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AT THE UNIVERSITY OF MANCHESTER

YOUR REF.

MELDONS,
FLETSAND ROAD,
WILMSLOW,
CHESHIRE.
TEL.: WILMSLOW 5888.

30th March, 1963

Messrs. Edgar Morton & Partner,
Consulting Engineering Geologists,
Styperson House,
Adlington,
Macclesfield.

Dear Mr. Morton,

Proposed Storage Reservoir at
Havant Thicket

I write to report on the results of the soil mechanics tests and their influence on the design and construction of an earth embankment 60 ft high.

1. A report of the numerical values of the soil mechanics tests carried out at the University is enclosed. You will also have the results of tests made by Messrs. Pre-Piling Surveys Ltd.
2. Considering first the strength of the London Clay on which the dam will be founded, Fig.1 shows the shear strength of undrained undisturbed samples plotted against depth. The results of tests made initially at the standard rate of 2% per minute have been neglected. The presence of fissures in the London Clay requires a slower rate of test in order to ensure uniformity throughout the sample and consequently a rate of 1% per hour was used for the majority of the tests and Messrs. Pre-Piling Surveys Ltd were instructed to do likewise.
3. Considering an average Downstream slope of $2\frac{1}{2}/1$ as might arise with a slope of $2\frac{1}{2}/1$ and a berm, the bank would fail at a shear of $6\frac{1}{2}$ p.s.i., and a strength of 10 p.s.i. would be required to ensure an adequate factor of safety of 1.5. It follows that either the bank must have an extended toe or the foundation requires consolidation during construction by means of sand drains. From Fig.1 the minimum depth of the drains would be 18 ft.
4. The presence of thin layers of fine silt in the laminations of the clay, as noted in paragraph 7(b) of your report dated 18th Dec. 1962, and as observed in the samples tested, could result in a spread of pore water pressure towards the toe. Consequently the use of a minimum number of sand drains through these silt layers is essential.
5. In order to design a drainage system and subsequently to provide adequate control during construction, measurements were made of the effective strength parameters of the foundation clays. Fig.2 shows the angle of shearing resistance in terms of effective stresses, ϕ' , plotted against the height above the Basal Beds. The commonly quoted value for London Clay is 20° and this value was found in places near the surface. With depth the value of ϕ' at this site was found to increase to over 30° . The average value of the cohesion intercept c' for all samples was 300 p.s.f. Both Figs 1 and 2 illustrate that the minimum strength of the foundation clays occurs just below the surface. Exceptionally low values of ϕ' of 13° have been found at B.K.4. The previous minimum value which I have met anywhere has been 15° and this is a matter for further investigation.

6. Fig.3 shows the observed pore water pressures at the peak effective stress ratio for a range of possible values of the major principal total stress. The results from Figs 2 and 3 have been used to make an effective stress analysis. This shows that, in the absence of drainage, the water pressure in the foundation would rise above the level of the bank near the crest, and that the factor of safety would be just below unity on completion. While this calculation supports that made using the undrained shear strengths it also indicates that 60% of the pore water pressure must be dissipated under the full 60 ft height of the bank in order to achieve a factor of safety of 1.5.
7. Owing to the presence of fissures and laminations the necessary spacing of the drains may be wider than that predicted on the basis of consolidation tests on small samples. The measured values of the coefficient of consolidation of samples tested under horizontal drainage in the pressure range to be expected from the bank lay between 25 and 85 ft²/yr. Below 15 ft depth the presence of silt layers should increase the real speed of pressure dissipation. The necessary spacing also depends on the value of ϕ' and on the rate of construction. On the basis both of calculations and of observations and experience on other sites of a similar nature I would suggest at this stage that drains be installed at 30 ft centres over the full depth of the London Clay, with intermediate drains at 15 ft centres to a depth of 15 ft below the surface.
8. Where the height of the dam exceeds 50 ft the drains should penetrate through the Basal Beds. They may then also control seepage uplift if the permeability of the Basal Beds is sufficiently low. This area applies to some 600 ft width in the centre of the valley. Between 50 and 35 ft height the depth of the deeper drains may be progressively reduced to 15 ft at a bank height of 35 ft. At this height the area is some 1400 ft wide. Elsewhere no foundation consolidation is necessary.
9. In view of the low strength of the surface clays it is nevertheless advisable to continue the use of a ground drainage blanket over the whole area of the seat of the bank, independent of its height.
10. In Figs 4 and 5 I have indicated the sort of design which meets the conclusions of your report and the present findings. In order to avoid the use of a deep cut-off trench through the Basal Beds and in order to employ sand drains over the foundation in the central area of the site, it is necessary to seal the clay core into the clay foundation near the Upstream toe. A horizontal clay blanket joins the central clay core to the partial cut-off. The latter is shown carried down 14 ft on the side of an open excavation.
11. Considering now the fill within the bank, the clay core, blanket and cut-off could be composed of London Clay. The surface weathered clays may have shear strengths between 5 and 14 p.s.i. and at their mean strength of 10 p.s.i. should be soft enough to form an impermeable seal and yet firm enough to be laid by mechanical plant. However clays at strengths less than 8 p.s.i. may have to be rejected, being too soft for mechanical plant. I am particularly concerned to find natural water contents as much as 14% wet of the Proctor Optimum, see item (4) of the University soil test report. Also Fig.6 shows that the low density and high water content at Optimum for these weathered London clays come outside the range of materials used on many other sites. This in itself is not necessarily a disadvantage but together with the low strengths and the high Liquid Limit values in the region of 72% prove the necessity for special care in the use of these materials.

12. Where silt laminations occur, containing water, the borrow material will soften after extraction. This may be the cause of the high water contents found on samples from B.H.s 4 and 10, with the exception of B.H.10, 1 $\frac{1}{2}$ -3 ft which may be locally dry at the surface. These materials would be quite unsuitable as main fill material. Furthermore the exceptionally low values of ϕ' would require flat slopes even with drainage. In this connection the test results on compacted samples by Messrs. Pre-Piling Surveys Ltd yield improbable values of ϕ' of 90.

13. For these reasons I have asked for the undisturbed samples obtained from the Reading Beds in order to investigate their suitability for use as the main rolled fill. They were not previously investigated owing to their depth below the surface near the seat of the bank. However they might be won from an area North of your line AA on Plan E. The detailed placement of these and the Basal Bed materials within the bank will in any event depend on your estimate of the relative quantities available and on considerations of haulage.

14. At this stage therefore the provisional profiles, Figs 4 and 5, indicate the main considerations to be borne in mind namely,

- i) The use of a partial upstream cut-off.
- ii) The use of drainage by sand drains and drainage blankets to control water pressures in the fill and foundation, owing to the wet nature of these clays and their low drained strengths.
- iii) In order to allow time for the drainage to operate it may well prove necessary to restrict the raising of the central area of the embankment to 45 ft in the first season.

15. During construction it is essential that water pressures in the foundation and in the fill be measured by means of piezometers and at this stage I estimate that a total number of 25 to 30 on one section would be required.

I hope that this information may prove sufficient to allow general progress to be made with the scheme. Prior to the finalisation of contract drawings and the specification you may feel it would be advisable to have a number of pits opened in the borrow areas which we could inspect and if necessary test in greater detail.

Yours sincerely,

Encl. 5 sheets of diagrams
Soil test report.

The Department of Engineering,
The University of Manchester,
Oxford Road,
Manchester, 13.

March, 1963.

Soil Mechanics Test Report on Undisturbed Samples from
Havant Thicket Reservoir Site, Portsmouth and Gosport Water Co.

1. Standard Undrained Triaxial Compression Tests on $1\frac{1}{2}$ " Dia.
Samples using frictionless end platens. Testing rate 2%
strain per minute. Fissured London Clay.

B.H.	Depth ft	Water Content %	Density p.c.f.	Cell Pressure p.s.i.	Deviator Stress p.s.i.	Mean shear strength p.s.i.
1.	$1\frac{1}{2}$ -3	32.1 31.4 31.6	121.5 121.0 120.0	0 20 40	17.6 31.5 23.8	12.1
1.	$11\frac{1}{2}$ -13	28.7 29.0 28.1	124.5 122.2 124.0	0 20 40	11.4 16.7 14.8	7.1
1.	$26\frac{1}{2}$ -28	$\frac{1}{2}$ 27.6 25.6	125.0 125.0 126.0	0 20 40	14.3 19.0 29.0	10.4
1.	$31\frac{1}{2}$ -33	- 26.0 26.8	124.5 126.0 124.5	0 20 40	15.3 16.7 32.0	10.7
1.	$36\frac{1}{2}$ -38	27.8 - 27.8	124.5 124.5 126.0	0 20 40	15.2 25.3 31.5	12.0
1.	$41\frac{1}{2}$ -43	27.9 25.6 25.8	127.0 125.5 127.5	0 20 40	23.8 45.4 18.1	14.5

As above but rate reduced to 0.0005" per min. and with filter
papers to speed distribution of water pressure.

1.	$46\frac{1}{2}$ -48	25.6 25.2 26.1	129.0 130.0 129.0	20 40 60	30.4 29.6 34.0	15.7
2.	$1-2\frac{1}{2}$	35.0 36.0 31.6	116 117 119	20 40 60	10.0 12.9 14.2	6.2
2.	$6\frac{1}{2}$ -8	30.1 29.5 28.3	121 121 121	20 40 60	26.6 19.1 23.9	11.6
2.	$13\frac{1}{2}$ -15	31.7 31.6 32.0	122 122 121	20 40 60	22.2 20.0 14.2	9.4

1) Continued.

B.H.	Depth ft	Water Content %	Density p.c.f.	Cell Pressure p.s.i.	Deviator Stress p.s.i.	Mean Shear Strength p.s.i.
2	16 $\frac{1}{2}$ -18	29.1 28.1 28.1	124 124 124	20 40 60	15.2 19.1 17.0	8.5
2	21 $\frac{1}{2}$ -23	29.2 28.0 27.5	125 127 125	20 40 60	27.5 33.8 27.1	14.7
2	26 $\frac{1}{2}$ -28	23.7 25.6 24.5	125 123 124	20 40 60	25.1 29.0 27.5	15.6
4	1 $\frac{1}{2}$ -3	35.6 36.1 35.8	117 117 116	20 40 60	16.0 8.5 10.5	5.8
4	4 $\frac{1}{2}$ -6	29.8 32.1 29.8	121 121 121	20 40 60	12.8 12.8 15.2	6.8
4	7 $\frac{1}{2}$ -9	31.8 31.6 31.6	120 121 121	20 40 60	15.8 24.8 23.5	10.7
4	13 $\frac{1}{2}$ -15	28.6 28.5 27.4	122 123 122	20 40 60	28.6 28.2 26.8	13.9

2. Consolidated-undrained triaxial compression tests with pore water pressure measurement on 1 $\frac{1}{2}$ " samples. Porous discs and frictionless end platens used with filter papers. Dead loading to equilibrium. Five hours to failure.

B.H.	Depth ft	Water Content %	Cell Pressure p.s.i.	Deviator p.s.i.	Sum p.s.i.	c' p.s.i.	ϕ'
4	4 $\frac{1}{2}$ -6	33.0	10 30 50	12.3 21.7 29.1	28.1 67.1 109.1	3.1	13.0
4	7 $\frac{1}{2}$ -9	32.0	10 30 50	16.1 25.8 33.4	31.1 70.2 108.6	4.6	13.5
10	6 $\frac{1}{2}$ -8 Remoulded		10 30 50	12.1 26.0 41.8	28.3 67.2 109.8	1.0	21.1

3. Oedometer Consolidation Tests on 3" Dia. Samples taken in a Horizontal Direction and using Single Drainage Direction over 1" length.

B.H.	Depth ft	Water Content %	Pressure tons/ft ²	Strain	Coefficient of Consolidation. ft ² /yr	
2	6 $\frac{1}{2}$ -8	30.2	$\frac{1}{2}$ 1 2 4	0.0032 0.0045 0.0113 0.0290	85 30	Fissured Brown Clay
2	13 $\frac{1}{2}$ -15	23.2	$\frac{1}{2}$ 1 2 4	-0.0003 0.0031 0.0077 0.0208	48 25	Fissured and Laminated Brown Clay
2	16 $\frac{1}{2}$ -18	30.2	$\frac{1}{2}$ 1 2 4	0.0069 0.0105 0.0190 0.0350	47 32	Ditto
4	7 $\frac{1}{2}$ -9	30.5	$\frac{1}{2}$ 1 2 4	0.0070 0.0112 0.0243 0.0392	250 31	Ditto
4	13 $\frac{1}{2}$ -15	29.4	$\frac{1}{2}$ 1 2 4	0.0008 0.0030 0.0110 0.0278	500 86	Friable Brown Clay and Yellow Patches.

