BRIDGE

REPLACEMENT

GEORGETOWN

30M12-108

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K.H. KING ASSOCIATES LIMITED

CONSULTANTS IN SOIL MECHANICS & FOUNDATION ENGINEERING

REF. NO. 303-S.3

30M12-108
GEOCRES No.

REPORT TO
COUNTY OF HALTON
ON
SOIL INVESTIGATION
PROPOSED BRIDGE REPLACEMENT
GEORGETOWN, ONTARIO

M.T.C. Site No.
10-216

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INTRODUCTION

K.H. King Associates Limited was retained by the County of Halton to conduct a subsurface soil investigation for the proposed bridge replacement in Georgetown, Ontario.

A set of drawings showing the location of the proposed project was supplied by the client.

The object of this investigation was to disclose the subsurface soil conditions at the site and to determine the relevant soil properties for the design and construction of the foundation for the proposed bridge replacement.

The findings of this investigation and our recommendations are presented in this report.

PROCEDURES

The field work consisting of two boreholes and two cone penetration tests was carried out on March 15 & 16, 1973 under the supervision of a senior soils technician who laid out the boreholes, obtained ground surface elevations, kept a record of field observations and conducted the field tests.

The boreholes were put down and the cone penetration tests were performed at the locations shown on the borehole location plan included as Figure 1.

The boreholes were advanced by a continuous-flight power auger to depths ranging from 15 ft. to 18 ft. The cone tests were advanced to depths of between 23 ft. and 25 ft. by driving a test cone using a 140 lb. hammer falling freely 30 inches.

Representative soil samples were recovered at frequent intervals of depth by means of a split-spoon sampler driven by Standard Penetration Test methods. The recovered soil samples were visually classified in the field, sealed in airtight jars and then re-examined in the laboratory.

The depth and type of samples, the Standard Penetration Test resistance and the cone penetration resistance are indicated on the borehole logs.

All elevations given in this report are referred to a local benchmark with an assumed elevation of 100.0 ft. The location of this local benchmark is indicated on the borehole location plan included as Figure 1.

A laboratory programme consisting of sieve analyses was carried out on selected representative soil samples. The test results are shown on the grain-size distribution charts included as Figures 6 and 7.

SUBSURFACE SOIL CONDITIONS

Details of the subsurface soil conditions are shown on the borehole logs. Generally speaking the subsurface soil at the site is a typical alluvial deposit consisting of stratified sand and gravel strata underlying a 4 foot thick sand and gravel or silt fill. There is a stratum of sand and gravel about 3 to 6 ft. in thickness. Below this stratum, a silty fine sand deposit of 7 ft. and 2 ft. thickness was encountered

in boreholes 1 and 2 respectively. Underlying the silty fine sand there is a sandy gravel deposit consisting of cobbles, gravel and sand, and occasional boulders to the maximum explored depths of 15 and 18 ft. where refusal to augering and penetration by driving was encountered. The sand and gravel deposit has a compact relative density as indicated by N-values ranging from 28 to over 100 blows per foot. The silty fine sand is described as being dense based on N-values ranging from 24 to 34 blows per foot obtained in this stratum. The gravel deposit is described as being very dense as it yielded N-values of over 100 blows per foot. The typical grain-size distribution curves of the silty fine sand and the gravel and sand are shown on Figures 6 and 7. The results of the two cone penetration tests are generally consistent with the findings of the borings.

GROUNDWATER CONDITIONS

After completion of the borings, free-standing water levels were observed at depths of 1.3 ft. and 2.4 ft. in boreholes 1 and 2 respectively. These observed water levels reflected the water level in the river and are believed to be the true water level at the site at the time this investigation was carried out.

DISCUSSION

It is understand that the existing bridge will be replaced by a twin structural plate corrugated steel pipe-arch culvert. The size of each culvert will be 17'-11" by 11'-8". The base of the culverts will be placed at El. 92±' and within the compact to dense sand and gravel deposit.

This investigation has shown that the site is underlain by alluvium consisting of stratified compact to very dense sand and gravel, silty fine sand and gravel deposits. The groundwater level was at El. 95±' at the time the field work was performed.

