Plot on 30 M11 map

WILLIAM A. TROW AND ASSOCIATES LTD.

SITE INVESTIGATIONS
LABORATORY TESTING
SOIL MECHANICS CONSULTATION

W. A. TROW, M.A.Sc., M.E.I.C., P.ENG.

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CH. 1-4644

Project: J1430 May 12, 1964

Maksymec and Associates,
Consulting Engineers,
84 Hillsdale Avenue East,
Toronto 7, Ontario.

30M11-174
GEOCRES No.

Attention: Mr. B. Maksymec, P. Eng.

Re: Foundation Investigation
Proposed Bridge Replacement
Mill Street, North York

Dear Sirs:

We have completed an investigation of the subsoil conditions at this site. The field work consisted of two sampled borings, one to a depth of 85 feet the other to 30 feet, carried out towards the end of April, 1964. Our observations and conclusions arising out of this work are outlined in the sections which follow. In order to expedite the submission of this report, we have taken the liberty of presenting it in an informal manner.

1) From 5 to 7 feet of sand fill, which was found to contain pieces of wood, underlies the concrete apron from which the holes were drilled (see Dwg. 1) On the west side, the fill was underlain by well graded sand to a depth of 15 feet. Beneath the graded sand on the west and the fill on the east, a deposit of dense to very dense fine sand was intersected. The competent nature of the fine sand is substantiated by laboratory tests which indicate that the average relative density of the material is 97% (Table I). The sand extends down to about 80 feet, below which level, extremely dense till and shale were encountered.

2) The hydrostatic pressure in the soil to a considerable depth corresponds to a water table which is generally a few inches above the level of the river. It appears, however, that a 2 to 3 feet thick layer of silt at a depth of 35 feet seals off an artesian condition which exists at depth in the sand. The artesian pressure was measured to reach a maximum of 6 feet above the top of the borehole; this corresponds with a water pressure some seven feet above the level of the Don River.

3) Because of the high water table and the variable nature of the fill and underlying graded sand, a piled foundation appears to be the only suitable type of support for the proposed bridge. While it would be possible to sheet an excavation and lower the water table by wellpoints, this would prove to be a costly and time consuming operation. Because the fine sand is dense to very dense, only a relatively small number of displacement piles will be required to support a bridge of the size that is contemplated.

4) The capacity of piles driven into the grey fine sand below a depth of 20 feet can be estimated from the expression:

$$Q = \frac{A}{F} \left\{ \gamma' \, D \, N \right\}$$

where:
- Q = the capacity of the pile in tons
- A = the area of the pile tip in square feet
- F = the factor of safety
- γ' = the submerged weight of the sand in tons per cubic foot
- D = the depth of the pile tip below the ground surface
- N = a bearing capacity factor.

For the case under consideration, the value of γ' for the dense sand = 70 pcf, N = 100 and F should equal 3.5. The expression reduces to the form.

$$Q = \frac{A}{3.5}\left\{\frac{70}{2000} \times D \times 100\right\} = A \times D$$

The effect of friction along the shaft of the pile will add a further factor of safety to the pile capacity.

5) Two alternative types of pile are recommended, (a) Franki Piles: The capacity of Franki type piles, in which an enlarged concrete bulb is formed in-situ at the bottom of a small cast-in-situ shaft, will depend upon the size of the concrete bulb that is created. For instance, a 3 feet diameter bulb formed at a depth of 25 feet would have a safe capacity of 175 tons based on the above expression. However, because the sand is so dense (see Table I) it may prove difficult to form, and to guarantee the formation of, a large diameter bulb. (b) Conventional Displacement Piles: Either wood, tubular steel or precast concrete piles could be driven into the sand. If the tip area of the pile is small, it would have to be driven to a considerable depth to develop an appreciable load carrying capacity. Wood piles would have to be cut off below the permanent ground water table to prevent decay. The depth to which each pile should be driven should be specified on the basis of the expression given above. This depth should be adhered to even though it may not represent the depth of refusal to driving. The advantage of the Franki type of pile is its high capacity at shallow depth. The fact that piles with adequate capacity can be formed at shallow depth is of importance because of the artesian conditions in the lower sand. Conventional piles driven into the deeper reaches of the sand could suffer from the effects of piping of the sand along the pile sides. This would tend to disturb

the soil and could reduce the capacity of the pile. For this reason it is recommended that step-taper piles of the Raymond type or a large butt-small tip wood piles be used if conventional piles are chosen. They would have wedging action when driven into the soil and should prevent piping of the sand.

