CONTENTS ENVELOPE 2651

DOCKET: 785/68

TENEMENT: NOT RELATED

TENEMENT HOLDER: --------

REPORT:

Hoskin G., Fargher & Oborn, 1969

REPORT OF FOUNDATION INVESTIGATION
at the Union Building, Adelaide
University, July 1968 to May-June 1969 (pgs. 3-12)

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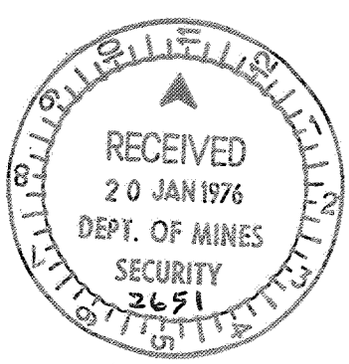
REPORT OF FOUNDATION INVESTIGATION

AT

THE UNION BUILDING, ADELAIDE UNIVERSITY

JULY, 1968 AND MAY-JUNE, 1969



HOSKING, FARGHER & OBORN CONSULTING ENGINEERS

209 MELBOURNE STREET NORTH ADELAIDE SOUTH AUSTRALIA 5006 67 3177

REPORT OF FOUNDATION INVESTIGATION AT THE UNION BUILDING, ADELAIDE UNIVERSITY, JULY, 1968 AND MAY-JUNE 1969

1. SCOPE OF INVESTIGATION

A preliminary investigation was carried out at two holes (UR 1 and UR2) within the confines of the Wills Refectory. Samples revealed varying strata of limestone in a weathered condition and sands of unknown density. It was not possible to test these sands with the available penetration apparatus because of the limiting clearances within the confines of the Wills Referectory. Accordingly it was recommended that a more comprehensive survey be undertaken allowing for a cone penetromeber investigation to be made of revealed sand beds.

Originally it was suggested that six holes be drilled but on examination of progressive results it was decided that only four holes were required to cover the requirements of Stage I work and work for Stage II in the Mayo Refectory. The bores, drilled during July, 1968, were numbers B1, B2, B3 and B5. Borehole locations are shown on drawing 1190/R.5 which accompanies this report.

As the result of the addition of a bookshop in the position of the eastern annexe, it was considered desirable to carry out further drilling in the position of borehole B6. This drilling occurred in May, 1969.

Drilling for bores UR1 and UR2 were carried out by the Mines Department. Drilling for bores B1, B2, B3, and B5 were carried out jointly by the Mines Department and Kenneth W.G. Smith, Schumann & Associates. For the latter bores a Mines Department cable tool was used to drill through hard layers and Smith, Schumann & Associates' Dutch Cone Penetrometer was used to examine sand beds. Bore B6 was drilled by the Mines Department using a cable tool.

Apparatus used for drilling holes UR1 and UR2 was either diamond drill or hydraulic push tube with wash lubrication. The locations of use of these pieces of apparatus are indicated on the borelogs.

2. TESTING

No laboratory testing was carried out except on bore B6 soils. The principal reasons for excluding laboratory testing on the early holes was as follows :

(a) Upper strata are unsuitable for laboratory testing and insitu testing using a static cone penetrometer wherever possible was considered appropriate. The cone penetrometer used was K.W.G. Smith, Schumann & Associates' Dutch Cone apparatus having a cone piston diameter of 2" (area 3.14 sq. ins) and having a cone area of 1.36 sq. ins.

(b) The deeper cohesive soils occurring beyond 15 ft. (except in bore B5 where they appear closer to the surface and similar to the soils in the subsequently tested bore B6) are not likely to be affected by the structural loads envisaged in future expansions. The clays at these depths are in a high state of suction and are very firm. Experience shows that settlements on these clays are of small order and that they have high shear strength.

If tall structures are to be built in future in the northern section of the building complex now occupied by the George Murray and Lady Symon buildings, it will be necessary to investigate the area to the north of bores B5 and B6 and particularly in the north east corner. For this work it would be desirable to carry out undisturbed sampling using a hollow spiral auger and to carry out triaxial testing at low strain rates in order to determine E values as well as c and ϕ values.

3. RELATIONSHIP TO OTHER INVESTIGATIONS

In the vicinity of the University, at the Adelaide Teachers College, the Law Building, the Forensic Laboratories and the extensions to the Public Library, the Mines Department has carried out drilling and has logged the boreholes. These boreholes have been made available to the Consulting Engineers and the information has been collated on drawing 1190/R.6 which accompanies this report. It has made possible the more accurate assessment of conditions at the Union Building. It will be also of significant use for further investigators in the University area. Copies of the Mines Department bores are held with the original copy of this report in the offices of Hosking, Fargher & Oborn. Locations of the holes are shown on drawing 1190/R.5. Figure I shows the part plan relating to the Union Building complex.

4. GENERAL DESCRIPTION OF FOUNDATIONS

4.1 Surface soils have been heavily disturbed from works and there is little evidence of original surface material. This will not effect the assessment of foundations however since footings will be seated at a significant depth below the surface.

4.2 The Principal feature of the foundations is the weathered "Hallett Cove Sandstone" which is a very calcareous material, and at the site of the Union buildings is better described as a "limestone"; the term used through the remainder of this report is "Limestone". Cementation is very irregular. This limestone has been heavily eroded at the site leaving a much shallower bed than occurs in the higher levels of the University. This is clearly shown in sections AA and BB of drawing 1190-R.6. Because of the varied state of weathering, the surface of "hard" limestone varies. At the highest level, in bores B1, B2 and B3 the R.L. of the hard limestone is approximately 200.6 ft. (Floor level Mayo refectory is 201.74 ft.)

Below the limestone is an irregular bed of fine washed sand having a very uniform grain size approximately 52 mesh retention with 100% passing No. 25 (eye values). These sands are very compact (see cone penetrometer results). This sand bed deteriorates into a more silty material with depth. The sand bed is cross bedded with the Hallet Cove Sandstones as shown in section BB. Allchurch refers to them as the "Plio-Pleistocene" sands. (Ref. 1).

Beyond the sand at an R.L. of approximately 185 are the clays of the Port Willunga beds they are uniformly stiff of high shear strength.

4.3 A water table at a depth of 25 ft. (R.L. 174) was struck in bore B6. This rose to R.L. 184 as a standing head. No other bore indicated ground water and it is suggested that either a local leakage water table or perched water table was struck in the sand bed at R.L. 177 which will act as an aquifer

It is considered unlikely that this will cause any problem with basements but because of its presence adequate precautions with basement underfloor drainage and moisture protection are required.

4.4 A very important feature is the large difference in soil stiffness shown between bores B1, B2 and B3 and B5 and B6.

5. DETAILED PROPERTIES OF SOILS ENCOUNTERED AS FAR AS THEY AFFECT FOUNDATION DESIGN.

5.1 TESTS UNDERTAKEN (Refer also to borelogs).

No Atterberg limit tests were taken.

Triaxial tests were conducted on materials from bore B6 at depths of 20', 22' and 23'6". The purpose of these tests was to assess an E value for the clay. A slow strain rate was adopted (0.004" per minute) in order to achieve greater accuracy for E values. Dutch Cone Penetrometer tests were

carried out for restricted layers in bores B1, B2 and B3. In bores B5 and B6 Mines Department cable tool percussion results have been taken.