4. Standard Proctor Compaction Tests

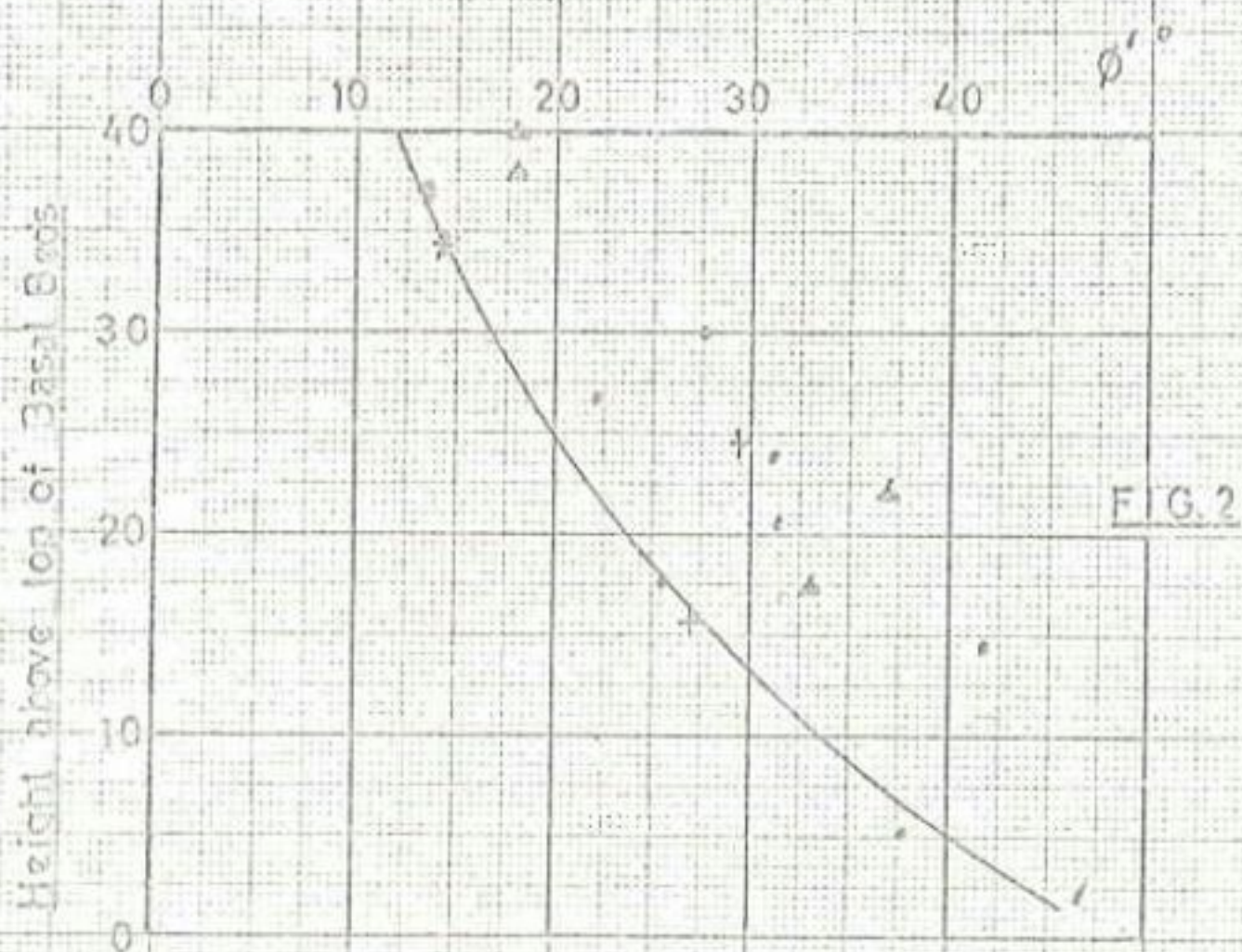
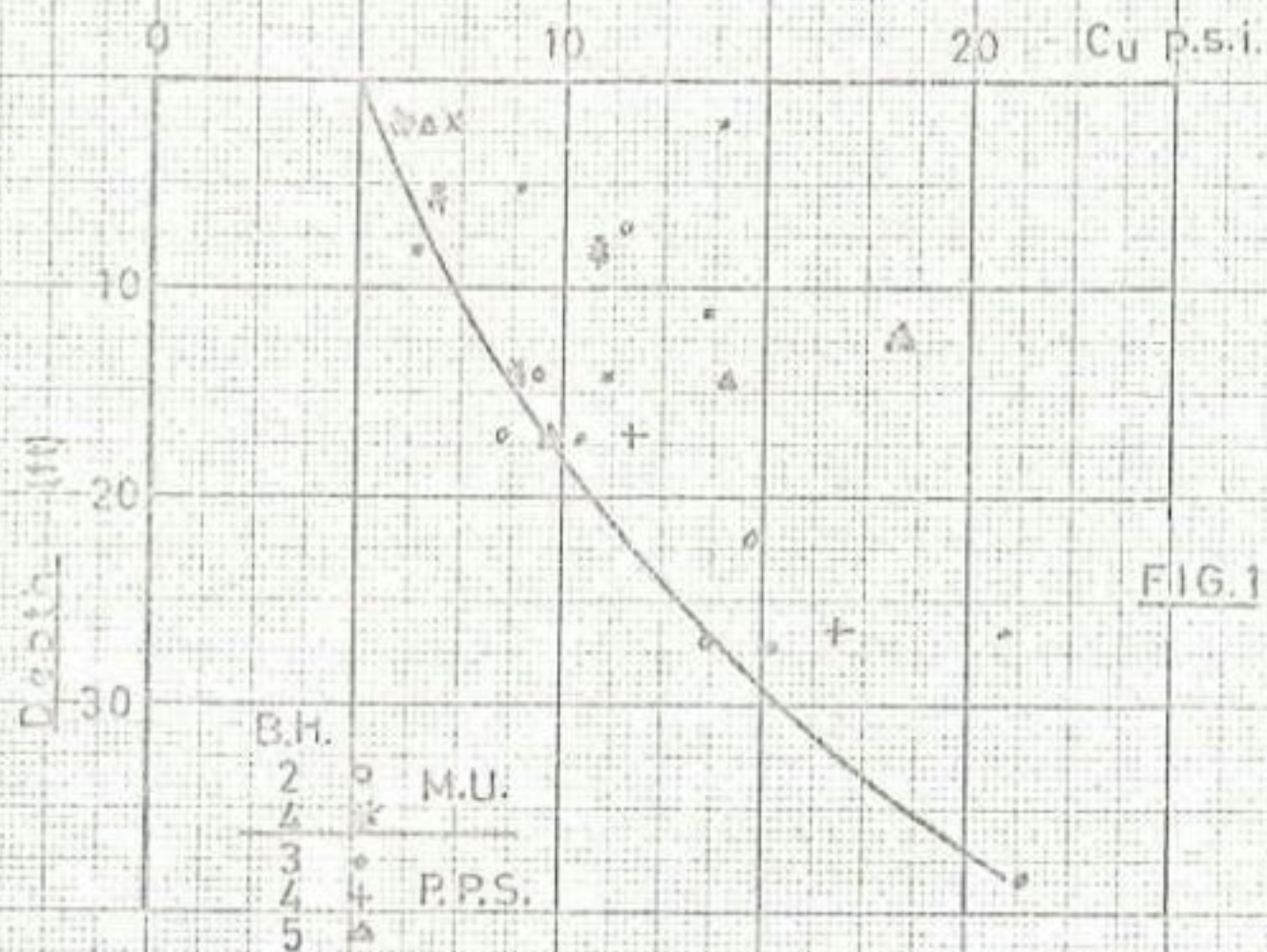
B.H.	Depth ft	Water Content %	Dry Density p.c.f.	Optimum Values % p.c.f.		Natural Water Content %
4	1 $\frac{1}{2}$ -3	22.3 23.2 24.5 26.0 28.8	90.0 92.8 93.4 92.5 88.5	24.5	93.4	36.5
4	4 $\frac{1}{2}$ -6	20.3 22.4 23.5 25.1 27.4 31.3	89.9 94.9 95.8 95.5 93.1 87.2	24.0	96.0	30.1
10	1 $\frac{1}{2}$ -3	20.0 22.5 24.5 27.5 28.8	96.0 97.0 96.2 93.5 90.8	24.5	96.2	26.9

4) Continued.

B.H.	Depth ft	Water Content %	Dry Density p.c.f.	Optimum Values % p.c.f.		Natural Water Content %
10	6 $\frac{1}{2}$ -8	19.4 21.4	97.4 98.0	21.4	98.0	35.1 to 42.5
Brown Clay		24.7	96.8			
Fissured		26.6	94.3			
and		30.1	89.3			
Laminated						
10.	16 $\frac{1}{2}$ -18	18.4 20.4	95.4 96.8	22.5	97.2	33.1 to 39.4
As above		24.8 27.2 30.6	96.0 93.5 88.5			

5. Identification Tests.

B.H.	Depth ft	Liquid Limit %	Plastic Limit %	% Clay %	Natural Liquidity Index
10	1 $\frac{1}{2}$ -3	72	28	-	-0.02
10	6 $\frac{1}{2}$ -8	63	26	46	0.25 - 0.45
10	16 $\frac{1}{2}$ -18	73	27	51	0.20 - 0.27
Disturbed sample of Reading Bed Red Clay		59	22		



