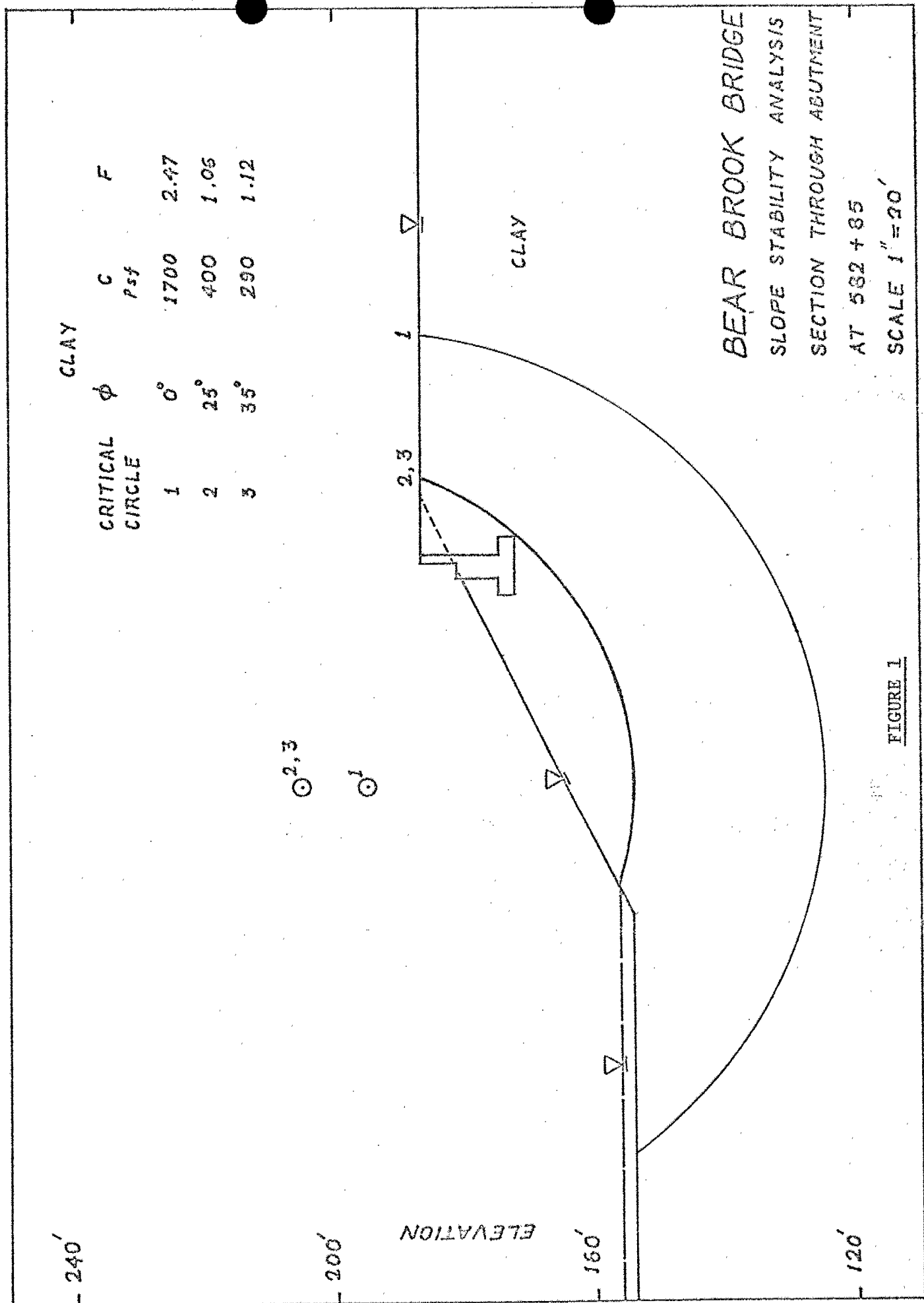
FONDEX LIMITED



Dr. J.D. Scott, P.Eng.

Encl.

