57-F-228C

AVENUE M

CROSSING

QUEENSWAY

OTTAWA

BA C78

McROSTIE & ASSOCIATES
CONSULTING ENGINEERS
OTTAWA 1
CANADA

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(C O P Y)

Foundation Investigation Avenue M at Queensway

1. FIELD WORK

Four boreholes and one probing were made in the locations shown on Plate One. The depths varied from approximately 30 to 50 feet depending on where rock which produced good core recovery was encountered. Hole No. 4 was made some time after the other holes to obtain more information on a possible fault zone in the area of the south abutment.

Standard penetration tests were made in the boreholes and split barrel samples recovered for visual classification. The underlying shale was diamond drilled and cores recovered for inspection and study. Groundwater levels were observed during the field programme.

2. OBSERVATIONS

Under a layer of topsoil, about 8 to 13 feet of loose silts and sands are found. Beneath these is glacial till of variable density to a depth of about 25 feet. Under the till is shale rock, the upper few feet of which is weathered or broken and in places is broken to a condiserable depth. The dip of the bedding planes in the shale was greater in Holes 1, 2 and 4 than in Hole 3 and approached 30 degrees. These relatively large variations from the normal horizontal bedding suggested that the advice of a geologist would be desirable and hence, as previously, Dr. V.K. prest of the Geological Survey of Canada was consulted.

Groundwater levels were within 4 feet of the surface and they can be expected to be within a few feet of this height at the driest seasons, and nearly at the surface in wet seasons.

3. DESIGN RECOMMENDATIONS

3.1 Geological Background

As in the investigation at Tremblay Road, the discussions with Dr. Prest and a study of the cores

leads to the conclusion that the site lies within a fault zone, and is probably at the edge of one of the faults. The probable causes of the fault would of course be as mentioned before, namely a shifting of the bedrock when the weight of the glaciers was removed.

The previous remarks on the significance of the fault area are still applicable. In the fault itself, no increase in soundness with depth would be found, also piles would penetrate considerably farther in the faulted rock than would otherwise be expected, and finally, any seismic movements would be more damaging to a structure built across a fault zone than otherwise.

3.2 Bearing Capacities

Owing to the variations in soil types and densities which were observed, the site has been divided into three areas and separate values recommended for each.

Centre Pier - for pier footings at about El. 200, a bearing value of 6000 p.s.f. is available. Groundwater control would be required plus inspection during construction for variations not disclosed by boreholes.

North Abutment - above El. 205 - soils not suitable for support of heavy structures.

El. 205 to 200 - 3000 pounds per sq.ft. available if groundwater control provided.

Below El. 200 - 6000 pounds per sq.ft. available but groundwater control required plus construction inspection for variations.

South Abutment - above El. 190 - soils not readily usable for support of heavy structures due to existence of scattered loose layers.

below El.190 - broken shale will support a minimum of 5000 p.s.f. with higher values at El. 180

3.3 Foundation Type

Some difficulty will no doubt be met in the excavation for the centre pier due to the depth below water table and the overlying loose silts and sands. Fortunately the pier excavation itself will be in the less pervious till soils and may soften but will not likely "flow". Similar difficulties may be met at the abutments but these excavations will likely be at a higher elevation and may be provided with drainage by the roadway cut.

