DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
ENGINEERING DIVISION

S.E. MEAT (AUST.) LIMITED - PROPOSED NEW BUILDING
Section 388, Hundred of Jessie
REPORT ON FOUNDATION INVESTIGATIONS

by

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ENGINEERING GEOLOGY SECTION

30th April, 1973

Rept.Bk.No. 73/115
D.M. No. 1177/72
G.S. No. 5120
Eng.Geol.No. 1972-36

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DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No. 73/115
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SUMMARY AND CONCLUSIONS

Interpretation of core samples from a single investigation bore indicates the following succession:

0 to 1 metres	Probable fill
1 to 2.5 metres	Possible fill
2.5 to 5.0 metres	Blanchetown Clay
5.0 to 12.0 metres	Parilla Sand
12.0 to 13.95 metres	Gambier Limestone

Founding in Blanchetown Clay is recommended, subject to the reservations detailed in Appendix 2. Uniformity of the upper surface of this unit should be thoroughly checked by auger holes or trenching.

A perched water table will probably form above Blanchetown Clay during wet seasons, foundations should be designed accordingly.

No effluent must be allowed access to the regional water table.

INTRODUCTION

One cable-tool hole has been drilled to investigate foundation conditions for a new abbatoir to be constructed for S.E. Meat (Aust.) Ltd. Location is shown on figure 1. Standard penetration tests were carried out at nominal 1.5 metre intervals and sealed tube samples were recovered for subsequent laboratory testing by the E.& W.S. Soils Laboratory. The bore log forms appendix 1 and results of laboratory tests form appendix 2.

A programmed second bore was cancelled by the site engineer.

REGIONAL GEOLOGY

The site is located close to the mapped boundary between Parilla Sand and Gambier Limestone (Figure 1). Thin Quaternary cover is not mapped (Naracoorte Geological Map 1:250 000).

SITE GEOLOGY

Geological observations were limited to examination of core recovered from a single bore. The geological succession, as inferred from this core, is summarized in Table 1.

TABLE 1 INFERRED GEOLOGICAL SUCCESSION

Depth (Metres)	Thickness (Metres)	Age	Formation	Comments
0 - 1.0	1.0	Recent	Not named	Probable fill
1 - 2.5	1.5	Recent	Not named	Possible fill
2.5 - 5.0	2.5	Pleistocene	Blanchetown Clay	
5.0 - 12.0	7.0	Pliocene	Parilla Sand	
12.0 - 13.95+	1.95+	Lower Miocene	Gambier Limestone	

A. Probable Fill. 0 to 1.0 metres

Silt and clay soils of variable plasticity. These materials appear to have been disturbed and are probably old fill. Although the soil test penetrometer indicates moderate strength, the blows required to drive sample tubes were low indicating low strengths.

B. Possible Fill. 1.0 to 2.5 metres

Silt soils, calcareous in upper 1 metre. Blows required to drive sample tubes were low indicating low strength.

Although the materials in the cores were not obviously disturbed, the presence at 2.4 metres of a 2 cm diam vertical hole infilled with gravel does suggest that some disturbance may have taken place in the past. These materials may be old fill or could be alluvium. Since some uncertainty remains, foundations should not be founded in this horizon without further investigations to adequately check lateral variability.

C. Blanchetown Clay. 2.5 to 5.0 metres

Mottled silty clay of high plasticity with moisture content approximately equal to the plastic limit. Blows required to drive sample tubes were low indicating low strengths.

These materials resemble the coarser phases of the Hindmarsh Clay of the Adelaide Metropolitan Area, and appear to be undisturbed. Minor volume changes may occur with changing moisture content but there was no indication of excessive movements.

Foundations within this unit are recommended subject to the reservations detailed in appendix 2, but the uniformity of the upper surface should be adequately checked by trenching or augering before design is finalized. Care must be taken to prevent ingress of water via excavations, surface ponding or broken pipes.

D. Parilla Sand. 5.0 to 12.0 metres

Medium dense sand with excess silty fines. Blow counts indicate variable strength. Permeability should be moderate.

Some densification may occur if piles are driven into this horizon.

E. Gambier Limestone. 12.0 to 13.95+ metres

Limestone, upper 1 metre weathered to highly calcareous sand with excess calcareous silt matrix, lower part strong limestone fragments in a weakly cemented matrix of calcareous silty fine sand.

Although blow counts are high and this material proved strong enough to damage a sampling tube, solution cavities are likely to seriously reduce the bearing capacity available.

GROUNDWATER

No water was cut in the investigation bore. However, Blanchetown Clay forms an effectively impervious horizon which probably supports a perched water table during wet seasons and it is recommended that saturation of foundation materials should be assumed in design calculations.

Departmental records suggest a regional water table at approximately 12 metres with a seasonal fluctuation of 1 to 2 metres. This water table was not encountered, possibly due to seasonal fluctuations, but it should have no significant effect on the proposed structure. Since this regional water table forms an extremely valuable source of fresh water it is essential that no contamination by effluent should occur. Strict governmental control over the underground disposal of effluent is imminent.

R. F. Jeune

RFJ:AM
30.4.73

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APPENDIX 1

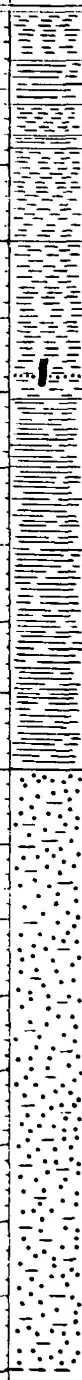
LOG OF BORE HOLE AND EXPLANATORY NOTES

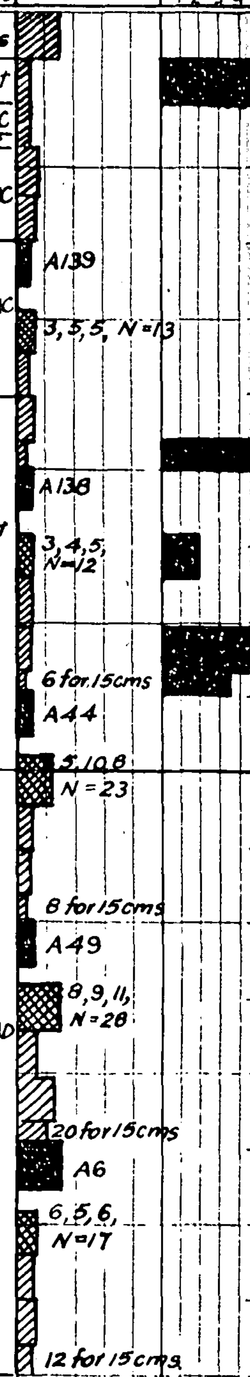
DEPARTMENT OF MINES · SOUTH AUSTRALIA

LOG OF CABLE TOOL HOLE

PROJECT S.E. MEATWORKS	SECTION 388	HOLE CH 1
FEATURE FOUNDATIONS	HUNDRED. JESSIE	SERIAL No. 343/73
LOCATION. NARACOORTE	CO-ORDS	R.L. Surface FT.
		R.L. Collar FT.
		Datum

GEOLOGICAL NOTES AND CLASSIFICATION			DEPTH m	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME (Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966)	WATER LEVEL	MOISTURE CONTENT	Consistency Compct. Dens'y	FIELD TEST DATA: BLOWS PER 30 cm
? RECENT		PROBABLE FILL		ML	SILT SOIL, LOW PLASTICITY. Dk. grey fine sandy silt. Trace angular gravel to 2cm.		H	Ls	
				CH	CLAY SOIL, HIGH PLASTICITY. Grey brown clay. Jointed, sheared.		<PL	St	
				ML	SILT SOIL, LOW PLASTICITY. Yellow calcareous fine sandy silt. Trace clay.		H	MC	
				CH	CLAY SOIL, HIGH PLASTICITY. Grey-brown clay. Jointed. Sheared.		<PL	St	
		POSSIBLE FILL	1.0	ML	SILT SOIL, LOW PLASTICITY. Orange-yellow calcareous fine sandy silt, trace clay. Friable to v. weakly cemented.		H	MC	
			2.0	MH	SILT SOIL, HIGH PLASTICITY. Grey-orange mottled clayey silt. Gravel to 5mm. Infilled 2cm.φ hole.		D	MC	A139; 3,5,5, N=13
PLEISTOCENE	BLANCHETOWN CLAY		3.0 – 4.0	CH	CLAY SOIL, HIGH PLASTICITY. Grey-orange mottled silty clay. Breaks into angular 5mm. blocks.		≈PL	St	A138; 3,4,5, N=12; 6 for 15cms; A44
? PLIO-PLEISTOCENE	? PARILLA SAND		5.0 – 9.0	SM	SAND SOIL, EXCESS SILTY FINES. Orange-brown/grey mottled silty fine sand. 15cm band brown-grey fine sand. Trace clay appears at 8·55m. becoming more common with increasing depth.	NO WATER CUT	D	MD	5,10,8 N=23; 8 for 15cms; A49; 8,9,11, N=28; 20 for 15cms; A6; 6,5,6, N=17; 12 for 15cms
			9.0		Cont. sheet 2				





TYPE OF SAMPLE	CONSISTENCY (Clays)	COMPACTNESS (Silts)	RELATIVE DENSITY (Sands)	MOISTURE CONTENT
A shoe (SA)	VS. — Very Soft	Ls — Loose	VL — Very Loose	H — Humid
D " (SD)	S — Soft	MC — Moderately Compact	L — Loose	D — Damp
E " (SE)	F — Firm	C — Compact	MD — Medium Dense	M — Moist
G " (SG)	St — Stiff	VC — Very Compact	D — Dense	W — Wet
Sealed Tube - A Shoe - SAL	V. St. — Very Stiff		VD — Very Dense	S — Saturated
Standard Penetration Test - SPT	H. — Hard			LL — Liquid Limit
				PL — Plastic Limit