As mentioned earlier, it may prove difficult to establish the as-constructed diameter of the bulb of a Franki type pile. If bulb piles are selected, it is recommended that one be load tested to twice the design capacity.

It may be that the existing bridge is supported on timber piling. Rather than attempt to drive a large number of new piles in among the old ones, it would appear to be more practical to drive a limited number of high capacity piles. Either Franki type or large diameter tapered piles appear to be the best solution for this site.

We trust that the information contained in this brief report will enable you to design the foundations for the proposed replacement structure. Should any questions arise, we would appreciate your call.

Yours very truly,

D H Shields

D.H. Shields, P. Eng.

DHS/bs.
Encls.

J1430

TABLE I

HOLE	SAMPLE	DEPTH FT.	WATER CONTENT %	ESTIMATED* NATURAL DRY DENSITY p.c.f.	BY LABORATORY TEST Minimum Dry Density psf	Maximum Dry Density pcf	RELATIVE DENSITY %
1	4	16 - 17.5'	21.7	106.2			
	5	20 - 21.5'	21.5	106.7	86.5	105.2	100
	6	24 - 25.5'	21.1	107.3			
	7	29 - 30.5'	20.2	109.1	87.3	111.0	94
	9	39 - 40.5	19.7	110.0	85.9	110.7	98
	11	49 - 50.5	22.0	105.8	84.0	106.3	98

* from the expression $\dfrac{S.G. \times Yw}{1 + \dfrac{W \times S.G}{100}}$ where: S.G. = specific gravity of the sand particles, assumed equal to 2.70

Yw = unit weight of water, 62.4 pcf

W = water content, per cent

two checks on the applicability of this expression were made by comparing the results of the equation with the results of direct determinations of the density of relatively undisturbed Shelby samples from hole 2. Sample 6 at 25 feet depth showed 110.0 pcf dry density by direct measurement while the equation gave 109.2 pcf; sample 7 at 29 feet showed 107.0 and 107.4 respectively.

the commonly accepted correlation between relative density and soil state is:

Relative Density	State of the Soil
0 - 15%	Very Loose
15 - 35%	Loose
35 - 65%	Medium Dense
65 - 85%	Dense
85 - 100%	Very dense.

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SITE INVESTIGATIONS · SOIL MECHANICS CONSULTATION

DRAWING No. 3.

PROJECT No. J1430.

LEGEND

BOREHOLE No. 2.

PROJECT Proposed Bridge Replacement.

LOCATION Mill Street, North York.

HOLE LOCATION See Dwg. 1.

HOLE ELEVATION 406.2 ft.

DATUM See Dwg. 1.

