



Foundation investigation for the proposed redevelopment of the HCC Bathurst Street car park

by R. C. DONALDSON

INTRODUCTION

A subsurface investigation to ascertain the foundation conditions at the Hobart City Council's Bathurst Street car park was carried out by the Department of Mines between 29 September and 8 October 1987.

The investigation comprised a five-hole drilling program with each borehole to be terminated in a sound or competent rock. A combination of auger and diamond-drilling methods was employed. Borehole locations are shown on Figure 1; the corresponding description of materials encountered are contained on the appended engineering log forms.

INVESTIGATIONS AND RESULTS

Site investigation works in and around the Hobart central business district have shown that the geology and foundation conditions change rapidly, both laterally and in depth. Previous investigations for the State Library and the SES headquarters, situated at either end of the car park, showed the foundations to be sandstone and dolerite respectively. A geological boundary was therefore expected at the car park site.

The results of the drilling showed that only hole 1 encountered Triassic age sandstone whilst holes 2 to 5 were terminated in Jurassic age dolerite. From the information available, it would appear that the boundary between the two rock types occurs near the southern corner of the car park, although details of its form and orientation remain unknown. The most probable form is thought to be a steeply-dipping contact striking east-west.

A Tertiary 'conglomerate' deposit was observed overlying bedrock in holes 1 and 4. The thickness of this deposit varies from about 1.2 m (hole 1) to some 4.9 m (hole 4). The origin of this material is uncertain but the deposits are considered to be alluvial or perhaps talus/slope-derived, and may possibly be as young as Pleistocene in age.

Similar 'conglomerate' deposits were reportedly encountered during the investigations for the State

Computer Centre on the corner of Melville and Harrington streets, while materials referred to as 'clay and dolerite boulders' were found to be overlying sandstone bedrock on the State Library site; these deposits are considered to be equivalent or similar to those found in holes 1 and 4.

The degree and depth of weathering across the site is highly variable, even over short lateral distances. For example, slightly weathered dolerite was encountered at approximately 3.5 m depth in hole 3, whilst a similarly weathered high strength material was noted as occurring at a depth of about 10.5 m in hole 2. Both holes have a similar surface elevation. The soil/rock interface can therefore be expected to vary, resulting in an irregular bedrock profile over the site.

Useful standing water level readings were only possible from holes 1, 2 and 5. Holes 3 and 4 partially caved in when the drilling rods were withdrawn on completion of the hole. Measurements were taken over a period of days to ensure levels had stabilised. The results indicate a groundwater table at approximately 5.0–5.3 m below current ground level.

Excavation on the site for a possible basement level would largely involve the removal of material having low strength or soil properties. Any hard rock conditions are likely to be sufficiently well jointed or fractured to be excavated without the use of explosives.

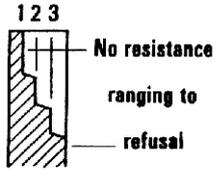
In summary, the majority of the site is underlain by dolerite; sandstone appears to be confined to an area in the vicinity of hole 1. The extent of the Tertiary 'conglomerate' deposits is not known. The weathering of the dolerite is highly variable and the soil/rock interface is likely to be irregular across the site. The water table is 5.0–5.3 m below the surface. All boreholes encountered material considered to be suitable as a foundation.

[28 October 1987]

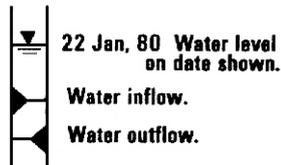
EXPLANATION SHEET FOR ENGINEERING LOGS

Borehole and excavation log

Penetration



Water



Notes - samples and tests

U50 Undistributed 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.	

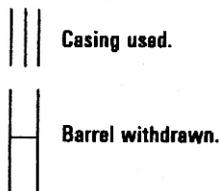
Notes: X on log is test result
— is range of results.

Density index

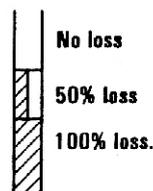
		%
VL	Very loose.	0 - 15
L	Loose.	15 - 35
MD	Medium dense.	35 - 65
D	Dense.	65 - 85
VD	Very Dense	85 - 100

Cored borehole log

Case - lift



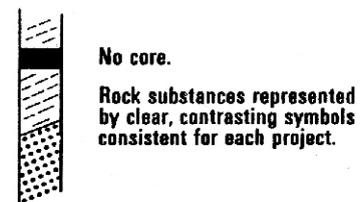
Fluid loss



Lugeons

Lugeon units (μL) are a measure of rock mass permeability. For a 48 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



Weathering

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

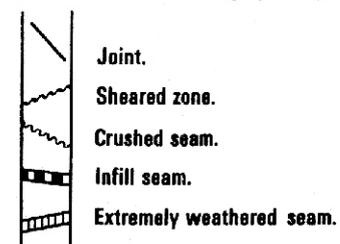
Strength

		point load strength index $I_{5(50)}$ (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.