Water level (date): 7 Dec. '66; Casing; WC — Water cut

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

ENGINEERING GEOLOGY SECTION

DRILL No. CT2	LOGGED BY R.F. JEUNE
TYPE	DATE 19th Dec '72
DRILLER TOOHEY	TRACED D.W.W.
START 11 Dec. 1972	CHECKED A.F.
FINISH 13 Dec 1972	
SHEET 1 OF 2	DRG No. S10099 Ke6

P.F. No S6676a MB

DEPARTMENT OF MINES · SOUTH AUSTRALIA

LOG OF CABLE TOOL HOLE

PROJECT S.E. MEATWORKS	SECTION 388	HOLE CH 1
FEATURE FOUNDATIONS	HUNDRED JESSIE	SERIAL No. 343/73
LOCATION NARACOORTE	CO-ORDS	R.L. Surface FT.
		R.L. Collar FT.
		Datum

GEOLOGICAL NOTES AND CLASSIFICATION			R.L.	DEPTH m	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME (Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966)	WATER LEVEL	Casing	MOISTURE CONTENT	Consistency Compct. Densy.	FIELD TEST DATA: BLOWS PER 30 cm (20 40 60 80)	SOILTEST P'TR'METER Units * (1 2 3 4)
							CONTINUED FROM SHEET 1						
PLIOCENE				9.0		SM				D	MD	A 12; 7, 9, 11, N=27	
				10.0		SC	SAND, EXCESS CLAY FINES. Brownish yellow clayey fine sand.			D	MD	12 for 15 cms; A 109; 6, 8, 9, N=23	
				11.0		CH	CLAY SOIL, HIGH PLASTICITY. Yellow-brown silty clay. Black flecks.			D	St		
						SM	SAND, EXCESS SILTY FINES. Orange silty fine sand, trace clay.			D	MD		
						CH	CLAY SOIL, HIGH PLASTICITY. Yellow-brown silty clay.			D	St	7 for 15 cms	
? LOWER MIOCENE	? GAMBIER LIMESTONE	Weathered Limestone		12.0		SM	SAND, EXCESS SILTY FINES. White highly calcareous silty sand, trace clay.			D	MD	A 22; 9, 12, 16, N=37	
		Relatively unweathered limestone		13.0		ROCK	LIMESTONE. Fragments of strong crystalline limestone in matrix of weakly cemented calcareous silty fine sand.			D	ROCK	A 124 DAMAGED	
				14.0			END OF BORE 13.95 METRES						

TYPE OF SAMPLE		CONSISTENCY (Clays)	COMPACTNESS (Silts)	RELATIVE DENSITY (Sands)	MOISTURE CONTENT
A shoe (SA)	Water level, (date) 7 Dec. '66	VS. — Very Soft	Ls — Loose	VL — Very Loose	H — Humid
D " (SD)	Casing	S — Soft	MC — Moderately Compact	L — Loose	D — Damp
E " (SE)	WC Water cut	F — Firm	C — Compact	MD — Medium Dense	M — Moist
G " (SG)		St. — Stiff	VC — Very Compact	D — Dense	W — Wet
Sealed Tube - A Shoe - SAL		V. St. — Very Stiff		VD — Very Dense	S — Saturated
Standard Penetration Test - SPT		H — Hard			LL — Liquid Limit
					PL — Plastic Limit

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

ENGINEERING GEOLOGY SECTION	
DRILL No. C.T 2	LOGGED BY R.F. JEUNE
TYPE	DATE 19th Dec. '72
DRILLER TOOHEY	TRACED D.W.W.
START 11 Dec 1972	CHECKED A.F.
FINISH 13 Dec 1972	
SHEET 2 OF 2	DRG No. S10099a Ke6

P.F. No S6676a MB

APPENDIX

LOGS OF CABLE TOOL HOLES AND EXPLANATORY NOTES

NOTES ON DRILLING PROCEDURES

Equipment

The drilling is carried out with a cable tool drilling plant using sampling tubes attached, through a vacuum head, to the sampling tools (Figs. 1 and 2).

Sampling Procedures

S.A. Samples

To obtain, for logging purposes, an almost continuous series of samples, with a relatively small amount of sample disturbance, SA type samples are taken. These are obtained by driving an "S" tube, fitted with a Mark A shoe (Fig. 2), into the material to be sampled.

The assembly is lowered carefully to the bottom of the hole, and the tube driven exactly 30 cm, and the number of blows required for the 30 cm of penetration recorded.

The sample, or core, is extruded from the sampling tube using an hydraulic ram. The extruded core is sealed in a labelled plastic bag and stored in a core box (Fig. 3).

The hole is reamed with a "D" or "E" shoe (Fig. 2) and then the next sample is taken, using the same procedure as above. Thus the hole proceeds by alternate sampling, reaming (and where required, casing) operations, and the samples form a continuous record of the materials penetrated except for a few centimetres which may be lost between samples during reaming operations.

SA sampling equipment is a composite sampler for simple class sampling. Details are as follows:-

"S" SERIES CUTTING SHOES

MARK	FEATURES	USES
A	Inside clearance 3%. Area Ratio 33%.	Continuous open-tube sampling in strong soils, in which it causes little deformation. Samples extruded and used for logging purposes. Hole is reamed after each sample.
D	Shoe belled out to 12.5 cm (4 29/32 in.) (just greater than outside dia. of vacuum head)	Continuous open tube sampling where considerable deformation of sample is permissible. Essentially self-reaming.

MARK	FEATURES	USES
E	Shoe belled out to 13.8 cm (5 7/16 in.) (just less than internal dia. of 15 cm casing)	Cleaning hole and reaming out hole.

Sealed Tube (LB) Samples

Sealed tube samples, for laboratory testing, are taken at various intervals during drilling. These are obtained by driving an "L" type sampling tube with a Mark B cutting shoe (Fig. 4) a distance of 30 cm into the material to be sampled.

Before the sample is taken the hole is cleaned out to the depth specified. The hole is not reamed or cased for at least 30 cm from the bottom, however, because these operations can cause considerable disturbance in the soil below. The sampling assembly is lowered carefully to the bottom of the hole, the sampling tube driven exactly 30 cm, and the number of blows recorded.

The sample is sealed in the tube by inserting in each end, plastic seals with rubber sealing rings, and the tube is then labelled and stored in a Laboratory Sample Box.

LB sampling equipment is a composite sampler for obtaining samples with the least possible disturbance. Details are as follows:

Sampler tube "L" type - ASSAB tube cadmium plated
10.2 cm (4.016 in.) I.D.
10.9 cm (4.282 in.) O.D.

Mark B shoe - ASSAB tube, heat treated, cadmium plated
Area ratio 15%
Inside clearance - 0.4%
Outside clearance - nil
Cutting edge angle - 7°.

Standard Penetration Test

The Standard Penetration Test (Terzaghi et al 1948) is used to test the in-situ density of sands and to give an indication of the consistency of clays, and compactness of silts. However the test results can be affected by several geological factors such as degree of cementation, and size and shape of grains. These factors should be taken into account in interpretation of results.

The equipment is illustrated in Fig. 5 and consists of a 5.1 cm (2 in.) diameter, sampling spoon (tube) and a hammer of standard weight (64 kg (140 lbs)).

With the equipment assembled as in Fig. 5 the hammer is allowed to fall on to the drill rods until the sampling shoe has penetrated 15 cm into the soil. The Standard Penetration Test is the number of blows (N) required to produce the next 30 cm of penetration.

NOTES ON DRILL LOG SHEETS

The logs are plotted on a standard cable-tool log form.

Near the centre of the form a graphic log of the materials encountered is shown.

In the column to the right of the graphic log, the soils are classified and described according to the Unified Soil Classification (U.S. Dept. of Interior, Bureau of Reclamation 1966) as shown on Figure 6.

To the left of the graphic log is a geological description of the materials sampled. This includes:-

........Geological age	)
........Soil unit name	) Printed vertically
........Type of material	)

........Mineral composition

........Grain shape

........Cementation

........Organic materials

Water levels are indicated by a small arrow with the date at which the observation was made.

In the blows per 30 cm column, a continuous histogram is made of the number of blows required to drive the sampling tube through each 30 cm of material. A hatching code is used to distinguish various types of sample. This code is reproduced at the bottom of each log sheet.

In the column on the far right of the log sheet, readings of unconfined compressive strength (qu) made with a Soiltest Penetrometer, are recorded. The readings are plotted as a histogram. The Soiltest Penetrometer only gives true values of qu when used in clays in which $\emptyset = 0$.

REFERENCES

TERZAGHI, K. and PECK, R.B., 1948. Soil Mechanics in Engineering Practice. John Wiley and Sons.

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION, 1966. Earth Manual, 2nd Edition.

