Section

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

ENGINEERING DIVISION

SUBSTATION - MT. BARKER
GEOLOGICAL INVESTIGATIONS PROGRESS REPORT No.1.
DESIGN STAGE

Section 4470, Hundred Macclesfield

Client - Electricity Trust of South Australia

by

W.R.P. BOUCAUT
SENIOR GEOLOGIST
ENGINEERING GEOLOGY SECTION

D.M.708/69

1st July, 1969

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept. Bk. No. 68/109
G.S. No. 4258
DM.708/69

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GEOLOGICAL INVESTIGATIONS PROGRESS REPORT No. 1
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DEPARTMENT OF MINES
SOUTH AUSTRALIA

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SUBSTATION - MT. BARKER

GEOLOGICAL INVESTIGATIONS PROGRESS REPORT NO. 1

DESIGN STAGE

Section 4470, Hundred Macclesfield

Client - Electricity Trust of South Australia

SUMMARY

The Electricity Trust of South Australia is to construct a sub-station at Mt. Barker. The single storey building of about 39 squares will be of modular block construction. The site was explored by 2 test pits 7 and 8 ft. deep.

The ground surface at the site is gently sloping (at about 3°, (Fig. 1). The ground surface if formed of an organic sandy silt. The test pits showed this topsoil to be about 0.7 ft. thick overlying red-brown clay soil of high plasticity, developed over weathered sandstone and schist bedrock. Rock is 2.6 ft. below the ground surface in Pit 1 and 1.7 ft. in Pit 2. The upper 1 ft. of rock is extremely weathered to a clay soil of low plasticity, sandy in parts.

The clay soil horizon developed over bedrock, in Pit 2 is reasonably strong but the similar horizon in Pit 1 is much weaker. In both pits it appears to be of the expansive type, that is, subject to seasonal swelling and shrinking movements of fairly severemagnitude.

Several alternative footing types, which have proved suitable for domestic homes under similar conditions are described.

INTRODUCTION

The Electricity Trust of South Australia is to construct a sub-

station at Mt. Barker, on the Mt. Barker to Echunga Road. The single storey switchhouse building of about 39 squares will be of modular block construction.

The site was explored by 2 test pits 7 and 8 ft. deep (Fig. 1). The pits were logged on 10th June, 1969 and the results discussed with Messrs. Jeanes and Perkin, ETSA on 13th June, 1969.

Logs of the pits are shown on Figures 2 and 3 and are summarised in section on Figure 1.

SITE GEOLOGY

The site is located on the gently sloping (about 3^{o}) side of a ridge in the Mt. Lofty Ranges. The ground surface is well grassed and formed by a black (organic) sandy silt.

The pits showed this topsoil to be about 0.7 ft. thick, overlying a red-brown clay soil of high plasticity, developed over weathered sandstone and schist bedrock. Rock is 2.6 ft. below the ground surface in Pit 1 and 1.7 ft. below in Pit. 2. The upper 1 ft. of rock is extremely weathered to a clay soil of low plasticity, sandy in parts.

The clay soil horizon developed over bedrock in Pit 2 is drier than its plastic limit and reasonably strong, with Soiltest Penetrometer readings of 3 to greater than 4.5 (the limit of the instrument). However the similar horizon in Pit 2 is wetter than its plastic limit and much weaker, with penetrometer readings of 2. This would suggest that the moisture content, and hence the strength of the clay, is variable over the site.

This clay horizon is also of the expansive type, and would be subject to swelling and shrinkage movements with changes in moisture content. The vertical component of these movements, translated to the surface, results in uplift forces sufficient to cause failure in foundations of inadequate strength.