FOUNDATION SHEAR STRENGTHS

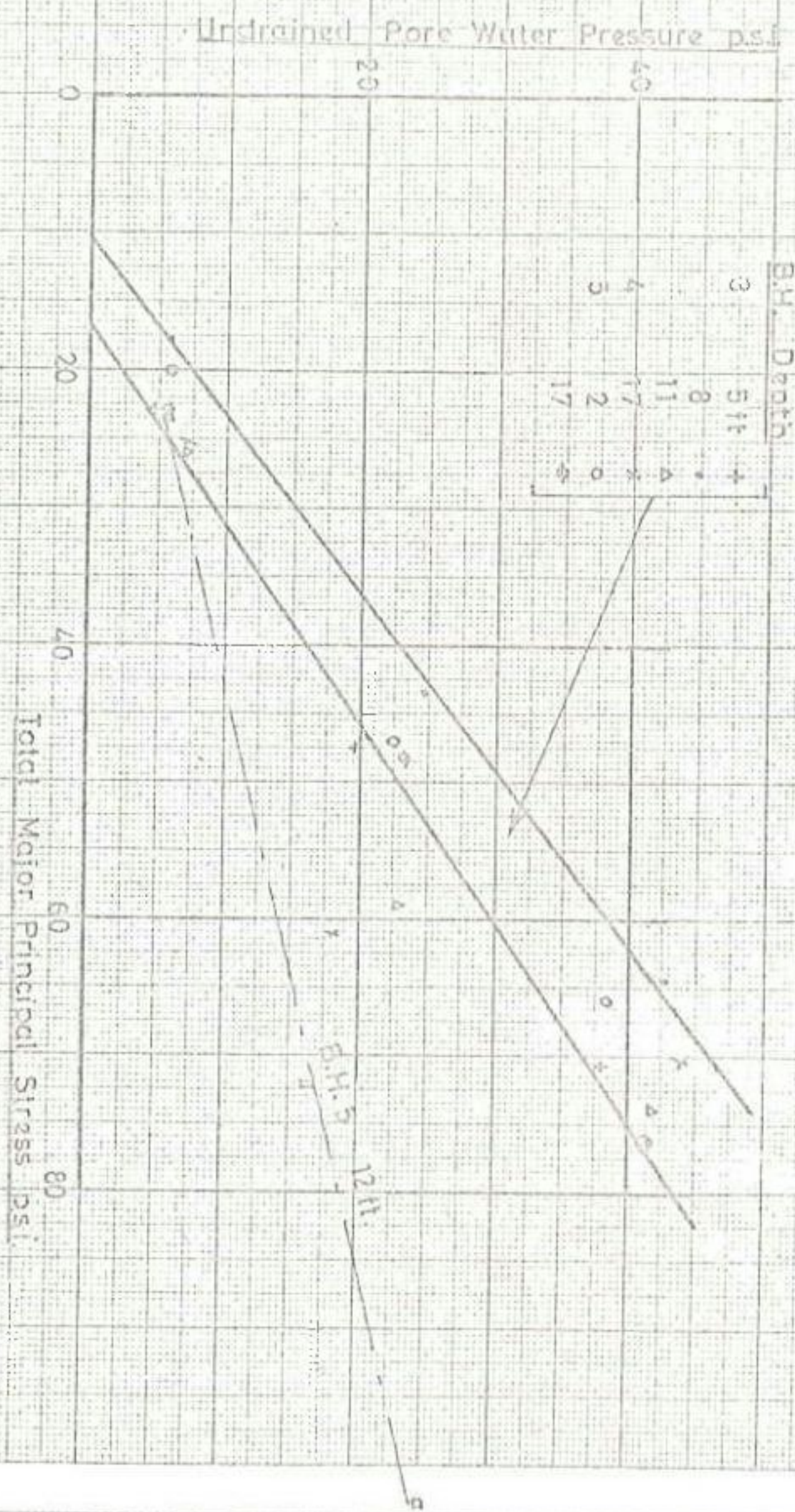


FIG. 3
FOUNDATION PORE PRESSURES

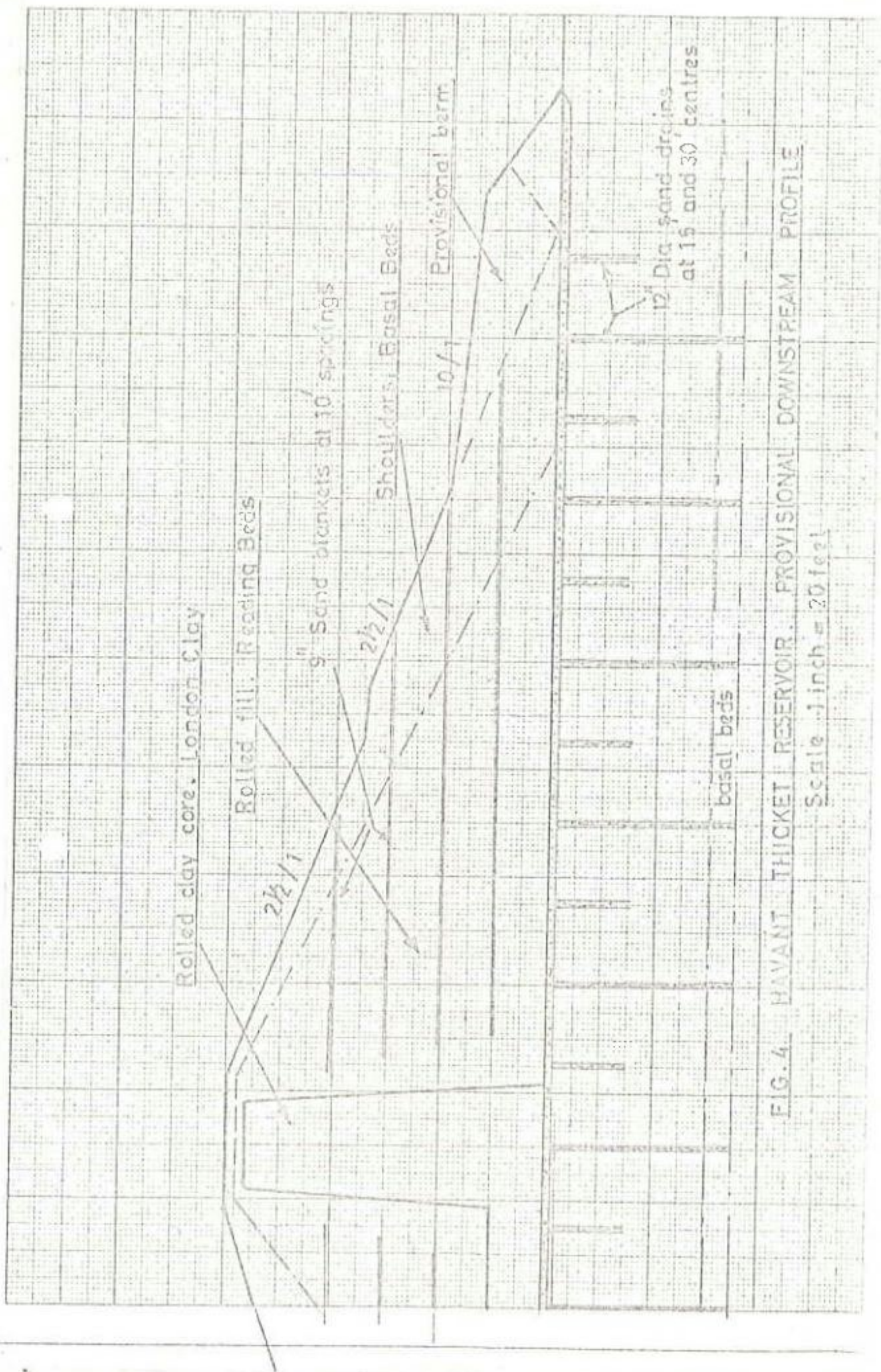


FIG. 4. HAVANT THICKET RESERVOIR. PROVISIONAL DOWNSTREAM PROFILE

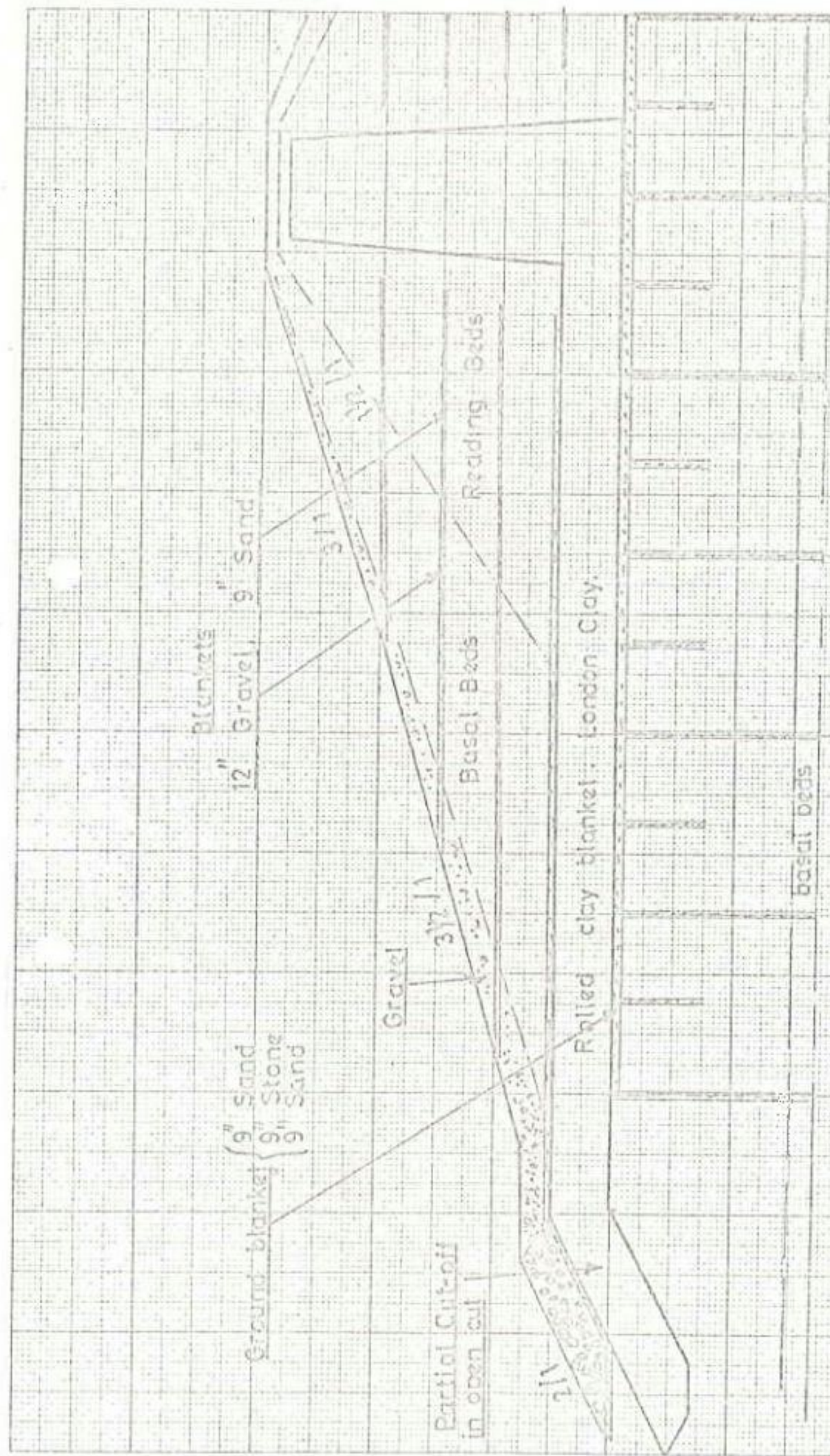


FIG.5 HAVANT THICKET RESERVOIR. PROVISIONAL UPSTREAM PROFILE

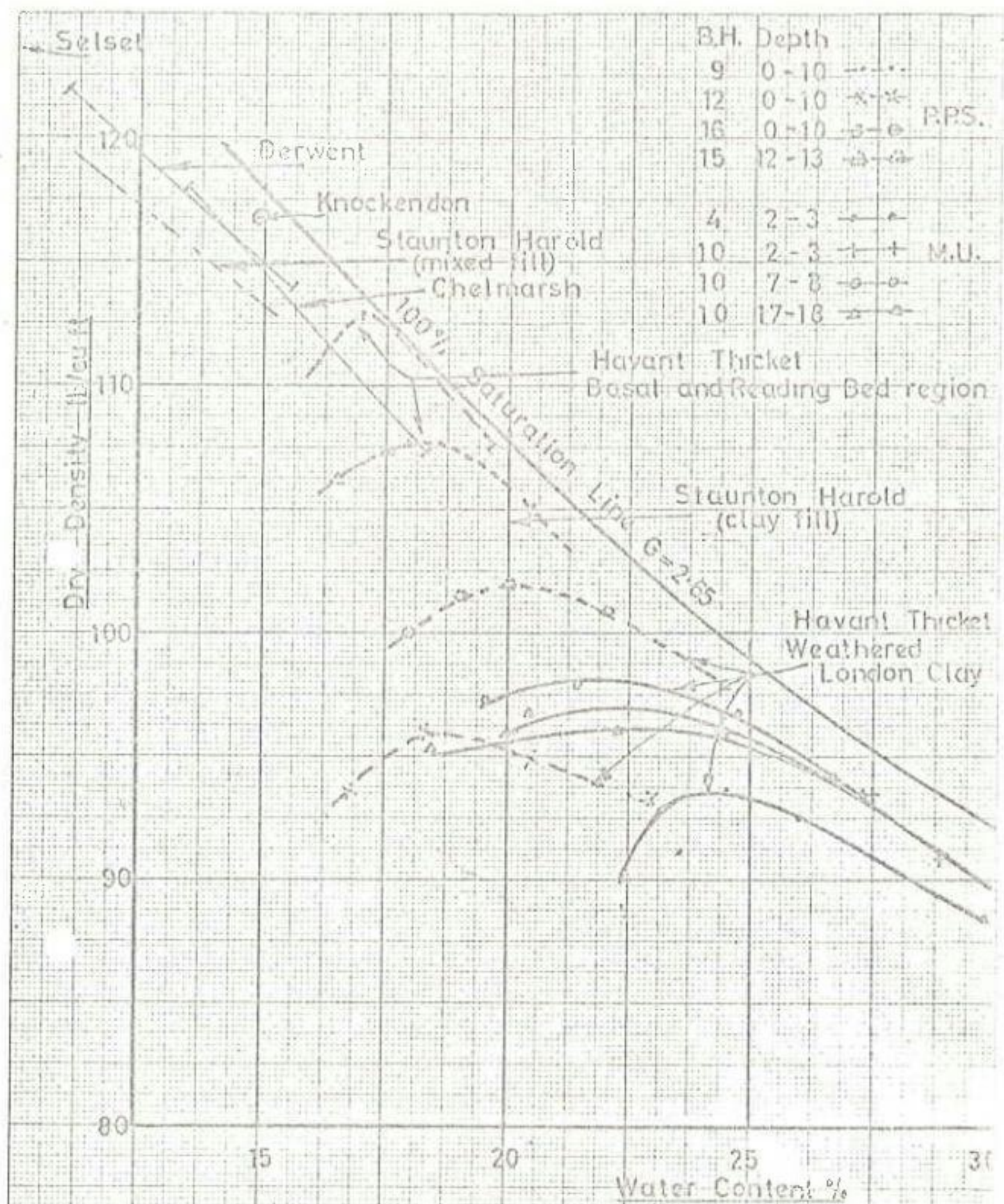


FIG. 6 - COMPACTION CURVES

SITE INVESTIGATION
at
HAVANT THICKET
for
PORTSMOUTH & GOSPORT
WATER COMPANY.
R.W. Hall Esq., M.I.C.E., M.I.W.E.,
Engineer,
26 and 28 Commercial Road,
Portsmouth : Hampshire.

Results of Tests as follows:-

Consolidation Tests on
undisturbed and compacted samples
Standard Proctor Compaction Tests.
Index Property Tests.
Grading Analyses.

Edgar Morton and Partner,
Consulting Engineering
Geologists,
Styperson House,
Adlington, Macclesfield.

Pre-Piling Surveys Ltd.,
Wharf Works,
Peterborough.

CONSOLIDATION TEST

DATE: January 1963.

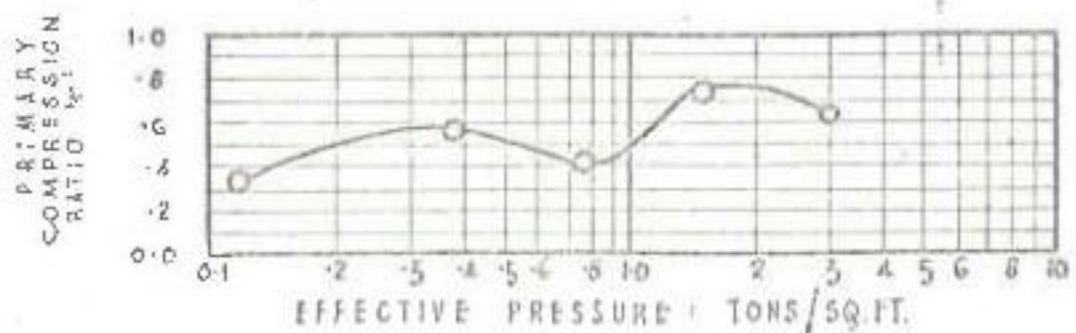
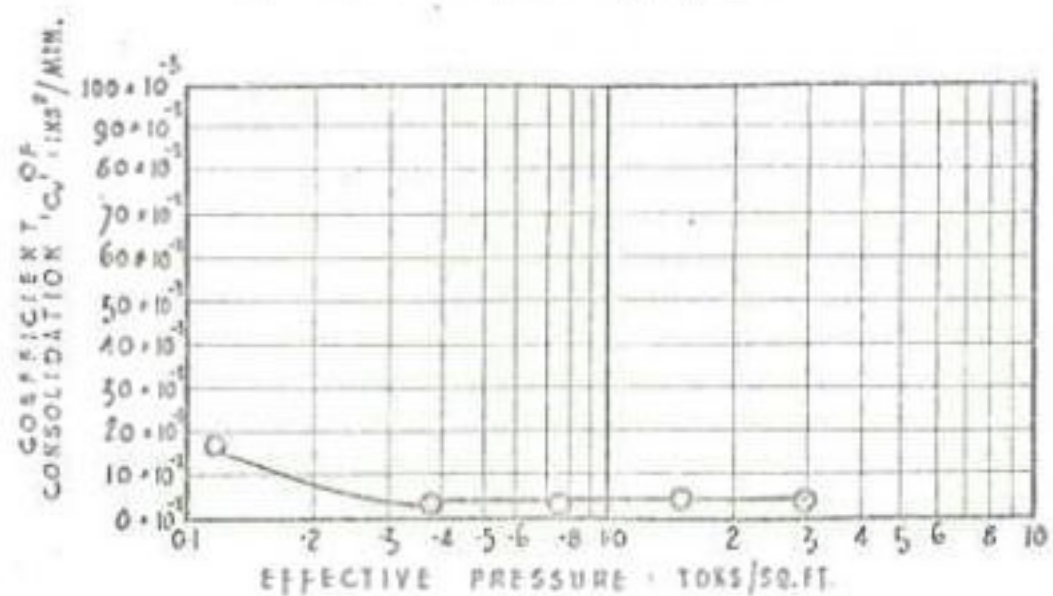
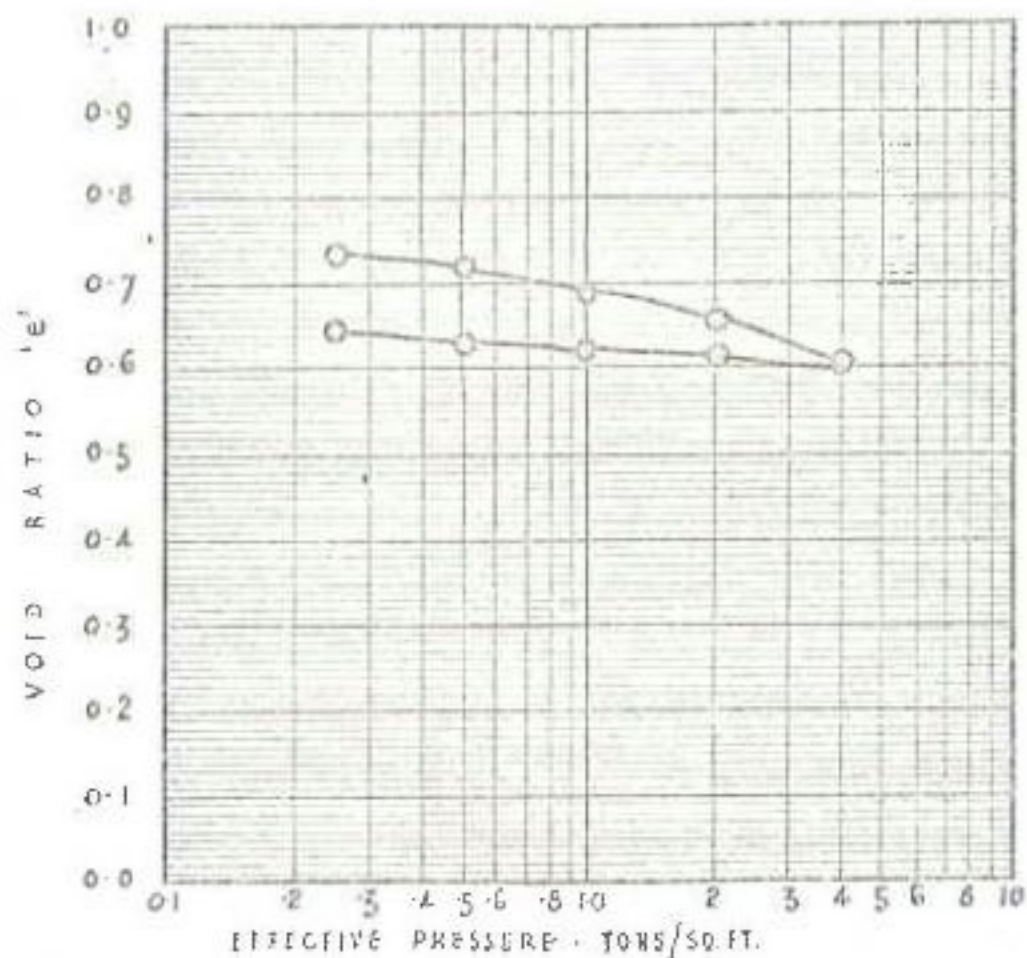
CONTRACT: Revient Shokat.
 SAMPLE REF.: Tube No. 3, Depth 1'50" - 3'00" B.S.
 DESCRIPTION: Grey and brown mottled clay with a few water-worn pebbles.

EFFECTIVE PRESSURE (TONS/SQ. FT.) p_1	VOID RATIO e
0	0.7217
$\frac{1}{2}$	0.7332
$\frac{1}{4}$	0.7212
1	0.6503
2	0.6552
4	0.6015
8	0.6120
1	0.6013
$\frac{1}{2}$	0.6312
$\frac{1}{4}$	0.6050
0	0.7210

PRESSURE RANGE (TONS/SQ. FT.) p_1	COEFFICIENT OF COMPRESSIBILITY (FT^2/TON) a_v	COEFFICIENT OF VOLUME DECREASE (FT^2/TON) m_v	COEFFICIENT OF CONSOLIDATION ($HR^2/MIN.$) c_v	COEFFICIENT OF PERMEABILITY ($HR^2/MIN.$) k_v
0 - $\frac{1}{2}$	0.700	0.0102	17.71×10^{-3}	36.10×10^{-7}
$\frac{1}{2}$ - 1	0.0560	0.0333	3.60×10^{-3}	5.98×10^{-7}
$\frac{1}{4}$ - 1	0.0503	0.0350	2.92×10^{-3}	1.50×10^{-7}
1 - 2	0.0721	0.0210	14.77×10^{-3}	1.50×10^{-7}
2 - 4	0.0243	0.0193	3.43×10^{-3}	2.31×10^{-7}

BULK DENSITY: 128 lb/cu.ft.
 DRY DENSITY: 106.9 lb/cu.ft.
 INITIAL W/C: 80.2%
 FINAL W/C: 27.1%

PRE PILING SURVEYS LTD., PETERBOROUGH.



CONSOLIDATION TEST

CONTRACT: Havant Thicket.

SAMPLE REF.: Tube No. 151, Bore No. 3, Depth 1'6" - 3'0"

DESCRIPTION: Gray and brown mottled clay with a few water-worn pebbles.

BULK DENSITY: 128.4 lb/cu.ft. DRY DENSITY: 106.9 lb/cu.ft.

INITIAL MOISTURE CONTENT: 20.2% FINAL MOISTURE CONTENT: 27.4%

DATE: January 1963.

PRE PILING SURVEYS LTD. PETERBOROUGH.