ENGINEERING CLASSIFICATION OF SOILS

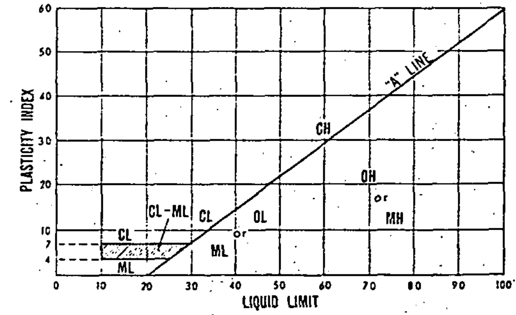
The Unified Soil Classification System

			FIELD INVESTIGATION PROCEDURES Excluding particles larger than 7·5cm and basing fractions on estimated weights	GROUP SYMBOL	GROUP NAME and typical materials
COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 B.S. sieve size	GRAVELS More than 50% of the coarse fraction is larger than 2mm. (retained on B.S.7 sieve)	CLEAN GRAVELS Little or no fines	Wide range in grain sizes, and substantial amounts of all intermediate particle sizes	GW	GRAVEL, well graded; gravel sand mixtures, little or no fines
			Predominantly one size or a range of sizes, with some intermediate sizes missing	GP	GRAVEL, poorly graded; gravel sand mixtures, little or no fines
		DIRTY GRAVELS Appreciable amount of fines	Non-plastic fines—for indentification see ML below	GM	GRAVEL, excess silty fines; poorly graded gravel-sand-silt mixtures
			Plastic fines—for identification see CL below	GC	GRAVEL, excess clayey fines; poorly graded gravel-sand-clay mixtures
	SANDS More than 50% of the coarse fraction is smaller than 2mm. (passing B.S.7 sieve)	CLEAN SANDS Little or no fines	Wide range in grain sizes, and substantial amounts of all intermediate particle sizes	SW	SAND, well graded; well graded sands, gravelly sands, little or no fines
			Predominantly one size or a range of sizes, with some intermediate sizes missing	SP	SAND, poorly graded; poorly graded sands, gravelly sands, little or no fines
		DIRTY SANDS Appreciable amount of fines	Non-plastic fines—for indentification see ML below	SM	SAND, excess silty fines; poorly graded sand-silt mixtures
			Plastic fines—for identification see CL below	SC	SAND, excess clayey fines; poorly graded sand-clay mixtures

		FIELD INVESTIGATION PROCEDURES on fraction smaller than 0.4mm. (passing B.S. 36 sieve)						GROUP SYMBOL	GROUP NAME and typical materials
		SOIL CAST (soil wet)	SOIL THREAD	SHINE	DILATANCY	ODOUR	DRY STRENGTH		
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 B.S. sieve size	SILTS AND CLAYS Liquid limit less than 50	Forms fragile cast Cracks form when kneaded while moist	Thick crumbly thread; easily broken	None to very dull	Distinct	Not significant	None to slight	ML	SILT SOIL, low plasticity; inorganic silts and very fine silty or clayey sands, rock flour
		Cast maybe handled freely without breaking Can be kneaded moist without cracking Material adheres to the hand	Thread can be pointed as fine as a lead pencil but is fragile	Moderate	None to slight	Not significant	Moderate	CL	CLAY SOIL, low plasticity; inorganic clays of low to medium plasticity, gravelly clay, sand, clays, silty clays, lean clays
		Cast fragile to cohesive material will adhere somewhat to the hand	Soft, weak, thread	None to very dull	Slight to distinct	Decayed organic matter	Low	OL	ORGANIC SOIL, low plasticity; organic silts and silt clays of low plasticity
	SILTS AND CLAYS Liquid limit more than 50	Moderately plastic and cohesive Material adheres somewhat to the hand	Weak to medium thread May be crumbly	Dull	None to slight	Not significant	Moderate Powdered soil feels floury	MH	SILT SOIL, high plasticity; inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		Very plastic and cohesive Material very sticky to the hand Greasy to touch	Very tough thread, can be rolled to a pin point	Very glossy	None	Strong earthy	High to very high Cannot be powdered by finger pressure	CH	CLAY SOIL, high plasticity; inorganic clays of high plasticity, fat clays
		Plastic and cohesive Feels slightly spongy Greasy to touch	Weak to medium thread Often soft and fibrous	Moderate to very glossy	None	Decayed organic matter	Moderate to high Powdered soil may be fibrous	OH	ORGANIC SOIL, high plasticity; organic clays of medium to high plasticity
		Readily identified by colour, odour, spongy feel and frequently by fibrous texture						Pt	PEATY SOIL; Peat and other highly organic soils

GRAIN SIZE CURVES to be used to identify soil fractions

LABORATORY CLASSIFICATION CRITERIA			
Coarse-grained soil classified on basis of percentage of fines, as follows PERCENT OF FINES / GRAVELS / SANDS Less than 5: GW GP / SW SP More than 12: GM GC / SM SC 5 to 12 Borderline cases, use 2 symbols	GW	$Cu = D60/D10$ Greater than 4 $Cc = (D30)^2/D10 \times D60$ Between 1 and 3	
	GP	Not meeting all gradation requirements for GW	
	GM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
	GC	Atterberg limits below "A" line or PI greater than 7	
	SW	$Cu = D60/D10$ Greater than 6 $Cc = (D30)^2/D10 \times D60$ Between 1 and 3	
	SP	Not meeting all gradation requirements for SW	
	SM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
	SC	Atterberg limits below "A" line or PI greater than 7	



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE-GRAINED SOILS

NOTE: BOUNDARY CLASSIFICATIONS: Soil possessing characteristics of two groups are shown as a combination of two group symbols, eg. GW-GC, well graded gravel with clay binder.

Based on "The Unified Soil Classification System" United States Department of the Interior, Bureau of Reclamation "Earth Manual" First Edition, Denver COLARADO 1960.

70-641 Bull.44

APPENDIX 2

RESULTS OF LABORATORY TESTING

by

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Designing Engineer
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SOUTH EASTERN MEATWORKS - NARACOORTE

SECTION 388, HUNDRED OF JESSIE

GENERAL

The proposed site for this Meatworks at Naracoorte is currently being investigated by Painter, Merryful and Associates of Sydney. They have engaged the S.A. Mines Dept. to do the drilling and they in turn have arranged for the Soils and Foundations Section to do the laboratory testing of the soil samples supplied by the Mines Dept. Nine "L" type 4" dia. sample tubes of soil from bore CH.1 were delivered to the Netley Laboratory during December, 1972.

SOIL TESTING

The laboratory soil testing was aimed at determining the quick undrained shear strength of the soil in its wettest state (and hence the safe bearing capacity of the soil at the respective depth and position of the sample). As the sample from 1.50 to 1.80 m depth was relatively close to the surface classification tests were done on it to ascertain whether it was likely to be expansive or not. The results of these tests are given below.

Description - grey and yellow SANDY CLAY
moisture content - 15%
liquid limit - 44%, plastic limit 20%, plastic index 24%
clay size 37%, silt size 14%, sand size 49%
linear shrinkage 14%, free swell 60

These tests, which are done on re-moulded soil specimens indicate that this sandy clay is unlikely to be expansive.

TRIAXIAL SHEAR TESTING

The triaxial shear tests are summarized in Table 1 and the Mohr Circles shown in Figs. 1 to 8. The sample from depth 13.65 to 13.95 m contained lumps of limestone and a descriptive sketch was made of the sample as an alternative to a shear test; this is shown in Fig. 9.

Every effort was made in the shear testing to simulate the soil replaced in the ground and sufficiently wetted-up to represent its winter condition. The means by which this was done are summarized in Appendix 1.

Bearing Capacity at 1.5 m for a strip footing

Ultimate bearing capacity = 5.9 x Cu + x depth

$$= (5.9 \times \frac{26.1}{2} \times 144 + 102.7 \times 5) \text{ lb/sq. ft.}$$

$$= 11100 + 513 = 11613 \text{ lb/sq. ft.}$$

Taking a factor of safety of 3,

the safe bearing capacity = 3870 lb/sq. ft.

<u>NOTE</u> The lower shear strength for the two specimens tested from this sample has been used. Although this may appear conservative it may in fact not be so as any fissuring in the clay would result in a lowering of its bearing capacity.

<u>Bearing Capacity below 1.5 m</u>

It is assumed that any foundation below 1.5 m will be a piled one. The design of these piles will require a knowledge of the soils shear strength - which is to be found in Table 1.

SRR:JPH
23.1.73

DESIGNING ENGINEER,
SOILS AND FOUNDATIONS

SOUTH EAST MEAT WORKS, NARACOORTE

BORE CH 1

All samples tested were run quick undrained at a speed of 2% per minute (0.06"/min.)

1.50 - 1.80 m

1st Specimen was saturated (by back pressure), consolidated under an effective lateral pressure equivalent to overburden.

2nd Specimen was saturated (by back pressure), consolidated under an effective lateral pressure equivalent to buoyant overburden.

3.00 - 3.30 m

Both specimens were run quick undrained at overburden pressure. (No saturation or consolidation)

4.50 - 4.80 m

As for previous sample

6.00 - 6.30 m

Both specimens were saturated (by back pressure), consolidated under an effective lateral pressure equivalent to buoyant overburden. The lateral pressure was then raised to overburden and the specimens were run quick undrained.

7.50 - 7.80 m

No specimens were cut as the sample was breaking up on extruding due to friction between the sample and the sides of the tube

9.00 - 9.30 m

Both specimens were consolidated under buoyant overburden pressure. The cell pressure was then raised to overburden and the specimens were run quick undrained.

10.50 - 10.80 m

As for 6.00 - 6.30 m

12.00 - 12.30 m

As for 6.00 - 6.30 m

13.65 - 13.95 m

No specimens were cut because sample was disturbed due to damaged tube.

