Submitted To: **VICTOR SUEN ARCHITECT**

GEOTECHNICAL INVESTIGATION

MCPHILLIPS STREET
WINNIPEG, MANITOBA

NOVEMBER 2013

FILE NO. 13-166-90

ENG-TECH
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Figure 1 – Site and Test Hole Location Plan
Modified Unified Classification System for Soils
Stratigraphic Test Hole Log (1)

1.0 INTRODUCTION

ENG-TECH Consulting Limited (ENG-TECH) completed the requested geotechnical investigation for the proposed comfort station for the bus loop on McPhillips Street, Winnipeg, Manitoba as shown in Figure 1. ENG-TECH understands that proposed single storey building without a basement or crawlspace will be 15.6 square meters in plan and the preferred foundation to support the station would be a thickened edge slab. The purpose of the investigation was to assess the soil conditions within or close to the footprint of the proposed station in order to determine if a thickened edge slab foundation would be suitable, and provide design recommendations for the foundation, drainage and concrete durability.

1.1 Scope of Work

ENG-TECH completed the following scope of work:

- Clearance of public underground utilities.
- A test hole drilling and soil sampling program.
- A laboratory testing program.
- Survey of test hole UTM coordinates.
- An assessment and engineering report outlining the investigation and recommendations as outlined above.

2.0 TEST HOLE DRILLING, SOIL SAMPLING and LABORATORY TESTING

ENG-TECH drilled a test hole (TH1) on October 25, 2013 at the location shown on Figure 1. The test hole was drilled using a 75 mm diameter hand auger to 2.3 m below existing grade, and then backfilled with the auger cuttings and sandy gravel fill upon completion of drilling.

The soil stratigraphy was visually classified at the time of drilling using the modified Unified Soil Classification System (USCS). Soil samples were collected off the auger at regular intervals and retained for testing in ENG-TECH's Winnipeg laboratory.

Moisture contents were determined on all soil samples collected (6), while one (1) atterberg limit test was completed on a selected sample. The results are shown on the test hole summary logs.

3.0 STRATIGRAPHY

The stratigraphy consisted of 200 mm of topsoil over a 0.9 m thick layer of clay fill underlain by a 1.0 m thick silt layer followed by clay to the depth explored.

The topsoil was black, moist, soft, and contained with organics, trace gravel. The clay fill was initially medium brown, moist, very stiff, highly plastic, contained trace to some silt, trace gravel & wood, and with depth became dark brown to black. The silt was light to medium brown, moist, soft, low plastic, and contained trace clay. The clay was medium brown, moist, stiff, highly plastic, and contained trace to some silt.

TH1 was dry and no sloughing was observed during drilling. Detailed stratigraphy descriptions are outlined on the test hole summary log.

4.0 RECOMMENDATIONS

4.1 General

Based on the soil conditions and magnitude of the expected loads a thickened edge slab bearing on the stiff to very stiff native clay or clay fill could be used at the site. The most current revision of the City of Winnipeg Standard Construction Specifications (Table CW 3110.2) shall be used for the base material recommended in this report.

4.2 Foundation

4.2.1 Thickened Edge Slab

ENG-TECH cautions shallow foundations, such as thickened edge slab, are prone to vertical movements resulting from changes in moisture content and frost jacking however, these movements can be minimized with adequate sub-grade preparation, and site drainage.

Some movement of the thickened edge slab should be expected with total and differential movements more than 35 and 20 mm, respectively, not expected. As such, the thickened edge slab could be constructed as outlined below using a ultimate limit states (ULS) bearing pressure of 120 kPa, and a serviceability limit states (SLS) bearing pressure of 100 kPa to support the load of the proposed building entirely on the perimeter thickened edge of the foundation. The thickened edge should be at least 0.60 m wide and the sub-base being stiff to very stiff native clay or clay fill.

The top of the thickened edge slab should be located at or above existing grade for drainage, and the base shaped to ensure a uniform base layer below the thickened edge slab. The base preparation for the proposed thickened edge slab shall extend 150 mm beyond the perimeter edge and be prepared as outlined below:

- Excavate the top soil and continue to excavate as required in order to obtain a minimum depth of 150 mm below the base of the slab design elevation. The materials at sub-grade design elevation should consist of stiff to very stiff clay fill.