Foundation

Based on the boring results, it is considered that the subsoil has an adequate bearing capacity to support the proposed hydraulic structures. The subsoil would provide an allowable soil bearing pressure of 2.5 t.s.f. for the structure foundation placed at or below El. 92.5 ft. The settlement under this pressure is estimated to be one inch and it will occur immediately upon application of the load.

Bedding & Backfilling

Prior to placing the fill, all boulders, soft areas, loose spots or organic matter should be removed and replaced by compacted granular material.

The corrugated culverts should be laid on a uniformly compacted granular pad extending to the full length of the span of the pipe arch. The minimum thickness of this granular cushion should be 8-inches. The granular fill under the haunches and around the pipe should be placed evenly on both sides in 6-inch layers and compacted uniformly to 95% of the Standard Proctor maximum dry density. This procedure should be continued to a level at least one foot above the top of the pipe-arch. Above this level to 4 feet below the sub-base of the roadway, the fill should be placed in layers no thicker than 8-inches and compacted to 90% of the Standard Proctor maximum dry density. Within 4 feet below the roadway sub-base, the degree of compaction should be increased to 95% of the Standard Proctor maximum dry density.

Excavated materials free from boulders, frozen material and organic matter are suitable to be used as backfill. Silt and silty fine sand materials as encountered in the borings are difficult to compact and should be excluded.

Excavation & Dewatering

After the river has been properly diverted, the sides of the excavation should be sloped back at a configuration of 1 vertical to 1½ horizontal or be supported by properly designed bracing and sheeting.

In view of the relatively pervious nature of the river bed, it is anticipated that the quantity of seepage water may be high during the high peak run-off season. This problem should be combated by either carrying out the excavations between close steel sheet piling driven to a sufficient depth to reduce the seepage or use high capacity pumps operating continuously with 100% standby.

Slope Stability &
River Bed Protection

With an ordinary embankment slope (not steeper than 1 vertical to 1½ horizontal) no slope stability problems are foreseen. However, the slopes and river bed should be protected against undermining and scouring by means such as rip-rap, gabions, sand-cement treatment or a paved apron.

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LOG OF BOREHOLE No. 1

JOB No 303-S.3 LOCATION: County Road #13 FIG. No: 2
JOB DESCRIPTION: Hungry Hollow Bridge Replacement
METHOD OF BORING: Augering DATE: March 15/73

ELEV. / DEPTH	SOIL DESCRIPTION	SAMPLES No	TYPE	"N"	PENETRATION RESISTANCE (blows/foot) 20 40 60 80 / SHEAR STRENGTH (K.S.F.)	WATER LEVEL
97.0	GROUND SURFACE					
0	Brown SAND & GRAVEL FILL					
1.5	Dark Brown Sandy SILT (Fill)					
4.5	Dense Brown SAND & GRAVEL with some cobbles	1	SS	35		
7.5	Compact to Dense Silty Fine SAND	2	SS	34		
		3	SS	31		
		4	SS	24		
14.5	Very Dense Sandy GRAVEL with numerous cobbles	5	SS	100/6"		
79.2		6	SS	100/2"		
17.8	End of Borehole Refusal @ 17.8' possibly on boulders					

W.L. @ 95.7' March 16/73

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LOG OF BOREHOLE Nº. 2

JOB Nº 303-S.3 LOCATION: County Road #13 FIG. Nº: 3
JOB DESCRIPTION: Hungry Hollow Bridge Replacement
METHOD OF BORING: Augering DATE: March 16/73

ELEV. / DEPTH	SOIL DESCRIPTION	SAMPLES Nº	TYPE	"N"	PENETRATION RESISTANCE (blows/foot) 20 40 60 80 / SHEAR STRENGTH (k.s.f.)	WATER LEVEL
97.8	GROUND SURFACE					
0	Brown Gravelly Sand (Fill)					
1.0	Dark Brown Sandy SILT (Fill)	1	SS	100/3"		
4.0	Compact Brown SAND & GRAVEL with some cobbles	2	SS	28		
10.0	Dense Silty Fine SAND	3	SS	51		
11.4	Very Dense Sandy GRAVEL with numerous cobbles & occ. boulders	4	SS	71		
82.8						
15.0	End of Borehole Refusal @ 15' possibly on boulders					