Job	SOUTH-EAST MEAT WORKS
Location	NARACOORTE
Reference	
Date	21-12-72
Operator	C.W.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

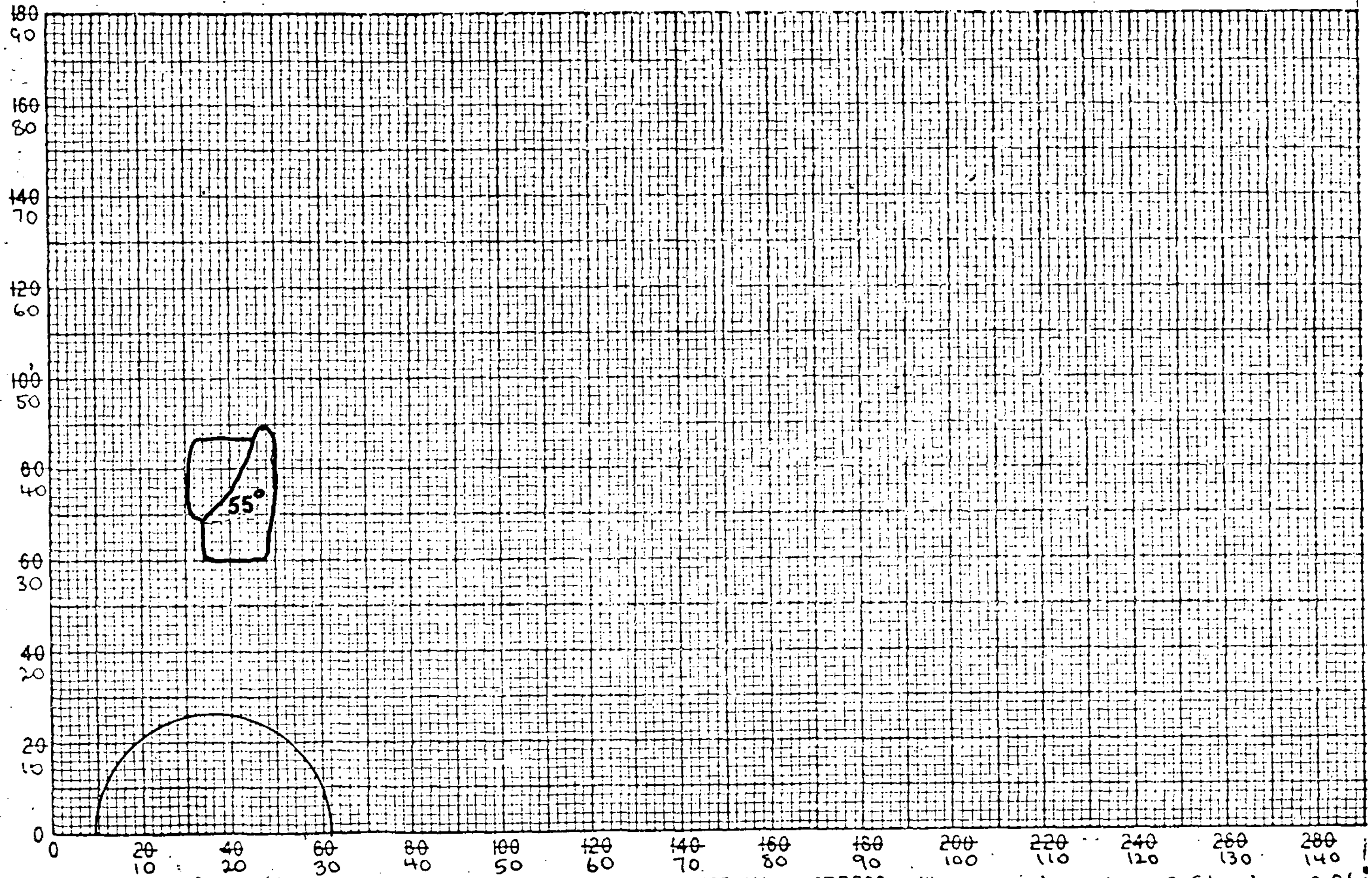
TRIAXIAL COMPRESSION

MOHR DIAGRAMS

Saturated, Quick Undrained at O/B

SAMPLE No. BORE CH.1 DEPTH 1.50 - 1.80M.

FIG. 1.



Rate of Strain = 0.06

Tan φ ________

C ________

Specimen Number	BEFORE TEST	AFTER TEST		
Wet Density (p.c.f.)	125.0	130.4		
Dry Density (p.c.f.)	102.7	104.6		
Moisture Content (% dry wt.)	21.7	24.7		
Degree of Saturation (%)	91.5	100.0		
Applied Lateral Pressure (psi.) σ_{III}		4.7		
Strain at Failure (%)		10.8		
Compressive Strength (psi.) $\sigma_I - \sigma_{III}$		26.1		
Maximum Princ. Stress (psi.) σ_I		30.8		
Radius of circle $\frac{1}{2}(\sigma_I - \sigma_{III})$		13.1		
Centre of circle $\frac{1}{2}(\sigma_I + \sigma_{III})$		17.8		

Job	South East Meat Works
Location	Naracoorte
Reference	
Date	21-12-72
Operator	12R3.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

TRIAXIAL COMPRESSION

MOHR DIAGRAMS

SATURATED, QUICK UNDRAINED @ BOYANT O/BURDEN

SAMPLE No. BORE C.H.1. DEPTH 1.50m-1.80m

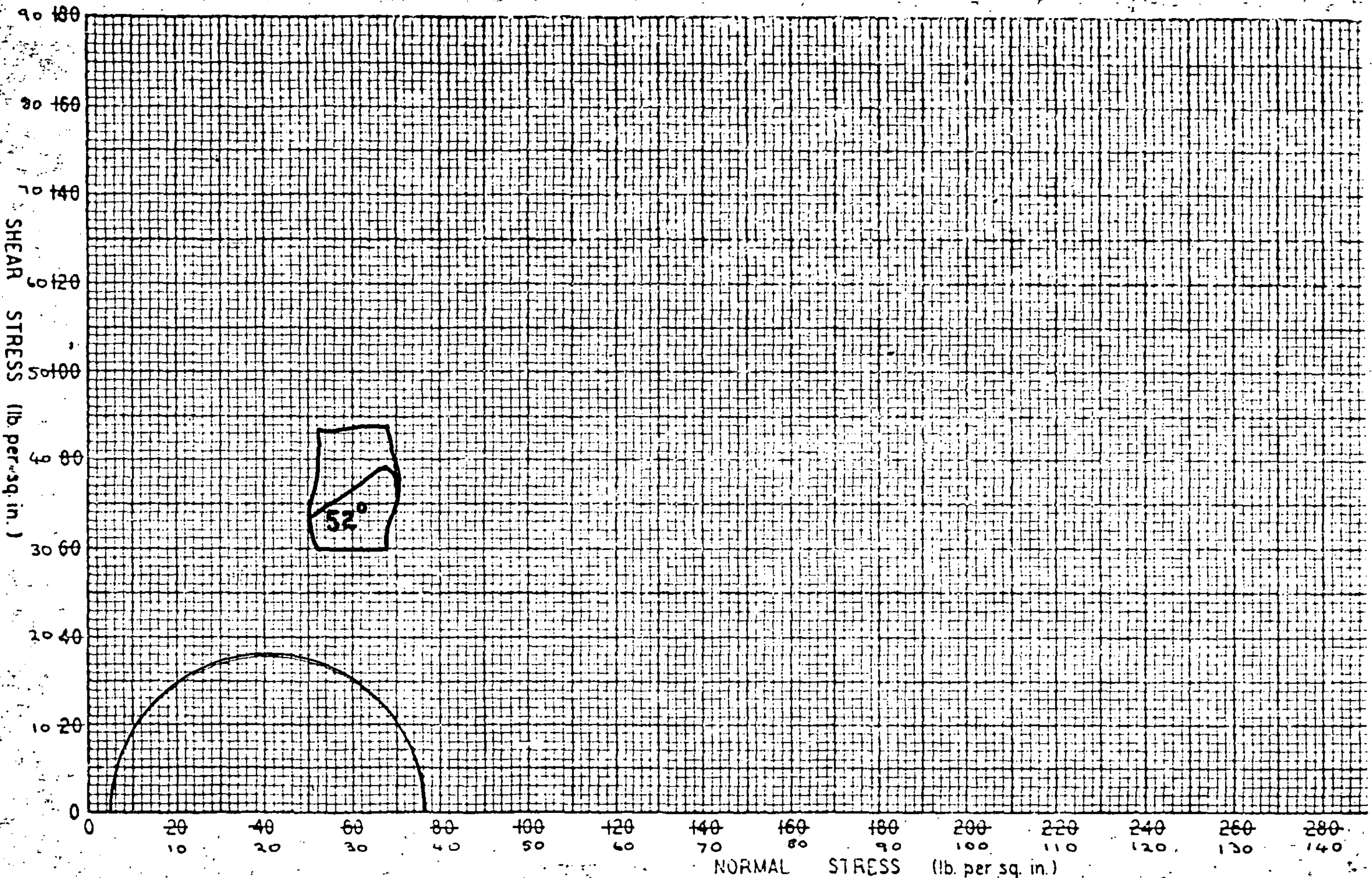


FIG 2.

Tan ø ______

C ______

Specimen Number	Before Test	After Test		
Wet Density (p.c.f.)	126.6	128.7		
Dry Density (p.c.f.)	104.5	103.9		
Moisture Content (% dry wt.)	21.1	23.9		
Degree of Saturation (%)	93.1	100.0		
Applied Lateral Pressure (p.s.i.) $\bar{\sigma}_{III}$		2.4		
Strain at Failure (%)		12.5		
Compressive Strength (p.s.i.) $\bar{\sigma}_1 - \bar{\sigma}_{III}$		35.8		
Maximum Princ. Stress (p.s.i.) $\bar{\sigma}_1$		38.2		
Radius of circle $\frac{1}{2}(\bar{\sigma}_1 - \bar{\sigma}_{III})$		17.9		
Centre of circle $\frac{1}{2}(\bar{\sigma}_1 + \bar{\sigma}_{III})$		20.3		