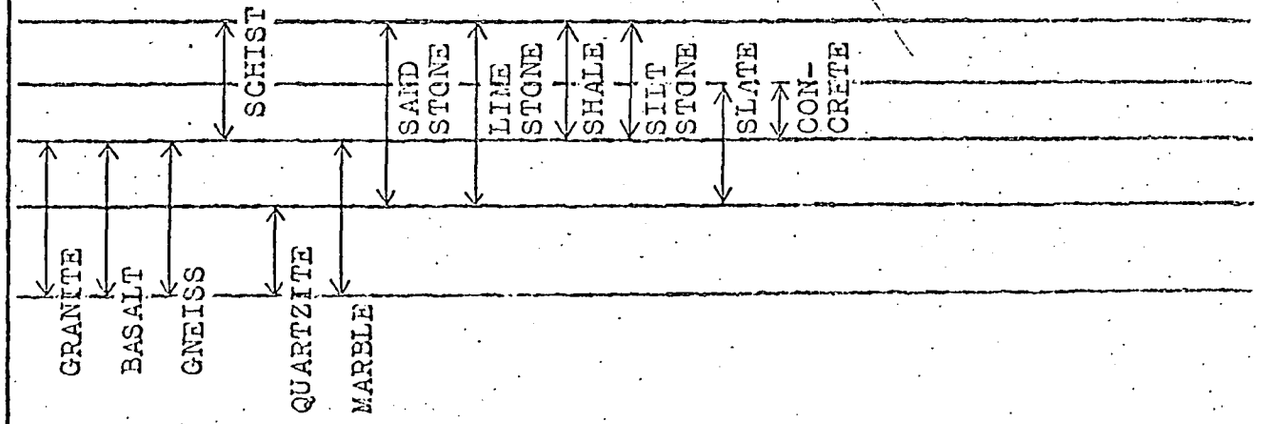
The bedrock below the extremely weathered zone, is a weak to very weak rock (Table 1), and its bearing capacity would be moderately high, with no tendency for settlement beneath foundations for normal single storey domestic type buildings.

TABLE 1

CLASSIFICATION OF CLAY SOILS AND ROCK SUBSTANCES
BY UNCONFINED COMPRESSIVE STRENGTH

	TERM	ABBREVIATION	UNCONFINED COMPRESSIVE STRENGTH (Kg/sq.cm)
SOIL PROPERTIES Disintergrates, or can be remolded in water	Very soft (clay)	VS	less than 0.25
	Soft "	S	0.25 - 0.5
	Medium "	M	0.5 - 1.0
	Stiff "	St	1.0 - 2.0
	Very Stiff "	V.St.	2.0 - 4.0
	Extremely stiff clay	E.St.	greater than 4.0
	Boundary Zone Substances		
ROCK PROPERTIES Do not disintergrate cannot be remolded, in water	Very weak rock	VWR	less than 70
	Weak "	WR	70 - 200
	Medium Strong "	MSR	200 - 700
	Strong "	SR	700 - 1800
	Very Strong "	VSR	greater than 1800

Range of strengths of some Common Rock Substances, in the Fresh State



No groundwater was encountered in the pits which are 7 to 8 ft. deep, and this indicates that no groundwater inflows should be encountered during excavations at the site. However it appears that the soils near the ground surface becomes saturated during "wet" periods and flow could occur from the topsoil exposed in any batters, during the winter months.

SUGGESTED FOOTING TYPES

If it is decided to seat the foundations within the clay soil horizon below the topsoil, that is, at or just below Foundation Depth No.1 (Fig. 1), then it would be necessary to design a foundation which

(a) imposed a loading on the soil of less than 2 tons/sq. ft.,

(b) had adequate strength to withstand differential ground movements of up to ½ inch due to expansion and contraction of the clay.

It would also be advisable to incorporate an "impermeable curtain" beneath the footings around the perimeter of the building to minimize changes in moisture content beneath the building. This curtain should extend to at least 1ft. into the underlying bedrock.

The following foundation types would probably be satisfactory for domestic type buildings constructed on this type of soil.

(1) Grillage Raft

This involves a concrete raft floor made integral with a concrete curtain beneath external and internal walls. Patent for this design is held by Fargher, Hosking and Oborn, Consulting Engineers who can supply full construction details.