5.2 TEST RESULTS AND THEIR INTERPRETATION

TABLE A : TESTS ON BORES B6.

SAMPLE	DEPTH	M/C	c k.s.f.	ϕ°	ALLOWABLE (LF 3.0) TERZAGHI BEARING PRESSURE k.s.f.		BLOWS/FT. N
A	20'	33%	2.74	$3\frac{1}{2}^\circ$	6.35	5.83 av.	16 av.
B	20'	36%	1.58	10°	5.30		
C	20'	35%	NO REASONABLE SAMPLE				
D	22'	31%	1.51	6°	3.86	4.67 av.	12 av.
E	23'6"	36%	1.15	15°	5.48		

The value of the elastic modulus, E (see Figure I), is approximately the same for all samples, namely :

For lateral confining pressure 10 p.s.i., E = 167 k.s.f.
For lateral confining pressure 25 p.s.i., E = 318 k.s.f.

Figure III shows the comparison between percussion readings in bores B1, B2 and B3 and those of B5 and B6. The percussion readings for B1, B2 and B3 have been computed using a relationship established from the Meyerhof paper (reference 2). Meyerhof gives: qc = 1.8N k.s.f. (equation 1).

When qc = coneresistance k.s.f.
N = standard penetrometer blows per foot,

but examination shows that for dense materials (for which the cone penetrometer was used)a better relationship would be: qc = 2.8N k.s.f.

This latter relationship has been used in assessing the comparison of effective standard penetration readings between boreholes.

Figure IV is taken from Meyerhof paper (ref. 1).

These penetration results are not precise but indicate clearly that a marked difference exists between foundation conditions for the SOUTH BLOCK and the BOOKSHOP. In the zone between bores B5 and B6 there is an unconformity which is caused by the River Torrens. It is considered that the upper clay deposits revealed in B5 and B6 are of relatively recent origin therefore.

5.3 BEARING CAPACITY

In the SOUTH BLOCK materials (Bores B1, B2 and B3) the bearing capacity of the soil is determined principally from indications from the cone penetrometer. Using Meyerhof (Ref. 2), and assuming the materials to be cohesionless, by Meyerhof equation 5(b)

$$q_{ultimate} = \frac{qcB}{40}\left[1 + \frac{D}{B}\right]$$

when q ultimate is the ultimate bearing capacity,
qc is the static cone resistance
B is the footing breadth
D is the footing depth.

For the materials encountered it is suggested that a cone resistance

of qc = 2.0 k.s.i. (288 k.s.f.) be used.
Therefore for a footing in the south block, with a load factor of 3 against failure, the allowable pressure q_s = q ultimate/3.

Figure V shows the permissible pressures accordingly.

In the BOOKSHOP area the bearing capacity of the soil is based primarily on the triaxial tests taken for bore B6. Table A gives the allowable bearing pressures using the Terzaghi analysis

$$q_D = 1.3c\ Nc + \gamma\ DfNq + 0.4\gamma\ BN\gamma.$$

The table values are given for γ = 0.11 k.c.f. ; Df = 3 ft. and ignoring the $N\gamma$ effect.

The level of footings will be some 15 ft. below the surface in the bookshop area and it is considered that the bearing pressure of footings should not exceed 4.7 k.s.f., related to an N value of 12 blows per foot and having consideration for the Terzaghi values shown in Table A.

5.4 SETTLEMENTS

The clay horizons have been overconsolidated by desiccation. Therefore normal Oedometer testing has not been undertaken. Instead for Bore B6 slow triaxial tests were undertaken, giving E values:

for confining pressures σ_m = 1.44 k.s.f. E = 167 k.s.f.
and ditto = 3.60 k.s.f. = 318 k.s.f.

Because of the relatively desiccated state of the soil a value of Poissons Ratio, v = 0.35 is recommended for all clays.

The "elastic" properties assigned to bore B6 materials can be considered as applicable to the materials of B5.

For values of N of approximately 12 blows per foot Schultze and Mezenbach (Ref. 3) indicate that a value of E determined according to $E_s = C_1 + C_2 N \pm Se$. For clays this is shown to be unreliable but for very silty clays or "clayey silts" it appears that values of C_1 = 4, C_2 = 11.5 Se = (say) 50 N being in blows/ft., the other units in kg/cm^2. This gives

$$Ep = 4 + 11.5N \pm 50 \text{ Kg/cm}^2.$$
$$= 8.1 + 23.5N \pm 102 \text{ k.s.f.}$$

Therefore for N = 12 Epercussion = 290 ± 102 k.s.f.
i.e. 390 > Ep > 188 k.s.f.

This corresponds with the range of values obtained from the triaxial test.

For materials from the SOUTH BLOCK area, settlement characteristics will be determined from the Dutch cone results. The most definitive information on the relationship between E and the cone resistance is given by Bachelier & Parez (Ref. 4). They use the Terzaghi-Buisman equation to establish that

$$E = \frac{2.3\ qf}{\alpha}$$

where qf is the cone resistance and α is a soil parameter.

A value of α for compact materials of sandy spectrum can be taken as 1.5. For evaluating E a range of values of qf is taken as 2.2-3.2 k.s.i. (317-461 k.s.f.) for bores B1, B2 and B3.

For sandy layers therefore 485 < E < 710 k.s.f.

For clay materials at depths below 15 ft. in bore B3 and, by inference, below 18 ft. in B2 and 16 ft. 6 in. in B1 a range of values of qf is 0.8 - 1.5 k.s.i. (115-216 k.s.f.). The materials tested by Bachelier and Parez and Buisman fall outside this range in clays and a value of α of 1.0 is recommended. Therefore for these layers it is suggested $287 < E < 498$.

5.5 SUMMARY OF TEST RESULTS

Figure VI shows a summary of results for the varying profiles and gives some design recommendations.

REFERENCES

1. Allchurch P.D. "Karst Topography on Hallett Cove Sandstone in the Adelaide City Area." Quarterly Geological Notes of the Geological Survey of South Australia No. 24 October, 1967

2. Meyerhof G.G. "Penetration Tests and the bearing capacity of Cohesionless Soils". Prof. A.S.C.E. Vol. 82 SM1 January, 1956.

3. Schultze & Menzenbach "The standard penetration test and the compressibility of soils." Proceedings 4th International Conference on Soil Mechanics and Foundation Engineering 1957.

4. Bachelier & Parez "Contribution to the study of soil consolidation by means of a cone penetrometer." Proceedings 6th International Conference on Soil Mechanics and Foundation Engineering 1965.