W.L. @ 95.4' March 16/73

LOG OF BOREHOLE Nº. CT1

JOB Nº 303-S.3 LOCATION: County Road #13 FIG. Nº: 4
JOB DESCRIPTION: Hungry Hollow Bridge Replacement
METHOD OF BORING: DATE: March 16/73

ELEV. / DEPTH	SOIL DESCRIPTION	SAMPLES Nº	SAMPLES TYPE	SAMPLES "N"	PENETRATION RESISTANCE (blows/foot) 20 40 60 80 / SHEAR STRENGTH (K.S.F.)	WATER LEVEL
103.4	GROUND SURFACE					
0	Uncompacted FILL (Inferred)					
10.0	Compact to Very Dense SAND & GRAVEL with occ. cobbles & boulders (Inferred)					
78.7						
24.7	End of Borehole					

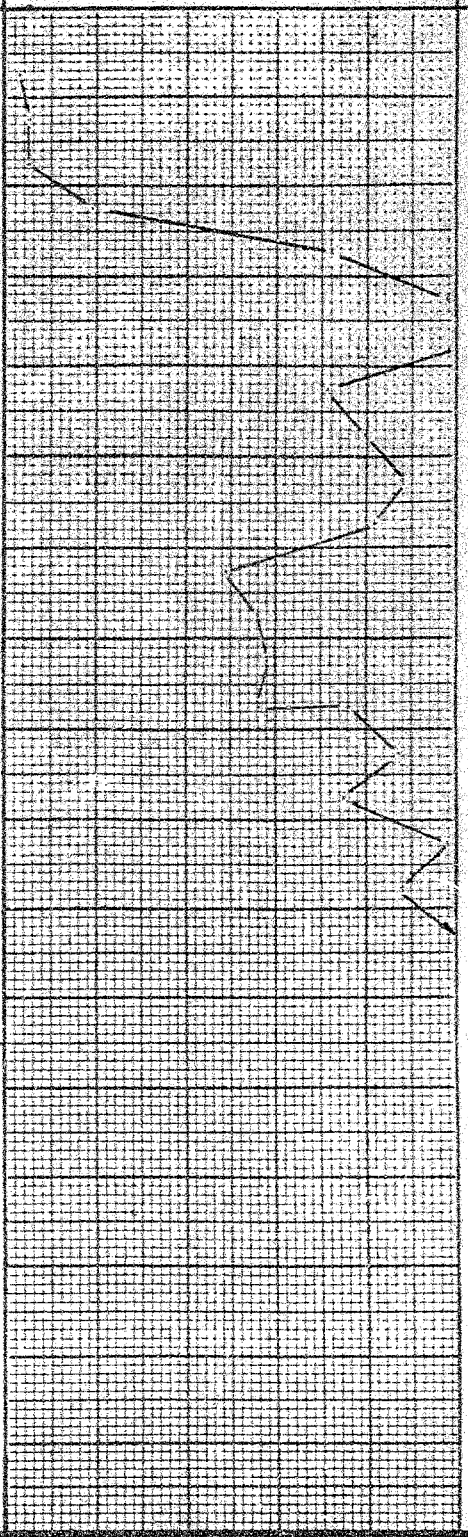
LOG OF BOREHOLE No. ...CT2...

JOB No 303-S.3 LOCATION: County Road #13 FIG. No: 5

JOB DESCRIPTION: Hungry Hollow Bridge Replacement

METHOD OF BORING: DATE: March 16/73

ELEV. / DEPTH	SOIL DESCRIPTION	SAMPLES No	SAMPLES TYPE	SAMPLES "N"	PENETRATION RESISTANCE (blows/foot) / SHEAR STRENGTH (K.S.F.)	WATER LEVEL
96.5	GROUND SURFACE					
0	Uncompacted FILL (Inferred)					
4.0	Compact to Very Dense SAND & GRAVEL with some cobbles & occ. boulders (Inferred)					
73.7						
22.8	End of Borehole					