(2) W. and G. No. 2

This involves the use of a concrete and polythene curtain beneah all external footings. The curtain is capped at or near the surface by a standard strip footing, which at this site could have the following dimensions.

External Walls: Depth 15 inches, width 18 inches, Reinforcement 6 x ½ inch diameter or 5/8 inch square twist rods (3 top, 3 bottom)

Internal Walls: Depth 15 inches, width 11 inches, reinforcement 4 x ½ inch

diameter or 3/8 inch square twist rods (2 top, 2 bottom)

Full construction details can be had from the Contractors, Wilkinson and Giaccio.

Footings will require stepping top and bottom to accomodate the slope. Steps should not exceed 2 courses (7 inches) in height and 1 course (3½ inches) is preferred.

If it is decided to excavate the site to form a level platform then the following footing type could be used.

..... Standard beam type footings seated at all points onto bedrock below the upper zone of extremely weathered material with soil properties. This is 3.7 ft. below the ground surface in Pit 1 and 2.5 ft below the ground surface in Pit 2. (Foundation Depth No. 2, Figure 1). Beams of the following dimensions should prove satisfactory at this site.

External Walls: Depth 18 inches, width 14 inches, reinforcement 6 x ½" or 3/8" square twist rods (3 top, 3 bottom).

Internal Walls: Depth 18 inches, width 11 inches, reinforcement 4 x ½ inch diameter or 3/8 inch square twist rods (2 top, 2 bottom).

If cut and fill methods are used, then in the areas of deeper fill it would be necessary to support the beams on under-reamed piers founded below the zone of extremely weathered bedrock.

GENERAL RECOMMENDATIONS

All surplus surface water, downhill drainage, roof runoff etc. should be carried well away from the footings in properly constructed drains of adequate capacity. Lawns and gardens should be kept well clear of the foundation area to prevent damage resulting from overwatering.

A wide concrete, or heavy asphalt paving completely surrounding the building will minimize soil moisture variations beneath the footings.

If a concrete paving is used it should be bonded to the footings by means of a bitumastic compound.