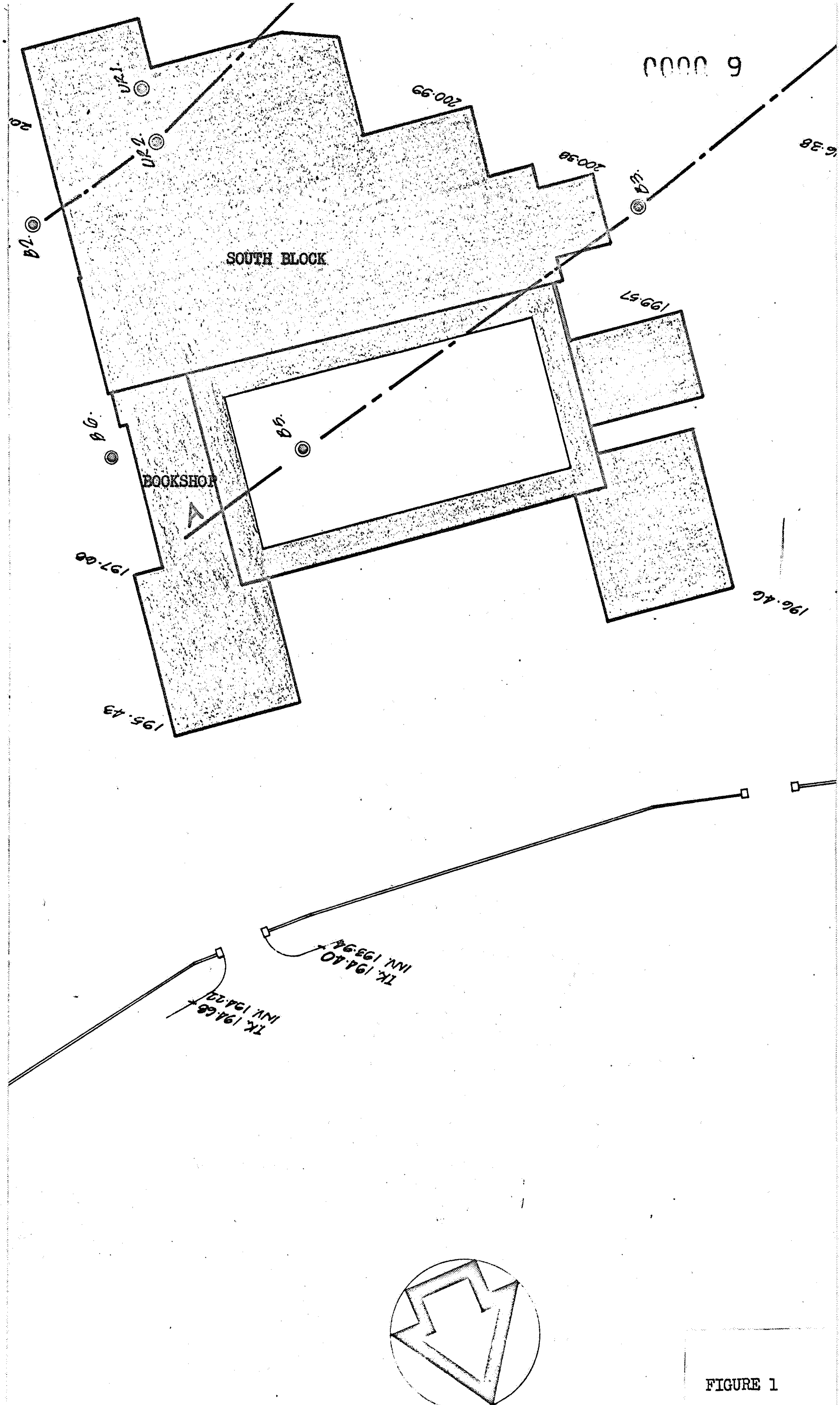
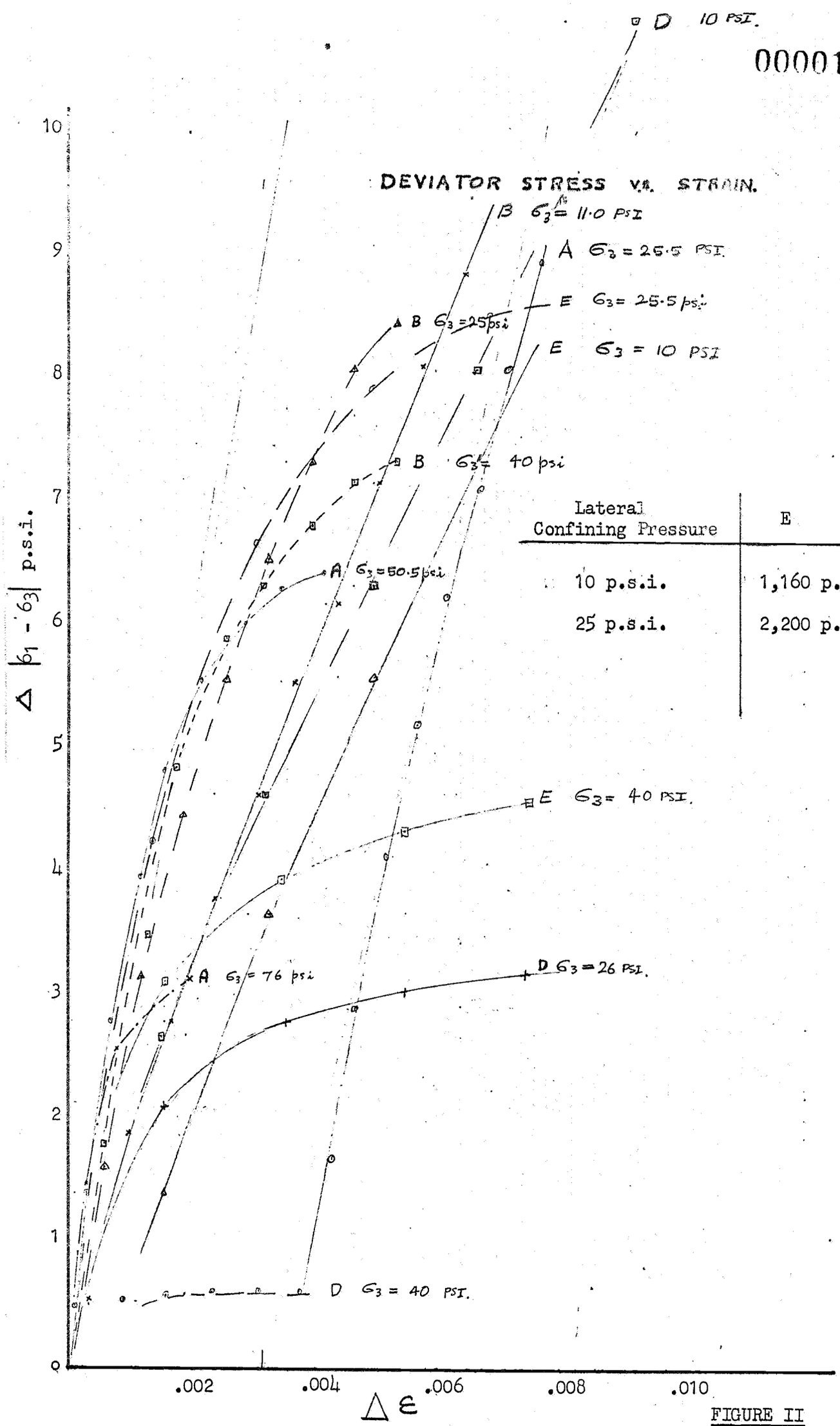

SOUTH BLOCK
BOOKSHOP
A
UR1
UR2
B2
B3
B5
B6
200.99
200.38
199.57
197.08
195.43
196.46
TK. 194.40
INV. 193.94
TK. 194.68
INV. 194.22

FIGURE 1



Lateral Confining Pressure	E
10 p.s.i.	1,160 p.s.i.
25 p.s.i.	2,200 p.s.i.