CONSOLIDATION TEST

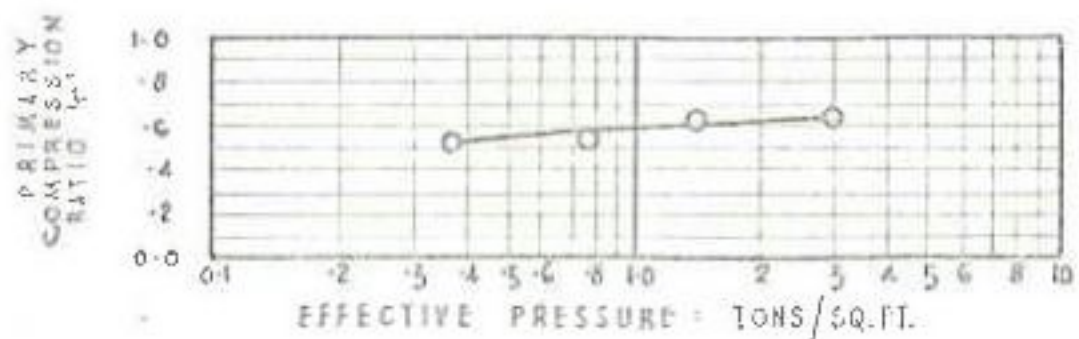
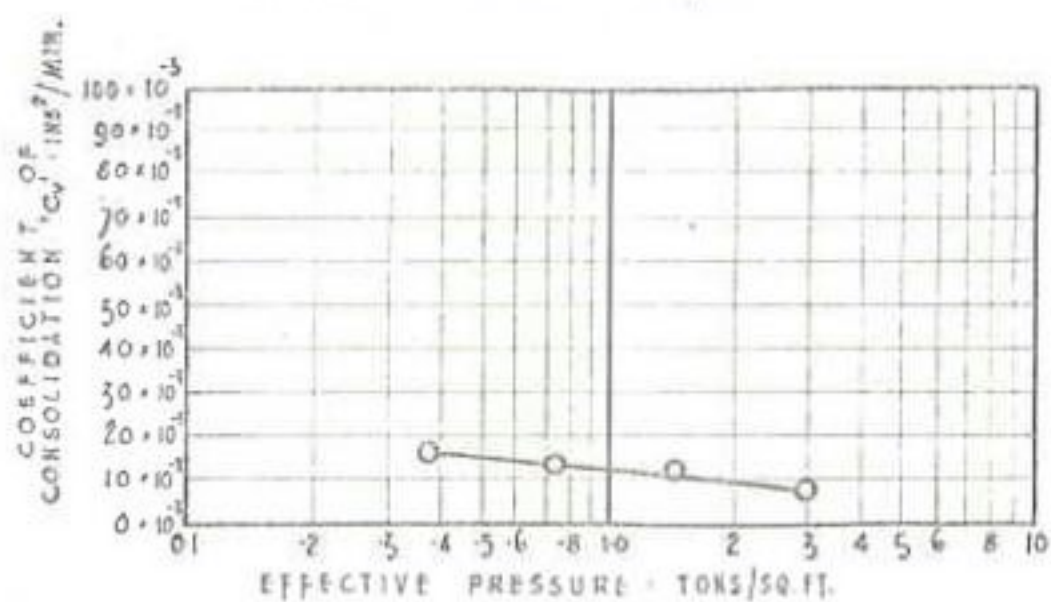
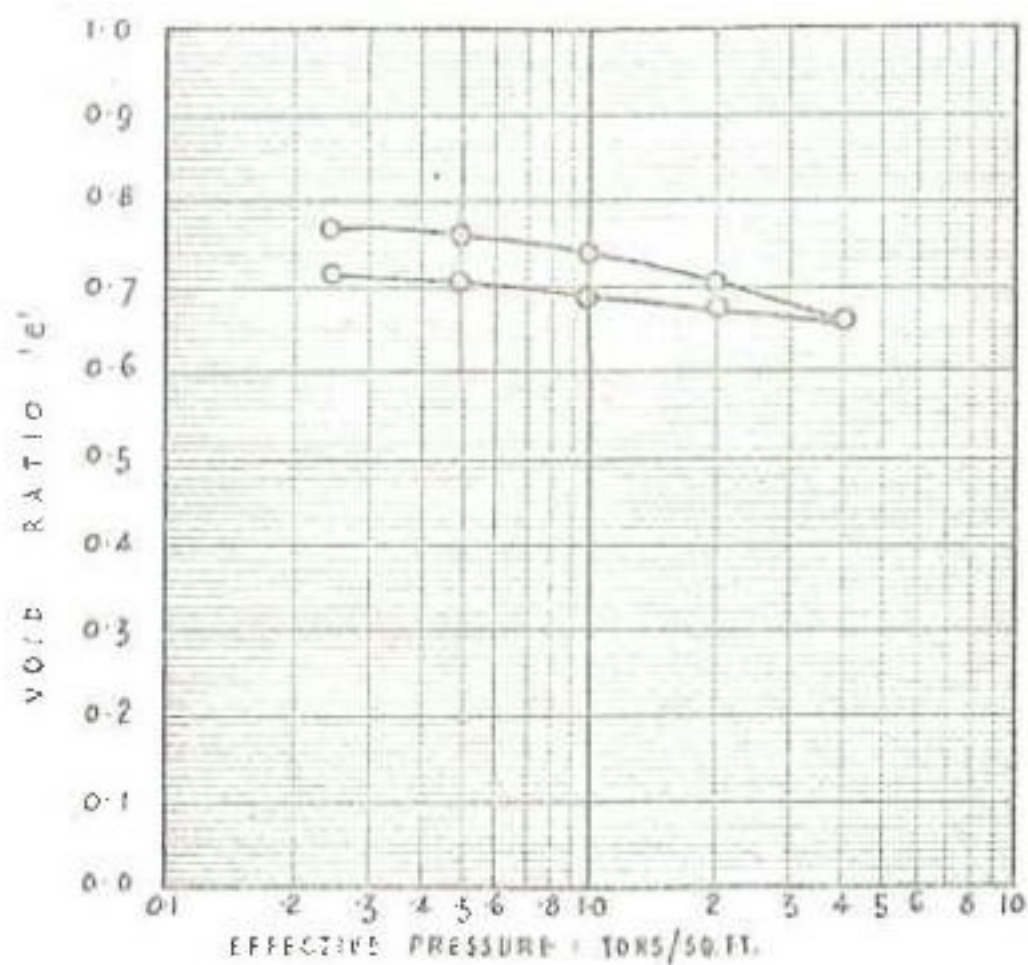
DATE: January 1963.

CONTRACT: Invent Mideast.
 SAMPLE REF.: Tube No. 176, Bore No. 3, Depth 10'6" - 12'0" D.S.
 DESCRIPTION: Grey-brown clay with pockets of fine sand.

EFFECTIVE PRESSURE (TONS/SQ. FT.)	VOID RATIO	PRESSURE RANGE (TONS/SQ. FT.)	COEFFICIENT OF COMPRESSIBILITY (α_v) (FT ² /TON)	COEFFICIENT OF VOLUME DECREASE (α_v) (FT ² /TON)	COEFFICIENT OF CONSOLIDATION (C_v) (IN ² /MIN.)	COEFFICIENT OF PERMEABILITY (k_v) (IN ⁵ /MIN.)
0	0.7083	0 - 1/2	0	0	0	0
1/2	0.7732	1/2 - 1	0.0225	0.0211	16.15×10^{-3}	17.65×10^{-7}
1	0.7685	1 - 2	0.0320	0.0270	13.05×10^{-3}	16.00×10^{-7}
2	0.7290	2 - 4	0.0218	0.0185	10.76×10^{-3}	9.05×10^{-7}
4	0.6634					
2	0.6701					
1	0.6319					
1/2	0.7115					
0	0.7413					
0	0.7200					

BULK DENSITY: 121.6 lb/cu.ft.
 DRY DENSITY: 95.7 lb/cu.ft.
 INITIAL W/C: 25.9 %
 FINAL W/C: 29.7 %

At this loading the sample expanded.



CONSOLIDATION TEST

CONTRACT : Havant Thicket.

SAMPLE REF: Tube No. 176, Bore No. 3, Depth 10'6" - 12'0" B.S.

DESCRIPTION : Grey black clay with pockets of fine sand.

BULK DENSITY : 121.6 lb/cu.ft.

DRY DENSITY : 95.9 lb/cu.ft.

INITIAL MOISTURE CONTENT : 26.9%

FINAL MOISTURE CONTENT : 29.7%

DATE : January 1963.

PRE PILING SURVEYS LTD - PETERBOROUGH.

CONSOLIDATION TEST

DATE: January 1963.

CONTRACT: Havant Thicket.

SAMPLE REF: No. 17, Bore No. 3, Depth 25'6" - 27'0" B.S.

DESCRIPTION: Highly fissured brown clay with lenses of black silt.

4

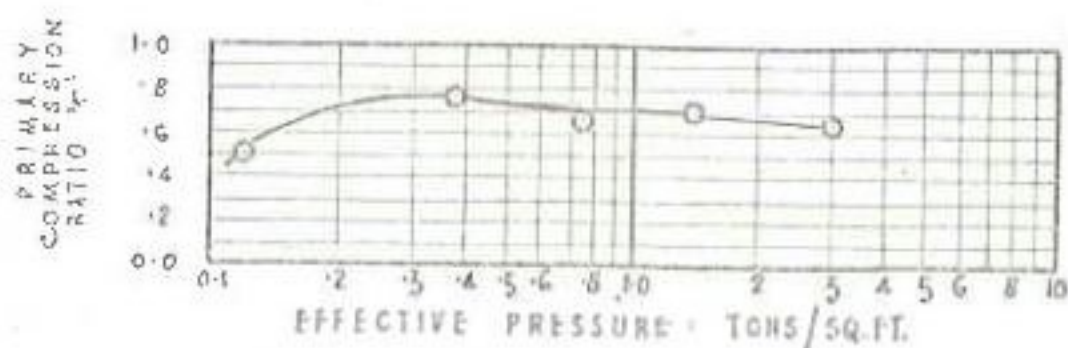
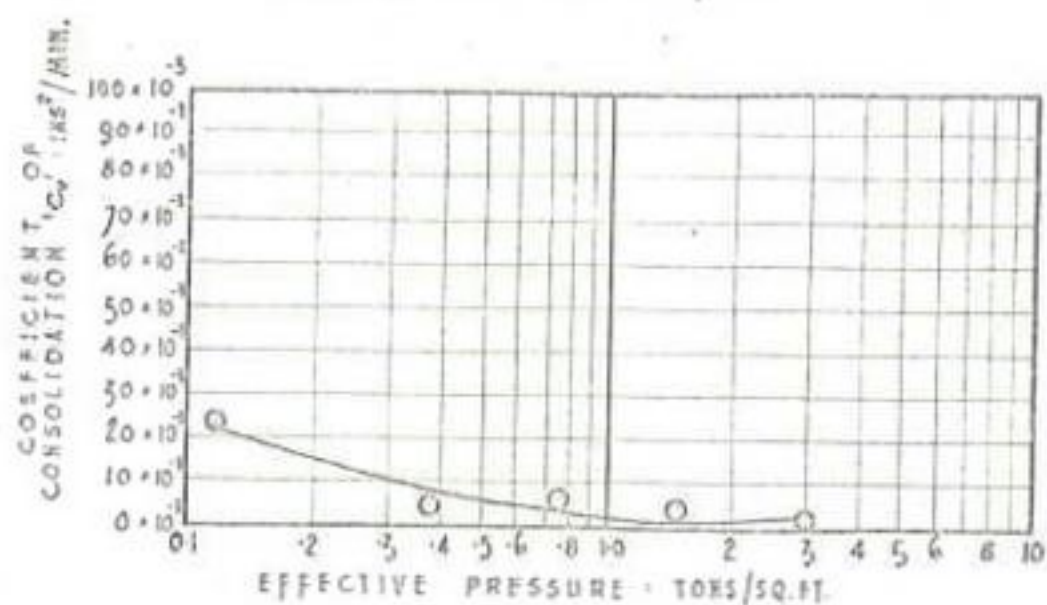
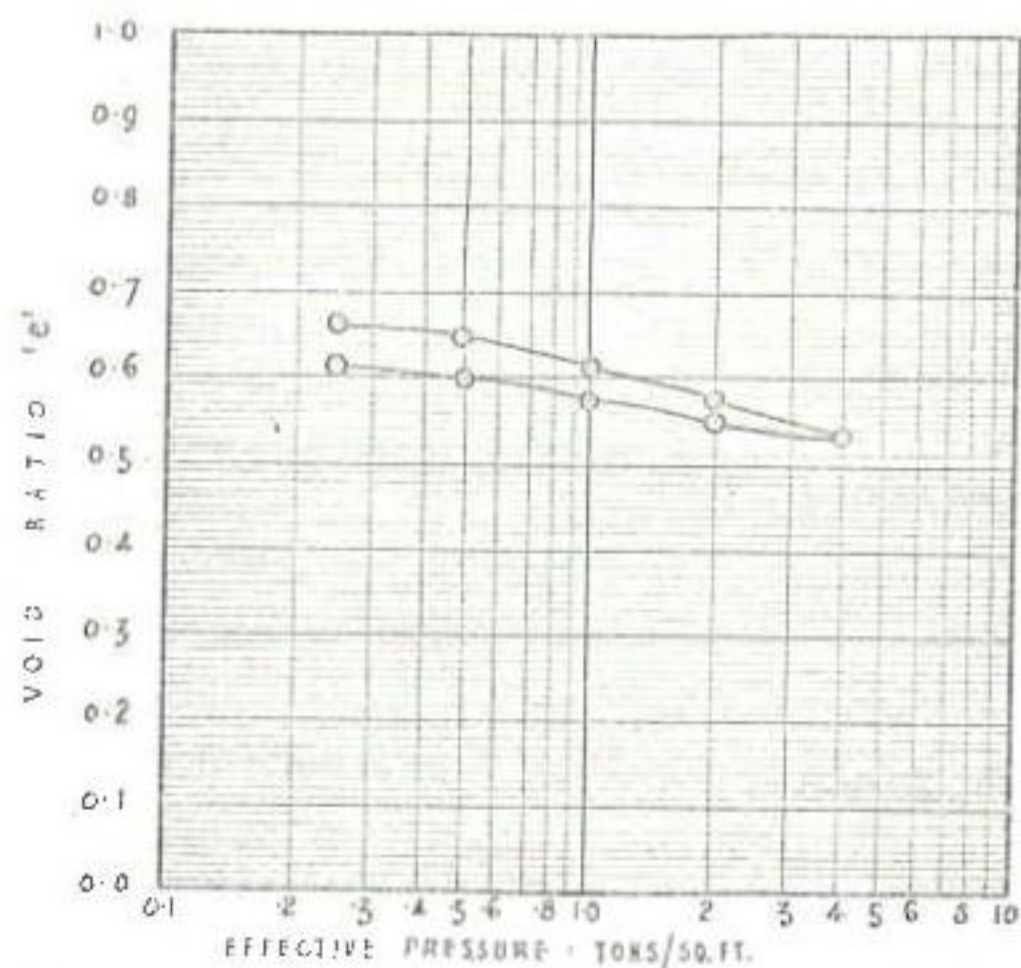
EFFECTIVE PRESSURE (TON/SQ. FT.)	VOID RATIO e	PRESSURE RANGE (TONS/SQ. FT.)	COEFFICIENT OF COMPRESSIBILITY (FT^2/TON) a_v	COEFFICIENT OF VOLUME DECREASE (FT^2/TON) m_v	COEFFICIENT OF CONSOLIDATION ($MS^2/MIN.$) c_v	COEFFICIENT OF PERMEABILITY ($MS/MIN.$) k
0	0.6357	0 - 1	0.1013	0.0521	22.79×10^{-3}	65.90×10^{-7}
1	0.6096	1 - 2	0.0003	0.0126	5.25×10^{-3}	9.65×10^{-7}
1	0.6125	1 - 2	0.0054	0.0100	5.03×10^{-3}	11.13×10^{-7}
1	0.6167	1 - 2	0.0377	0.0236	4.24×10^{-3}	5.67×10^{-7}
2	0.5720	2 - 4	0.0005	0.0132	2.39×10^{-3}	1.47×10^{-7}

BULK DENSITY: 125.7 lb/cu.ft.

DRY DENSITY: 100.9 lb/cu.ft.

INITIAL W/C: 26.5%

FINAL W/C: 26.9%



CONSOLIDATION TEST

CONTRACT: Havant Thicket.

SAMPLE REF: Tube No. 174, Bore No. 3, Depth 25'6" - 27'0" B.S.

DESCRIPTION: Highly fissured brown clay with traces of black silt.

BULK DENSITY: 125.7 lb/cu.ft.

DRY DENSITY: 100.9 lb/cu.ft.

INITIAL MOISTURE CONTENT: 24.5%

FINAL MOISTURE CONTENT: 26.8%

DATE: January 1965.

PRE PILING SURVEYS LTD. PETERBOROUGH.

