

#67 - F - 262M

GABLER BRIDGE

LOT 9/10 , CON. 7

WEST MISSOURI TWP.

BA 2709
Site 19-185

H. Q. GOLDER & ASSOCIATES LTD.

SOIL AND FOUNDATION ENGINEERS

HEAD OFFICE - TORONTO, ONTARIO

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747 HYDE PARK ROAD
LONDON, ONTARIO
471-9600

November 8, 1967.

R. C. Dunn & Associates Ltd.,
747 Hyde Park Road,
LONDON, Ontario.

LOT 9 1/2 = cont 7

ATTENTION: Mr. N. W. Warner, P. Eng.

RE: Subsurface Investigation,
Gabler Bridge, West Nissouri Twp.,
Middlesex County, Ontario.

Dear Sirs:

This letter reports the results of a subsurface investigation carried out at the site of the proposed reconstruction of Gabler Bridge, located between Lots 9 and 10 of Concession VII in the Township of West Nissouri, Middlesex County, Ontario. It is proposed to replace the existing bridge with a new 40 foot span structure.

Two boreholes were put down on October 20th, 1967, at the locations shown on Figure 1 using a trailer mounted power auger. The boreholes were put down through the edge of the existing roadway fill to depths of 27 and 30 feet, and standard penetration tests carried out at regular intervals in the boreholes. The samples obtained from the boreholes were returned to our London office for detailed examination, and representative testing. The field work was supervised throughout by a soils engineer from our London office.

The ground-water level was observed in a perforated standpipe installed in Borehole 1, and readings taken up to three weeks after completion of the investigation.

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The soil conditions encountered in the boreholes are shown in detail on the Record of Borehole sheets enclosed with this report, and an inferred soil stratigraphy along the centreline of the roadway together with a boring plan is shown as Figure 1. The results of the laboratory testing are shown on the Record of Borehole sheets and on Figure 2.

The elevations given in this letter are referred to a bench mark consisting of a red paint mark on the wingwall at the northwest corner of the existing bridge. The elevation of this bench mark was given as 69.00 referred to a local datum.

The site is located near the periphery of the physiographic area known as the Caradoc Sand Plains where the sand overlying the till is only a few feet thick and is found predominantly in the river valleys. The Waubesa Creek, over which the bridge is to be constructed, meanders in a flood plain some 10 feet below the general level of the surrounding agricultural land.

The borings show that there is about 8 feet of loose to compact variable clayey silt fill containing some organic material and occasional sand or gravel. Below the fill, there is 2 to 3 feet of alluvial deposits that vary from a compact clayey silt to a dense sand and gravel. The predominant stratum underlying the site is a very dense grey fine sandy silt till which was encountered in both boreholes at about Elevation 58 and lower. This stratum contains occasional seams and layers of sand and zones of clayey silt till. The "N" values measured in the standard penetration tests gave values of at least 60 blows per foot and generally greater than 100 blows per foot. The natural water content of the sandy silt till is 10 to 12 per cent increasing to 18 per cent in the clayey silt till zone. A typical grain size curve for the till is presented as Figure 2. The stabilized groundwater at the site was found to coincide with river water level at about Elevation 60 to 61.

The proposed structure may be safely founded on spread footings bearing on the till with an allowable

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bearing pressure of 4 tons per square foot at Elevation 58 or deeper depending on the scour protection required.

There should be no major ground-water seepage into the excavations during construction providing the stream water is properly directed and the alluvial materials are removed. Minor seepage into the excavations through fissures or sand seams can be easily handled by pumping from sump pumps.

We trust that this report provides sufficient information for the foundation design of the proposed bridge. If there are any points that require further clarification, please do not hesitate to contact our office.

Yours truly,

H. Q. GOLDER & ASSOCIATES LTD.,

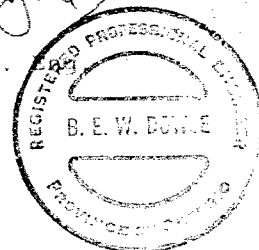
Brian E. W. Dowse

Brian E. W. Dowse, P. Eng.

BEWD:cmm

67580

November, 1967



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LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS auger sample
CS chunk sample
DO drive open
DS Denison type sample
FS foil sample
RC rock core
ST slotted tube
TO thin-walled, open
TP thin-walled, piston
WS wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch diameter, 60 degree cone one foot, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch drive open sampler one foot.