FIGURE II

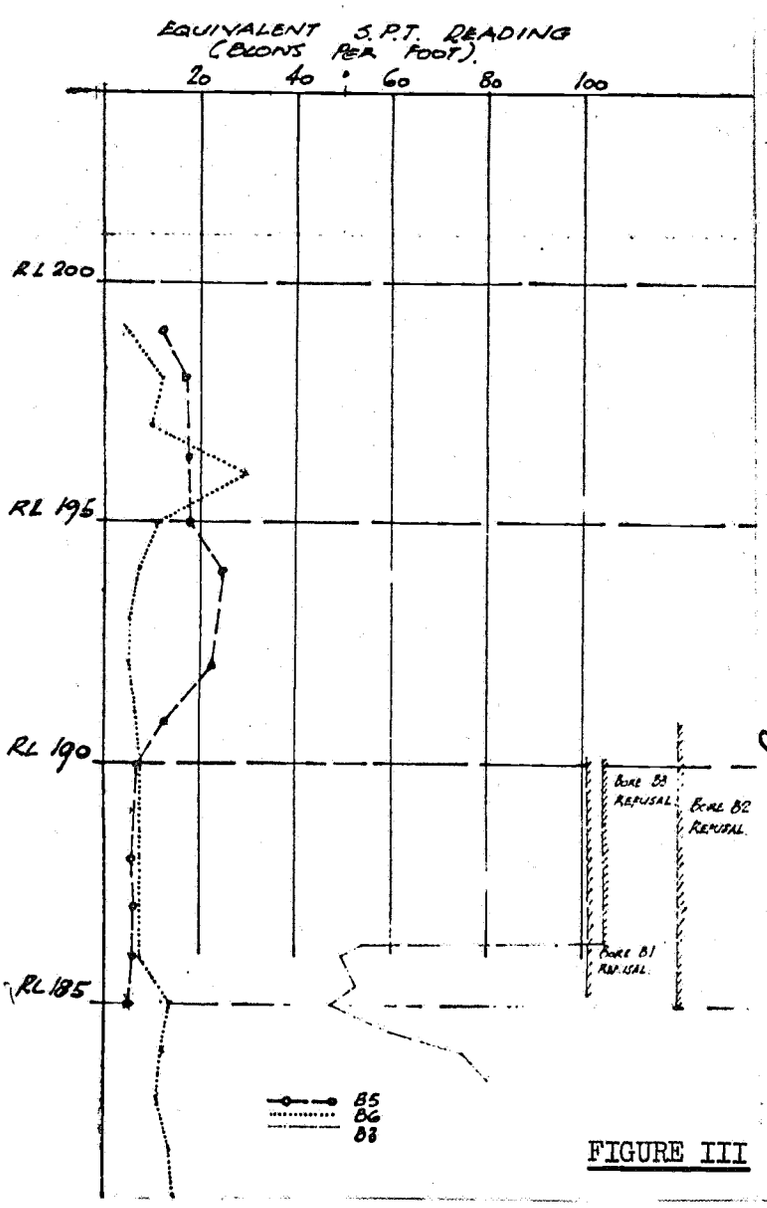


FIGURE III

FIGURE V

Analysis of Footing Safe Bearing Pressure Using Dutch Cone Pentrometer Results.