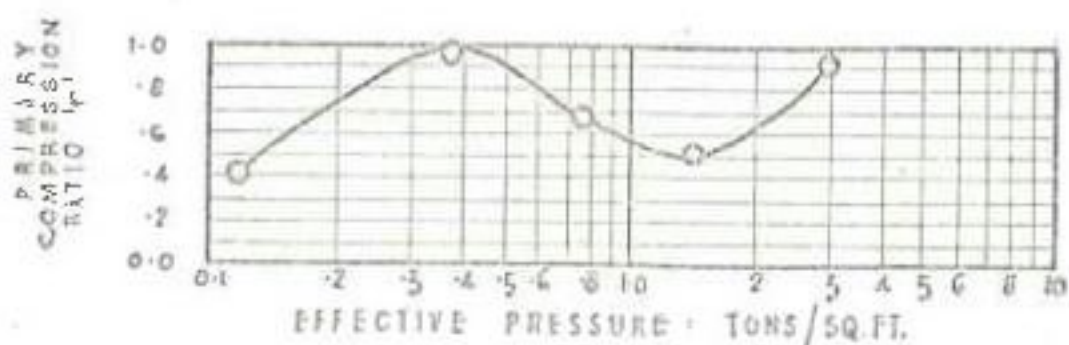
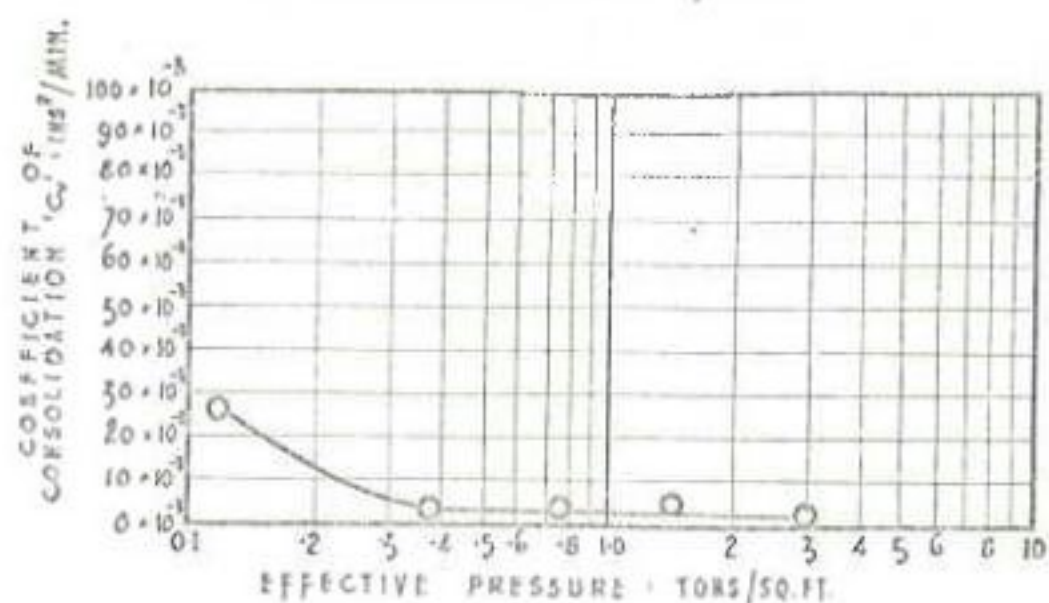
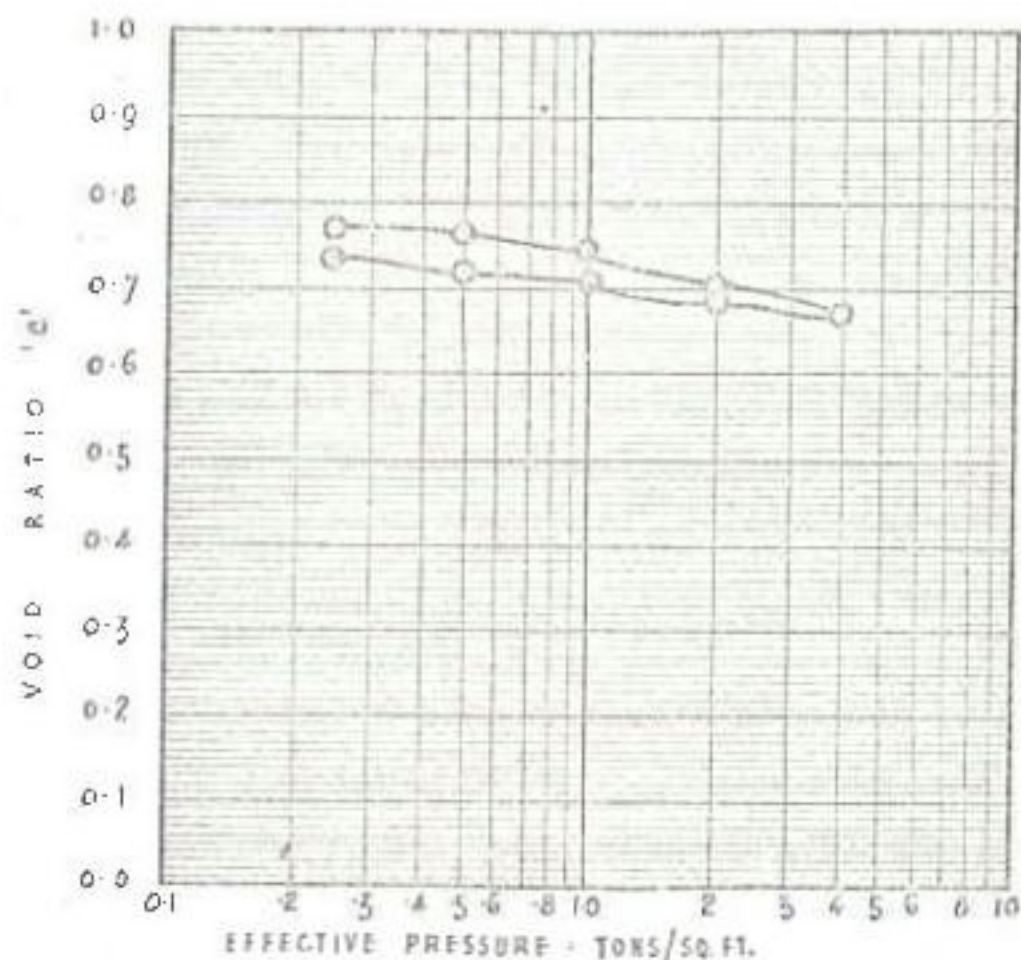
CONSOLIDATION TEST

DATE: January 1963.

CONTRACT: Navy's Exhibit.
 SAMPLE REF.: Tube No. 176, Bore No. 4, Depth 16'6" - 18'0" B.S.
 DESCRIPTION: Highly fissured grey-brown clay with small calcite crystals.

EFFECTIVE PRESSURE (TONS/SQ.FT.) p'	VOID RATIO e	PRESSURE RANGE (TONS/SQ.FT.) p'	COEFFICIENT OF COMPRESSIBILITY (FT^2/TON) a_v	COEFFICIENT OF VOLUME DECREASE (FT^2/TON) m_v	COEFFICIENT OF CONSOLIDATION ($MS^2/MIN.$) c_v	COEFFICIENT OF PERMEABILITY ($MS/MIN.$) k'
3	0.7276	0 - 3	0.0360	0.0538	26.00×10^{-3}	63.60×10^{-7}
2	0.7736	3 - 4	0.0356	0.0201	3.55×10^{-3}	3.27×10^{-7}
1	0.7645	4 - 1	0.0456	0.0255	3.77×10^{-3}	4.55×10^{-7}
1	0.7412	1 - 2	0.0355	0.0205	5.12×10^{-3}	1.77×10^{-7}
2	0.7059	2 - 4	0.0173	0.0103	2.00×10^{-3}	0.24×10^{-7}

BULK DENSITY: 121.8 lb/cu.ft.
 DRY DENSITY: 93.5 lb/cu.ft.
 INITIAL W/C: 30.3%
 FINAL W/C: 30.6%



CONSOLIDATION TEST

CONTRACT : Havant Thicket.

SAMPLE REF. Tube No. 194, Bore No. 4, Depth 16'6" - 18'0" B.S.

DESCRIPTION : Highly fissured grey-brown clay with selenite crystals.

BULK DENSITY : 121.8 lb/cu.ft.

DRY DENSITY : 93.5 lb/cu.ft.

INITIAL MOISTURE CONTENT : 30.3%

FINAL MOISTURE CONTENT : 30.6%

DATE : January 1963.

PRE PILING SURVEYS LTD. - PETERBOROUGH.

CONSOLIDATION TEST

DATE: January 1963.

CONTRACT: Havant Thicket.

SAMPLE REF: Tube No. 172, Core No. 5, Depth 11'6" - 13'0" B.S.

DESCRIPTION: Highly fissured friable grey-brown clay with various discolorations.

EFFECTIVE PRESSURE (TONS/SQ. FT.)	VOID RATIO e
0	0.9119
1	0.8123
1	0.7726
1	0.7652
2	0.7246
5	0.6566
2	0.6202
1	0.6057
1	0.7035
1	0.7173
0	0.7052

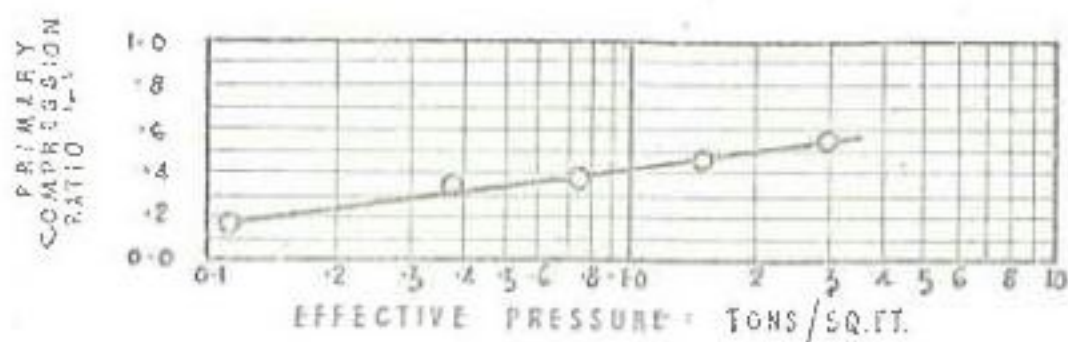
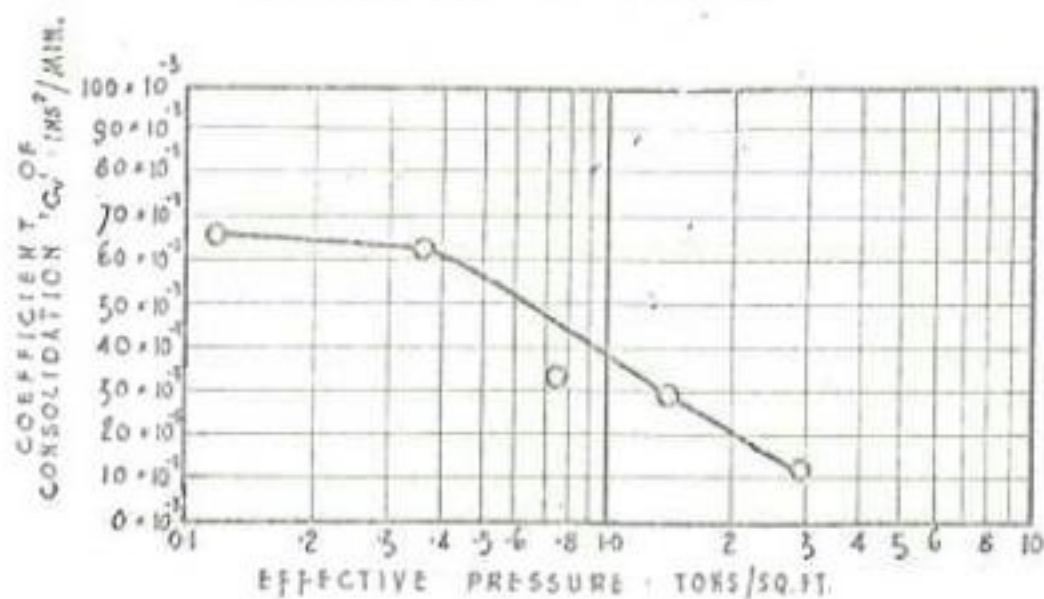
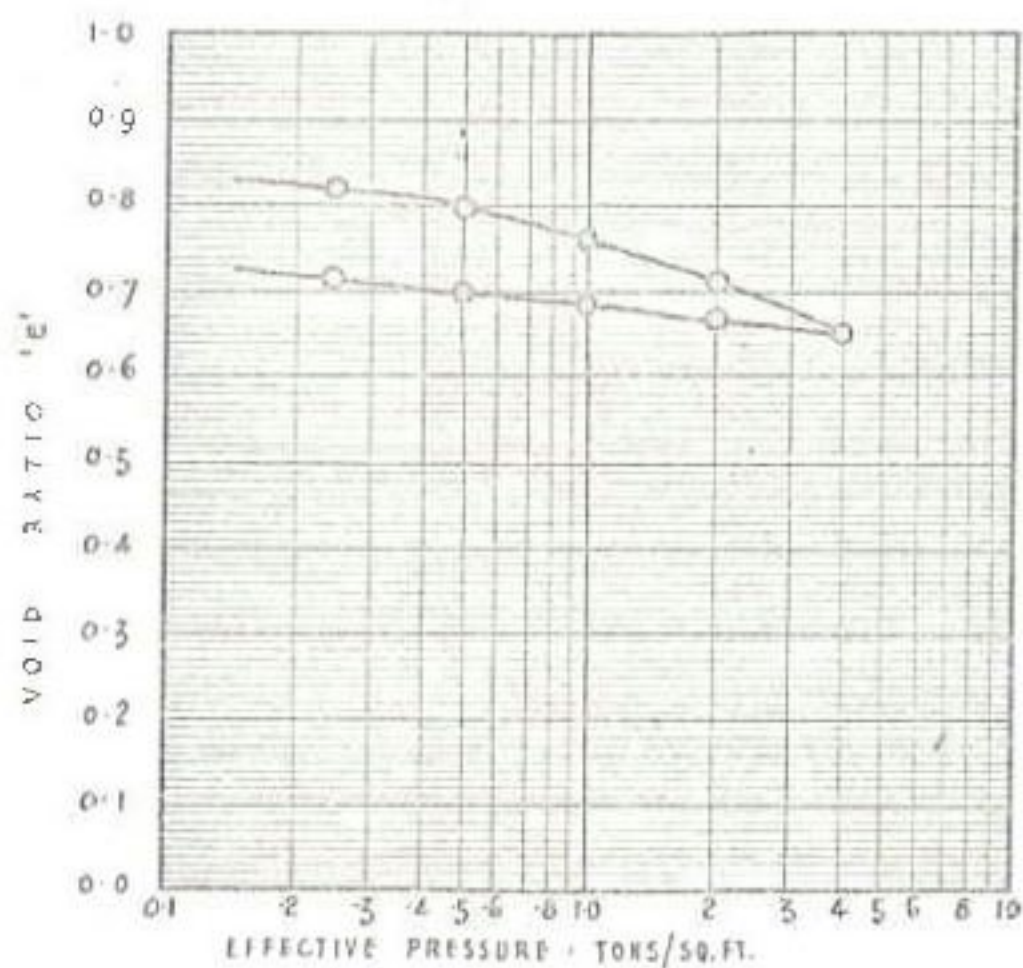
PRESSURE RANGE (TONS/SQ. FT.)	COEFFICIENT OF COMPRESSIBILITY (FT^2/TON) a_v	COEFFICIENT OF VOLUME DECREASE (FT^3/TON) m_v	COEFFICIENT OF CONSOLIDATION ($MS^2/MIN.$) c_v	COEFFICIENT OF PERMEABILITY ($MS/MIN.$) k
0 - 1	0.1283	0.0629	63.90×10^{-5}	$1.99.00 \times 10^{-7}$
1 - 2	0.0918	0.0469	61.70×10^{-5}	$1.96.20 \times 10^{-7}$
2 - 5	0.0712	0.0400	55.50×10^{-5}	53.20×10^{-7}
5 - 2	0.0404	0.0273	23.60×10^{-5}	55.90×10^{-7}
2 - 0	0.0390	0.0172	11.75×10^{-5}	3.82×10^{-7}

BULK DENSITY: 126.8 lb/cu.ft.

DRY DENSITY: 89.9 lb/cu.ft.

INITIAL W/C: 22.8 %

FINAL W/C: 50.0 %



CONSOLIDATION TEST

CONTRACT: Havant Thicket.

SAMPLE REF: Tube No. 172, Bore No. 5, Depth 11'6" - 13'0" B.S.

DESCRIPTION: Highly fissured friable grey brown clay with ferrous discolourations.

BULK DENSITY: 116.8 lb/cu.ft.

DRY DENSITY: 89.9 lb/cu.ft.

INITIAL MOISTURE CONTENT: 29.8%

FINAL MOISTURE CONTENT: 30.0%

DATE: January 1963.

PRE PILING SURVEYS LTD. - PETERBOROUGH.