- Shape the subgrade via cut and fill as required then hard compact the surface to 98% Maximum Dry Density (MDD) at ± 2% of optimum moisture content (ASTM D 698) to remove any voids created during excavation.

- If silty or soft spots are encountered, sub-excavate 300 mm and backfill in 2 equal lifts using medium to highly plastic clay compacted to 98% MDD.

- Place a +/-150 mm thick lift of crushed limestone base and compact it to 100% of MDD immediately below the base of the slab.

- Place a vapour barrier consisting of 6 mil poly (minimum) between the crushed limestone base and underside of the slab.

4.3 Drainage

Proper surface drainage is essential to reduce the potential of frost action, and to reduce excess moisture from migrating under the slab. Surface drainage should be controlled by ensuring a minimum grade away from the building of 5% for well compacted surface soils and 2% for paved surfaces for a minimum distance of 2 m. Runoff from the roof should be directed a minimum distance of 1.5 m from the perimeter of the comfort station to reduce the potential of excessive moisture near the slab.

4.4 Foundation Concrete

General

All concrete should be designed, specified, and constructed in accordance with CSA standard A23.1-09, Concrete Materials and Methods of Concrete Construction using the Performance Specification Alternative as outlined in Table 5 of CSA A23.1-09.

Under the performance alternative, the concrete supplier shall assume responsibility for the performance of the concrete as delivered and the contractor shall assume responsibility for the concrete in place. The owner shall specify performance requirements including: the required structural criteria and concrete strength at age, the concrete exposure class for durability, and any other properties that may be required to meet the owner's performance requirements such as colour, architectural requirements, and special surface finishes. The owner reserves the right to request the supplier provide satisfactory documentation that the proposed mix design will achieve the strength, durability, and performance requirements specified by the owner, and that the mix design satisfies the requirements of CSA A23.1-09. In addition, the owner may request the contractor submit documentation demonstrating the owner's performance requirements have been met during construction and placement.

Based on Tables 1, 2, 3, and 4 of CSA A23.1-09, the concrete in contact with the local soils can be classified as a C-2 exposure class for the thickened edge slab, which may be exposed to chlorides with freezing and thawing. The concrete design can be selected as structurally required by design however ENG-TECH recommends the concrete be designed to meet the minimum specifications outlined below for durability.

Thickened Edge Slabs (C-2)

28 day minimum compressive strength of 32 MPa
Maximum water/cementing materials ratio of 0.45
Maximum nominal aggregate size of 20 mm
Type Gu or Gub cement
Air content of 5-8%

5.0 CLOSURE

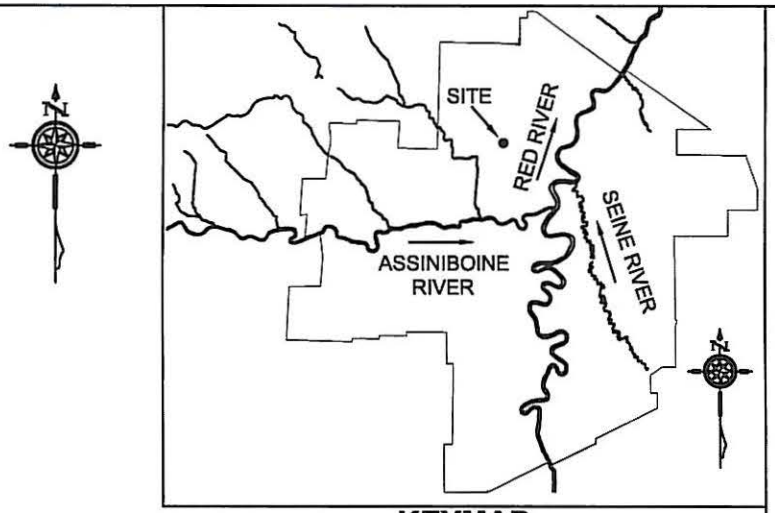
ENG-TECH trusts this is all the information you require. If you have any questions or require additional information, please contact the undersigned.

