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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

TOPICAL REPORT NO. 92

GEOLOGICAL INVESTIGATION OF FOUNDATION CONDITION FOR THE PROPOSED GEOLOGICAL SURVEY BUILDING, CALGARY, ALBERTA

J. S. SCOTT

OTTAWA

1964

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INTRODUCTION

An examination of the site of the proposed Geological Survey Building, adjacent to the Calgary Campus of the University of Alberta (Fig. 1) was made on August 12, 1964.

The purpose of the examination was to assess the geological aspects of the foundation conditions at the site to serve as a guide to the planning and construction of the building.

Several 3 inch diameter auger borings, to a depth of 30 feet, were originally proposed as part of the investigation, however, the auger was unavailable at the time the site investigation was made. Foundation excavations, bore-hole logs and soil test data were available for examination on the Calgary Campus and these have provided most of the data for this report.

Acknowledgments

Dr. E.W. Brooker, Department of Civil Engineering, University of Alberta, Edmonton, accompanied the writer during the site investigation and subsequently obtained pertinent information from foundation engineering consultants in Edmonton and from the Department of Public Works of the Province of Alberta.

Burns and Dutton, contractors for the construction of Calgary Hall, permitted the examination of bore-hole and soil test data for the foundation of that structure.

The information obtained from these various sources is gratefully acknowledged.

GEOLOGY OF THE SITE

Throughout the Calgary area sandstones and shales of Tertiary age are overlain by Pleistocene and Recent sediments comprising mainly sand and gravel, till, lacustrine sand, silt and clay, and aeolian deposits of fine sand and silt.

Geological materials underlying the University of Alberta, Calgary Campus are lacustrine deposits of silt, clay and fine sand that are, throughout most of that area, mantled by aeolian deposits of fine sand and silt. Similar materials are to be found underlying the site of the proposed Geological Survey building.

Tharin (1960), in describing the glacial geology of the Calgary area, has assigned the name "Calgary Silt" to these lacustrine sediments. These materials were deposited during Late Pleistocene time in Lake Calgary that was formed by the damming of the Bow Valley by a continental glacier. Aeolian modification of the lacustrine sediments followed the deglaciation of the area and consequent draining of Lake Calgary.

Foundation borings on the Calgary Campus (Fig. 2) show that the lacustrine sediments are at least 60 feet thick and may be as much as 125 feet thick as reported by Tharin (1960). These deposits are probably underlain by till; however, in one bore-hole (E-4, Fig. 2) shale is recorded on the log at a depth of 50 feet.

Tharin, J.C. (1960): Glacial Geology of the Calgary Area; Ph.D. thesis, Univ. of Illinois, Urbana, Illinois.

Variations in lithology of the lacustrine sediments can be anticipated over relatively short horizontal and vertical distances. An indication of the lenticular character of the sediments underlying the Calgary Campus is shown on Figure 2. It is probable that similar lithologic variations exist at the site of the proposed Geological Survey building.

GROUNDWATER CONDITIONS

The presence of free water at a depth of 20 feet below ground surface was recorded on some bore-hole logs examined by the writer. Saturated clayey silt was also observed at a depth of approximately 18 feet below surface in the foundation excavation for Calgary Hall near the location of bore-hole C-3 on Figure 2.

It is probable that the configuration of the water-table conforms closely to that of the topographic surface at a depth of 20 feet below the topographic surface. The relationship of the site area to the regional topography is such that vertically downward movement of groundwater beneath the site is to be expected.

Meyboom (1961, p. 36) points out that the fine-grained deposits of Lake Calgary do not yield water freely to wells; however, the presence of fine sands and silts within the lacustrine sequence (Fig. 2) suggests the possibility that "quick" conditions could occur in excavations below a depth of 20 feet.

Sulphate is present only in minor quantity in the groundwater, as shown in Figure 3 and is probably not in sufficient quantity to preclude the use of normal Portland cement for construction.