WH sampler advanced by static weight—weight, hammer

PH sampler advanced by pressure—pressure, hydraulic

PM sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Relative Density	<i>N</i> , blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	<i>c_u</i> , lb./sq. ft.
Very soft	Less than 250
Soft	250 to 500
Firm	500 to 1,000
Stiff	1,000 to 2,000
Very stiff	2,000 to 4,000
Hard	over 4,000

IV. SOIL TESTS

C consolidation test
H hydrometer analysis
M sieve analysis
MH combined analysis, sieve and hydrometer¹
Q undrained triaxial²
R consolidated undrained triaxial²
S drained triaxial
U unconfined compression
V field vane test

NOTES:

¹Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

²Undrained triaxial tests in which pore pressures are measured are shown as \bar{Q} or \bar{R} .

LIST OF SYMBOLS

I. GENERAL

π	= 3.1416
e	= base of natural logarithms 2.7183
$\log_e a$ or $\ln a$	natural logarithm of a
$\log_{10} a$ or $\log a$	logarithm of a to base 10
t	time
g	acceleration due to gravity
V	volume
W	weight
M	moment
F	factor of safety

II. STRESS AND STRAIN

u	pore pressure
σ	normal stress
σ'	normal effective stress ($\bar{\sigma}$ is also used)
τ	shear stress
ϵ	linear strain
ϵ_{xy}	shear strain
ν	Poisson's ratio (μ is also used)
E	modulus of linear deformation (Young's modulus)
G	modulus of shear deformation
K	modulus of compressibility
η	coefficient of viscosity

III. SOIL PROPERTIES

(a) Unit weight

γ	unit weight of soil (bulk density)
γ_s	unit weight of solid particles
γ_w	unit weight of water
γ_d	unit dry weight of soil (dry density)
γ'	unit weight of submerged soil
G_s	specific gravity of solid particles $G_s = \gamma_s / \gamma_w$
e	void ratio
n	porosity
w	water content
S_r	degree of saturation

(b) Consistency

w_L	liquid limit
w_P	plastic limit
I_P	plasticity index
w_s	shrinkage limit
I_L	liquidity index = $(w - w_P) / I_P$
I_C	consistency index = $(w_L - w) / I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
D_r	relative density = $(e_{max} - e) / (e_{max} - e_{min})$

(c) Permeability

h	hydraulic head or potential
q	rate of discharge
v	velocity of flow
i	hydraulic gradient
k	coefficient of permeability
j	seepage force per unit volume

(d) Consolidation (one-dimensional)

m_v	coefficient of volume change = $-\Delta e / (1+e) \Delta \sigma'$
C_c	compression index = $-\Delta e / \Delta \log_{10} \sigma'$
c_e	coefficient of consolidation
T_v	time factor = c_e / d^2 (d , drainage path)
U	degree of consolidation

(e) Shear strength

τ_f	shear strength
c'	effective cohesion
ϕ'	effective angle of shearing resistance, or friction
c_u	apparent cohesion*
ϕ_u	apparent angle of shearing resistance, or friction
μ	coefficient of friction
S_f	sensitivity

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = c_u$ is taken as half the undrained compressive strength.

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RECORD OF BOREHOLE 1

LOCATION

See Figure 1

BORING DATE

JUL 29 1967

DATUM

LOCAL

BOREHOLE TYPE

POWER AUGER BORING

BOREHOLE DIAMETER

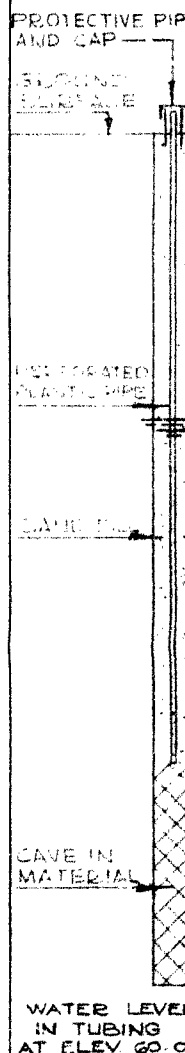
4.5"

SAMPLER HAMMER WEIGHT 140 LB.

DROP 30 INCHES

PEN. TEST HAMMER WEIGHT - LB.