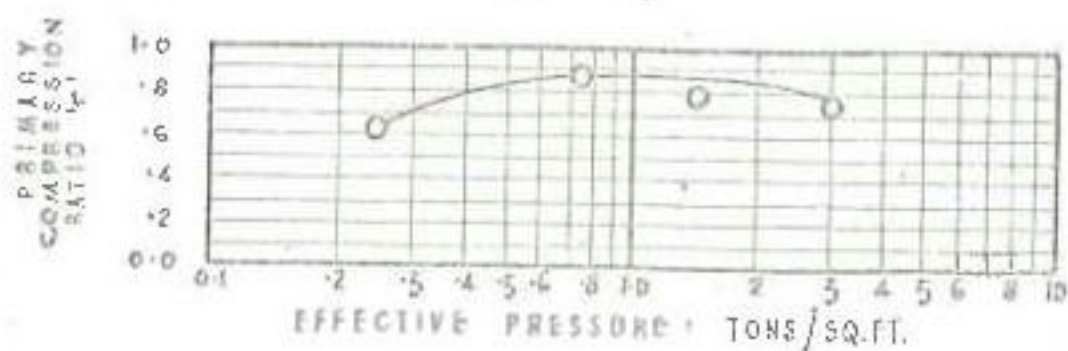
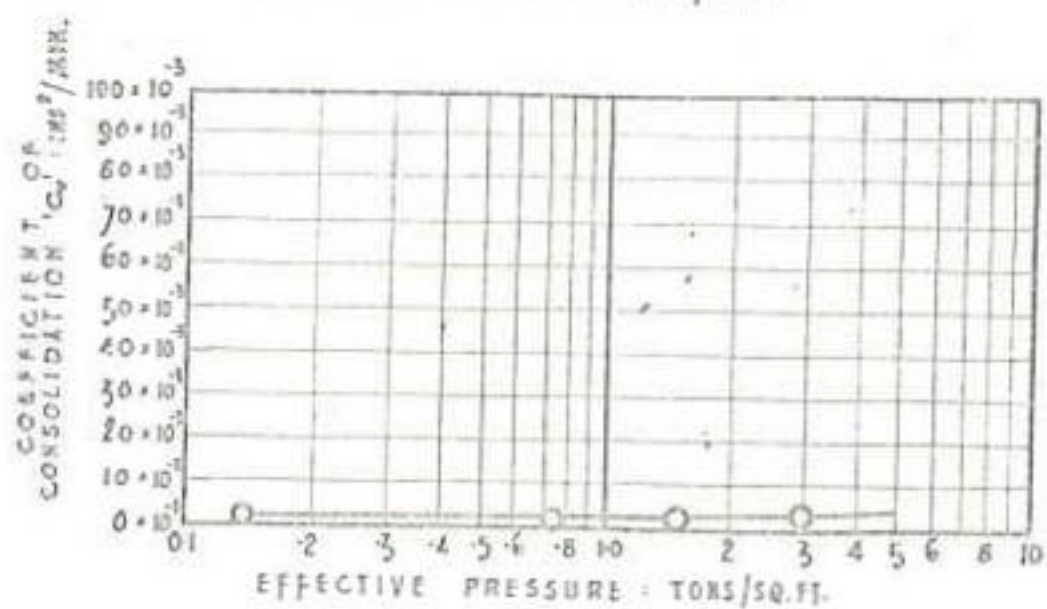
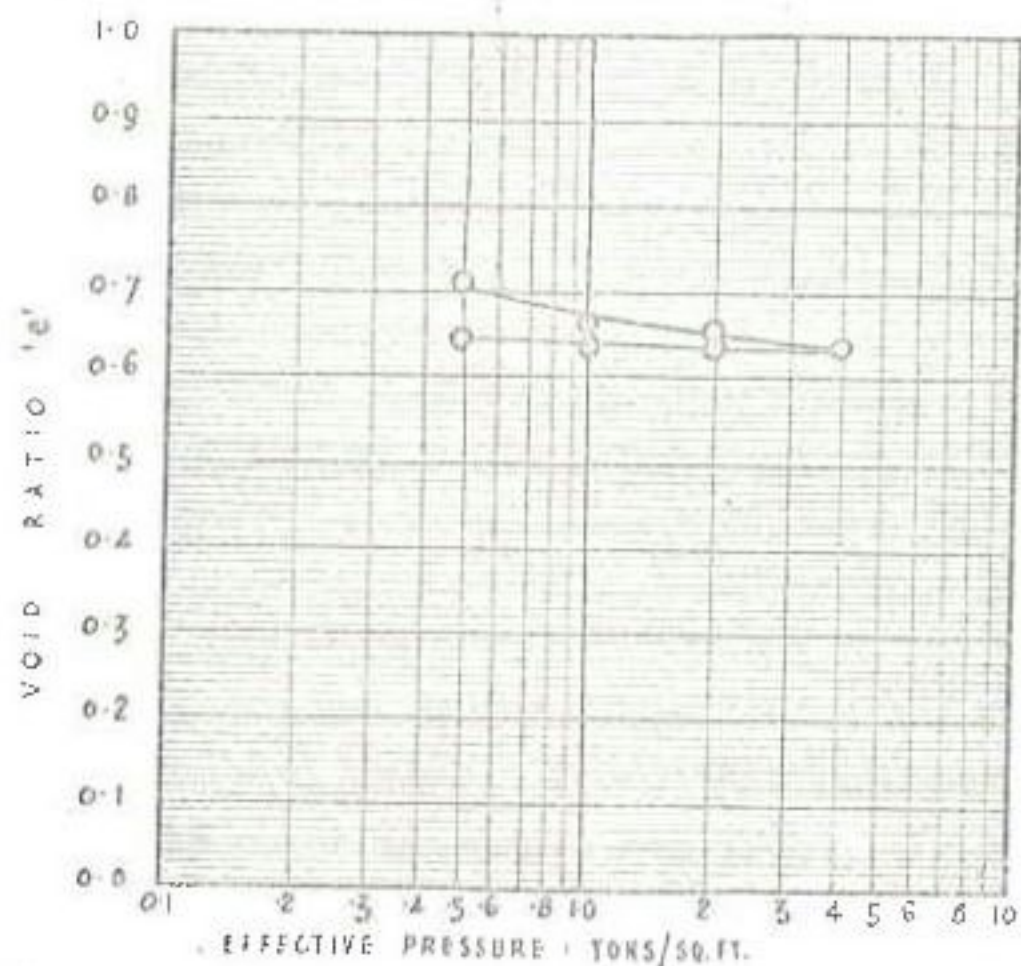
CONSOLIDATION TEST

DATE : January 1963.

CONTRACT : Havant Thicket.
 SAMPLE REF. : Borehole 9: Mixture of fragmentary samples 0 - 10 ft. depth.
 DESCRIPTION : Brown and grey silty sandy clay with flint and roots.

EFFECTIVE PRESSURE (TONS/SQ. FT.) p_1'	VOID RATIO e_1'	PRESSURE RANGE (TONS/SQ. FT.) p_2'	COEFFICIENT OF COMPRESSIBILITY (FT^2/TON) a_v'	COEFFICIENT OF VOLUME DECREASE (FT^2/TON) m_v'	COEFFICIENT OF CONSOLIDATION ($IN^2/MIN.$) c_v'	COEFFICIENT OF PERMEABILITY ($IN^2/MIN.$) k_1'
0	0.8356	0 - $\frac{1}{2}$	0.2544	0.1435	1.73×10^{-3}	11.10×10^{-7}
$\frac{1}{2}$	0.7084	$\frac{1}{2}$ - 1	0.0946	0.0562	1.95×10^{-3}	4.90×10^{-7}
1	0.5611	1 - 2	0.0568	0.0318	2.13×10^{-3}	3.43×10^{-7}
2	0.5043	2 - 4	0.0288	0.0183	2.65×10^{-3}	2.18×10^{-7}
4	0.5467					
2	0.5536					
1	0.5585					
$\frac{1}{2}$	0.5666					
0	0.6320					

BULK DENSITY : 120.0 lb/cu.ft.
 DRY DENSITY : 93.9 lb/cu.ft.
 INITIAL W/C. : 28.0%
 FINAL W/C. : 23.8%



CONSOLIDATION TEST

CONTRACT: Havant Thicket.

SAMPLE REF: Borehole 2, Frag. samples 0 - 10 ft. depth.

DESCRIPTION: Brown and gray silty sandy clay with flint and roots.

BULK DENSITY: 120.0 lb/cu.ft.

DRY DENSITY: 93.9 lb/cu.ft.

INITIAL MOISTURE CONTENT: 28.0%

FINAL MOISTURE CONTENT: 23.8%

DATE: January 1963.

PRE PILING SURVEYS LTD. - PETERBOROUGH.

CONSOLIDATION TEST

DATE: January, 1969.

CONTRACT: Harwin's Wharf.

SAMPLE NO: Borehole 12: Mixture of fragmentary samples 0 - 10 ft. depth.

DESCRIPTION: Brown and gray sandy silty clay with roots.

EFFECTIVE PRESSURE (TONS/SQ. FT.) p_1	VOID RATIO e
0	1.0013
1/4	1.0257
1	1.0013
2	0.9560
1/2	0.9375
2	0.9077
1	0.9006
1/2	0.8775
0	1.1320
	..

PRESSURE RANGE (TONS/SQ. FT.) p_1	COEFFICIENT OF COMPRESSIBILITY (FT^2/TON) a_v	COEFFICIENT OF VOLUME DECREASE (FT^3/TON) m_v	COEFFICIENT OF CONSOLIDATION ($MS^2/MIN.$) c_v	COEFFICIENT OF PERMEABILITY ($MS/ATH.$) k
0 - 1/4	- 0	- 0	- 0	- 0
1/4 - 1	0.0032	0.0076	2.76×10^{-3}	2.50×10^{-7}
1 - 2	0.0033	0.0085	1.27×10^{-3}	1.51×10^{-7}
2 - 1/2	0.0033	0.0179	0.60×10^{-3}	0.45×10^{-7}

BULK DENSITY: 113.5 lb/cu.ft.

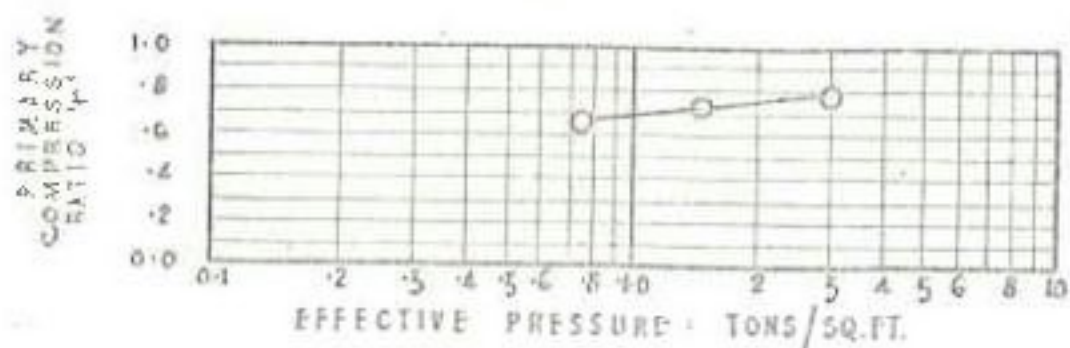
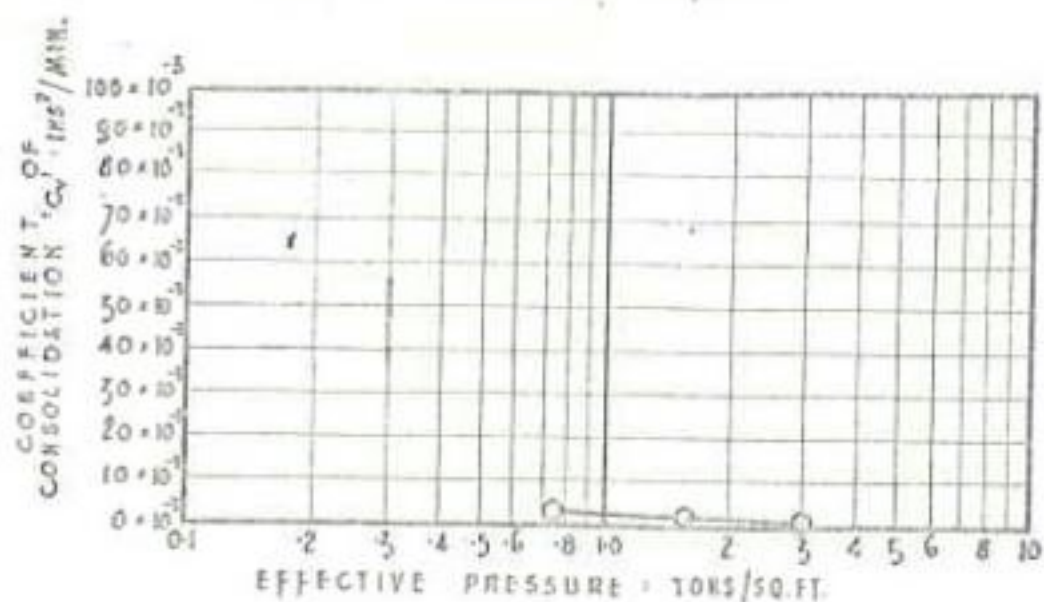
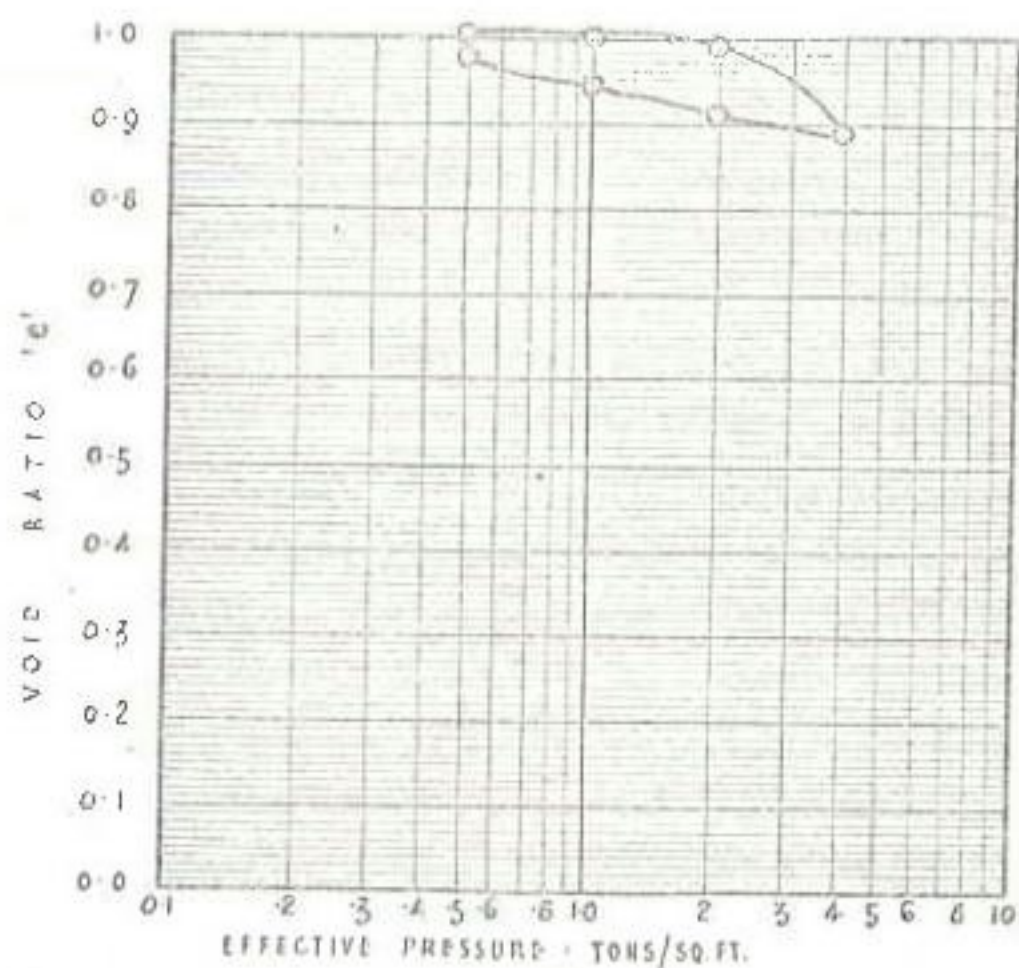
DRY DENSITY: 85.5 lb/cu.ft.

INITIAL M/C: 32.3%

FINAL M/C: 42.9%

* Samples expanded with this increment of load.

Note: This sample was compacted in the Proctor Mold at natural moisture content.



CONSOLIDATION TEST

CONTRACT : Havant Thicket.

SAMPLE REF. : Borehole 12: Frag. samples 0 - 10 ft. depth.

DESCRIPTION : Brown and grey sandy silty clay with roots.

BULK DENSITY : 113.5 lb/cu.ft.

DRY DENSITY : 85.5 lb/cu.ft.

INITIAL MOISTURE CONTENT : 32.8%

FINAL MOISTURE CONTENT : 42.9%

DATE : January 1963.

PRE PILING SURVEYS LTD : PETERBOROUGH.

CONSOLIDATION TEST

DATE: January 1963.