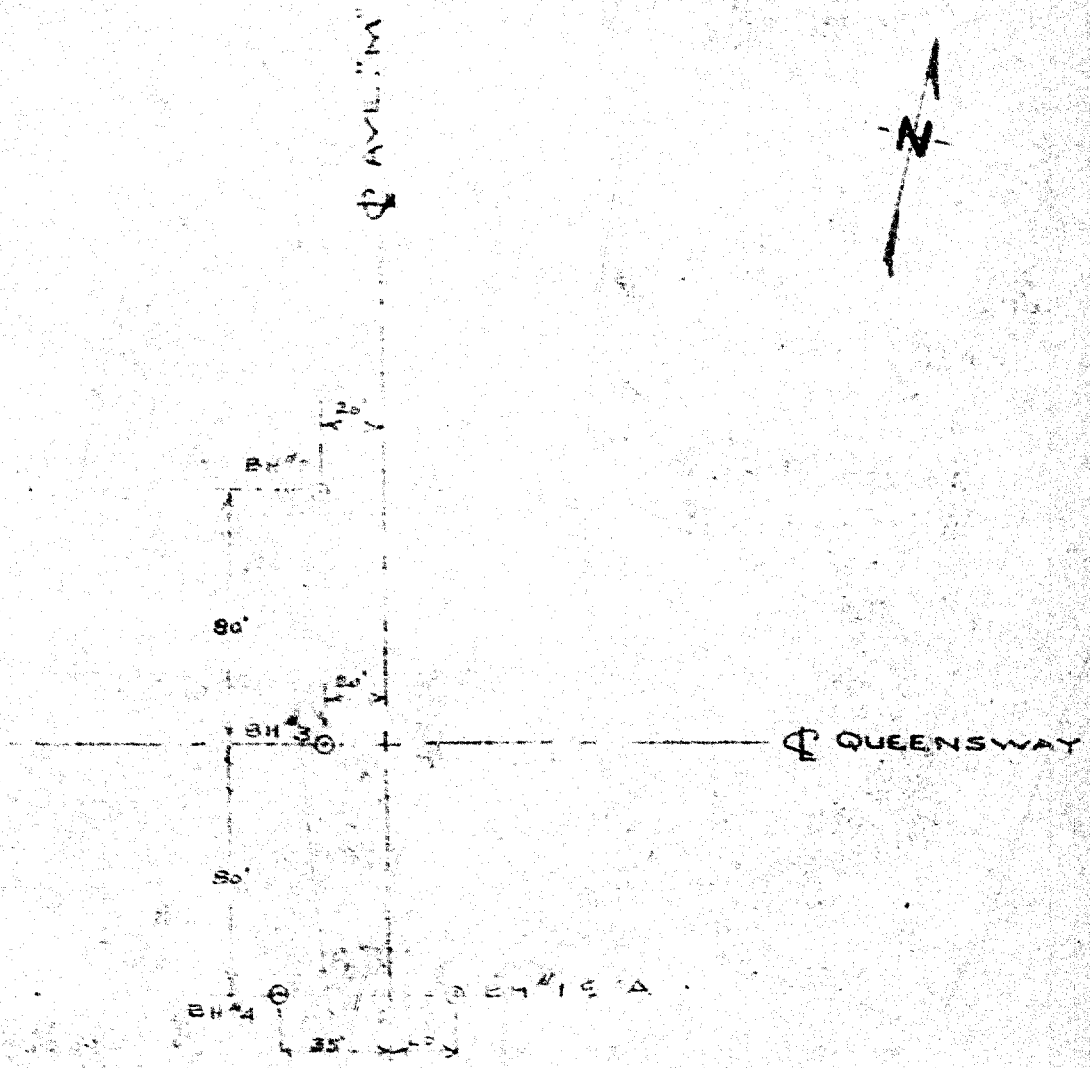
Most of the problems of construction and of support would be lessened by the use of piles which would transfer the structure loads to the shales and broken shales below. For this reason, piles will no doubt be considered as a foundation type at this site.

The contract arrangements for piles in the North and South abutments should, however, be sufficiently flexible to provide for the construction of and payment for wide variations in the depth of the penetration which may be required to achieve the desired resistance.

4. CONSTRUCTION PRECAUTIONS

Excavations below groundwarer in loose silts or sands are always troublesome and the centre pier excavation falls in this category. A system of sheet pile cutoffs, soldier piles and lagging, or predrainage by wellpoints will probably be necessary to make this excavation unless all the loose soils are removed as part of the roadway grading stage of the contract.

Also, since variations were seen even between fairly closely spaced boreholes, construction inspection of the excavation will have more than the usual significance. Variations between borehole locations are possible and must be guarded against if the soils are being used for structural support.



McROSTIE & ASSOCIATES	
CONSULTING ENGINEERS	
BOREHOLE LOCATIONS	
AVENUE "M" & QUEENSWAY	
SCALE 1" = 60'	PLATE 1

FORM S-10-2

McROSTIE & ASSOCIATES
CONSULTING ENGINEERS
OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF LABORATORY TESTS

AVENUE "M" & QUEENSWAY

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 217.7

REMARKS GEODETIC DATUM - GROUND SURFACE AT STA. 516+00 EL. 214.85.