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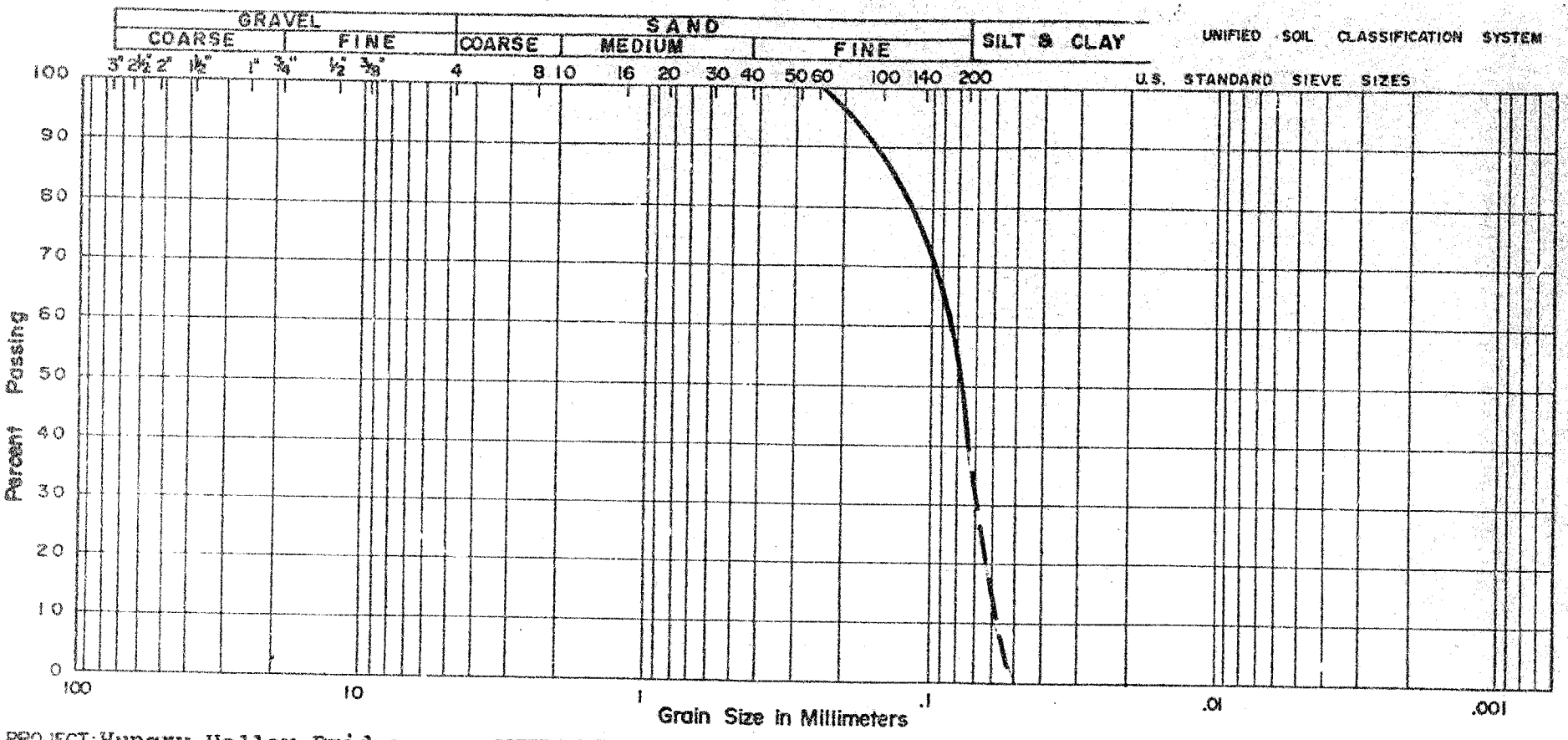
GRAIN SIZE DISTRIBUTION

OUR REFERENCE Nº 303-S3



PROJECT: Hungry Hollow Bridge
LOCATION: County Road #13
BOREHOLE Nº: 1
SAMPLE Nº: 3
DEPTH:
ELEVATION:

COEFFICIENT OF UNIFORMITY :
COEFFICIENT OF CURVATURE :

Classification of Sample and Group Symbol:

Silty Fine SAND

PLASTIC PROPERTIES

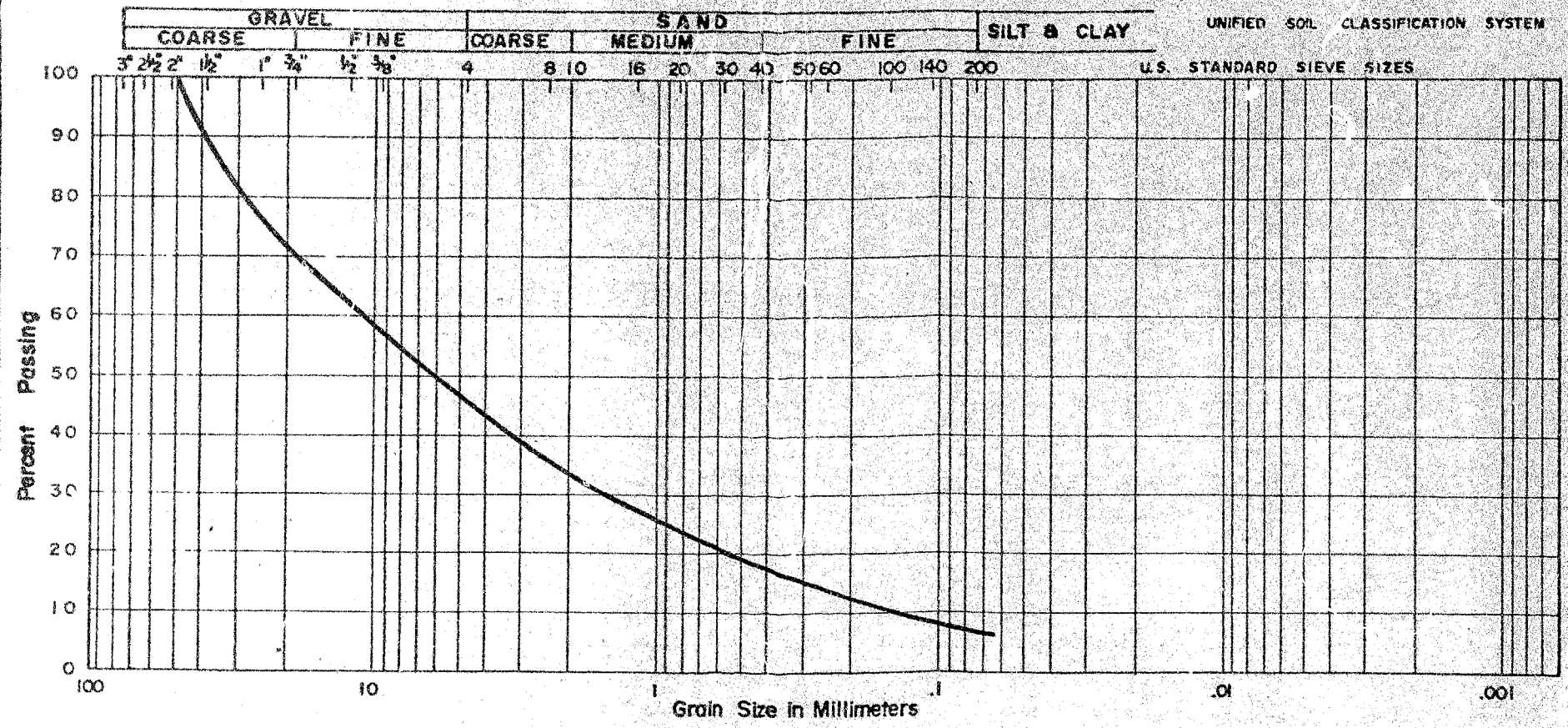
LIQUID LIMIT	%	=
PLASTIC LIMIT	%	=
PLASTICITY INDEX	%	=
MOISTURE CONTENT	%	=

ENCLOSURE Nº 9

K.H. KING ASSOCIATES LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE Nº 303-S3



PROJECT: Hungry Hollow Bridge
LOCATION: County Road #13
BOREHOLE Nº: 2
SAMPLE Nº: 2
DEPTH:
ELEVATION:

COEFFICIENT OF UNIFORMITY:
COEFFICIENT OF CURVATURE:

Classification of Sample and Group Symbol:

GRAVEL & SAND

PLASTIC PROPERTIES

LIQUID LIMIT	%	=
PLASTIC LIMIT	%	=
PLASTICITY INDEX	%	=
MOISTURE CONTENT	%	=

ENCLOSURE Nº 7