q_s - safe bearing pressure

B - footing breadth

D - footing depth

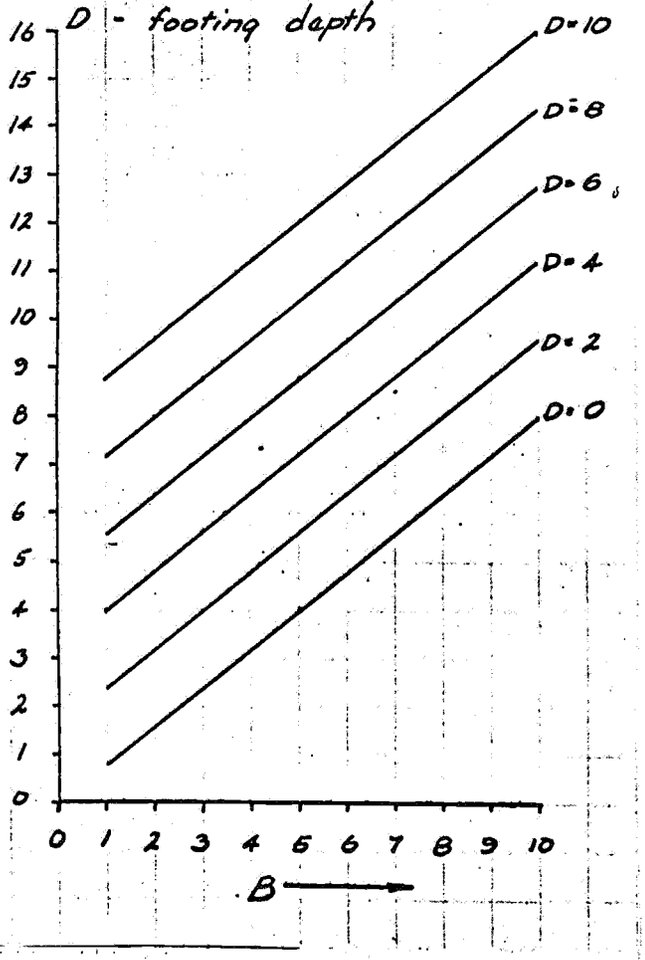


FIGURE IV

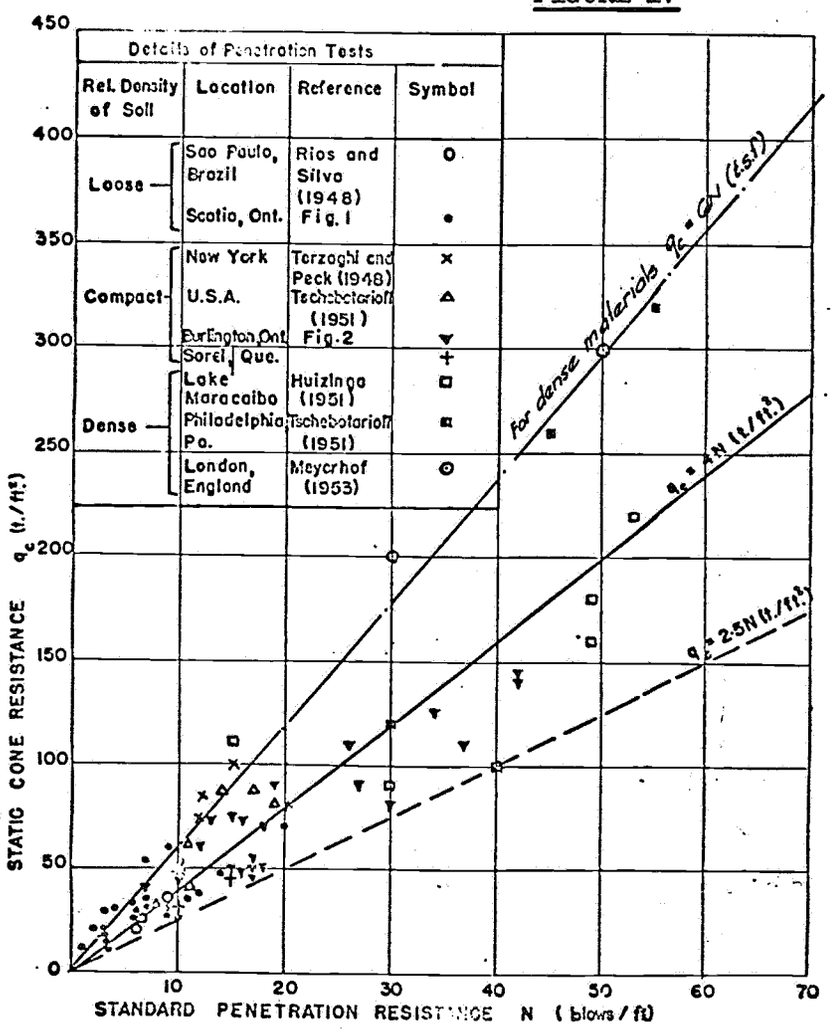


FIG.3. COMPARISON OF STATIC CONE RESISTANCE AND RESULTS OF STANDARD PENETRATION TESTS

FIG VI

GENERALISED SECTION	RANGE OF N BLOWS PER FOOT	DUTCH CONE RESISTANCE k.s.f.	ALLOWABLE BEARING PRESSURE k.s.f.	RECOMMENDED POISSON'S RATIO ν	ASSESSED RANGE OF E VALUES k.s.f.
SOUTH BLOCK **BORES UR1, UR2, B1, B2, B3**					
0 SURFACE indeterminate surface material 1·5' Weathered limestone materials generally hard at top with increasing deterioration 9 10		in excess of 500	Great care should be taken if founding in this horizon: probes should be advanced to check strata below. Should generally be satisfactory.		>500
Compact to very dense fine sands with some gravels 15 16·5		320 to 490		0·30	485 to 710 use 550 for design
Very firm silty clays with some calcareous lumps and diffuse lime		115 to 216		0·35	287 to 498 use 350 for design
BOOKSHOP **BORES B5, B6**					
SURFACE Material of doubtful origin containing some limestone & filling 4 6	12-18 (1 at 30)	-	-	-	
Calcareous clay of high plasticity. Exhibiting sand lens in bore B6	7-8		< 4 k.s.f.	0·30	< 167
15 End of B5 15 Containing limestone lumps below a depth of 14'			4·7	0·35	167 to 318 (Use 180 for design at 15')
Static Water level 24 Clayey sandy aquifer Struck water					

BOREHOLE LOG (FROM MINES DEPARTMENT CORES)

BORED FOR ADELAIDE UNIVERSITY UNION
LOCATION WILLS REFECTORY SOUTH WEST CORNER
BOREHOLE NO. UR 1

TYPE OF BORING DIAMOND DRILL & HYDRAULIC PUSH
DIAM. OF BORING 1½" and 2"
INCLINATION VERTICAL

GROUND SURFACE R.L. FLOOR LEVEL - 24"
DATE STARTED 23/5/68 **COMPLETED** 30/5/68
SHEET NO. 1 of 2.

Depth	R.L.	Colour	Structure & Texture	Description of Strata	Soil Symb.	C kips/ft²	Ø	S.P.T.	Density lbs/ft³	m_v ft²/kip	m/c	P/L	L/L	P.I.	Pocket penetr.	Sampled
	Floor level = R.L. 00			Unlogged strata sampled by Smith-Schumann. Resistance at 4'0" depth prevented further logging. Mines Department commenced at depth 4'0".												PUSH TUBE TO 4'0"
4'0"		Khaki becoming very pale at depth	Not capable of accurate description because of disturbance -fine granular all passing 100 mesh sieve.	Probable weathered limestone with moderate cementing (?). Cf. Bore 2.	ML(?)											DIAM-OND DRILL TO 7'9"
5ft.	-7.00															
6'0"		Pale/dirty white	Uniform rock	Fine grained limestone of moderate hardness. Weathered in lower section.												
7'1"		Khaki mottling	Firmly cemented fine grained. Low compressibility.	Weathered sediments containing silts, slight line only present.	ML											BEYOND 7'9"
7'9"		N O T U B E	S A M P L E O B T A I N E D.	* Clayey fine sand. Clay binder washed on.												HYDRAULIC PUSH TUBE WITH WASH LUBRICATION.
9'6"		Pale grey/off white	Hard uniform rock	Fine grained limestone very hard	SP(?)											
10ft.		(10'0" to 16'0" S A M P L E	N O T U B E T A K E N).	*Suspected clayey (silty?) fine sand not recoverable with equipment on hand. Reference to material at 18'8" indicates probable little binder. S.P.T. test to be conducted on Bore UR 2	SP(?)											
		(?) Pale khaki to off white	(?) Loose granular slightly plastic.													
15ft.																
16'0"		Pale grey and white	Fine-firm/plastic	Mottled calcareous clay	CH										2.5	
16'9"		NO RECOVERED SAMPLE.	SUSPECTED SIMILAR TO 10'0" - 16'0" SAMPLE		SP(?)											
18'2"		Mottled khaki-grey v. pale grey-brown	Firm hard gritty Granular (-52 sieve)	Calcareous sandy clay medium plasticity. Thin sand seam-(fine silty sand)	CL CH SP											
18'8" 19'0"		Mottled khaki grey	Hard, gritty	Calcareous sandy clay of medium - high plasticity, lime.	CH										4.5	
19'8" 20ft.		Pale grey with white mottling	Firm-hard some fissuring	Silty clay of high plasticity obviously very weakened residue. Very little lime in clay body.	CH										>4.5	

Logged P.J.F on 1st June, 1968

HOSKING FARGHER & OBORN
CONSULTING ENGINEERS
209 MELBOURNE ST., NORTH ADELAIDE

ENV 2651-3

BOREHOLE LOG (FROM MINES DEPARTMENT CORES)

BORED FOR ADELAIDE UNIVERSITY UNION
LOCATION WILLIS REFECTORY
BOREHOLE NO. UR 2

TYPE OF BORING DIAMOND DRILL & HYDRAULIC PUSH
DIAM. OF BORING 1½" and 2"
INCLINATION VERTICAL

GROUND SURFACE R.L. FLOOR LEVEL - 2
DATE STARTED 30/5/68 COMPLETED 1/6/68
SHEET NO. 2 of 2.