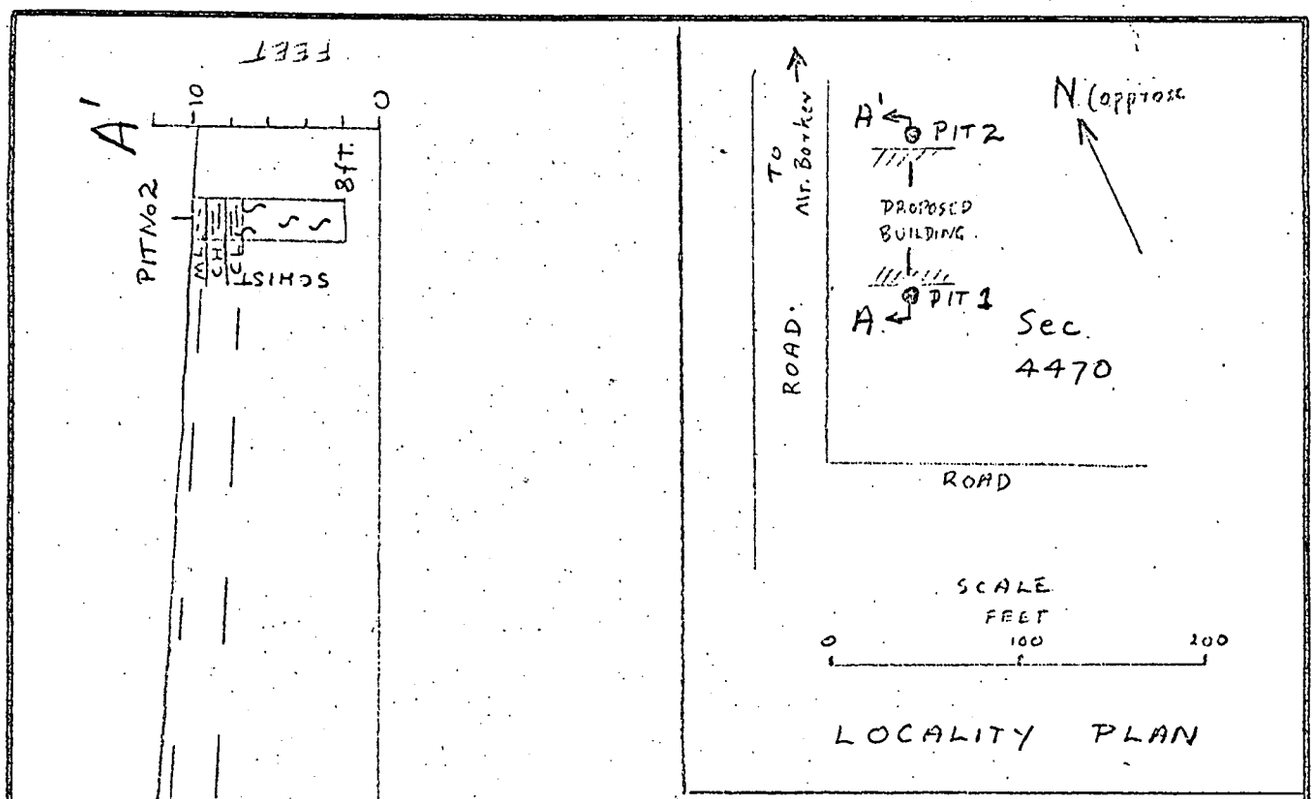
W.R.P. Barnard

SENIOR GEOLOGIST

ENGINEERING GEOLOGY SECTION

WRPB:NHW

1.7.69.



LOCALITY PLAN

FIG 1

DEPARTMENT OF MINES — SOUTH AUSTRALIA			
ENGINEERING GEOLOGY SECTION	Drn. WAB.	SUBSTATION - MT. BARKER	SCALE: As Shown
	Tcd. WAB	LOCALITY PLAN AND GEOLOGICAL SECTION	G.S. 7342
	Chkd.		
	Exd.		DATE: 27 June 69

DEPARTMENT OF MINES SOUTH AUSTRALIA

PIT NO 1

LOG OF PIT

(SOUTH)

PROJECT . SUBSTATION ETSA

LOCATION . MT. BARKER SECTION 4470 HUNDRED MACCLESFIELD

LANDFORM. HILLY

RELIEF . EXCESSIVE Direction of fall. NORTHERLY

MICRORELIEF FLAT

DRAINAGE External . RAPID Internal SLOW Surface Absorption SLIGHT

SURFACE VEGETATION Type . FODDER GRASS

SAMPLE NUMBER	SOIL/ROCK HORIZON	R.L (Feet) DEPTH (Feet)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification U.S.B.R. Earth Manual 1st Ed. Rev 1963	OTHER GEOLOGICAL PEDOLOGICAL DESCRIPTION	SOIL/ROCK STRUCTURE	WATER LEVEL	MOISTURE CONTENT	Consistency Compactness Rel Density	SOILTEST PENETROMETER UNITS * 1 2 3 4
		0		ML	SILT SOIL, low plasticity, organic. Est. up to 5% SAND, fine grained. Dark grey.	Sand is quartz grains. Numerous vegetation roots.			W	Ls	
		1		CH	CLAY SOIL, high plasticity. Reddish brown with some grey mottling	vegetation roots up to 5 mm. dia. Infilled root tubes to 3mm dia.	Mainly subvertical, few horizonal structural units. Moderate sheens on faces	No water cut	PL ≦	F/St	
		2		CH/CL	Gradational boundary CLAY SOIL, low plasticity, grey, with some red brown mottling	Numerous hair rootlets	Structural units sub-vertical				
		3		CL/SC	CLAY SOIL, low plasticity, grading in parts to SAND, excess fines in beds up to 5 mm.	BEDROCK, extremely weathered.			PL ≦		
		4		Rock	Gradational SANDSTONE, micaceous grey to brown	weathered	very weak to weak rock				
		5									
		6									
		7			Base of pit 7 ft.					Estimated	
		8									

REMARKS

* These values refer to clay soils only and provide an indication of their consistency.