ENGINEERING LOG - CORED BOREHOLE

borahole no. 1
sheet 2 of 2

project H.C.C. CARPARK REDEVELOPMENT. location BATHURST ST. HOBART.											
co-ordinates REFER PLAN			drill type GEMCO 210D			hole commenced 29 SEPT '87					
R.L.			drill method NQ TRIPLE TUBE			hole completed 30 SEPT '87					
inclination VERTICAL			drill fluid			drilled by G. BAKER (MINES)					
bearing						logged by R. DONALDSON					
checked by											
drilling information				rock substance				rock mass defects			
case-lift	fluid loss	water	notes	lugesons	metres	graphic log	substance description rock type: grain characteristics, colour, structure, minor components.	weathering	strength	defect spacing mm.	defect description thickness, type, inclination, planarity, roughness, coating.
				0.3 3 30 100	R.L. depth						
			RQD								
			14		3		SANDSTONE: fine grained, yellow brown, bedding well developed (very thin to laminated) @ 5° to hor ^l .	HW			Most defects are joints parallel to bedding. Some more steeply dipping joints occur. Joint surfaces rough & irregular.
			0		4						
		29 OCT '87	0		5						
			0		6						
			0		7		MUDSTONE: red brown with yellow brown mottles, fissured. Remains to chl clay.	EW			
			0		7		SANDSTONE: fine grained, yellow brown with red mottles. Bedding well developed as above, some cross-bedding.	EW			
			22		8			H.W			
			59		8						
			77		9						
					10						
											EW seam, 20mm (cl), dipd 5°

Hole terminated @ required depth of 10.00m in Sandstone.

ENGINEERING LOG - BOREHOLE

barshole no. 2
sheet 1 of 3

penetration		support	water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
1	2				R.L.	depth							
project H.C.C. CARPARK REDEVELOPMENT location BATHURST ST., HOBART co-ordinates REFER PLAN drill type GEMCO 210D hole commenced 30 SEPT '87 R.L. 16.98m drill method AUGER hole completed 31 SEPT '87 inclination VERTICAL drill fluid logged by G. BAKER (MINES) bearing checked by R. DONALDSON													
								GC	Clayey GRAVEL: fine-medium, blue grey + brown, clay of medium plasticity, some brick fragments	D	VD		Asphalt and sub-base
				1 N ⁴				OH-CH	Sandy CLAY: high plasticity, black-brown, sand fine-medium, some coarse sand, trace fine gravel, trace wood fragments.	M Z PL	F		Topsoil.
				2 3 5				CH	CLAY: high plasticity, olive green + black, some fine-medium sand, trace fine gravel.	M Z PL	St		Sub-soil
				5 N ⁴				CH	CLAY: high plasticity, red-brown with yellow brown and green grey mottles and streaks, some fine sand, trace fine-medium gravel (sw-nw dolerite). Some thin (2-3mm) calcite seams.	M Z PL	St	VS	Residual Clay grading into extremely weathered Dolerite.
				7 11 18									
				8 12 21									
				9 13 23									
				10 14 25									
				11 15 26									
				12 16 27									
				13 17 28									
				14 18 29									
				15 19 30									
				16 20 31									
				17 21 32									
				18 22 33									
				19 23 34									
				20 24 35									
				21 25 36									
				22 26 37									
				23 27 38									
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				26 30 41									
				27 31 42									
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				32 36 47									
				33 37 48									
				34 38 49									
				35 39 50									
				36 40 51									
				37 41 52									
				38 42 53									
				39 43 54									
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				41 45 56									
				42 46 57									
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				96 100 111									
				97 101 112									
				98 102 113									
				99 103 114									
				100 104 115									