Job	SOUTHEAST MEATWORKS
Location	NARACOORTE
Reference	
Date	9-4-73

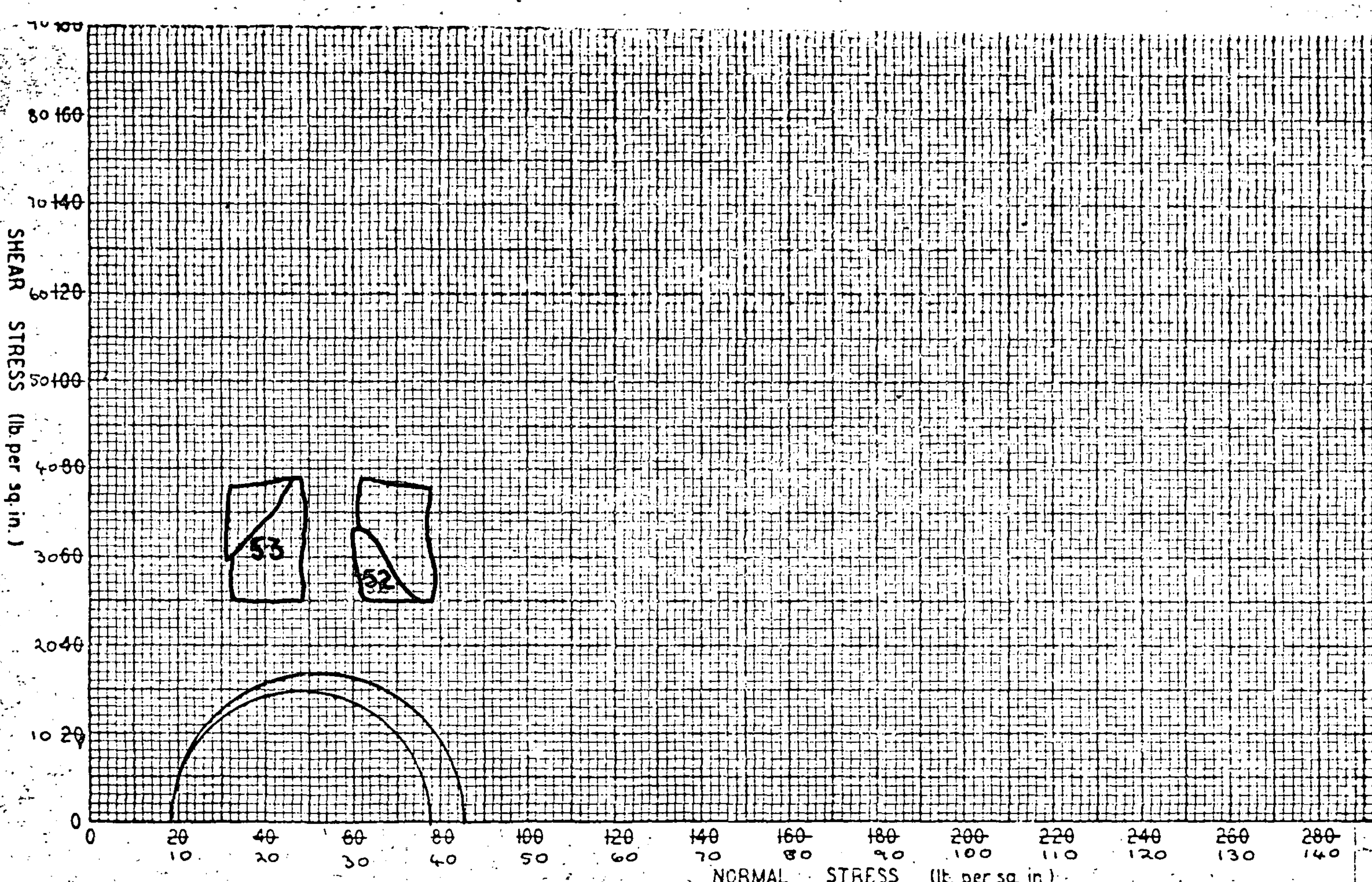
THE ENGINEERING AND WATER SUPPLY DEPARTMENT

TRIAXIAL COMPRESSION

MOHR DIAGRAMS

SAMPLE No. BORE C.H.1. DEPTH 3.00m - 3.30m

FIG 3.



Tan ø ______

C ______

Specimen Number	BEFORE TEST	AFTER TEST	BEFORE TEST	AFTER TEST
Wet Density (p.c.f.)	126.5	127.0	128.9	129.2
Dry Density (p.c.f.)	106.7	107.3	108.8	109.1
Moisture Content (% dry wt.)	18.6	18.4	18.5	18.4
Degree of Saturation (%)	85.5	85.8	89.9	90.2
Applied Lateral Pressure (p.s.i.) σ_{III}		9.1		9.3
Strain at Failure (%)		21.7		12.5
Compressive Strength (p.s.i.) $\sigma_1 - \sigma_{III}$		29.8		33.4
Maximum Princ. Stress (p.s.i.) σ_1		38.9		42.7
Radius of circle $\frac{1}{2}(\sigma_1 - \sigma_{III})$		14.9		16.7
Centre of circle $\frac{1}{2}(\sigma_1 + \sigma_{III})$		24.0		26.0

Job	SOUTH EAST MEATWORKS
Location	NARACOORTE
Reference	
Date	9-1-73
Operator	A.B. & C.W.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

TRIAXIAL COMPRESSION

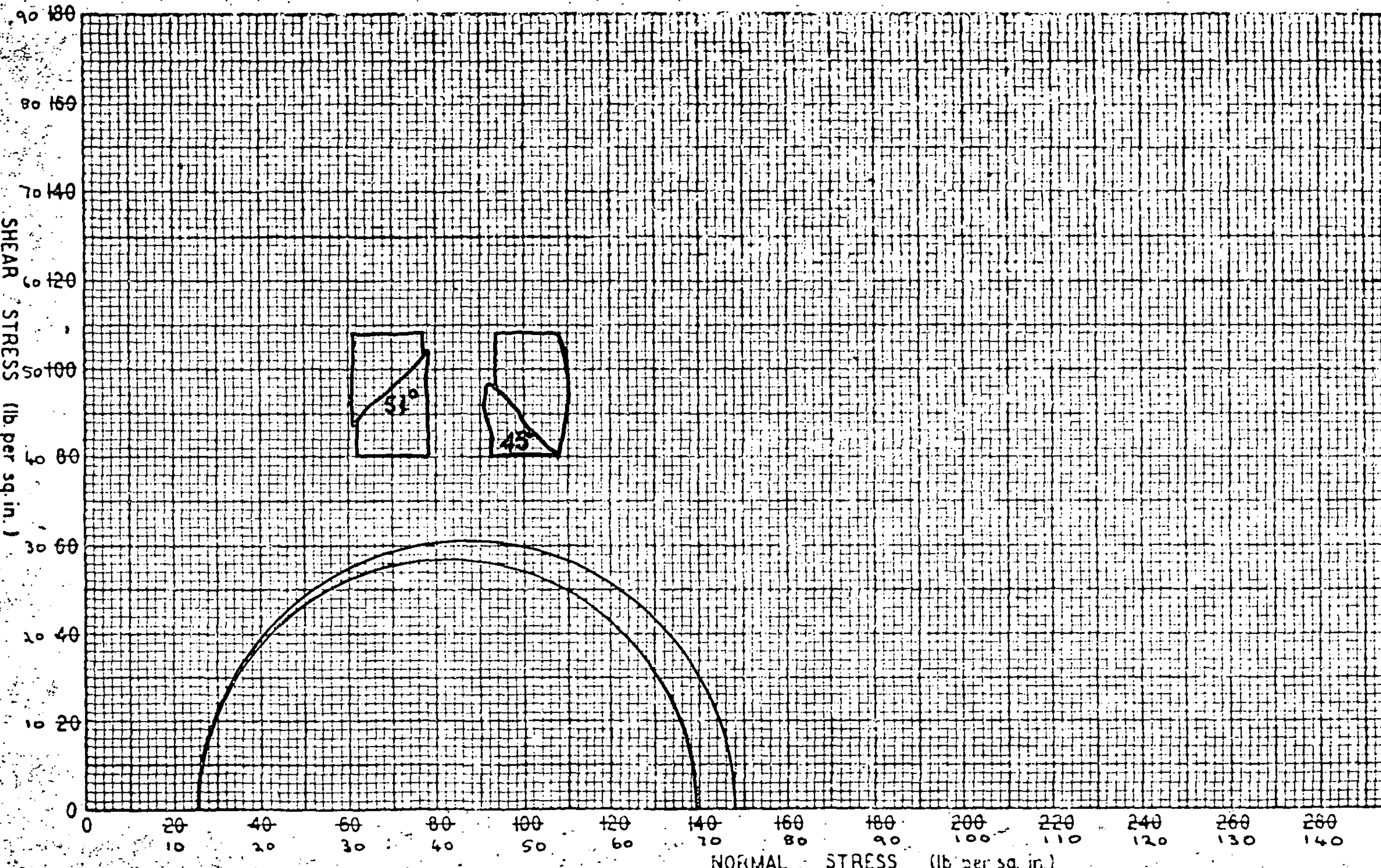
MOHR DIAGRAMS

SAMPLE No. BORE C.H.1 DEPTH 4.50m - 4.80m

FIG 4.

Tan ø ------

C ------



Specimen Number	BEFORE TEST	AFTER TEST	BEFORE TEST	AFTER TEST
Wet Density (p.c.f)	120.8	121.3	123.0	122.5
Dry Density (p.c.f.)	94.5	95.1	96.6	96.4
Moisture Content (% dry wt.)	27.8	27.6	27.3	27.1
Degree of Saturation (%)	94.1	94.8	97.2	95.9
Applied Lateral Pressure (p.s.i.) σ_{III}		12.8		13.0
Strain at Failure (%)		4.2		8.3
Compressive Strength (p.s.i.) $\sigma_I - \sigma_{III}$		56.7		61.0
Maximum Princ. Stress (p.s.i.) σ_I		69.5		74.0
Radius of circle $\frac{1}{2}(\sigma_I - \sigma_{III})$		28.4		30.5
Centre of circle $\frac{1}{2}(\sigma_I + \sigma_{III})$		41.2		43.5

Job	South East Meatworks
Location	Naracoorte
Reference	
Date	9-1-73
Operator	A.B. & C.W.