ENGINEERING PROPERTIES OF FOUNDATION SOILS

An indication of the physical properties of foundation soils underlying Calgary Hall is shown on Figure 3. The N values (number of blows from a 140 lb hammer with a free fall of 30 inches required to cause 1 foot penetration of a standard Raymond sampler) show a general increase with depth particularly beyond depths of 35 to 40 feet.

Unconfined compressive strengths also show a general increase with depth.

No laboratory data on the consolidation characteristics of the lacustrine clays were available at the time of the site investigation.

The basement excavation for Calgary Hall was cut up to 20 feet into aeolian sand overlying lacustrine silt. Both of these materials were exposed in essentially vertical slopes and only minor sloughing of the excavation walls was observed.

Concrete was poured into the bored and belled pile excavations at Calgary Hall within 15 minutes following removal of the boring rig from the site. The bell end of the pile excavation was at a depth of approximately 30

Meyboom, P. (1961): Groundwater Resources of the City of Calgary and Vicinity; Res. Coun. Alberta, Bul. No. 8.

feet basement grade thus it is assumed that the bell would remain open at this depth for at least 15 minutes.

FOUNDATION DESIGN FOR BUILDINGS ON THE CALGARY CAMPUS

According to Bernard, Curtis and Hoggin, Foundation Consultants, Edmonton, all buildings on the Calgary Campus are founded on either Franki piles or on bored and belled cast-in-place reinforced concrete piles with a pile tip elevation of from 30 to 40 feet below basement grade.

The design dimensions, exclusive of the specifications for reinforcing steel, for Calgary Hall, a five storey building, are shown in Table 1.

FOUNDATION PERFORMANCE OF THE OIL AND GAS CONSERVATION BOARD CORE LABORATORY

Details of the foundation design for the Core Lab., immediately adjacent to the site of the proposed Geological Survey Building, were not available at the time of the site investigation. Examination of the core storage area, however, revealed no sign of distress to the floor slab from the relatively high floor loads imposed by the storage of core samples. Barely noticeable differential settlement was observed across one expansion joint which was immediately adjacent to the columns of a core storage rack but no sign of foundation differential settlement was detected.

CONCLUSIONS

1. Foundation conditions at the site of the proposed Geological Survey building will be similar to those at the adjacent Calgary Campus of the University of Alberta.

2. Variations in lithology of the lacustrine sediments that will form the foundation materials for the proposed Geological Survey building can be anticipated over relatively short horizontal and vertical distances.