Copies to: Mr. K.L. Kleinsteinber, P.Eng.
Mr. A.J. Lynch, P.Eng.
McNeely, Lecompte & Associates Ltd.



BEAR BROOK BRIDGE
 SLOPE STABILITY ANALYSIS
 SECTION THROUGH ABUTMENT
 AT 532+85
 SCALE 1"=90'

FIGURE 1

Dr. K.Y. Lo
482 Village Green Avenue
London 64, Ontario
7 March 1972

Mr. A. Rutka
Materials and Testing Engineer
Department of Transportation and
Communications
Downsview 464, Ontario

Attention: Mr. A.G. Stermac,
Principal Foundation Engineer

Re: Proposed Crossing of County Road No. 8 and
Bear Brook. Township of Clarence, Counties
of Prescott and Russell

Dear Mr. Rutka:

In accordance with your letter of February 29th,
1972, and discussions with Mr. A.G. Stermac and Mr. K.G.
Selby of your Department, I have completed the stability
study of the slopes at the South Abutment. The findings
of this study have been verbally transmitted to Mr. Selby
on March 2nd, 1972, and are reported in the following
paragraphs. The soils information is based on the
Consultant's Report on this project.

Since no testing to determine the failure envelope
of the clay has been performed, the approach taken here
is to use a "residual" strength envelope determined from
the analysis of a number of slides of natural slopes in
geologically similar areas.

Using this nonlinear "residual" strength envelope, three cross-sections of the natural banks at the site were analysed. The results indicate factors of safety of about 0.7. This implies that large portions of the trial slip surface have not passed the peak strength condition. Since the natural slopes are stable, the actual factor of safety will be at least unity. Therefore, factors of safety computed for design sections should be modified by the ratio of 1/0.7. This has been done for the factors of safety in terms of effective stress reported below.

For $\phi = 0$ analysis, the average vane strength measured is about 1,600 psf within the depths under consideration. Because of the possibility of strength anisotropy and time effects, both of which usually reduce the strength, it is believed that a value of 1,000 psf is a reasonable estimate. For total stress analysis, therefore, the undrained shear strength is taken as 1,000 psf.

The results of stability analyses of the south slopes in terms of total and effective stresses are summarized in Table 1. The conditions pertaining to construction sequence and ground water are also indicated. The results show that slopes trimmed to 2:1 will have a minimum factor of safety of 1.3 and will be stable provided that construction of pier should be performed within sheet piling and pier construction precedes that of the abutment.

With the proposed dimensions of the footings for the pier (50 ft. x 13 ft.) and the abutment (62.5 ft. x 9 ft.), the increase in vertical pressure is 2,000 psf. The factor of safety for bearing capacity is adequate and settlement will be small since the increase in pressure is within the preconsolidation pressure. The abutments and piers may be founded on spread footings, as proposed.

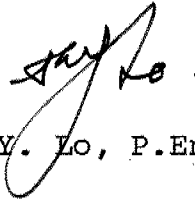
Condition Analysed	Factor of Safety for		
	2:1	2¼:1	2½:1
<u>Interim Condition</u>			
Pier construction precedes abutment construction. Sheet piles to be used.			
(a) Total stress analysis	2.6	3.0	3.5
(b) Effective stress analysis G.W.T. 6 ft. below surface	1.3	1.35	1.38
Without sheet pile Construction slope 1:1			
(a) Total stress analysis	2.4	--	--
(b) Effective stress analysis	1.0	--	--
<u>Final Condition</u>			
With abutment loads on			
(a) Total stress analysis	2.3	2.7	3.0
(b) Effective stress analysis			
i) G.W.T. at surface	1.3	1.45	1.60
ii) G.W.T. at 6 ft. below surface	1.4	1.5	1.55

TABLE 1 - Summary of Stability Analysis of South
Abutment Slope, Bear Brook

The factor of safety of the footings against sliding is also adequate.