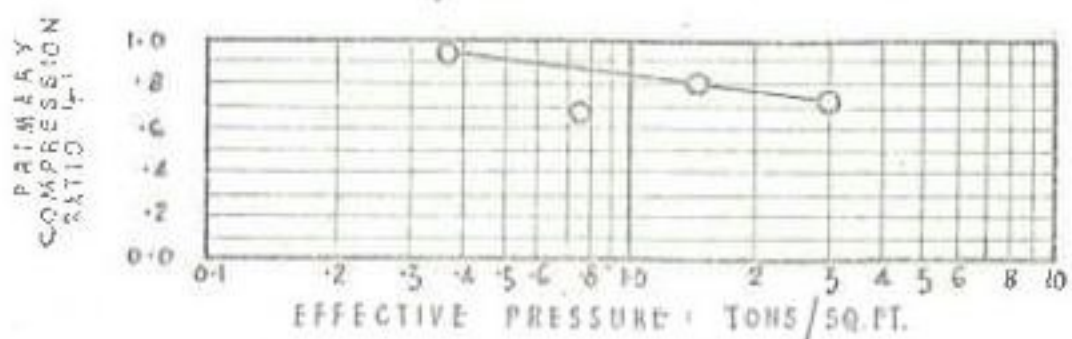
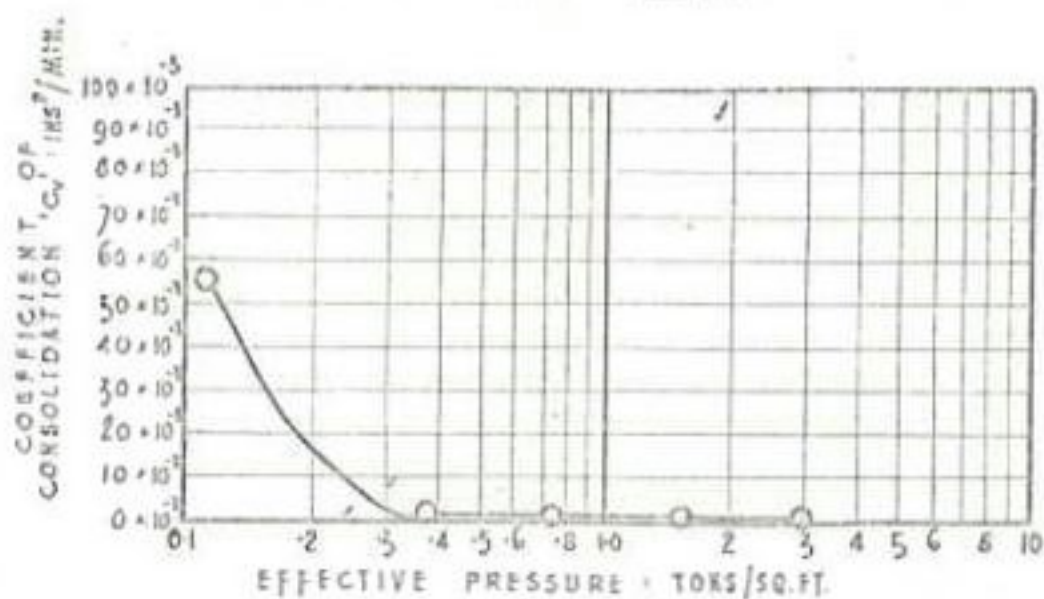
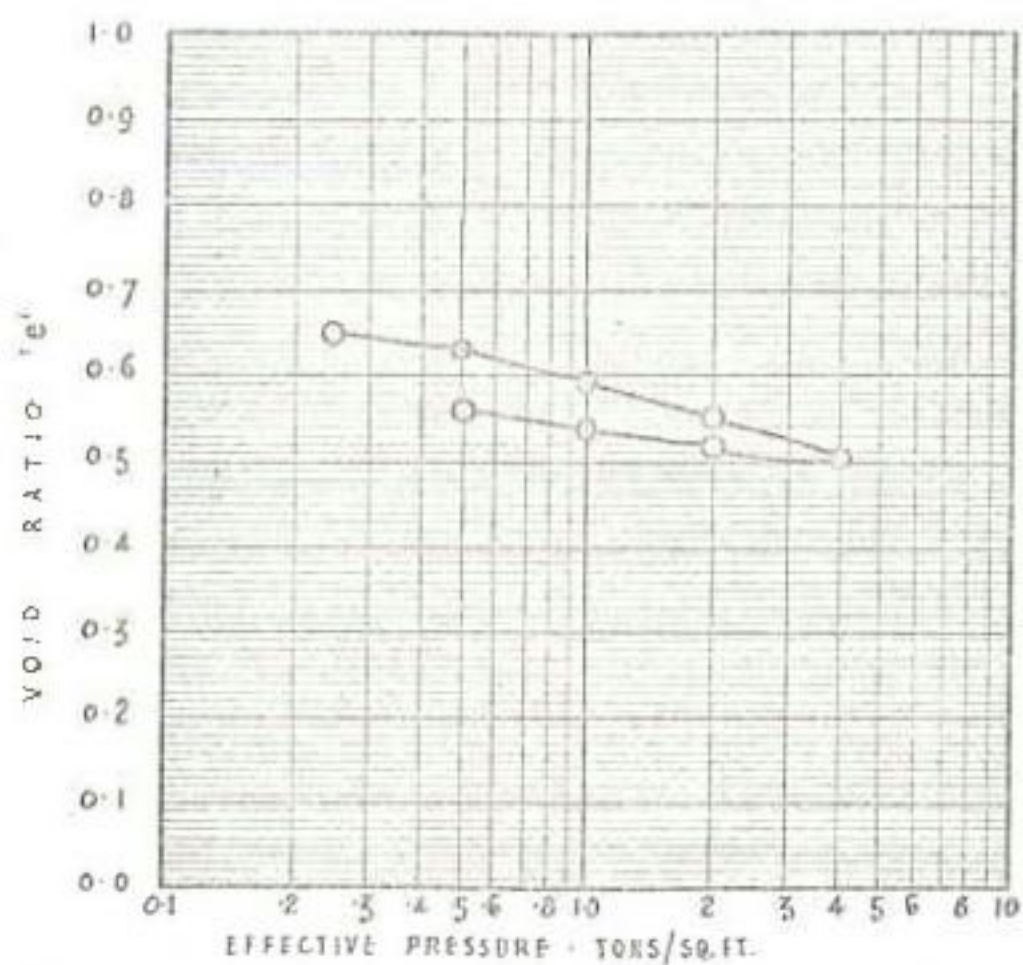
CONTRACT: Harant Shale.
 SAMPLE REF: Tube No. 226, Borehole No. 15, Depth 12'0" - 13'0"
 DESCRIPTION: Gray and dark gray bottled clay.

EFFECTIVE PRESSURE (TONS/SQ. FT.) p'	VOID RATIO e	COEFFICIENT OF COMPRESSION (FT ² /TON) a_v	COEFFICIENT OF VOLUME DECREASE (FT ³ /TON) m_v	COEFFICIENT OF CONSOLIDATION (185%/MIN.) c_v	COEFFICIENT OF PERMEABILITY (185%/MIN.) k'
0	0.6111				
1/4	0.6026	0.0664	0.0005	1.31×10^{-3}	2.62×10^{-7}
1/2	0.5970	0.0754	0.0007	1.16×10^{-3}	2.67×10^{-7}
1	0.5933	0.0915	0.0008	0.95×10^{-3}	1.19×10^{-7}
2	0.5903	0.0210	0.0057	0.52×10^{-3}	0.43×10^{-7}

BULK DENSITY: 132.3 lb/cu.ft.
 DRY DENSITY: 111.2 lb/cu.ft.
 INITIAL W/C: 13.8%
 FINAL W/C: 19.0%

* Sample expanded under this increment of load.

Note: This sample was compressed in the Proctor mold at natural moisture content.



CONSOLIDATION TEST

CONTRACT: Havant Thicket.

SAMPLE REF.: Tube No. 226: Bore 15 : Depth 12'0" - 13'0"

DESCRIPTION: Grey and dark red mottled clay.

BULK DENSITY: 132.3 lb/cu.ft.

DRY DENSITY: 111.2 lb/cu.ft.

INITIAL MOISTURE CONTENT: 18.9%

FINAL MOISTURE CONTENT: 25.0%

DATE: January 1963.

PRE PILING SURVEYS LTD. - PETERBOROUGH.

CONSOLIDATION TEST

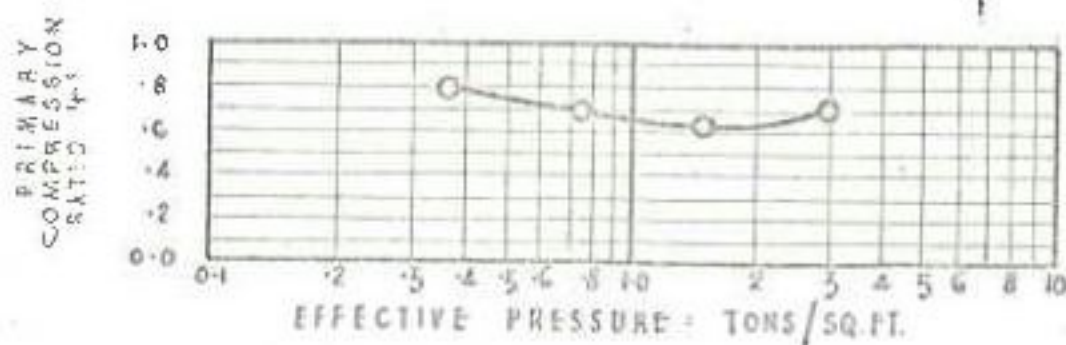
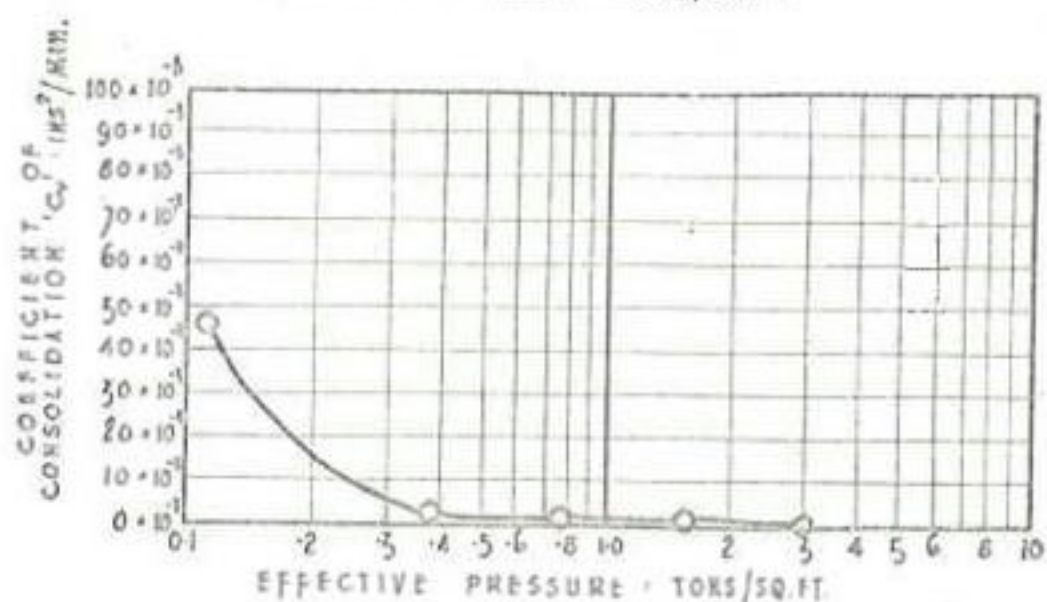
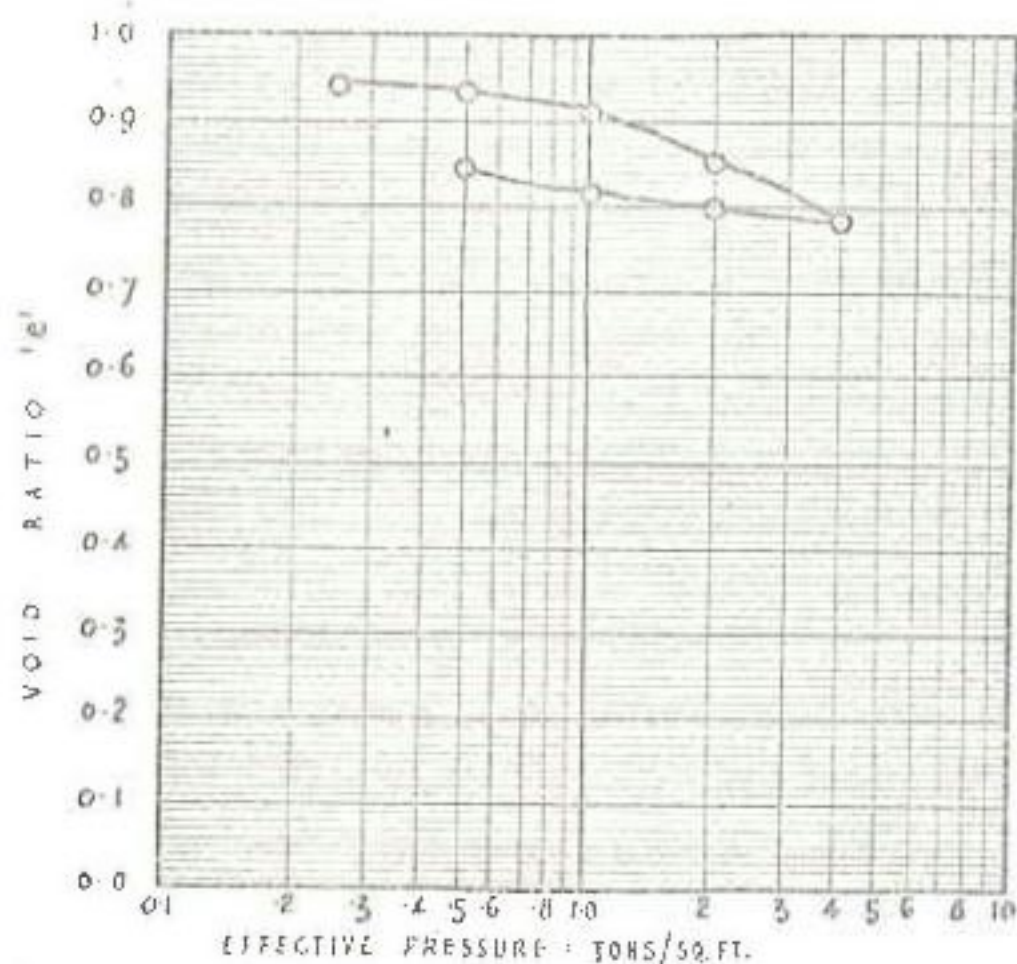
DATE: January 1963.

CONTRACT: "Carnegie Wharf".
 SAMPLE REF: Borehole 16, thickness of fragmentary samples 0 - 10 ft. depth.
 DESCRIPTION: Brown, orange and grey clay with a few small gravel particles.

EFFECTIVE PRESSURE (TONS/SQ. FT.)	VOID RATIO	PRESSURE RANGE (TONS/SQ. FT.)	COEFFICIENT OF COMPRESSIBILITY (FT ² /TON)	COEFFICIENT OF VOLUME DECREASE (FT ² /TON)	COEFFICIENT OF CONSOLIDATION (IN ² /MIN.)	COEFFICIENT OF PERMEABILITY (IN ³ /MIN.)
0	0.9603	0 - 1/2	0.0072	.0037	1.625×10^{-3}	7.11×10^{-7}
1/2	0.9375	1/2 - 1	0.0340	.0176	1.90×10^{-3}	1.15×10^{-7}
1	0.9220	1 - 2	0.0524	.0274	1.50×10^{-3}	1.79×10^{-7}
2	0.9053	2 - 4	0.0503	.0271	0.72×10^{-3}	0.85×10^{-7}
4	0.8729		0.0554	.0195	0.76×10^{-3}	0.65×10^{-7}

BULK DENSITY: 116.3 lb/cu.ft.
 DRY DENSITY: 89.0 lb/cu.ft.
 INITIAL W/C: 31.2%
 FINAL W/C: 33.1%

Note: This sample was compacted in the Proctor mould at natural moisture content.



CONSOLIDATION TEST

CONTRACT : Havant Whicket.

SAMPLE REF. : Borehole 16: Frag. samples 0 - 10 ft. depth.

DESCRIPTION : Brown, orange and grey clay with a few small particles of gravel.

BULK DENSITY : 116.8 lb/cu.ft.

DRY DENSITY : 89.0 lb/cu.ft.

INITIAL MOISTURE CONTENT : 31.2%

FINAL MOISTURE CONTENT : 33.1%

DATE : January 1963.

PRE PILING SURVEYS LTD. : PETERBOROUGH.

CONSOLIDATION TEST

CONTRACT: Hercules Materials.