Depth	R.L.	Colour	Structure & Texture	Description of Strata	Soil Symb.	C kips/ft²	∅	S.P.T.	Density lbs/ft³	m_v ft²/kip	m/c	P/L	L/L	P. I.	Pocket penetr.
Unlogged strata sampled by Messrs. Smith, Schumann & Assoc. Mines Department begins at 4'3"															
4'3"		Grey brown- off white	Varies from hard rock to (very weathered) plastic and plastic-gritty.	Limestone of varying states of weathering - from very hard to weathered plastic material.											
5 ft.															
6'6"			Gritty	Zone of intense weathering	CH										
7'0"															
7'6"		Off white	Hard, massive	Limestone- weathered											
		Pale khaki to khaki to off white	Friable semi cemented in part with some large boulder	Zone of weathered (silty-sand) material containing large limestone fragments or boulders	GM and SM-SL										
9'6"															
10 ft.															
		Very pale golden brown to pale khaki	Very loose granular (grain size -52 BS Sieve)	Sands of very open structure having uniform grain size. There are some sections containing silts and here the grain size reduces to predominantly (-100) Particularly from 15'0" - 16'6".	SP (SM)			ESTIMATED ONLY APPROXIMATELY.							
15 ft.															
17'0"		Pale khaki	Firm, granular	Silty fine sand - very slight clay binder	SM										
17'6"		Mottled grey and khaki.		Hard silty clay, some line M/C << P/L	CH										>4.5
20'0"															

HOSKING FARGHER & OBORN
CONSULTING ENGINEERS
209 MELBOURNE ST., NORTH ADELAIDE

ENV 2651-4

BOREHOLE LOG

BORED FOR ADELAIDE UNIVERSITY UNION
LOCATION WILLS REFECTORY OUTSIDE SOUTH EAST CORNER.
BOREHOLE NO. B1.

TYPE OF BORING PERCUSSION DRILLING AND DUTCH CONE PENETROMETER WITH PUSH TUBE.
DIAM. OF BORING
INCLINATION VERTICAL

GROUND SURFACE R.L. ----
DATE STARTED 8. 7.68 COMPLETED 9.7.68
SHEET NO. 1.

Depth	R.L.	Colour	Structure & Texture	Description of Strata	Soil Symb.	C kips/ft²	∅	Reduced Dutch Cone ksi	Density lbs/ft³	m_v ft²/kip	m/c	P/L	L/L	P. I.	Pocket penetr.	Sampling Method
1.		Pinky brown														
2.		Mottled: Dirty white and pale pinky brown and dark brown	Friable	Limestone with varying amounts of weathering. Some hard lumps but more generally friable & some patches of plastic material.											3.5	Percussion drilling
3.																
4.		Pinkish browny grey	Dense fine granular Sample extremely disturbed and very wet due to sampling method.	Calcareous poorly graded fine sand (approx. No.52 sieve) Numerous fragments of limestone.	SP											
5.								Because of difficulty								
6.								in sampling the Dutch								
7.								Cone could not be used								
8.								in these strata.								
9.								Refusal values would								
10.		Greenish grey	Dense fine/granular with lens (?) of coarse gravel.	(Approx. No.52 sieve) Uniform (grey) sand/with greenish silty fines.				be generally achieved. 2.39								Dutch cone and push tube.
11.		Mottled: Yellowish brown to yellow and light grey.	Dense fine granular	Uniform (grey) sand (as above) with (yellow brown) silty fines.				2.60								
12.																
13.		Mottled: yellowish brown to yellow and light grey.	Fine granular. Some undisturbed sections of the sample indicate very dense sand.	Uniform sand (Approx. No.52 sieve)	SP			2.60								
14.								2.43								
15.																
16.																
17.		Mottled: greeny light/grey with yellowy brown.	Friable fissured firm plastic material.	Mottled fissured clay with isolated lumps of calcareous material.	CL-CH							<P/L			4.2 >5.0 3.6 3.6	Push tube
18.																
19.		Mottled: yellowy brown with light greeny grey and dirty white	Friable fissured firm plastic material.	Silty clay with larger lumps of calcareous material.	CL											

Vert. scale 1" = 4/10

HOSKING FARGHER & OBORN
CONSULTING ENGINEERS
209 MELBOURNE ST., NORTH ADELAIDE

ENV2651-5

BOREHOLE LOG

BORED FOR ADELAIDE UNIVERSITY UNION
LOCATION WILLS REFECTORY OUTSIDE NORTH EAST CORNER
BOREHOLE NO. B2.

TYPE OF BORING PERCUSSION DRILLING AND DUTCH CONE PENETROMETER WITH PUSH TUBE
DIAM. OF BORING
INCLINATION VERTICAL

GROUND SURFACE R.L. ----
DATE STARTED 9.7.68 COMPLETED 12.7.68
SHEET NO. 2.

Depth	R.L.	Colour	Structure & Texture	Description of Strata	Soil Symb.	C kips/ft²	∅	Reduced Dutch Cone.	Density lbs/ft³	m_v ft³/kip	m/c	P/L	L/L	P.I.	Pocket penetr.	Sampling Method.
								k.s.i.								
>1.		Varied: Pinkish brown White, Dark brown	Dense, friable	Weathered limestone. Pockets of dark brown clay.												
2.															2.4 3.5 3.5	
2.		Mottled: dirty white Light brown, Dark Brown.	Variable: hard rock to gritty plastic material.	Weathered limestone varying from hard rock to powdery material and clayey pockets.												
3.		Mottled: light and dark brown with white lumps Yellowy brown	Friable, slightly plastic and gravelly Dense, granular. Very wet disturbed sample because of drilling method adopted in strata above.	Weathered calcareous material. Pockets of brown clayey silt. Lumps of limestone towards bottom. Poorly graded fine calcareous sand silt mixture. Numerous small fragments of limestone.	CL-CH?			Because of difficulty						2.9 1.9	1.9 1.8	Percussion Drilling.
4.					SP-SM			In sampling the Dutch								
5.								Cone could not be used								
6.								in these strata.								
7.								Refusal values would be								
8.								generally achieved.								
9.		Mottled: White, yellow light brown, dark brown	Generally dense granular with some gravel of approx. ½".	Fine poorly graded (Uniform) sand with little fines and some ½" subangular gravel.	SP			2.19								Dutch cone with push tube.
10.																
11.																
12.		Yellowy brown	Dense fine granular. Very wet disturbed sample.	Poorly graded sand silt mixture	SP											
13.		Light yellowy brown	Very dense, granular, little cohesion.	Poorly graded sand silt mixture	SP			2.31								
14.		Yellowy brown	Stiff, granular with some cohesion.	Fairly well graded calcareous sand with significant silty fines.	SW-SM											
15.		Yellow	Very dense, granular, little cohesion.	Fine uniform sand with silty fines and some 3/8" angular gravel.	SP			2.31								
16.																
17.		Mottled: light greenish grey and yellow with occasional dirty white	Stiff, fissured, friable medium plastic.	Mottled fissured silty clay with occasional lumps of limestone	CL-SM							<P/L			3.6 5.0 4.3 4.3	Push tube.
18.																
19.															3.3	
20.																

HOSKING FARGHER & OBORN
CONSULTING ENGINEERS
209 MELBOURNE ST., NORTH ADELAIDE

EW 2651-6

BOREHOLE LOG

BORED FOR ADELAIDE UNIVERSITY UNION
LOCATION OUTSIDE WESTERN END OF REFECTORIES
BOREHOLE NO. B3.