DROP - INCHES

SOIL PROFILE			SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE - BLOWS / FT. -----					COEFFICIENT OF PERMEABILITY k, CM. / SEC.				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
ELEVATION DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.		SHEAR STRENGTH C _u , LB./SQ. FT.					WATER CONTENT, PERCENT					
							W _p	W	W _L	5	10	15	20				
60.1	GROUND - SEAL					70											
59.0	LOOSE TO COMPACT BROWN TO DARK BROWN CLAYEY SILT OCCASIONAL SAND AND GRAVEL AND ORGANIC MATERIAL (FILL)		1	1	6												
58.0			2	1	10												
57.0	COMPACT BROWN CLAYEY SILT WITH PIECES OF AGGREGATE		3	1	10												
56.0	VERY DENSE GREY SAND AND GRAVEL		4	1	15												
55.0			5	1	10												
54.0			6	1	10												
53.0	VERY DENSE GREY FINE SANDY SILT TILL WITH OCCASIONAL SEAMS OF SAND		7	1	10												
52.0			8	1	10												
51.0			9	1	10												
42.1			10	1	10											WATER LEVEL IN TUBING AT ELEV. 60.0 NOV. 8, 1967	
27.0	END OF HOLE																

15

10

5

Percent axial strain at failure

15-10-5 Percent axial strain at failure

VERTICAL SCALE
1 INCH TO 5'-0"

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CHECKED

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RECORD OF BOREHOLE 2

LOCATION

See Figure 1

BORING DATE

OCT 20, 1967

DATUM LOCAL



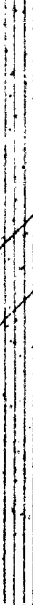

BOREHOLE TYPE


POWER AUGER BORING

BOREHOLE DIAMETER 4.5"

SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES

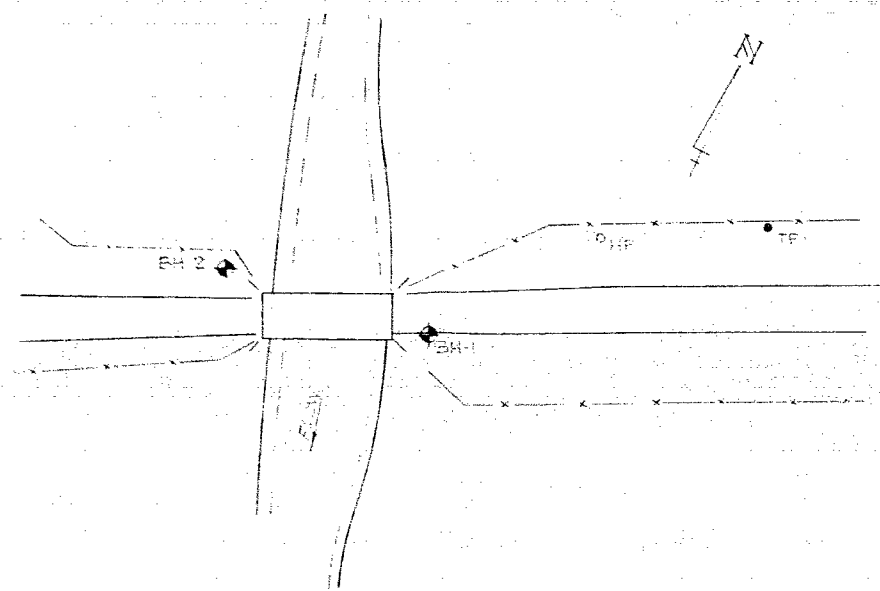
PEN. TEST HAMMER WEIGHT - LB. DROP - INCHES

SOIL PROFILE			SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FT. -----					COEFFICIENT OF PERMEABILITY k, CM. / SEC.				ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
ELEVN. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FT.		SHEAR STRENGTH C _u , LB. / SQ. FT.					WATER CONTENT, PERCENT					
												W _p W W _L 5 10 15 20					
						75											
70.4 60.0	GROUND SURFACE LOOSE BROWN CLAYEY SILT OCCASIONAL SAND AND GRAVEL AND ORGANIC MATERIAL (FILL)		1	SP	5	70											
			2	"	7	65											
61.9 58.5	COMPACT GRAY BROWN FINE TO MEDIUM SAND WITH TRACE OF SILT		3	"	12												
59.9 10.5			4	"	20	60											
			5	"	100												
			6	"	65	55											
	VERY DENSE GRAY FINE SANDY SILT TILL WITH CLAYEY SILT TILL ZONE FROM ELEVATION 53 TO 43		7	"	77												
			8	"	60	50											
			9	"	100	45											
40.4 30.0	END OF HOLE		10	"	100	40											
							 Percent axial strain at failure										
																WATER LEVEL AT ELEVATION 16.4 DURING DRILLING OCT 20, 1967	