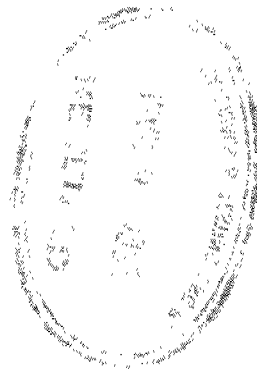
It is recommended that the slopes at the abutments be trimmed to 2:1. The pier excavation should be carried out within sheet piles. The piers should be constructed before the abutment. Spread footings at elevations and of sizes as indicated in the drawing supplied are satisfactory.

Yours very truly,

A handwritten signature in dark ink, appearing to read 'K.Y. Lo', written over the printed name.

K.Y. Lo, P.Eng.

KYL:nd







cc: Mr. A. G. Stermac
Hwy. 401 and Keele Street,
Downsview 464, Ontario.

Telephone: 248-3260
(Area Code 416)

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS

MINISTER: HONOURABLE ~~CHARLES M. McLEOD~~
Gordon R. Carton, Q. C.

DEPUTY MINISTER: A. T. C. McNAB

February 29, 1972

Dr. K. Y. Lo,
Department of Civil Engineering,
University of Western Ontario,
London, Ontario.

Dear Dr. Lo:

This is to confirm Mr. Stermac's request of Friday, February 25, 1972, for your services in connection with our review of foundation conditions at the site of the proposed crossing of County Road No. 8 and Bear Brook, Township of Clarence, Counties of Prescott and Russell.

Specifically, we request you to study the factual information in the foundation report and carry out stability analyses of the proposed slopes using your method of analysis which takes into account the anisotropic nature of the subsoil. We would also like your opinion as to the most suitable type of foundation to be used to support the new structure.

It was agreed that charges for this work will be at the per diem rate of \$150.00.

We would be pleased to have your report by March 3, 1972.