3. Firm strata, adequate to support end-bearing piles, will probably be found at depths of 35 to 50 feet below surface.

4. Saturated materials can be expected at depths below 20 feet below the topographic surface.

5. Lenses of fine sand and silt prone to "quicking" could occur in excavations below 20 feet.

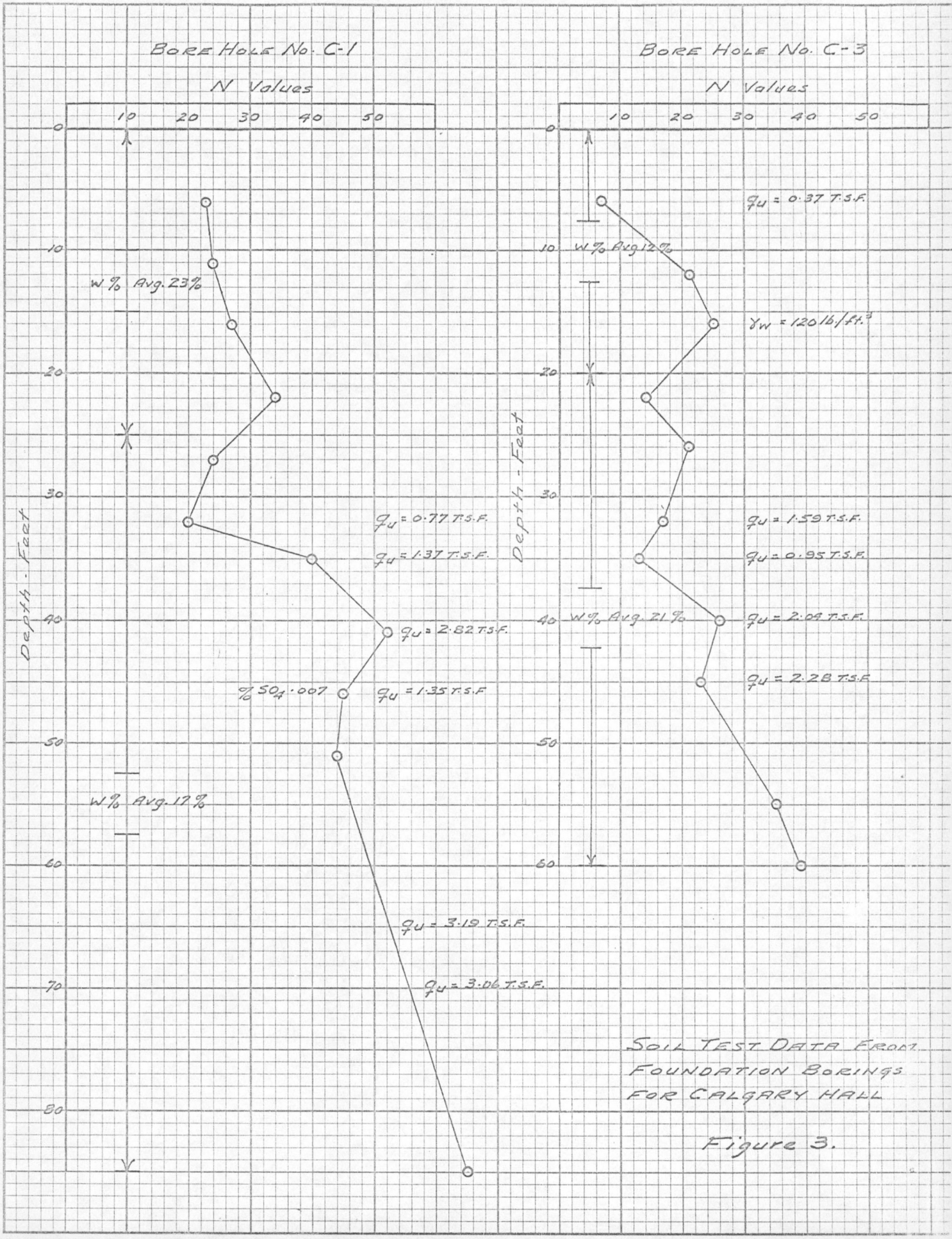
6. Low density fine-grained materials or highly compressible clay strata do not appear to be present at foundation depths in the site area.

RECOMMENDATIONS

1. A minimum of 1 boring to a depth of 60 feet at the corners of the proposed structure should be made to confirm the presence of firm strata for end-bearing piles and which will also provide adequate data for the design of shallow foundations should these be anticipated.

2. Geological correlation of the bore-hole data should be made to determine the relative continuity of the foundation conditions.

3. Structural detail and foundation conditions of the Oil and Gas Conservation Board Core Laboratory should be examined to serve as a guide to the foundation design of the Geological Survey Building.



SOIL TEST DATA FROM FOUNDATION BORINGS FOR CALGARY HALL

Figure 3.

Load (Kips)	Shaft Diam.	Bell Diam.
20 - 50	16"	-
70 - 80	20"	-
100	20"	34"
110 - 125	20"	42"
130	20"	42"
140 - 180	20"	60"
200 - 260	24"	68"
270 - 300	30"	72"
330 - 350	30"	82"
360 - 430	30"	90"
440 - 520	36"	102"
540 - 620	36"	108"
660	30"	90"

Design Dimensions for Bored and Belled Cast-in-Place Reinforced Concrete Piles for Foundation of Calgary Hall.

Table 1.