Sincerely,
ENG-TECH Consulting Limited

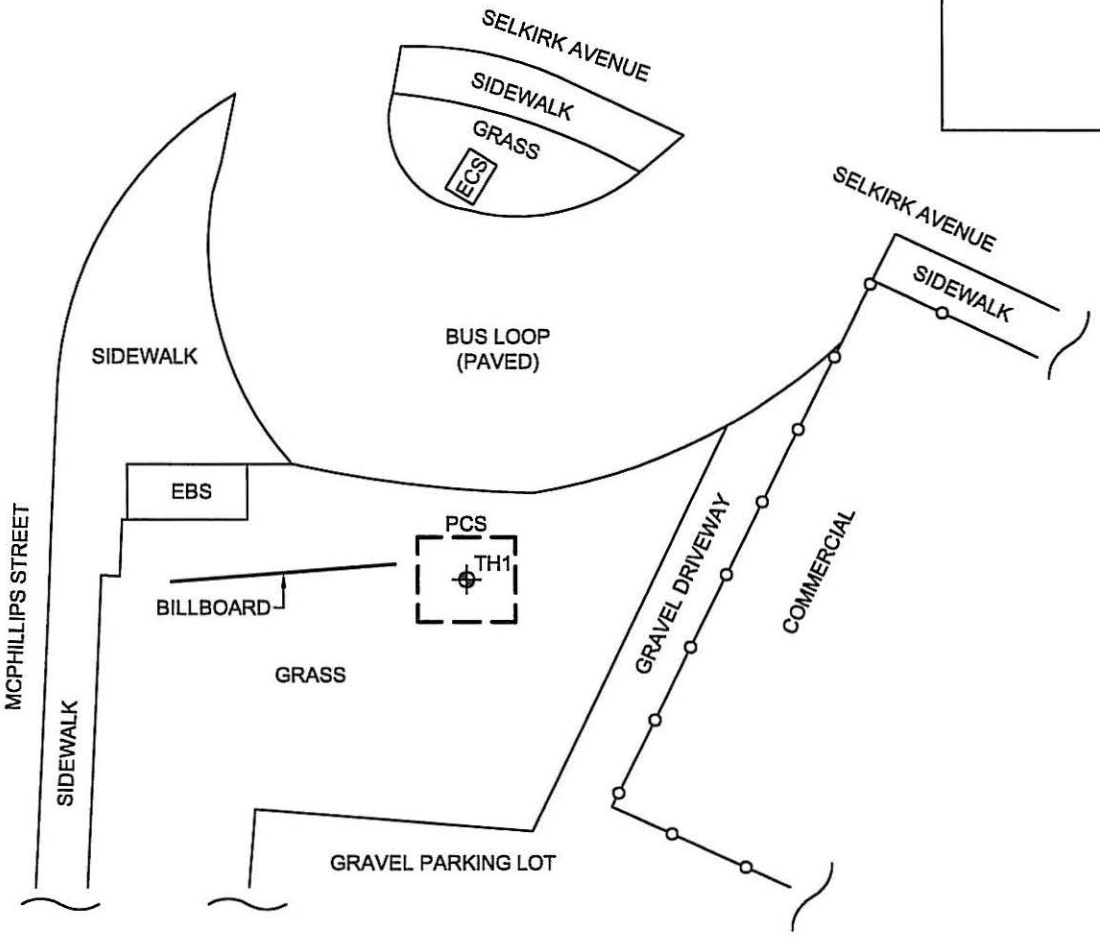
Clark Hryhoruk, M.Sc., P.Eng.
Principal, Geotechnical Engineer

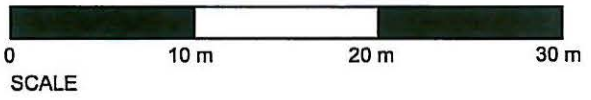
CDH/alh

TEST HOLE LOCATION TABLE		
HOLE #	GPS COORDINATES OF TEST HOLES OCTOBER 25, 2013	
	UTM	14U
TH 1	5531459	0631454



KEYMAP





LEGEND

TH1 — TEST HOLE

FENCE

PCS — PROPOSED LOCATION OF COMFORT STATION (APPROX.)

