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1986/33. Preliminary site investigation for the Institute of Sports building at Newnham

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Abstract

An auger hole was drilled at the site of a proposed building at Newnham. A 1.2 m thick surface layer of river terrace silt and gravel was underlain by a moist brown clay with a hardpan of sandy clay at the base at 3.2 m depth. Below this hardpan was a dry, orange, hard clay and drilling stopped in this clay when heavy gravel was encountered at 4.3 m depth. The clay and sandy clay are thought to belong to the Launceston Beds of Tertiary age. When tested all clays were highly plastic and expansive. With such clays foundation movements can be anticipated at this site.

INTRODUCTION

At the request of R. Gowland (of R.J. and L.C. Gowland Structural Drafting) an auger hole was drilled at the proposed site of the Institute of Sports building. The building is to be located between the gymnasium and the residential colleges at the northern end of the Tasmanian State Institute of Technology campus at Newnham [EQ102164].

PREVIOUS INVESTIGATION

C. Pryor, the architect for the proposed building, had a small investigation pit dug in the middle of the site. The pit was approximately one metre deep and its sides were beginning to collapse when the drilling was undertaken. The pit exposed a surface layer of unconsolidated light grey silt with scattered pebbles. The silt was dry and very easy to dig. At the bottom of the pit was coarse gravel mixed with brown clay.

The aim of the auger drilling was to penetrate the gravel and to establish the properties of any clay present below.

DRILLING

A light trailer-mounted Triefus drill rig was used to auger a 4.3 m deep hole. The augers were 100 mm diameter and clay was sampled at the end of each flight or where a change of lithology occurred.

LITHOLOGICAL SEQUENCE

Below the surface layer of river terrace silt and gravel, the sequence drilled to 3.2 m comprised brown clay and grey-brown clay. At this depth, a sandy clay lense or bed was encountered with a hard cemented layer at its base at 3.5 m. Below this hardpan the clay was orange in colour, harder and drier. At 4.3 m depth the drill appeared to be riding on coarse gravel and could not penetrate deeper.

Occasional rounded pebbles of dolerite and quartzite were encountered in

both the upper and lower clay. From field tests, the clays were highly plastic, and so probably expansive. The clays were moist, although not exceptionally so. The upper clay was very stiff and the lower clay hard. The samples were measured using a pocket penetrometer on disturbed samples collected from the auger, but these results appeared to be confirmed by drill penetration.

The upper silt with a gravel layer at its base is considered to be a river terrace deposit of probable Quaternary age, whereas the underlying clay and sandy clay sequence is considered to belong to the Launceston beds of Tertiary age (Longman, 1964).

LABORATORY RESULTS

The laboratory results confirm the field tests and show that the clay above and below the sandy clay lense (or bed) is highly expansive. The clay sample (Sample 1) collected from immediately below the surface silt and gravel bed had a very high liquid limit (159) with a high plastic index (129). It also had a high linear shrinkage (27%) and a high moisture content (37%). The clay continues to be very highly plastic throughout the upper layer with a plastic index of 114 from Sample 2 at 2.5 m depth, this sample having a moisture content of 38% and a linear shrinkage of 28%.

Sample 3, collected from just above the sandy clay layer at 3.0-3.2 m depth, shows a decline in moisture content to 29% but the plastic index (87) and linear shrinkage (26%) are both high (fig. 1).

The orange clay below the sandy clay is slightly more sandy than the upper clay, as well as being drier and harder, but is essentially the same clay, as shown from the X.R.D. composition and quartz fraction results (Table 2), as well as its high plastic index etc. (Samples 4 and 5, Table 2).

CONCLUSIONS

(1) The sequence drilled at this site is characteristic of much of the north Launceston area of the East Tamar. Thin scattered river terrace deposits of sand, silt and gravel of presumed Quaternary age overlie clay, sandy clay with minor beds or lenses of sandy clay, soft sandstone and gravel of the Launceston Beds of Tertiary age.

(2) The clay below the surface deposit is highly expansive.

(3) The high moisture content of the clay below the surface deposit of silt with basal gravel indicates that the overlying sediments are permeable, allowing surface water to reach the expansive clay.

(4) Given a very wet winter, a wetting front moving down through the clay would probably reach the sandy clay layer at the base of the upper clay at 3.2 m depth. The hardpan (cemented layer) in this sandy clay has probably developed as a result of these long term cycles of wetting and drying.

RECOMMENDATIONS

(1) The foundations of the proposed building be designed to withstand or compensate for expansive clay movements.

(2) Depending on the size of the building, some thought should be given to the surrounding layout of the site (concrete paths, lawns, trees etc.) and the likely effects on the moisture content of the clay in relation to the moisture content in the clay beneath the building.