HOLE NO. 1

DATE JUNE 10-12, 1957

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION
				GROUND SURFACE	0	217.7
				TOP SOIL	1.0	
		3 FOR 6"	1-1	LOOSE SILT WITH FINE SAND		
		20		MEDIUM DENSE FINE & MEDIUM SAND	3.0	214.7
		27	1-2	MEDIUM DENSE SILT	5.0	
		7	1-3	LOOSE SILT	6.5	211.2
		5 FOR 6"	1-4	LOOSE FINE SAND	10.0	
		20		MED. DENSE FINE SAND	10.5	207.2
		3 FOR 6"	1-5	LOOSE SILT	11.5	
		13			13.3	
				LOOSE TILL	13.5	
		9	1-6		14.0	
		6 FOR 6"			16.0	201.7
		18	1-7	MEDIUM DENSE TILL		
					20.0	197.7
		7		LOOSE SANDY TILL		
		7	1-8			
		8	1-9			
		11 FOR 6"			26.0	191.7
				MED. DENSE SANDY TILL	27.5	
		60 FOR 3"	1-10	DENSE TILL	28.1	189.6
				BROKEN, WEATHERED SHALE ROCK - DIP 30°		
				(DRILLED, CORE RECOVERY) 42%		
					33.3	
				BROKEN SHALE ROCK DIP 30°		
				(DRILLED - CORE RECOVERY) 57%		
					38.3	179.4
				SHALE ROCK DIP 30°		
				(DRILLED - CORE RECOVERY) 71%		
					43.3	
				SHALE ROCK DIP 30°		
				(DRILLED - CORE RECOVERY) 90%		
					48.3	169.4

PENETRATION TEST

140 LB. HAMMER | NO CASING
30 INCH DROP | 1 3/8 INCH DIA. ROD

BLOWS PER FOOT

0 20 40 60 80 100

OVERNIGHT WATER LEVEL (EL. 213.7) 4.0'

MED. DENSE WELL GRADED SAND
MED. DENSE TILL

110 BLOWS PER 4"

END OF PROBING EL. 169.4

% WATER CONTENT

PLATE 2

FORM S-10-2

McROSTIE & ASSOCIATES
CONSULTING ENGINEERS
OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF LABORATORY TESTS

AVENUE "M" & QUEENSWAY

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 214.1

REMARKS SEE NOTE PLATE 2

DATE JUNE 12-14 '57

HOLE No. 2

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION	PENETRATION TEST (LB. HAMMER / INCH DROP / BLOWS PER FOOT; NO CASING / INCH DIA. ROD)
				GROUND SURFACE	0	214.1	
				TOP SOIL 1.0			
		2 for 6" 8	2-1	LOOSE CLAYEY SILT 3.0	3		(211.0) ← OVERNIGHT WATER LEVEL 3.1
				LOOSE SILT 5.0 5.5			
		5 for 6" 17	2-2	MED. DENSE SILT & FINE SAND 6.5	6		LOOSE FINE SAND & SILT
				LOOSE FINE SAND 8.0 8.5		205.6	
		6 6 for 6"	2-3	MEDIUM DENSE TILL 10.0	9		LOOSE WELL GRADED SAND & STONE
		36	2-4	DENSE TILL 12.5	12		
		6 for 6" 20 for 6" 38 for 6"	2-5	MED. DENSE TILL 13.0			
		42 58 for 6"	2-6	DENSE TILL	15		
		138	2-7		18		
		162	2-8		21		
		92	2-9	VERY DENSE SILT 22.5	24		
		85 for 6" 48 for 3"	2-10	DENSE SILTY TILL 25.0		188.9	
				SHALE ROCK (DRILLED - CORE RECOVERY) 78% DIP 20° 29.9	27		
				BROKEN SHALE ROCK DIP 20° (DRILLED - CORE RECOVERY) 64% 33.6	30		
				BROKEN SHALE ROCK (DRILLED - CORE RECOVERY) DIP 20° 61% 36.1	33		
				SHALE ROCK DIP 20° (DRILLED - CORE RECOVERY) 78% 41.1	36	178.0	
				SLIGHTLY BROKEN SHALE ROCK DIP 20° (DRILLED - CORE RECOVERY) 70% 46.8	39		
				SHALE ROCK DIP 20° (DRILLED) - CORE RECOVERY 100% 48.9	42		
				BOTTOM OF HOLE	45		
					48	165.2	