ECS = EXISTING COMFORT STATION

EBS = EXISTING BUS SHELTER

NO.	DATE	ISSUE / REVISION
0	Nov 7/13	report

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ENG. STAMP:

APEGM
Certificate of Authorization
ENG-TECH Consulting Limited
No.2475 Expiry: April 30, 2014

CLIENT:
VICTOR SUEN ARCHITECT

PROJECT:
GEOTECHNICAL INVESTIGATION - MCPHILLIPS STREET, WINNIPEG, MANITOBA

DWG DESCRIPTION:
SITE AND TEST HOLE LOCATION PLAN

SCALE:
AS SHOWN

DRAWN BY: ALH

DATE: NOVEMBER 2013

FILE No.: 13-166-90

CLIENT DWG/FIG. No.:

ENG-TECH DWG/FIG. No.: 1

NO.:

P:\2013\Projects\166(OTC)\90(Victor Suen Architect)\Mcphillips and Selkirk\Drawings\Figure 1 – Site and Test Hole Location Plan.dwg

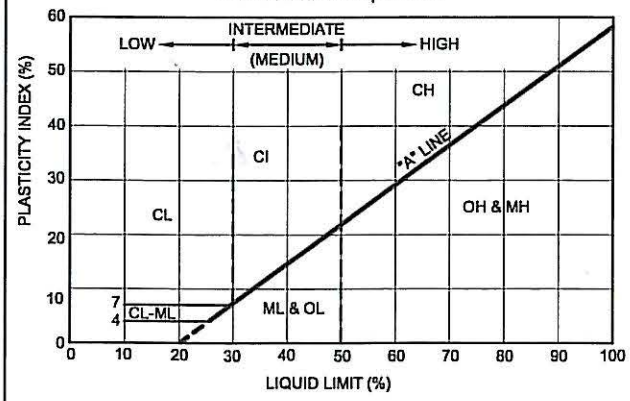
MODIFIED UNIFIED CLASSIFICATION SYSTEM FOR SOILS

MAJOR DIVISION			GROUP SYMBOL	GRAPH SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75 µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75 mm	CLEAN GRAVELS (TRACE OR NO FINES)	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 4$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ TO 3
			GP		POORLY GRADED GRAVELS, GRAVEL- SAND MIXTURES, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY GRAVELS (WITH SOME OR MORE FINES)	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE AND P.I. MORE THAN 7
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75 mm	CLEAN SANDS (TRACE OR NO FINES)	SW		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	$C_U = \frac{D_{60}}{D_{10}} > 6$; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} = 1$ TO 3
			SP		POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	NOT MEETING ABOVE REQUIREMENTS
		DIRTY SANDS (WITH SOME OR MORE FINES)	SM		SILTY SANDS, SAND-SILT MIXTURES	ATTERBERG LIMITS BELOW "A" LINE OR P.I. LESS THAN 4
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES	ATTERBERG LIMITS ABOVE "A" LINE AND P.I. MORE THAN 7
FINE GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75 µm)	SILTS BELOW "A" LINE NEGLIGIBLE ORGANIC CONTENT	LL ≤ 50%	ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHTY PLASTICITY	CLASSIFICATION IS BASED UPON PLASTICITY CHART (SEE BELOW)
		LL > 50%	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS	
	CLAYS ABOVE "A" LINE NEGLIGIBLE ORGANIC CONTENT	LL ≤ 30%	CL		INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY OR SILTY CLAYS, LEAN CLAYS	
		30% < LL ≤ 50%	CI		INORGANIC CLAYS OF MEDIUM PLASTICITY, SILTY CLAYS	
		LL > 50%	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
	ORGANIC SILTS & CLAYS BELOW "A" LINE	LL < 50%	OL		ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
		LL > 50%	OH		ORGANIC CLAYS OF HIGH PLASTICITY	
HIGHLY ORGANIC SOILS			Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS	STRONG COLOUR OR ODOUR, AND OFTEN FIBROUS TEXTURE