PENETRATION RESISTANCE

2" O.D. SPLIT TUBE —o—o—o—

2" I.D. SHELBY TUBE —x—x—x—x—

2" DIA. CONE ————

SHEAR STRENGTH

UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE ⦶

UNCONFINED COMPRESSION ⊗

VANE TEST AND SENSITIVITY (S) +S

NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX X LI

ATTERBERG LIMITS

LIQUID LIMIT —o

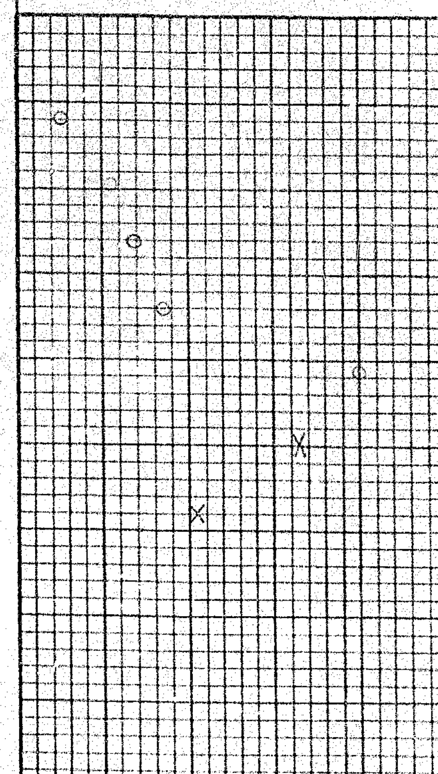
PLASTIC LIMIT ⊢—

SAMPLE TYPE

2" O.D. SPLIT TUBE

2" I.D. SHELBY TUBE

3" O.D. SHELBY TUBE

SYMBOL	SOIL DESCRIPTION	ELEV. FEET	DEPTH FEET	PENETRATION RESISTANCE 350 FT. LB. BLOWS/FT. 20 40 60 80 / SHEAR STRENGTH P.S.F.	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS % DRY WEIGHT	SAMPLE TYPE AND No.	NATURAL UNIT WEIGHT P.C.F.
	surface of concrete lining	406.2	0				
	FILL-sand with pieces of wood.	401.2					
	SAND-grey, silty fine sand dense to very dense.		10				
			20				
	End of Bore	376.7	30				
			40				

Notes:

1) BX casing driven and washed clear as required.
2) On completion, the water level was at 4.3 foot depth.

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SITE INVESTIGATIONS · SOIL MECHANICS CONSULTATION

DRAWING NO. 2.
PROJECT NO. J1430.

30M11-174

LEGEND

PENETRATION RESISTANCE
- 2" O.D. SPLIT TUBE
- 2" I.D. SHELBY TUBE
- 2" DIA. CONE

SHEAR STRENGTH
- UNDRAINED TRIAXIAL AT OVERBURDEN PRESSURE
- UNCONFINED COMPRESSION
- VANE TEST AND SENSITIVITY (S)

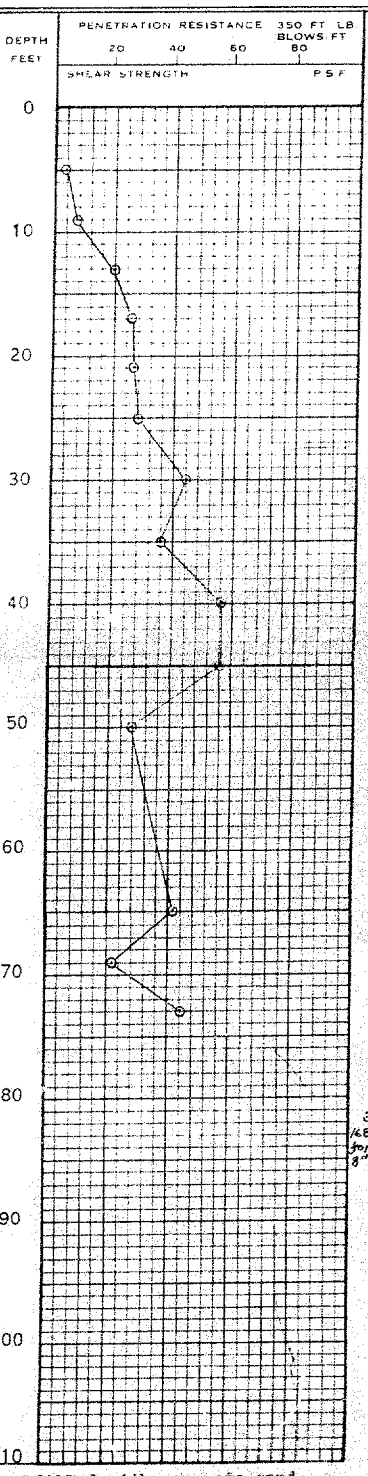
NATURAL MOISTURE CONTENT AND LIQUIDITY INDEX

ATTERBERG LIMITS
- LIQUID LIMIT
- PLASTIC LIMIT

SAMPLE TYPE
- 2" O.D. SPLIT TUBE
- 2" I.D. SHELBY TUBE
- 3" O.D. SHELBY TUBE

BOREHOLE NO. 1
PROJECT Bridge Site
LOCATION Mill Street near Yonge
HOLE LOCATION South west corner of existing bridge
HOLE ELEVATION 406.2 ft.
DATUM See Dwg. 1.