 15-10 5 Percent axial strain at failure
VERTICAL SCALE
1 INCH TO 5'-0"

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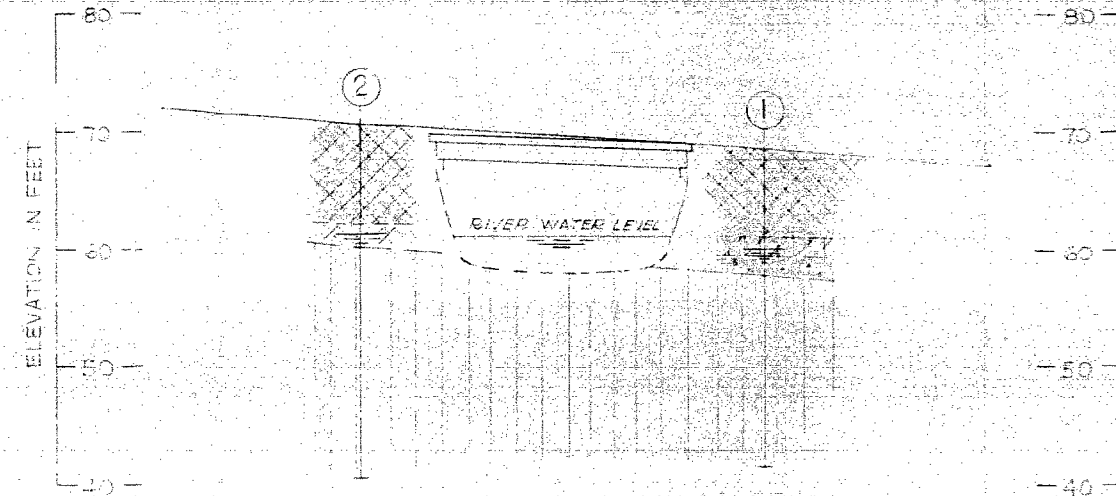
DRAWN _____
CHECKED _____WATER LEVEL AT
ELEVATION 60.4
DURING BORING
OCT 20, 1967



SCALE: 1"=40'

REFERENCE

TOWNSHIP OF WEST MISSOURI
R.C. DUNK AND ASSOCIATES
GABLED BRIDGE
JOB NO 61115 DRAWING 101

SECTION ALONG CENTRE LINE OF ROAD

HORIZONTAL 1"=20'
VERTICAL 1"=10'

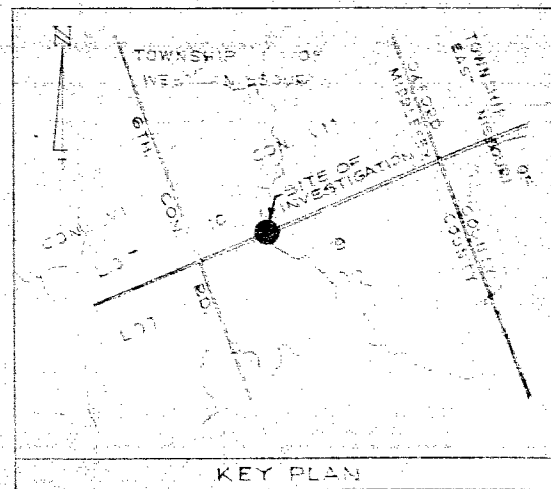
STRATIGRAPHY

- LOOSE TO COMPACT BROWN CLAYEY SILT
OCCASIONAL SAND AND GRAVEL (FILL)
- COMPACT BROWN CLAYEY SILT
- COMPACT GREY BROWN FINE TO MEDIUM
SAND WITH TRACE OF SILT
- VERY DENSE GREY SAND AND GRAVEL
- VERY DENSE GREY FINE SANDY SILT TILL

LEGEND

- BORING HOLE IN PLAN
- BORING HOLE IN ELEVATION
- WATER LEVEL IN BORING HOLE
NOV. 8, 1967.

SPECIAL NOTE: DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT BORING HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN BORING HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.



KEY PLAN

Drawn, NOV. 7, 1967.

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Made
Chkd.
Appd.

GRAIN SIZE DISTRIBUTION SANDY SILT TILL

FIGURE 2