ENGINEERING LOG - CORED BOREHOLE

borehole no. **2**
sheet **3** of **3**

project H.C.C. CARPARK REDEVELOPMENT		location BATHURST ST, HOBART.											
co-ordinates REFER PLAN	drill type GEMCO 210 D	hole commenced 30 SEPT '87	hole completed 31 SEPT '87										
R.L.	drill method NQ TRIPLE TUBE	drilled by G. BAKER (MINES)	logged by R. DONALDSON										
inclination VERTICAL	drill fluid	checked by											
bearing													
drilling information				rock substance				rock mass defects					
case lift	fluid loss	water	notes	lugoons	metres		graphic log	substance description rock type: grain characteristics, colour, structure, minor components.	weathering	strength	defect spacing mm.	defect description	
					R.L.	depth						thickness, type, inclination, planarity, roughness, coating.	significant
			32					red brown. Concentric weathering pattern co-incident with prominent fractures → "kernel" or "cone stone" structure.	HW				
			85			11		Dolerite as above - colour blue grey.	HW SW				← Shear plane, 5mm @ 90°
			77			12			FR.				Most defects are joints dipping @ 30-60°. Joints irregular, surfaces rough, often with thin calcite coatings. Fe staining prominent along joints in H.W. rock.
			85			13							
						14							
						15		Hole terminated @ required depth of 14.5m in Dolerite.					

ENGINEERING LOG - BOREHOLE

borehole no. **3**
 sheet **1** of **2**

penetration		support water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetr- ometer kPa			structure, geology
1	2			R.L.	depth						25	50	100	
project H.C.C. CARPARK REDEVELOPMENT. location BATHURST ST, HOBART. co-ordinates REFER PLAN drill type GEMCO 210 D hole commenced 5 OCT '87 R.L. 17.20 m drill method AugER hole completed 5 OCT '87 inclination VERTICAL drill fluid bearing drilled by G. BAKER (MINES) bearing checked by R. DONALDSON														
1 2 3														
HOLE CAVED IN ON COMPLETION OF 6 OCT '87														
			5 N ^o 4			SC	Gravelly clayey SAND: fine-medium, brown and black, clay of medium-high plasticity, gravel fine-medium, some china, glass.	D	MD					Asphalt + sub base / fill.
			4 N ^o 9		1	CH	Sandy CLAY: high plasticity, black, sand fine-medium, some coarse, trace fine gravel.	D	VFH					Topsoil.
			3 N ^o 9			OH			H					
			7 N ^o 29		2	CH	Sandy CLAY: high plasticity, olive-green to brown, sand fine-medium, some coarse.	M	VFH					Residual Clay
			12 N ^o 29					PL						
			17 N ^o 29			SC (SP)	Clayey SAND: fine-medium, some coarse, green-grey with orange mottles, clay of medium-high plasticity, trace fine gravel.	D	D					Extremely - Highly weathered Dolerite
			44 N ^o 260		3									
			58 N ^o 260				DOLERITE: fine-medium grained, green grey and yellow brown.							H.W.-Sw. Dolerite
			62 N ^o 260											
					4		Continued on Cored Borehole log - sheet 2							

ENGINEERING LOG - CORED BOREHOLE

borehole no. **4**
sheet **2** of **3**

project H.C.C. CARPARK REDEVELOPMENT location BATHURST ST, HOBART.																	
co-ordinates REFER PLAN				drill type GEMCO 210D			hole commenced 6 OCT '87										
R.L.				drill method NQ TRIPLE TUBE			hole completed 8 OCT '87										
inclination VERTICAL				drill fluid			drilled by G. BAKER (MINES)										
bearing							logged by R. DONALDSON										
checked by																	
drilling information				rock substance				rock mass defects									
case lift	fluid loss	water	notes	lugesons	metres	graphic log	substance description rock type: grain characteristics, colour, structure, minor components.	weathering	strength	defect spacing mm.	defect description thickness, type, inclination, planarity, roughness, coating.						
												0.3	1	3	10	30	100
			ROD														
			Hole cased in at 4.70m on completion.				4 CONGLOMERATE: subrounded gravel + cobble sized, red, yellow brown + green grey fragments of dolerite, mudstone, and sandstone in a grain supported sandy clay matrix.	EW HW			← shear seam, 10mm @ 50° ← crush seam, 20mm @ 10° (CH)						
			0								Most defects are joints dipping @ 10-60. Joints irregular, surfaces rough, some Fe stained, some with calcite coating. Some calcite seams (2-3mm) and veining.						
			0				5 DOLERITE: fine grained, red to red brown, remnant dolerite fabric evident.	EW									
			0														
			0														
			0				8 brown - blue/grey, black specks red-brown + yellow brown.	HW EW									
			0				brown - blue/grey, black specks red brown + yellow brown.	HW EW		← Calcite seam 3mm @ 50°							
			0				fine-medium grained, blue grey + brown, black specks.	HW									
			33							← Crush seam, 40mm (CH) ← Crush seam, 50mm (CH)							