Yours very truly,

AR/MdeF

A. Rutka
Materials and Testing Engineer

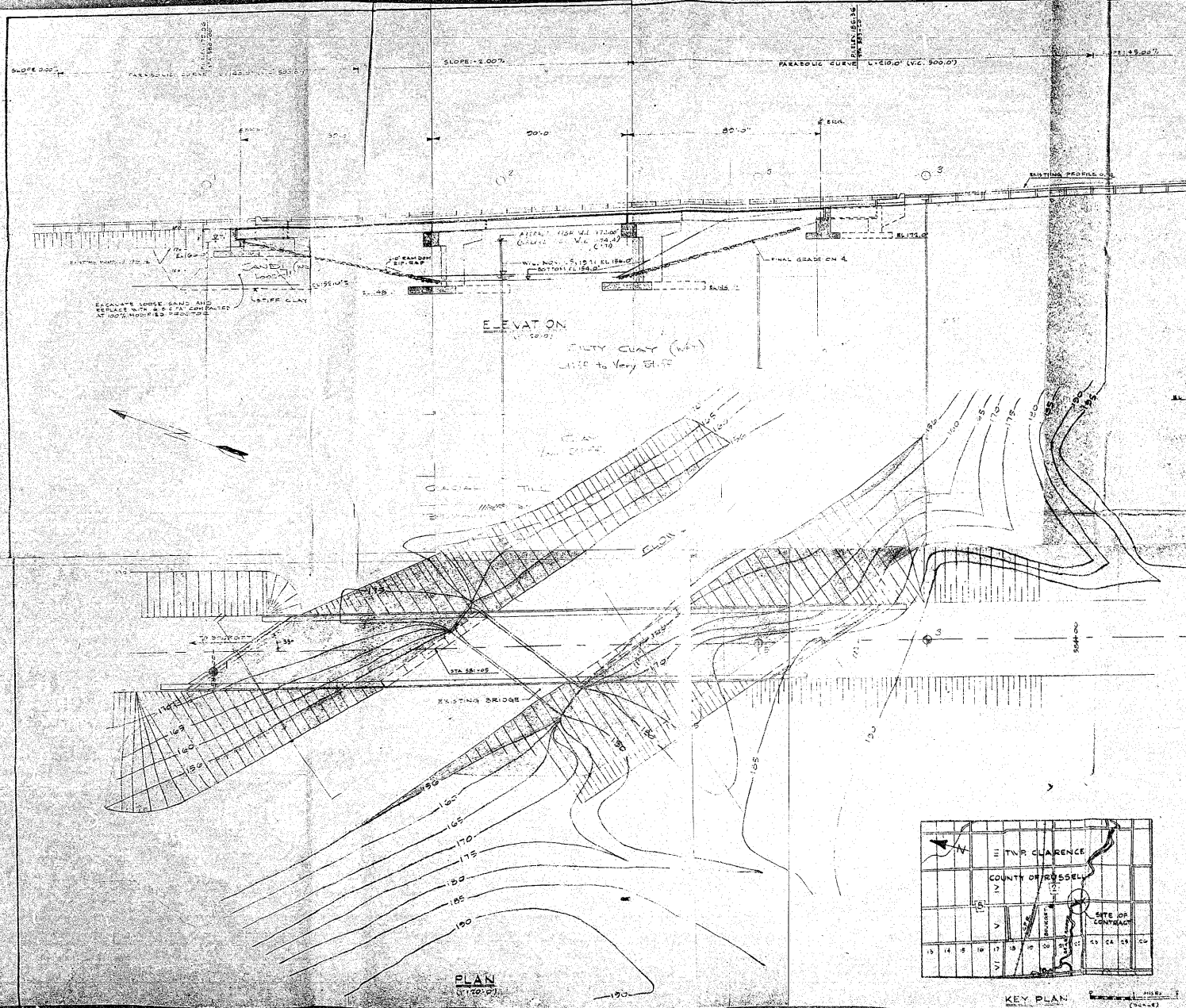
Copies to: Messrs. A. G. Stermac

W. W. Fry

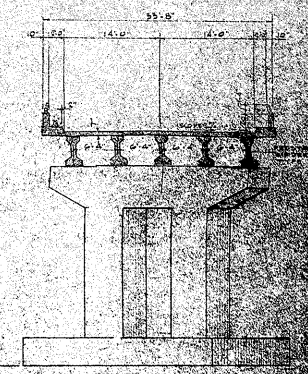
Mrs. Mae Andrews

A. Rutka

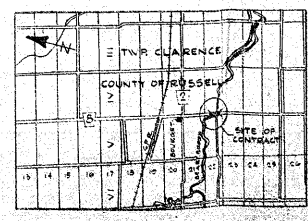
M. & T. Files



ELEVATION
(1:50,000)
SILTY CLAY (Wt)
Wt 10 to Very Silty



- 1-LOADING H20-S16
- 2-REINFORCING STEEL: INTERMEDIATE BRIDGE
- 3-CLAS OF CONCRETE
- 4-DECK & PARAPET WALLS: 4000 P.S.I.
- 5-ALL EXPOSED CORNERS TO HAVE 1/2" MIN. THICKNESS
- 6-BRIDGE CLEAR COVERING FOR REINFORCING STEEL
- FOOTING, ABUTMENTS & PIER: 15"
- DECK SLAB-TOP: 1 1/2"
- 8-REINFORCING STEEL NOTATION
- 9-REINFORCING STEEL NOTATION
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- 100-REINFORCING STEEL NOTATION



PRELIMINARY
No. 1
JAN 17 1972

RECEIVED
JAN 18 1972
Mr. & Mrs. Russell

STRUCTURE NO. 27-193

UNITED COUNTIES of PRESCOTT & RUSSELL
McNEELY, LECOMPT & ASSOCIATES LTD.
CONSULTING ENGINEERS

BEAR BROOK BRIDGE

COUNTY: RUSSELL	ROAD NO. 8
TWP. CLARENCE	LOT 22 BET. CON. A & CON. B
DESIGN: P. PROULX	SCALE: 1" = 10'
DRAWN: [blank]	CONTRACT NO. [blank]
APPROVED: [blank]	DRAWING NO. [blank]
DATE: [blank]	DATE: [blank]