REFERENCES

LONGMAN, M. J. 1964. Geological atlas one mile series. Sheet 39 (8315S). Launceston. *Department of Mines, Tasmania*.

MOORE, W. R. 1983. Subsurface geological investigation of cracked houses in the Mowbray area, Launceston. *Unpubl. Rep. Dep. Mines Tasm.* 1983/24.

[24 June 1986]

Table 1. SOIL LABORATORY TESTING RESULTS

Hole no.	Sample no.	Depth (m)	Moisture content (%)	Plastic limit	Liquid limit	Plastic index	Linear shrinkage (%)
1	S1	1.3	37	30	159	129	27
	S2	2.5	38	27	141	114	28
	S3	3.0	29	28	115	87	26
	S4	3.4	27	22	90	68	23
	S5	4.3	28	24	103	79	25

Table 2. X-RAY DIFFRACTION MINERALOGY OF CLAY SAMPLES

Sample	Clay mineralogy (%)			Total quartz (%)
	Montmorillonite	Kaolinite	Goethite	
S1	15-20	50-55	30-35	5-10
S2	25-30	40-45	25-30	5-10
S3	25-30	40-45	25-30	5-10
S4	20-25	40-45	30-35	10-15
S5	20-25	45-50	25-30	10-15

Soil testing and clay mineralogy testing by R.N. Woolley Department of Mines, Hobart.