ADDITIONAL SYMBOLS

TILL, FILL, TOPSOIL, CONCRETE, SHALE, LIMESTONE, SANDSTONE, GRANITE

PLASTICITY CHART FOR SOILS PASSING 425 µm SIEVE



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PLASTIC SOILS

MOISTURE	PLASTICITY	INTRUSIONS	CONSISTENCY	POCKET PEN (TSF)	(N)
DRY	LOW	ROOTLETS	VERY SOFT		< 2
DAMP	MEDIUM	OXIDES	SOFT	0 - 0.5	2 - 4
MOIST	HIGH	MICA	FIRM	0.5 - 1.0	4 - 8
WET		GYPSUM	STIFF	1.0 - 2.0	8 - 15
		ETC.	VERY STIFF	2.0 - 4.0	15 - 30
			HARD	> 4.0	> 30

TSF x 95.8 = kPa (q_u) $S_u = \frac{1}{2} \times q_u$

SOIL DESCRIPTIONS

TRACE:	0 - 10%	BOULDERS:	> 200 mm	COARSE SAND:	2 - 4.75 mm
SOME:	10 - 20%	COBBLES:	75 - 200 mm	MEDIUM SAND:	0.425 - 2 mm
WITH:	20 - 35%	COURSE GRAVEL:	19 - 75 mm	FINE SAND:	0.075 - 0.425 mm
AND:	35 - 50%	FINE GRAVEL	4.75 - 75 mm	FINES:	< 0.075 mm

GRANULAR SOILS

MOISTURE	DENSITY	GRADATION	INTRUSIONS	SPT (N)
DRY	VERY LOOSE	POORLY	ROOTLETS	0 - 4
DAMP	LOOSE	WELL	OXIDES	4 - 10
MOIST	MED. DENSE		MICA	10 - 30
WET	DENSE		FINES	30 - 50
	VERY DENSE		ETC.	> 50

DEFINITIONS

LL = LIQUID LIMIT
P.I. = PLASTICITY INDEX
C_U = COEFFICIENT OF UNIFORMITY
q_u = UNCONFINED COMPRESSIVE STRENGTH
S_u = UNDRAINED SHEAR STRENGTH
C_C = COMPRESSION INDEX
PL = PLASTIC LIMIT

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Engineering And Testing Solutions That Work For You

Test Hole #: TH1

Client: Victor Suen Architect
Site: See Figure 1
Location: Winnipeg, Manitoba
Project: Geotechnical Investigation - McPhillips Street, Winnipeg, Manitoba

File No.: 13-166-90
Date Drilled: October 25, 2013
Grade Elevation: 100.0 m
Water Elevation: -

Depth (m)	Description	Elevation (m)
0.0	Ground Surface	100.0
	Topsoil (200 mm) - black, moist, soft, with organics, trace gravel.	
	Clay Fill (CH) - medium brown, moist, very stiff, highly plastic, trace to some silt, trace gravel & wood.	
	- below 0.6 m, dark brown to black.	
1.0		99.0
	Silt (ML) - light to medium brown, moist, soft, low plastic, trace clay.	
2.0		98.0
	Clay (CH) - medium brown, moist, stiff, highly plastic, trace to some silt.	
	End of Test Hole - end of test hole at 2.3 m below grade. - test hole dry and sloughing from silt layer during drilling. - test hole backfilled with auger cuttings and sandy gravel fill upon completion of drilling.	
3.0		97.0

Sample No.	Sample Type	Moisture Content (%)	Blows/300 mm
S1		7.2	
S2		26.8	
S3		32.2	
S4		20.2	
S5		21.8	
S6		38.8	

Moisture Content (%): PL I----------X----------I LL; 20 40 60 80

SHEAR STRENGTH (kPa)		
P. Pen	Torvane	UC
144		
120		
72		

ENG- TECH Consulting Limited

Logged by: Adam H.

Reviewed by: CHA

Drilled By: Eng-Tech Consulting Ltd.
Drill Rig: Hand Auger
Auger Size: 75 mm

Completion Depth: 2.3 m
Completion Elevation: 97.7 m
Sheet: 1 of 1

SAMPLE TYPE: SPLIT BARREL | SHELBY TUBE | AUGER CUTTINGS | SPLIT SPOON