TYPE OF BORING PERCUSSION DRILLING AND DUTCH CONE PENETROMETER WITH PUSH TUBE.
DIAM. OF BORING
INCLINATION VERTICAL

GROUND SURFACE R.L. ----
DATE STARTED 10.7.66. COMPLETED 11.7.66.
SHEET NO. 3.

Depth	R.L.	Colour	Structure & Texture	Description of Strata	Soil Symb.	C kips/ft²	∅	Reduced Dutch Cone (ksi)	Density lbs/ft³	m_v ft²/kip	m/c	P/L	L/L	P. I.	Pocket penetr.	Sampling Method.
1.		Dark brown		Clayey silt with lumps (approx. ¼") of limestone and grass roots												
		Mottled: white, cream yellow and brown.	Friable, slightly plastic, gravelly	Limestone: weathered and with some clay.												
2.		"	Friable slightly plastic, gravelly.	Weathered limestone with lumps of sandstone and lumps of brown silty soil Lumps of uniform sand and pockets of low plasticity clay	ML-GM											
3.		As above with predominance of white and khaki.	Friable slightly plastic, gravelly.	As above but limestone and sand pockets predominating.	ML											
4.		Browny cream	Friable, coarse gravelly.	Predominantly fine dense well graded yellow sand with occasional lumps of grey clay, brown silty clay and a few pieces of sandstone with calcareous sections.	SP			Because of difficulty								Percussion Drilling
5.		Browny cream	Fine granular, very wet and disturbed due to sampling method (grain size approx. No.52 sieve).					in sampling the Dutch								
6.				Fine silty calcareous sand with isolated gravel particles.	SP-GM			cone could not be used								
7.								in these strata.								
8.								Refusal values would								
		Browny cream	Dense fine granular (passing approx. No. 100 sieve).	Fine calcareous silty sand, occasional ½" gravel	SP			be generally achieved.								
9.		Browny yellow	Dense fine granular (passing approx. No. 100 sieve).	Fine uniform silty sand	SP											
10.																
11.		Khaki with white patches.	Dense fine granular passing approx. No.52 sieve, gravelly (approx. ¾")	Silty sand with some sandstone.	SP-GM											
12.		Khaki with yellow	Dense fine granular (passing No.52 sieve Approx.)	Silty sand.	SP			2.77								Dutch cone and push tube.
13.		Yellowish browny cream.	Fine granular (passing approx. No.52 sieve)					3.47								
14.																
15.		Mottled: light greeny grey with browny yellow.	Fissured, plastic, stiff.	Medium plasticity silty clay Slightly sandy, particularly near top.	CL-CH			0.88 0.92 0.81 1.04 1.39 1.50				<P/L		(3 (3.4 3.6 (4.2 (3.2 3.2 (4 (3.5 (5.0		Dutch cone & push tube alternately
16.																
17.																
18.																
19.		Yellowy brown	Friable, firm, slightly plastic, gritty.	Sandy clay, containing lumps of calcareous material.	CL									3.2 4.1 3.4 4.2		
20.																

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CONSULTING ENGINEERS
209 MELBOURNE ST., NORTH ADELAIDE

ENV 2651-7

BOREHOLE LOG

BORED FOR ADELAIDE UNIVERSITY UNION
LOCATION CLOISTERS
BOREHOLE NO. B5.

TYPE OF BORING PERCUSSION DRILLING
DIAM. OF BORING
INCLINATION VERTICAL

GROUND SURFACE R.L.
DATE STARTED 13. 7.68 COMPLETED 13.7.68
SHEET NO. 4.

Depth	R.L.	Colour	Structure & Texture	Description of Strata	Soil Symb.	C kips/ft²	Ø	Percussion Drilling Blows/ft.	Density lbs/ft³	m_v ft²/kip	m/c	P/L	L/L	P.I.	Pocket penetr.	Sampling Method
1.		Dark brown	Friable cohesive fine granular	Sandy soil with grass roots			1	13½								
		Mottled: light & Dark brown	Friable, cohesive gritty and gravelly.	Calcareous silty soil with clay binder. Occasional lumps of limestone, (hard and soft)	SP-CL										1.5 1.1 1.2 1.8	Percussion Drilling.
2.								18								
3.		Varies: light & dark browns	Cohesive, plastic, gritty and gravelly.	Calcareous clayey sandy soil with lumps of limestone.	CL_SP											
4		Brown	Fine (passing No.100 sieve) uniform granular. Friable with some cohesion.	Lump of red brick indicates disturbed material above 4' depth.				18							2.9 3.0	
5		Brown		Fine uniform very silty sand.	SP			18.							0.9 1.3,1.4	
			Fine uniform gritty plastic.	Low plasticity silty clay.	CL-ML										1.3,1.5	
6		Light brown	Friable cohesive fine grained.	Low plasticity clayey silt (calcareous) numerous limestone fragments.	ML			24								
7		Dirty white and light brown	Bouldery	Weathered limestone											1.9	
		Light brown	Friable, fairly plastic, slightly gravelly.	" "	CL-CH										1.5	
8		Light brown	Plastic and slightly gravelly.	Calcareous clay with lumps of limestone.	CL-CH			22½							1.9 1.5	
9		Light brown	Plastic and slightly gravelly.	" " " " " "	CH			12				>P/L and increases with depth.			1.5 1.5	
10								9							1.4 1.5	
11															1.4 1.4 1.2	
12								6							1.4	
		Light brown	Gravelly plastic tending to be fissured.	Slightly calcareous clay containing lumps of limestone.	CH-GC			6							1.6 1.7 1.03 softer	
13		Light brown	Plastic, gravelly to bouldery.	" " " " " "	CH-GC			6							1.03 patch 1.0 0.8	
14																
15		Milky brown	Plastic, gravelly	Fairly calcareous clay with lumps of limestone.	CH-GC			5¼							1.8 1.0 1.4 1.2	
16																
17																
18																
19																
20																

HOSKING FARGHER & OBORN
CONSULTING ENGINEERS
209 MELBOURNE ST., NORTH ADELAIDE

EW 2651-8

BOREHOLE LOG

BORED FOR ADELAIDE UNIVERSITY UNION BUILDING
LOCATION NEAR EASTERN WALL OF WARDEN'S OFFICE
BOREHOLE NO BG.

TYPE OF BORING PERCUSSION DRILLING
DIAM. OF BORING 6" RECOVERING 4" DIA. CORES
INCLINATION

GROUND SURFACE R.L. 103.4 (Approx.)
DATE STARTED 12-5-69 COMPLETED 13.5.69
SHEET NO. 1.