SOIL DESCRIPTION	ELEV FEET	SAMPLE TYPE AND NO
8 inches of concrete surface	406.2	
FILL-grey fine sand and gravel, pieces of wood and bricks.		SS1, SS2
SAND-grey, well graded sand with fine gravel.	397.2	SS3
SAND-grey, fine, silty sand, dense.	390.7	SS4, SS5, SS6, SS7
Layer of grey sandy silt with gravel sizes.	372.2	SS8
-thin seam of grey, sandy silt noted at 45 feet.	369.7	SS9, SS10, SS11, SS12
-thin seam of grey silt noted at 70 feet depth.		SS13, SS14
SAND TILL-grey silty sand with gravel, very dense. Refusal to Sampler	327.2	SS15
	323.7	



Notes: 1) BX casing driven and washed clean as required.
2) With casing at 39 feet over week end, water rose to 11 inches depth.
3) With casing at 72 feet overnight, water flowed out of top of casing at +4".
4) hole advanced to 85 feet by diamond core drill, encountered alternate layers of shale and silt till.
5) When removing casing, an artesian pressure of up to 70 inches was measured, hole sealed at 35' with a bentonite plug and cement and then backfilled with concrete sand.

DOCUMENT MICROFILMING IDENTIFICATION.

G.I-30 SEPT. 1976

GEOCRES No. 30 M 11 -174

DIST. 6 REGION CENTRAL

W.P. No.

CONT. No.

W. O. No.

STR. SITE No.

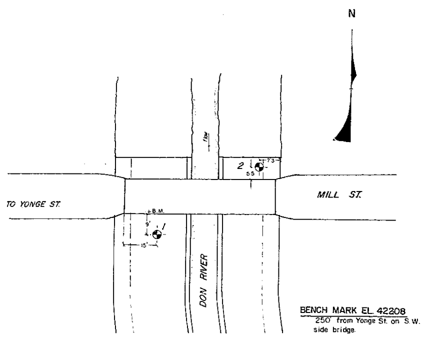
HWY. No.

LOCATION MILL ST & DON RIVER.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 1

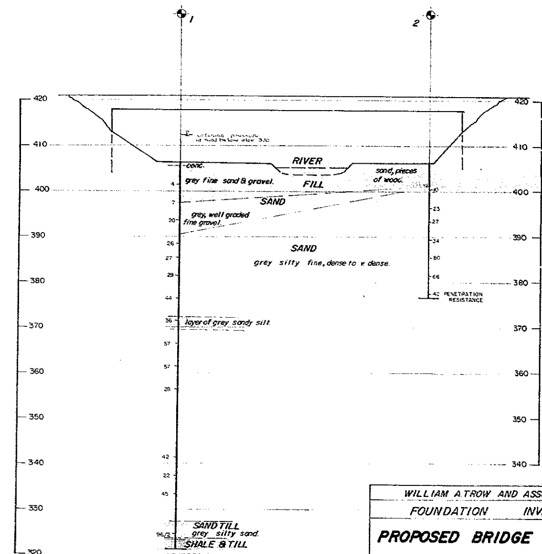
REMARKS: DOCUMENTS TO BE UNFOLDED BEFORE MICROFILMED

SOME DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENTS



PLAN

SCALE: 1 IN. = 20 FT.



INTERPRETED SUBSOIL STRATIGRAPHY

SCALE: HOR. & VERT. 1 IN = 10 FT.

30 M11 - 174

GEOCRES

WILLIAM A. TROW AND ASSOCIATES LIMITED

FOUNDATION INVESTIGATION

PROPOSED BRIDGE REPLACEMENT

MILL STREET

TORONTO ONTARIO

PROJ. 1430 / DATE MAY 1964 / DWG. Nº 1

SOME DEFECTS IN NEGATIVE DUE

TO CONDITION OF ORIGINAL DOCUMENTS