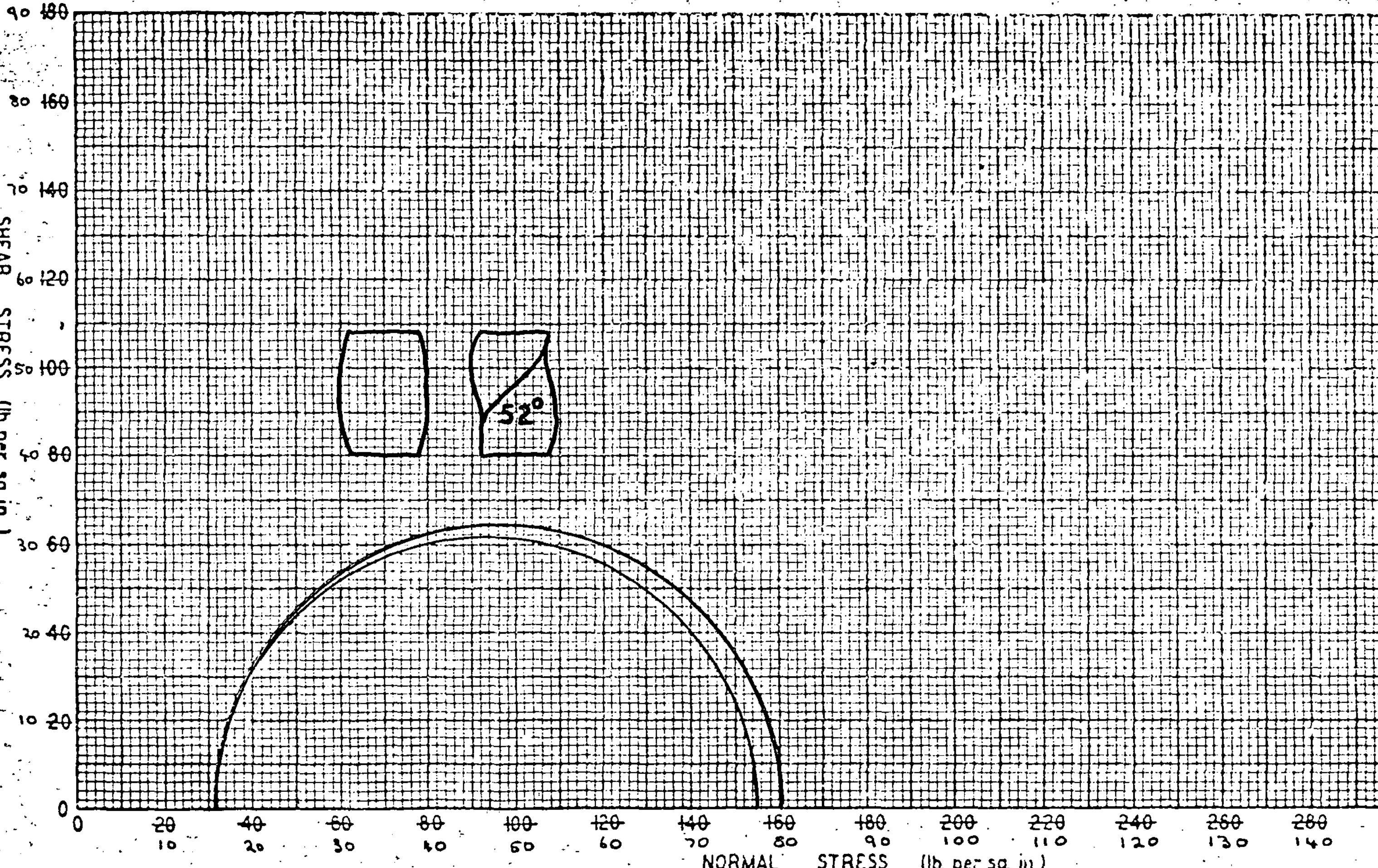
THE ENGINEERING AND WATER SUPPLY DEPARTMENT

TRIAXIAL COMPRESSION

MOHR DIAGRAMS

SAMPLE No. BORE CH1.
DEPTH 6.00m - 6.30m

FIG 5.



Tan ø ------

C ------

Specimen Number	Before Test	After Test	Before Test	After Test
Wet Density (p.c.f.)	111.4	120.1	113.6	124.4
Dry Density (p.c.f.)	104.0	104.7	105.6	107.8
Moisture Content (% dry wt.)	7.2	14.7	7.6	15.4
Degree of Saturation (%)	32.1	66.6	35.2	75.9
Applied Lateral Pressure (p.s.i.) σ_{III}		15.6		15.9
Strain at Failure (%)		10.0		6.7
Compressive Strength (p.s.i.) $\sigma_1 - \sigma_{III}$		64.5		61.5
Maximum Princ. Stress (p.s.i.) σ_1		80.1		77.4
Radius of circle $\frac{1}{2}(\sigma_1 - \sigma_{III})$		32.3		30.8
Centre of circle $\frac{1}{2}(\sigma_1 + \sigma_{III})$		47.9		46.7

Job	South East Meat Works
Location	Naracoorte
Reference	
Date	10-1-73
Operator	[illegible] & C.W.

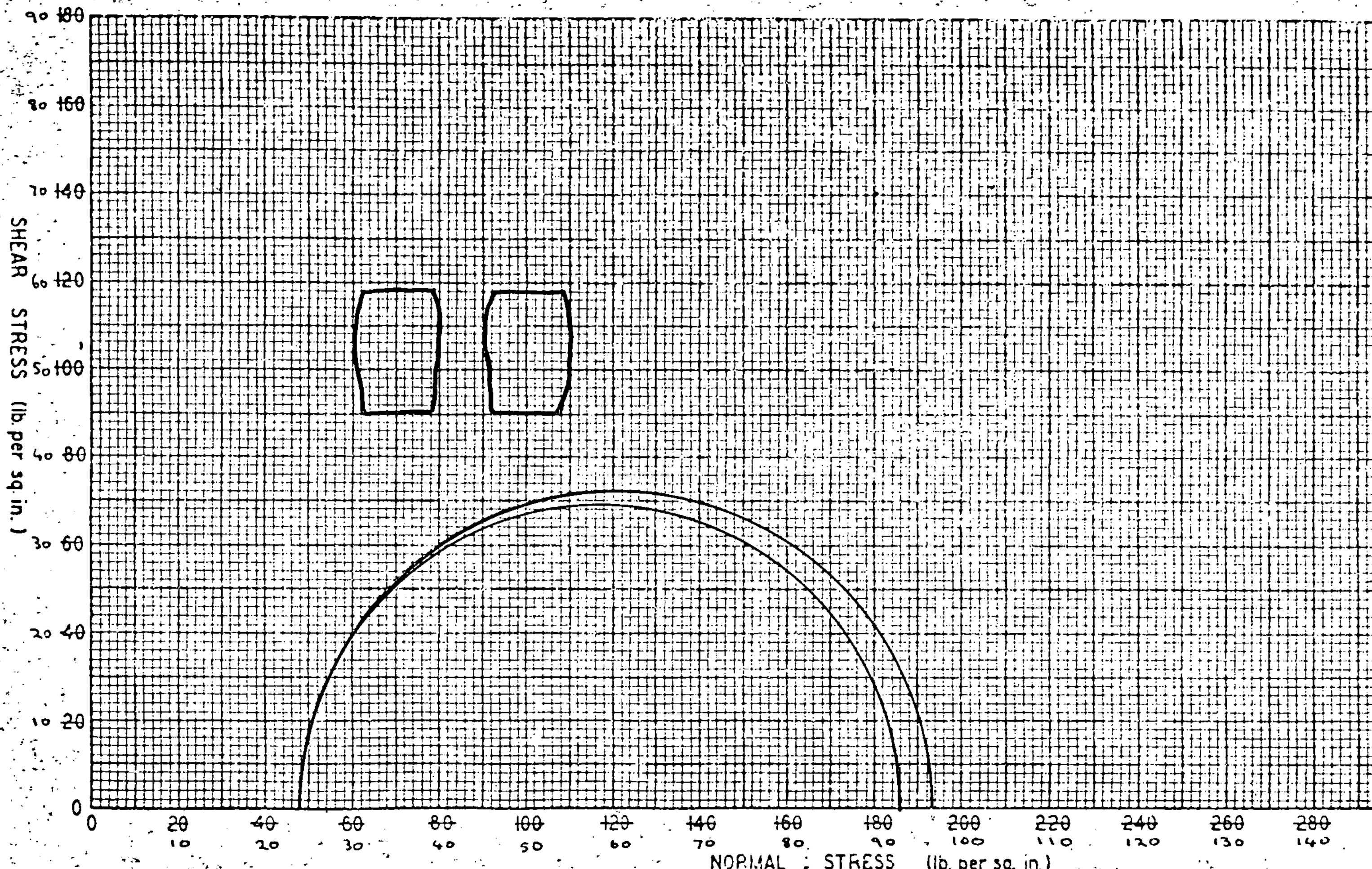
THE ENGINEERING AND WATER SUPPLY DEPARTMENT

TRIAXIAL COMPRESSION

MOHR DIAGRAMS

SAMPLE No. Bore C.H.1. Depth 9.00m - 9.30m.

FIG 6.



C

Tan φ

Specimen Number	Before Test	After Test	Before Test	After Test
Wet Density (p.c.f.)	113.7	117.6	115.2	117.0
Dry Density (p.c.f.)	102.8	102.7	102.9	102.9
Moisture Content (% dry wt.)	10.6	14.5	11.9	13.7
Degree of Saturation (%)	45.8	62.6	51.8	59.6
Applied Lateral Pressure (psi.) σ_{III}		23.7		24.0
Strain at Failure (%)		15.8		9.2
Compressive Strength (psi.) $\sigma_I - \sigma_{III}$		69.3		72.6
Maximum Princ. Stress (psi.) σ_I		93.0		96.6
Radius of circle $\frac{1}{2}(\sigma_I - \sigma_{III})$		34.6		36.3
Centre of circle $\frac{1}{2}(\sigma_I + \sigma_{III})$		58.3		60.3

Job	SOUTH EAST - MEATWORKS
Location	NARACOORTE
Reference	
Date	15-1-73
Operator	AB & C.W.