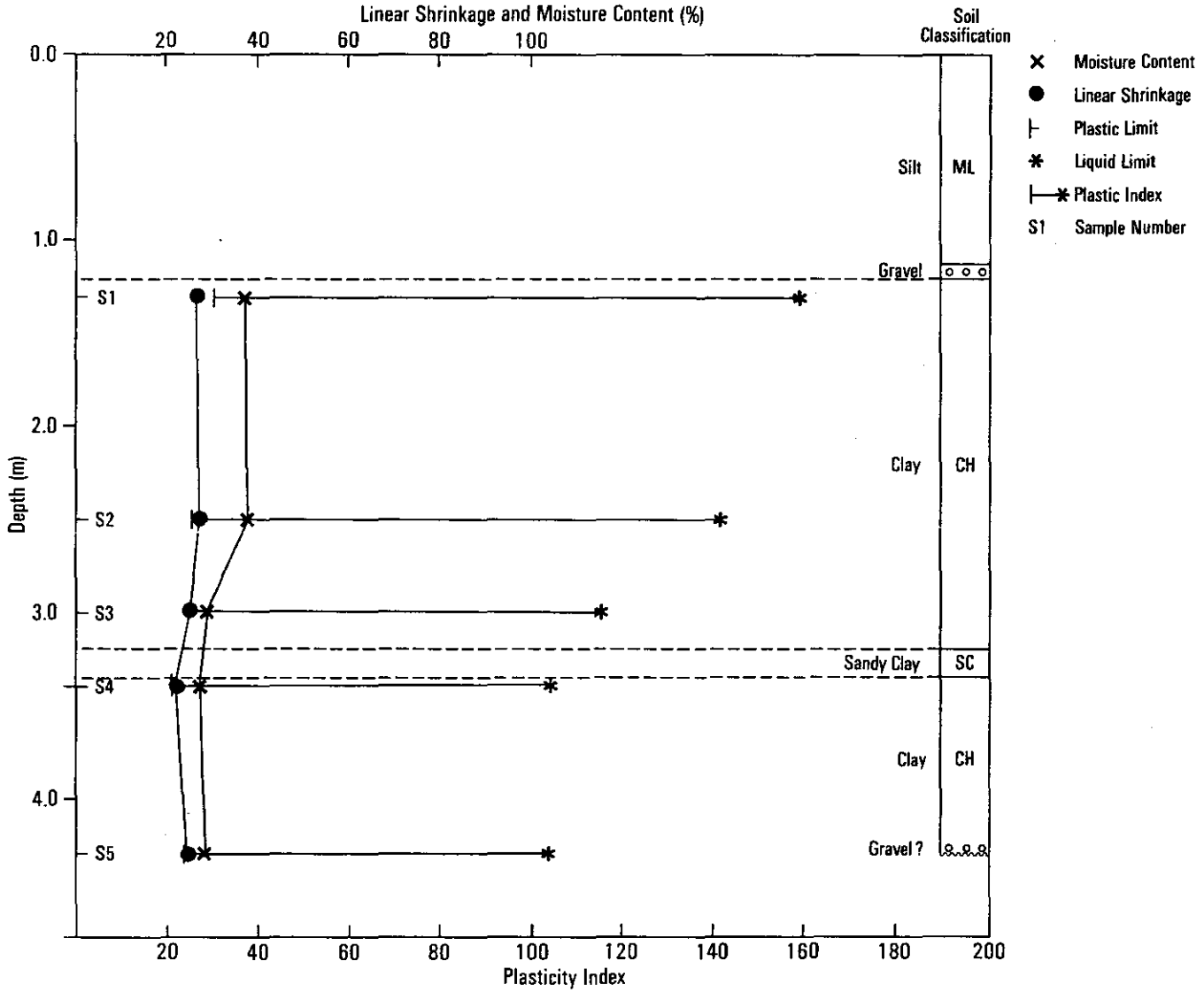

Figure 1. *Soil testing results.*

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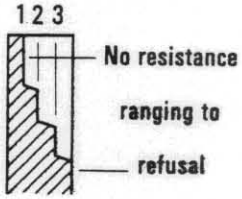
6/7

EXPLANATION SHEET FOR ENGINEERING LOGS

Borehole and excavation log

Penetration



Water

22 Jan. 80 Water level on date shown.

Water inflow.

Water outflow.

Notes - samples and tests

U50	Undisturbed sample 50mm diameter.
D	Disturbed sample.
N	Standard penetrometer blow count for 300mm.
N*	SPT + sample.

Material classification

Based on Unified Soil Classification System.

In Graphic Log materials are represented by clear contrasting symbols consistent for each project.

Moisture content

D	Dry, looks and feel dry.
M	Moist, no free water on hand when remoulding.
W	Wet, free water on hand when remoulding.
LL	Liquid limit.
PL	Plastic limit.
PI	Plasticity Index.

eg. M > PL – Moist, moisture content greater than the plastic limit.

Consistency

		hand penetrometer (kPa)
VS	Very soft.	< 25
S	Soft.	25 – 50
F	Firm.	50 – 100
St	Stiff.	100 – 200
VSt	Very stiff.	200 – 400
H	Hard.	> 400
Fb	Friable.	

Notes: X on log is test result

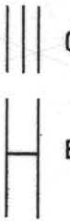
— is range of results.

Density index

		%
VL	Very loose.	0 – 15
L	Loose.	15 – 35
MD	Medium dense.	35 – 65
D	Dense.	65 – 85
VD	Very Dense	85 – 100

Cored borehole log

Case - lift



Casing used.

Barrel withdrawn.

Fluid loss

No loss

50% loss

100% loss.

Lugeons

Lugeon units (μL) are a measure of rock mass permeability. For a 46 to 74mm diameter borehole 1 Lugeon is defined as a rate of loss of 1 litre per metre per minute. 1 Lugeon is roughly equivalent to a permeability of 1×10^{-4} mm/sec.

Graphic log

No core.

Rock substances represented by clear, contrasting symbols consistent for each project.

Weathering

Fr	Fresh.
SW	Slightly weathered.
HW	Highly weathered.
EW	Extremely weathered.

Strength

		point load strength index $I_{s\,(50)}$ (MPa)
EL	Extremely low.	< 0·03
VL	Very low.	0·03 – 0·1
L	Low.	0·1 – 0·3
M	Medium.	0·3 – 1
H	High	1 – 3
VH	Very high.	3 – 10
EH	Extremely high.	> 10

Note: X on log is test result.

Significant defects

Significant defects shown graphically.

Joint.

Sheared zone.

Crushed seam.

Infill seam.

Extremely weathered seam.

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ENGINEERING LOG – BOREHOLE

borehole no. 1

sheet 1 of 1

7/7

project: Institute of Sports building — location: T.S.I.T. Campus, Newnham, Launceston

co-ordinates: 5102-54164 — drill type: Triefus — hole commenced: 6.5.86

drill method: Auger — hole completed: 6.5.86

R.L.: 22 m (approximate) — drilled by: B.E. Cox

inclination: vertical — drill fluid: None — logged by: W.R. Moore

bearing: -- — checked by:

penetration 1 2 3	support	water	notes samples, tests	metres R.L. / depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa (25 50 100 200 400)	structure, geology
	None	None		1.0		ML	*SILT* with minor gravel. *SILT* grey and grey-brown, fine-poorly graded. Gravel - scattered pebbles, coarse, 25-50 mm quartzite pebbles.	D	VL ↓ L		Silt
						GP	*GRAVEL* - Med. to coarse, poorly graded	D	MD		Gravel
			S1	2.0		CH	*CLAY* - Brown to grey-brown, highly plastic. Odd pebble of quartzite and dolerite.	M < PL	V St.		Clay
			S2								
			S3	3.0							
						SC	*SANDY CLAY* - Orange clay, low plasticity, sand, fine.	D	H		Sandy clay Hardpan
			S4	4.0			*CLAY* - Orange-brown, highly plastic. Some small pebbles.	M < PL	H		Clay
			S5				Drilled to refusal, possible gravel layer. Depth 4.3 m.				

5 cm