% WATER CONTENT

PLATE 3

L. M. CO — A 19146

FORM S-10-2

McROSTIE & ASSOCIATES
CONSULTING ENGINEERS
OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF LABORATORY TESTS

AVENUE "M" & QUEENSWAY

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 215.5

REMARKS SEE NOTE PLATE 2

HOLE NO. 3

DATE JUNE 14-16 '57

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION	PENETRATION TEST (.....LB. HAMMER, ...INCH DROP; NO CASING, ...INCH DIA. ROD; BLOWS PER FOOT)
		3 for 6"	3-1	GROUND SURFACE	0	215.5	
				TOP SOIL	1.0		
				LOOSE SILT & FINE SAND	3.0	3	← WATER LEVEL AFTER (213.6) 1 HR. 1.9'
					3.5		← LOOSE SILT
					4.2	211.5	MED. DENSE SILT
		6	3-2	MEDIUM DENSE SILT		6	
		7	3-3		5.5		
		7 for 6"		MEDIUM DENSE FINE SAND	9.5	9	
				BOULDERS	12.2	12	203.5
		41	3-4	MEDIUM DENSE TILL			
		82	3-5	DENSE TILL	15.0	15	200.5
		15 for 6"		MED. DENSE TILL	16.0		
		131 for 10"	3-6		17.5	18	198.0
		145	3-7	DENSE, SANDY TILL		21	
		155	3-8			24	
		171	3-9		24.2	191.3	
				SHALE ROCK (DRILLED - CORE RECOVERY 87%)	27		
					31.5	30	
				SHALE ROCK (DRILLED - CORE RECOVERY 91%)		33	
					36.5	36	179.0
				BOTTOM OF HOLE	39		

% WATER CONTENT

PLATE 4

L.M.C.—A15146

FORM S-10-2

McROSTIE & ASSOCIATES
CONSULTING ENGINEERS
OTTAWA CANADA

SOIL PROFILE AND SUMMARY OF LABORATORY TESTS

AVENUE "M" & QUEENSWAY

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 216.4

REMARKS SEE NOTE PLATE 2

HOLE No. 4

DATE JULY 15-17, '57

PENETRATION TEST — ..... LB. HAMMER ..... INCH DROP — NO CASING ..... INCH DIA. ROD — BLOWS PER FOOT

UNCONFINED COMPRESSIVE STRENGTH KIPS/FT.²	SMALL SCALE PENETROMETER KIPS/FT.²	STANDARD PENETRATION BLOWS/FT.	SAMPLE NUMBER	DESCRIPTION OF SOIL	DEPTH IN FEET	ELEVATION
				GROUND SURFACE		
				TOP SOIL	0	216.4
				SILT & FINE SAND	0.5	
		8	4-1	LOOSE SILT	3.0	213.4
				MED. FINE SAND & SILT	3.5	
				SILT	5.0	
		15	4-2	MEDIUM DENSE SILT	6.5	209.9
		5	4-3	LOOSE SILT	9	
		6	4-4		11.5	205.4
		15 for 6"		MED. DENSE WELL GRADED SAND WITH GRAVEL	12	
		27	4-5			
				MEDIUM DENSE TILL	15	
		19	4-6			
		21	4-7		18.5	197.9
		23 for 6"			18	
		63	4-8		21	
				DENSE TILL		
		132	4-9		24	
		56 for 4"	4-10			
					27.3	189.1
				BROKEN, WEATHERED LIMY SHALE ROCK (DRILLED-CORE RECOVERY 63%) DIP 30°	30	
					31.2	185.2
				SHALE ROCK WITH LIMY SHALE LAYERS (DRILLED-CORE RECOVERY 90%) DIP 30°	33	
					36	
					37.9	178.4
				SHALE ROCK WITH LIMY SHALE LAYERS, BROKEN - DIP 35° (DRILLED-CORE RECOVERY 58%)	39	
					40.7	175.7
				SHALE ROCK WITH LIMY SHALE LAYERS - DIP 30° (DRILLED-CORE RECOVERY 51%)	42	
					43.9	172.5
				SHALE ROCK WITH LIMY SHALE LAYERS - DIP 30° (DRILLED-CORE RECOVERY 73%)	45	
					48	
					48.9	167.5
				BROKEN SHALE ROCK WITH LIMY SHALE LAYERS (DIP 30° - DRILLED CORE RECOVERY 59%)	51	
					53.9	
				BOTTOM OF HOLE	54	162.5

(211.6) WATER LEVEL AFTER 2 HR 4.8'

DEFECTS IN NEGATIVE DUE TO CONDITION OF ORIGINAL DOCUMENT

% WATER CONTENT

PLATE 5

L. M. CO.—A10146