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

TRIAXIAL COMPRESSION

MOHR DIAGRAMS

SAMPLE No. BORE CH.1.
DEPTH 10.50m - 10.80m

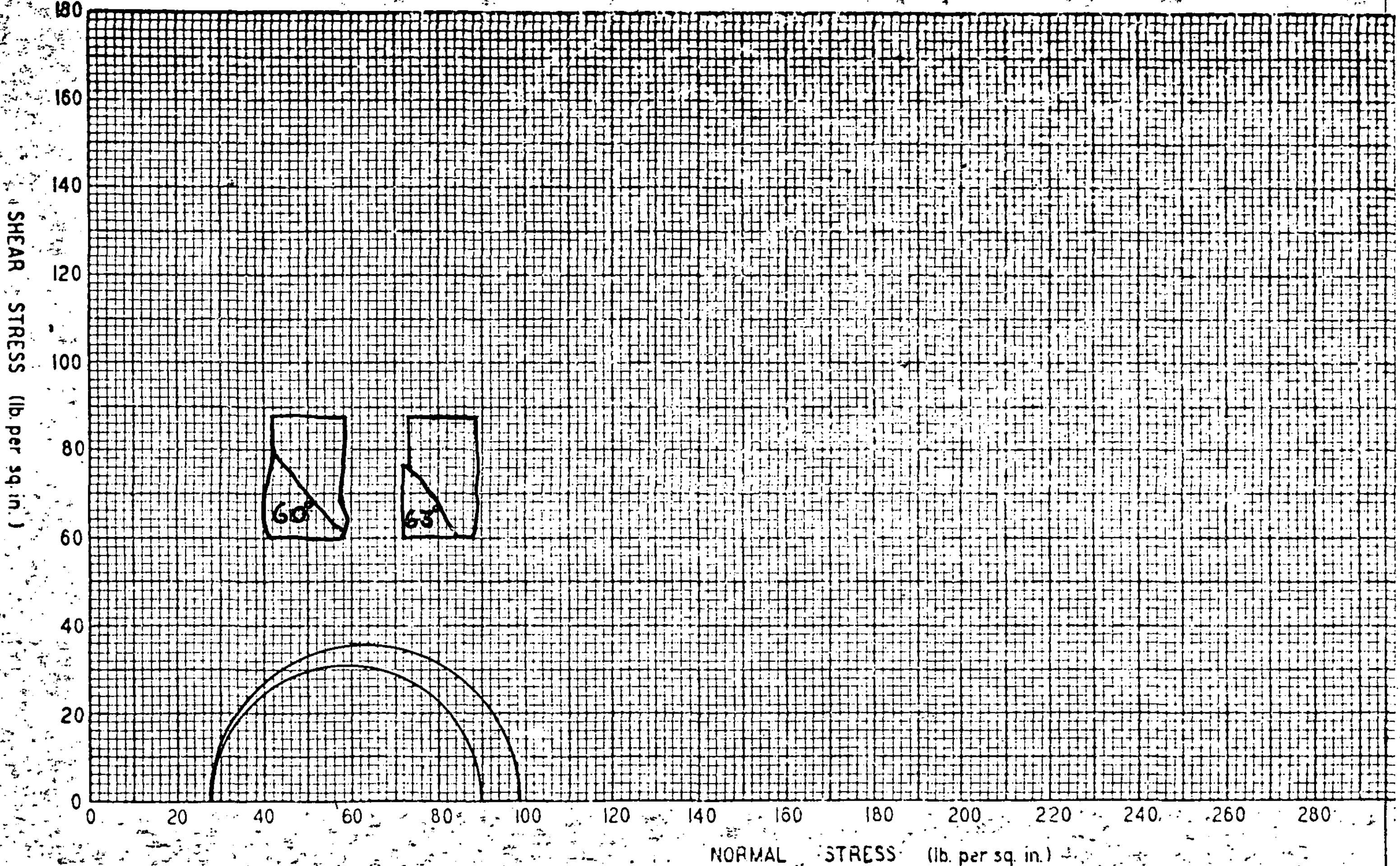
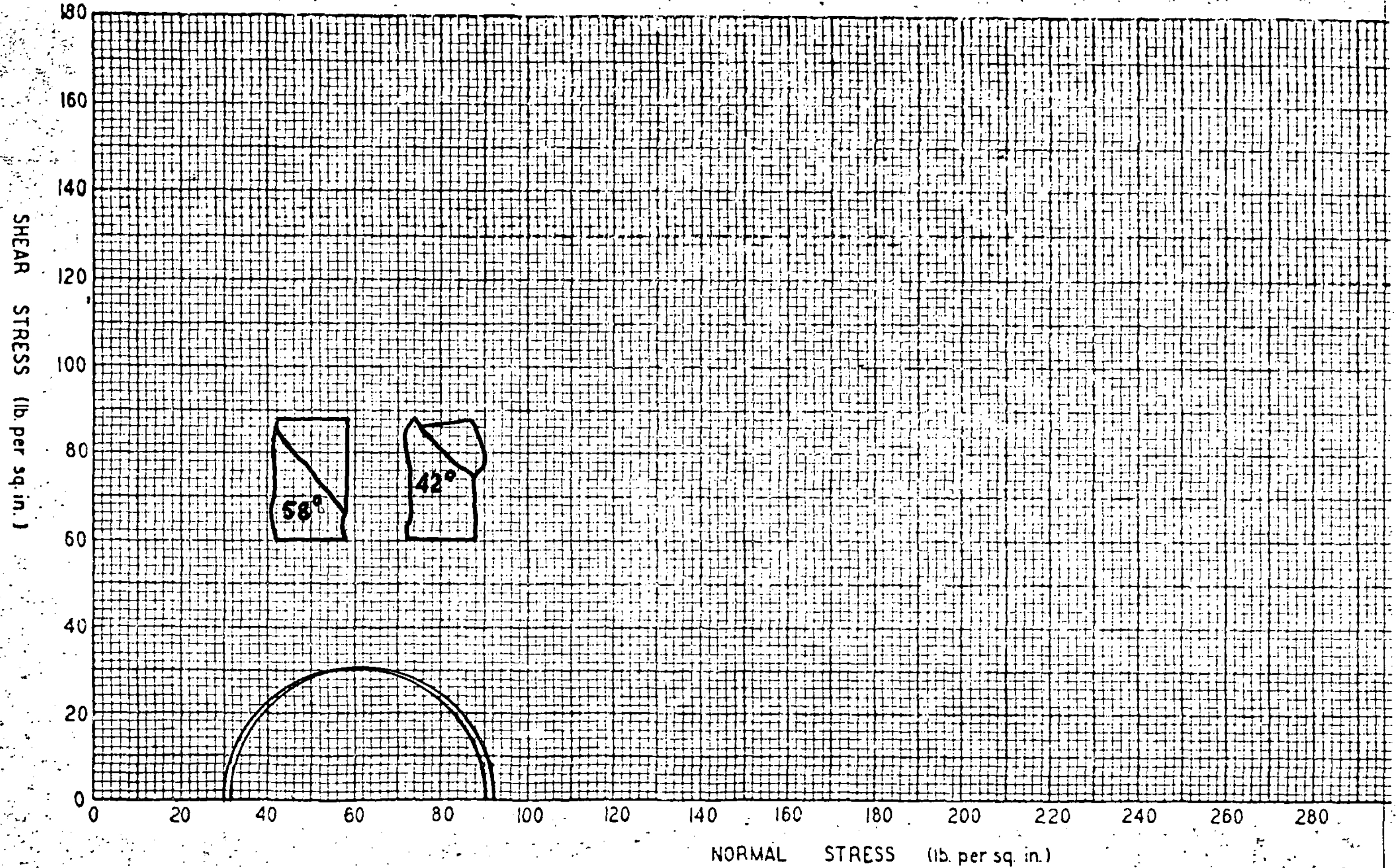


FIG 7.

Tan ø

C

Specimen Number	BEFORE TEST	AFTER TEST	BEFORE TEST	AFTER TEST
Wet Density (p.c.f.)	112.9	122.2	115.0	126.2
Dry Density (p.c.f.)	95.5	98.4	102.2	105.3
Moisture Content (% dry wt.)	18.2	24.2	12.6	19.8
Degree of Saturation (%)	64.9	92.8	52.9	90.2
Applied Lateral Pressure (p.s.i.) σ_{III}		27.4		27.9
Strain at Failure (%)		3.3		3.3
Compressive Strength (p.s.i.) $\sigma_I - \sigma_{III}$		70.7		61.2
Maximum Princ. Stress (p.s.i.) σ_I		98.1		89.1
Radius of circle $\frac{1}{2}(\sigma_I - \sigma_{III})$		35.4		30.6
Centre of circle $\frac{1}{2}(\sigma_I + \sigma_{III})$		62.8		58.5



Job	SOUTH EAST MEAT WORKS
Location	NARACOORTE
Reference	
Date	16-1-73
Operator	[signature]

THE ENGINEERING AND WATER SUPPLY DEPARTMENT

TRIAXIAL COMPRESSION

MOHR DIAGRAMS

SAMPLE No. BORE C.H.1
DEPTH 12.00m - 12.30m

FIG 8.

Tan. ø ______

C ______

Specimen Number	Before Test	After Test	Before Test	After Test
Wet Density (p.c.f.)	109.4	121.0	114.0	122.0
Dry Density (p.c.f.)	75.2	81.6	80.7	84.0
Moisture Content (% dry wt.)	45.5	48.2	41.4	45.3
Degree of Saturation (%)	98.4	100.0	100.0	100.0
Applied Lateral Pressure (psi.) σ_{III}		30.3		31.6
Strain at Failure (%)		3.3		6.7
Compressive Strength (psi) $\sigma_I - \sigma_{III}$		60.1		60.5
Maximum Princ. Stress (psi) σ_I		90.4		92.1
Radius of circle $\frac{1}{2}(\sigma_I - \sigma_{III})$		30.0		30.3
Centre of circle $\frac{1}{2}(\sigma' + \sigma''')$		60.3		61.9

SOUTH EAST MEAT WORKS — NARACOORTE

BORE CH.1

DEPTH 13·65 m – 13·95 m

BLOWS 36

SCALE – HALF SIZE

CALCRETE ROCKS IN YELLOW LIMEY MATRIX

UNCONFINED COMPRESSIVE STREN. of MATRIX = 1·75 T.S.F.