Depth	R.L.	Colour	Structure & Texture	Description of Strata	Soil Symbol	Tons/ft²	Blows/ft. XXXX	Density lbs/ft³	mv ft²/kip	m/c	P.L.	L.L.	P.I.	Pocket penetr. (Tons/ft²)
1.		Dark brown	Firm, slightly plastic	Silty sandy calcareous clay topsoil			5							
2.		Pale pinkish brown	Friable, firm, moderately plastic.	Weathered limestone			12							
3.		Black.					10							
4.							30							
5.		Light brown	Firm plastic with virtually no development of any structure.	Calcareous clay of high plasticity.	CH		14							>5.0
6.							8			P/L				2.6
7.							6							2.0
8.			Isolated small gravels	Limestone nodules occurring throughout. Isolated fragments of stone up to 3"			6							2.6
9.							7							2.0
10.							7							1.8
11.				Becoming sandy towards bottom			6							
12.							6			> P/L				
13.							7							3.4
14.		Golden red-yellow	Loose granular passing No.100 sieve	Uniform sand with some clayey fines	SP		7							
15.							13							
16.		Mottled light green-grey and mustard	Firm, plastic tending to be friable. Blocky structure	Calcareous clay of moderately high plasticity	CH		12			P/L				
17.							11							
18.				Some very highly calcareous inclusions (weathered limestone lumps)			14							3.0
19.														2.6
20.							27			16/ft. average				3.2
21.							22							2.6
22.							17			12/ft. average				
23.														
24.		Mottled grey and yellowy brown	Granular passing No.25 sieve. Considerable cohesion	Wet clayey sand	SP-CL		1							
25.							14							
							26							

Water Table.

HOSKING FARGHER & OBORN
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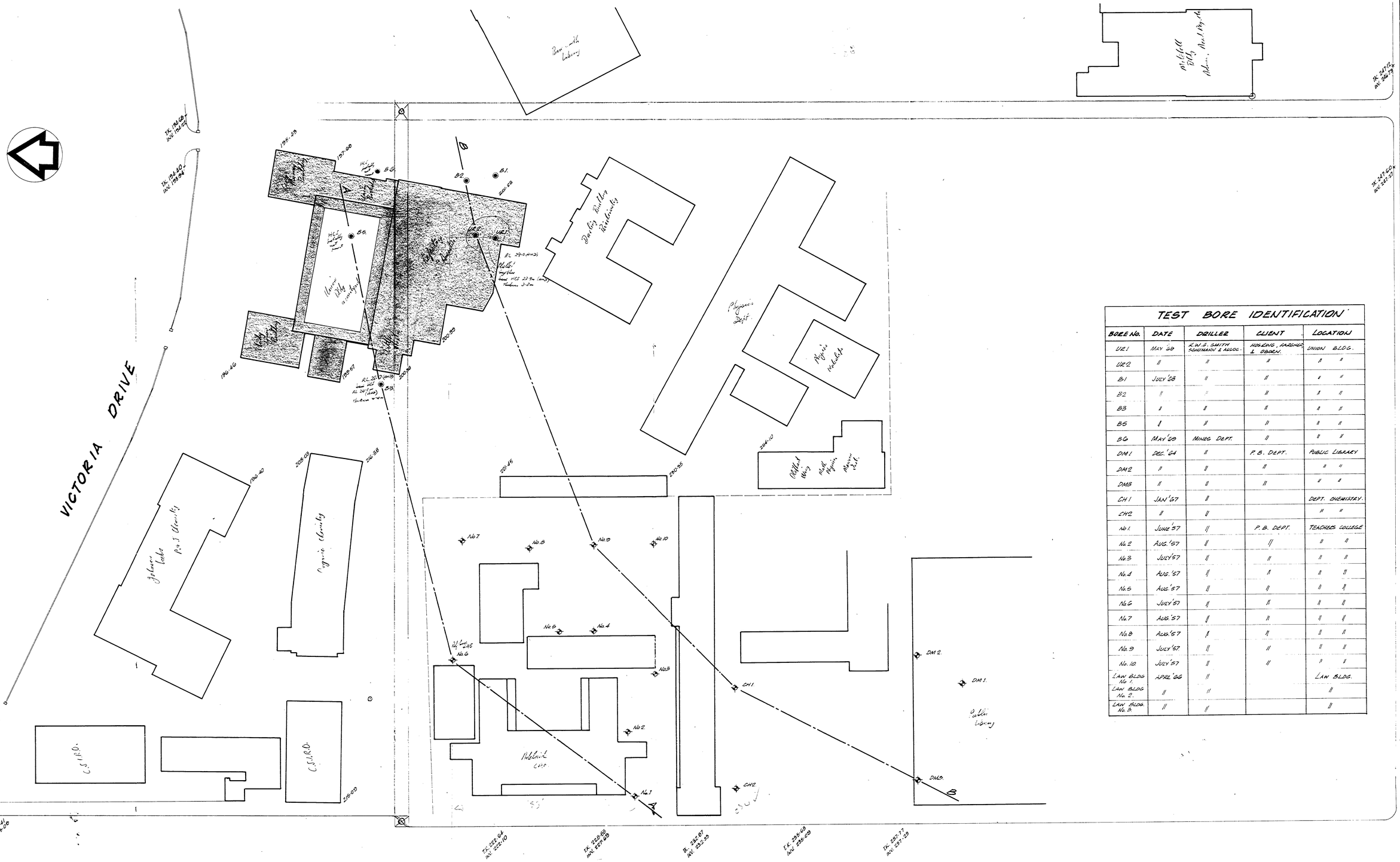
209 MELBOURNE ST., NORTH ADELAIDE

ENV 2651-9



TEST BORE IDENTIFICATION

BORE No.	DATE	DRILLER	CLIENT	LOCATION
UE1	MAY '68	K.W.G. SMITH SCHUMANN & ASSOC.	HOSKING, FARGHER & OBORN.	UNION BLDG.
UE2	"	"	"	" "
B1	JULY '68	"	"	" "
B2	"	"	"	" "
B3	"	"	"	" "
B5	"	"	"	" "
BG	MAY '68	MINES DEPT.	"	" "
DM1	DEC '64	"	P.B. DEPT.	PUBLIC LIBRARY
DM2	"	"	"	" "
DM3	"	"	"	" "
CH1	JAN '67	"		DEPT. CHEMISTRY.
CH2	"	"		" "
No1.	JUNE '57	"	P.B. DEPT.	TEACHERS COLLEGE
No.2	AUG. '57	"	"	" "
No.3	JULY '57	"	"	" "
No.4	AUG. '57	"	"	" "
No.5	AUG. '57	"	"	" "
No.6	JULY '57	"	"	" "
No.7	AUG. '57	"	"	" "
No.8	AUG. '57	"	"	" "
No.9	JULY '57	"	"	" "
No.10	JULY '57	"	"	" "
LAW BLDG No 1.	APRIL '66	"		LAW BLDG.
LAW BLDG No. 2.	"	"		"
LAW BLDG. No. 3.	"	"		"

1190-R5

No.	REVISION	BY	DATE	No.	REVISION	BY	DATE

AMENDMENTS

DRAWN	CHECKED
C.P.	
APPROVED	SCALES
	40 Ft. to 1 inch.
DATE	
Jan. 69.	

UNIVERSITY OF ADELAIDE
UNION BUILDINGS. FOUNDATION INVESTIGATION SITE PLAN.

HOSKING, FARGHER & OBORN
CONSULTING ENGINEERS
209 MELBOURNE STREET, NORTH ADELAIDE. 67 3177

ENV 2651-1

DRAWN	G.P.	CHECKED	
APPROVED		SCALES	As shown.
DATE	Jan. 69.		

UNIVERSITY OF ADELAIDE
UNION BUILDINGS. FOUNDATION INVESTIGATION BOREHOLE LOG.

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ENV 2651-2