CLASSIFICATION		CONSISTENCY (CLAY)	COMPACTNESS (SILT)	RELATIVE DENSITY (SAND)	MOISTURE CONTENT	ENGINEERING GEOLOGY SECTION
Great Soil Group	Water level (date) 7 May 67	VS — Very Soft	Ls — Loose	VL — Very Loose	H — Humid	PLANT ETSA LOGGED R.K.T
Subgroup	W/C Water cut	S — Soft	MC — Moderately Compact	L — Loose	D — Damp	TYPE Auger DATE 10 June 67
REFERENCE		F — Firm	C — Compact	MD — Medium Dense	M — Moist	DRILLER TRACED
Fuller		St — Stiff	VC — Very Compact	D — Dense	W — Wet	START CHECKED
Map		V. St — Very Stiff		VD — Very Dense	S — Saturated	FINISH
Photo		H — Hard			LL — Liquid Limit	SHEET 1 OF 1 DRG No S7343 HC1
					PL — Plastic Limit	

PF No 9000 HB

DEPARTMENT OF MINES | SOUTH AUSTRALIA

LOG OF PIT

PIT NO 2 (NORTH)

PROJECT SUBSTATION - ETSA

LOCATION MT. BARKER SECTION . HUNDRED .

LANDFORM HILLY

RELIEF EXCESSIVE Direction of fall. NORTHERLY

MICRORELIEF FLAT

DRAINAGE External RAPID Internal SLOW Surface Absorption . SLIGHT

SURFACE VEGETATION Type . FODDER GRASS

SAMPLE NUMBER	SOIL/ROCK HORIZON	R.L. (Feet) DEPTH (Feet)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification U.S.B.R. Earth Manual 1st Ed. Rev 1963	OTHER GEOLOGICAL / PEDOLOGICAL DESCRIPTION	SOIL/ROCK STRUCTURE	WATER LEVEL	MOISTURE CONTENT	Consistency Compactness Density	SOILTEST PENETROMETER UNITS * 1 2 3 4
		0		ML	SILT SOIL, low plasticity, organic. Est. up to 5% SAND, mainly fine grained.	Numerous vegetation roots to 5mm. Sand is quartz.			W	Ls	
		1		CH	CLAY SOIL, high plasticity. Red brown some grey mottling	Vegetation roots to 5mm dia.	SAND infilling dykes (joints) CLODDY. Structural units have moderate sheens	NO WATER OUT	<PL	V St.	>4.5
		2		CL/SC	CLAY SOIL, low plasticity, grading in parts to SAND, excess fines. Grey to red brown	BEDROCK extremely weathered			<PL		
		3		Rock	SCHIST, micaceous grey to brown	weathered	very weak to weak rock				
		4									
		5									
		6									
		7									
		8			Base of pit 8 ft.						

REMARKS

* These values refer to clay soils only and provide an indication of their consistency.

CLASSIFICATION		CONSISTENCY CLAY	COMPACTNESS SILT	RELATIVE DENSITY SAND	MOISTURE CONTENT	ENGINEERING GEOLOGY SECTION
Great Soil Group	Water level (date) 7 May 67	VS — Very Soft S — Soft F — Firm St — Stiff VSt — Very Stiff H — Hard	Ls — Loose MC — Moderately Compact C — Compact VC — Very Compact	VL — Very Loose L — Loose MD — Medium Dense D — Dense VD — Very Dense	H — Humid D — Damp M — Moist W — Wet S — Saturated Ll — Liquid Limit Pl — Plastic Limit	PLANT ETSA. Auger TYPE DRILLER START FINISH LOGGED RKT DATE 19 June 67 TRACED CHECKED
Subgroup	Water out					
REFERENCE						
Driller						