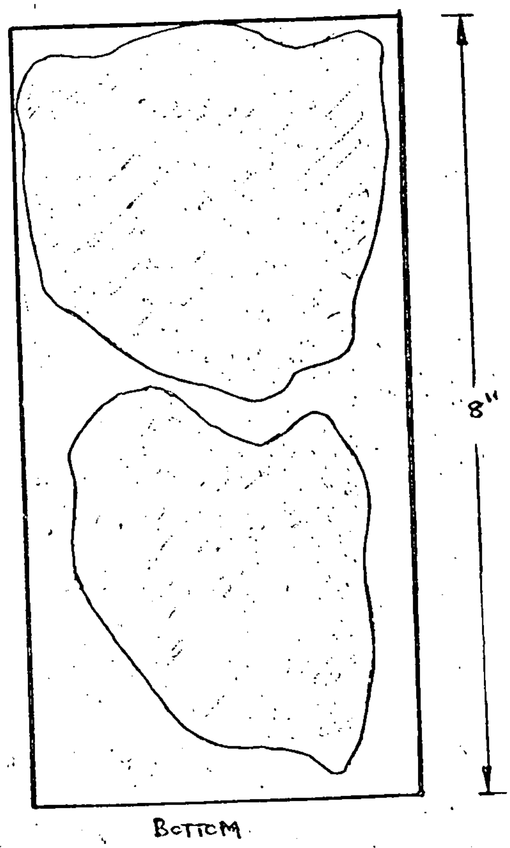
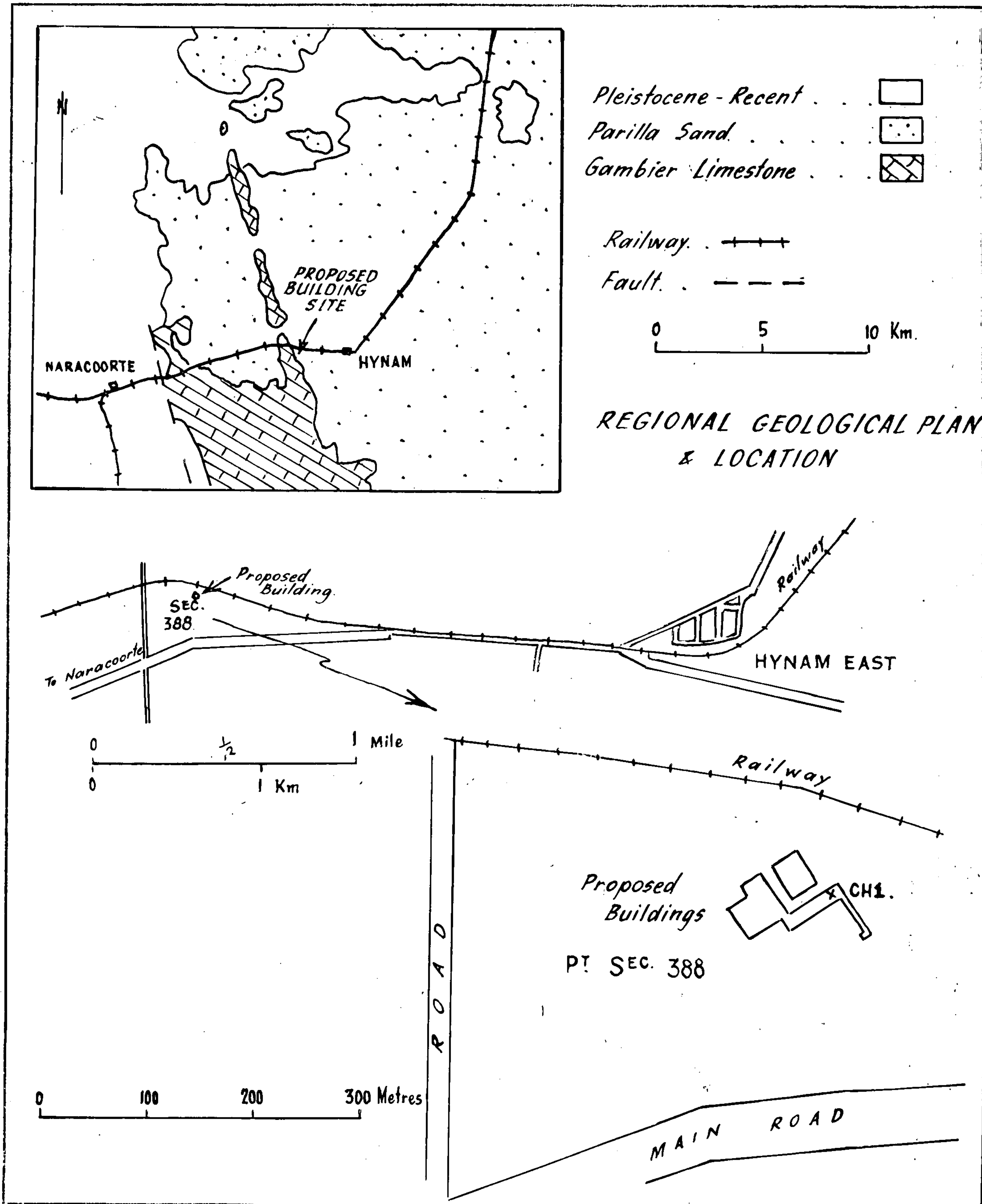


FIG 9.

SAMPLE		DESCRIPTION	U.C.S.	Specimen	Assumed	IN SITU			TRIAXIAL COMPRESSION					AFTER TEST		
Bore-hole	Depth Samp. No.		TSF / psi	No.	S.G.	m.c. %	γd p.c.f.	Sat. %	Consol. press. psi	App. Lat. Press. σ_3 p.s.i.	Max. Princ. Stress σ_1 p.s.i.	Compr. Strength $\sigma_1-\sigma_3$ p.s.i.	Strain at Failure %	m.c. %	γd p.c.f.	Sat. %
1	1.50m - 1.80m	GREY AND YELLOW SANDY CLAY. (8 BLOWS)	/	1.	2.70	21.7	102.7	91.5	4.7 (EFFECT)	4.7 (EFFECT)	30.8 (EFFECT)	26.1 (EFFECT)	10.8	24.7	104.6	100.0
				2.	2.70	21.1	104.5	93.1	2.4 (EFFECT)	2.4 (EFFECT)	38.2 (EFFECT)	35.8 (EFFECT)	12.5	23.9	103.9	100.0
1	3.00m - 3.30m	GREY MOTTLED BROWN SANDY CLAY. (8 BLOWS)	/	1.	2.72	18.6	106.7	85.5		9.1	38.9	29.8	21.7	18.4	107.3	85.8
				2.	2.72	18.5	108.8	89.9		9.3	42.7	33.4	12.5	18.4	109.1	90.2
1	4.50m - 4.80m	GREY MOTTLED YELLOW AND BROWN CLAY. (8 BLOWS)	/	1.	2.74	27.8	94.5	94.1		12.8	69.5	56.7	4.2	27.6	95.1	94.8
				2.	2.74	27.3	96.6	97.2		13.0	74.0	61.0	8.3	27.1	96.4	95.9
1	6.00m - 6.30m	ORANGE BROWN MEDIUM SAND. (12 BLOWS)	/	1.	2.66	7.2	104.0	32.1	6.9	15.6	80.1	64.5	10.0	14.7	104.7	66.6
				2.	2.66	7.6	105.6	35.2	7.2	15.9	77.4	61.5	6.7	15.4	107.8	75.9
1	7.50m - 7.80m	GREY BROWN MEDIUM SAND (30 BLOWS)	/	1.					SAMPLE BROKE UP ON EXTRUDING							
				2.												
1	9.00m - 9.30m	BROWN MEDIUM SAND (17 BLOWS)	/	1.	2.66	10.6	102.8	45.8	10.7	23.7	93.0	69.3	15.8	14.5	102.7	62.6
				2.	2.66	11.9	102.9	51.8	11.0	24.0	96.6	72.6	9.2	13.7	102.9	59.6
1	10.50m - 10.80m	BROWN MEDIUM SAND W/- SEAMS OF BROWN CLAY. (14 BLOWS)	/	1.	2.68	18.2	95.5	64.9	12.3	27.4	98.1	70.7	3.3	24.2	98.4	92.8
				2.	2.68	12.6	102.2	52.9	12.8	27.9	89.1	61.2	3.3	19.8	105.3	90.2
1	12.00m - 12.30m	BROWN CLAY (9 BLOWS)	/	1.	2.72	45.5	75.2	98.4	13.0	30.3	90.4	60.1	3.3	48.2	81.6	100.0
				2.	2.72	41.4	80.7	100.0	14.3	31.6	92.1	60.5	6.7	45.3	84.0	100.0
1	13.65m - 13.95m	LARGE CALCRETE ROCKS IN YELLOW LIMESTONE MATRIX (36 BLOWS)	1.75 /	1.					SAMPLE HIGHLY DISTURBED DUE TO DAMAGED TUBE							
				2.												
			/	1.												
				2.												

SOUTH EAST MEATWORKS
NARACOORTE BORE CH.1.

SUMMARY OF TRIAXIAL COMPRESSION DATA.



ENGINEERING GEOLOGY SECTION	DEPARTMENT OF MINES – SOUTH AUSTRALIA	Scale: –
Compiled: R. F. Jeune	S.E. MEATWORKS, NARACOORTE	Date: 27th Feb. 73.
Drn. B.S.G. Ckd.	FOUNDATION INVESTIGATIONS LOCALITY PLAN	Drg. No. S · 10185 Ke6

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