SAMPLE REF.: Tube No. 225, Downhole No. 20, Depth 17'0" - 18'5".

DESCRIPTION: Light blue, grey, red and yellow mottled clay.

DATE: January 1965.

EFFECTIVE PRESSURE (TONS/SQ. FT.) p_1'	VOID RATIO e	PRESSURE RANGE (TONS/SQ. FT.) p_1'	COEFFICIENT OF COMPRESSIBILITY (FT^2/TON) a_v	COEFFICIENT OF VOLUME DECREASE (FT^4/TON) m_v	COEFFICIENT OF CONSOLIDATION ($MS^2/MIN.$) c_v	COEFFICIENT OF PERMEABILITY ($MS/MIN.$) k_v
0	0.5999	0 - $\frac{1}{2}$	0.1555	0.0090	53.50×10^{-3}	121.6×10^{-7}
$\frac{1}{2}$	0.5937	$\frac{1}{2}$ - 1	0.2060	0.0635	1.20×10^{-3}	8.22×10^{-7}
1	0.6000	1 - 2	0.0050	0.0592	2.07×10^{-3}	6.15×10^{-7}
2	0.5805	2 - 3	0.0556	0.0357	0.21×10^{-3}	1.57×10^{-7}
3	0.5219	3 - 4	0.0318	0.0203	0.23×10^{-3}	0.90×10^{-7}

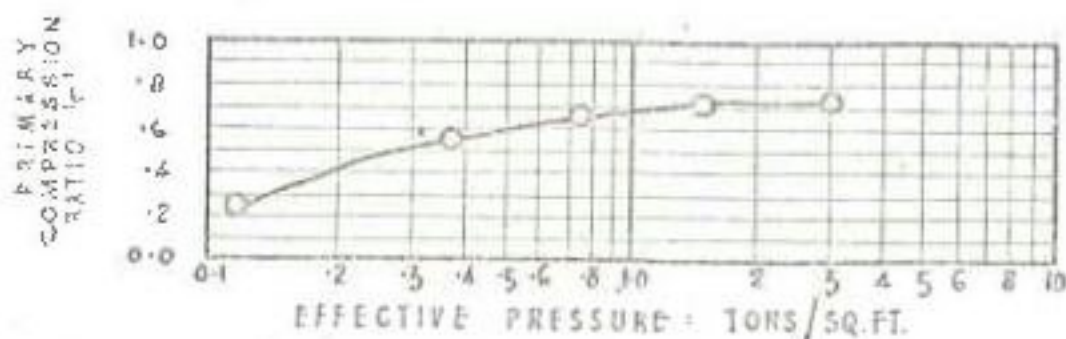
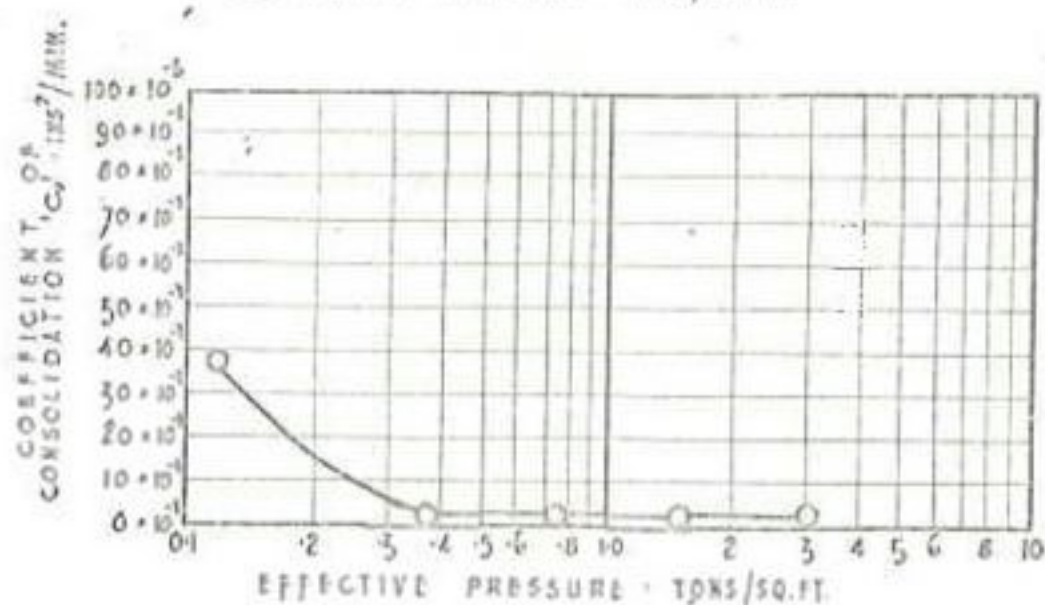
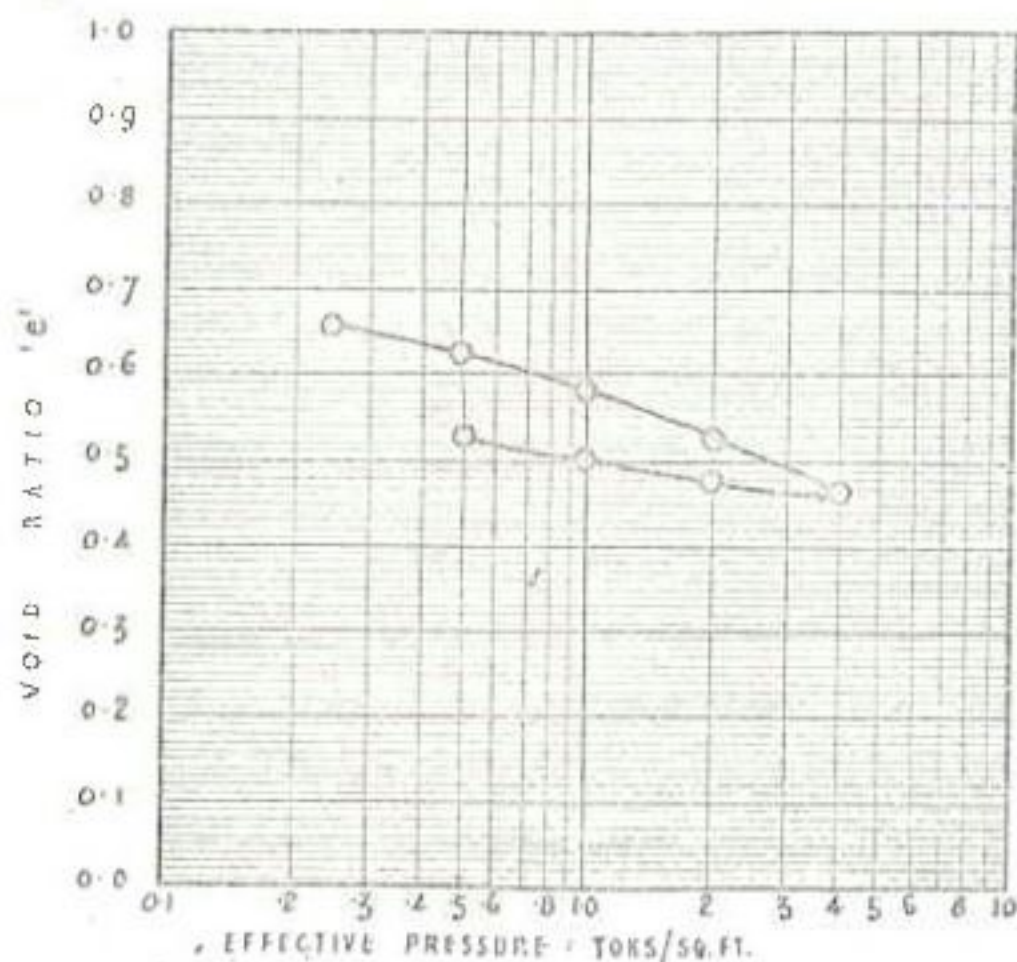
BULK DENSITY: 135.5 lb/cu.ft.

DRY DENSITY: 112.0 lb/cu.ft.

INITIAL W/C: 17.8%

FINAL W/C: 26.2%

Note: This sample was compacted in the Proctor mold at natural moisture content.



CONSOLIDATION TEST

CONTRACT: Havant Wharf.

SAMPLE REF.: Tube No. 225; Bore 20, Depth 17'0" - 18'6"

DESCRIPTION: Light blue, grey, red and yellow mottled clay.

BULK DENSITY: 134.5 lb/cu.ft.

DRY DENSITY: 112.0 lb/cu.ft.

INITIAL MOISTURE CONTENT: 27.4%

FINAL MOISTURE CONTENT: 26.2%

DATE: January 1963.

PRE PILING SURVEYS LTD., PETERBOROUGH.

PROCTOR COMPACTION TEST

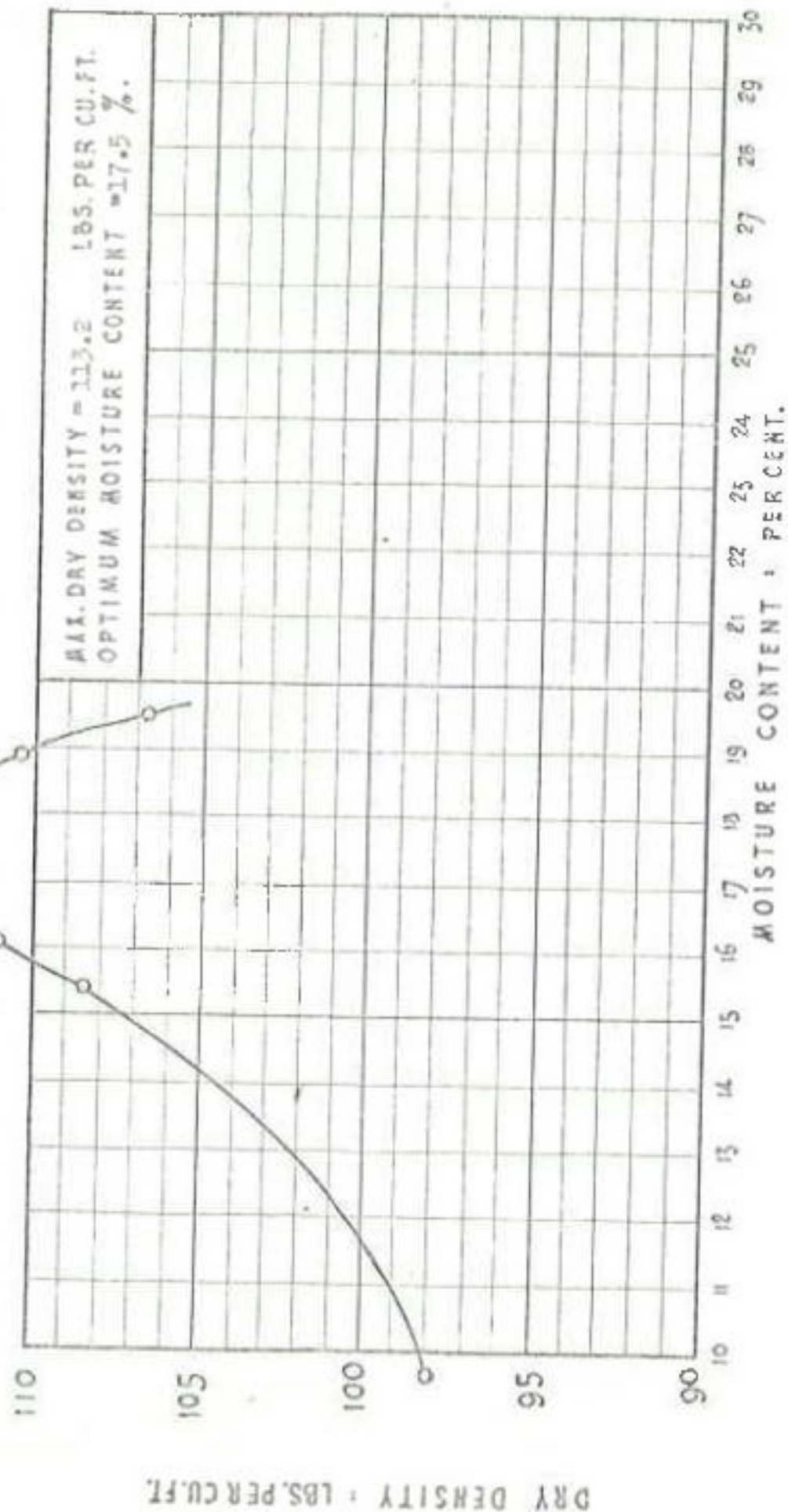
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SAMPLE REF:

DESCRIPTION:

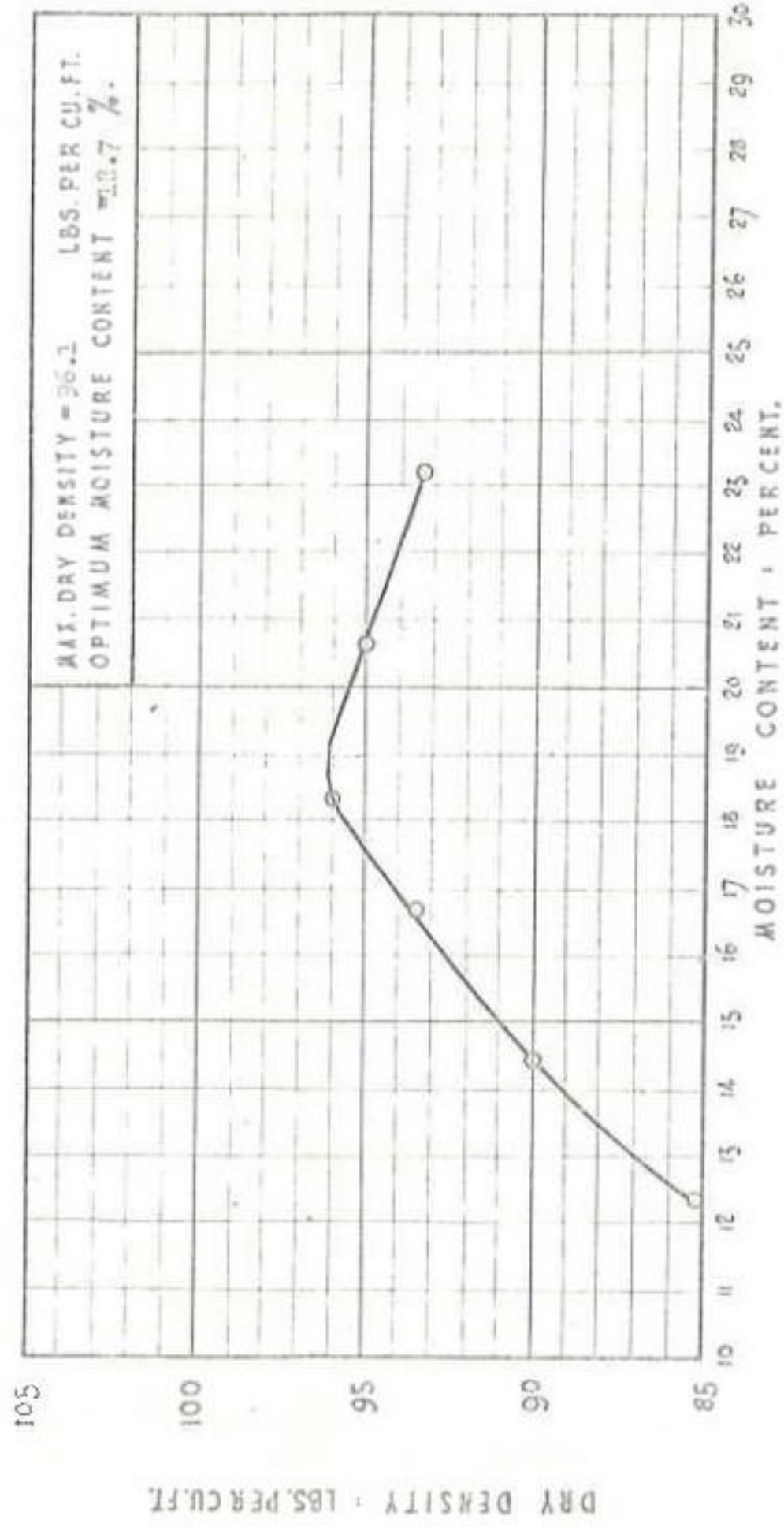
DATE: January 1963.

Mixture of fragmentary samples 0 - 10 ft. depth in Bore 9.
Brown and grey silty sandy clay with flint and roots.



PROCTOR COMPACTION TEST

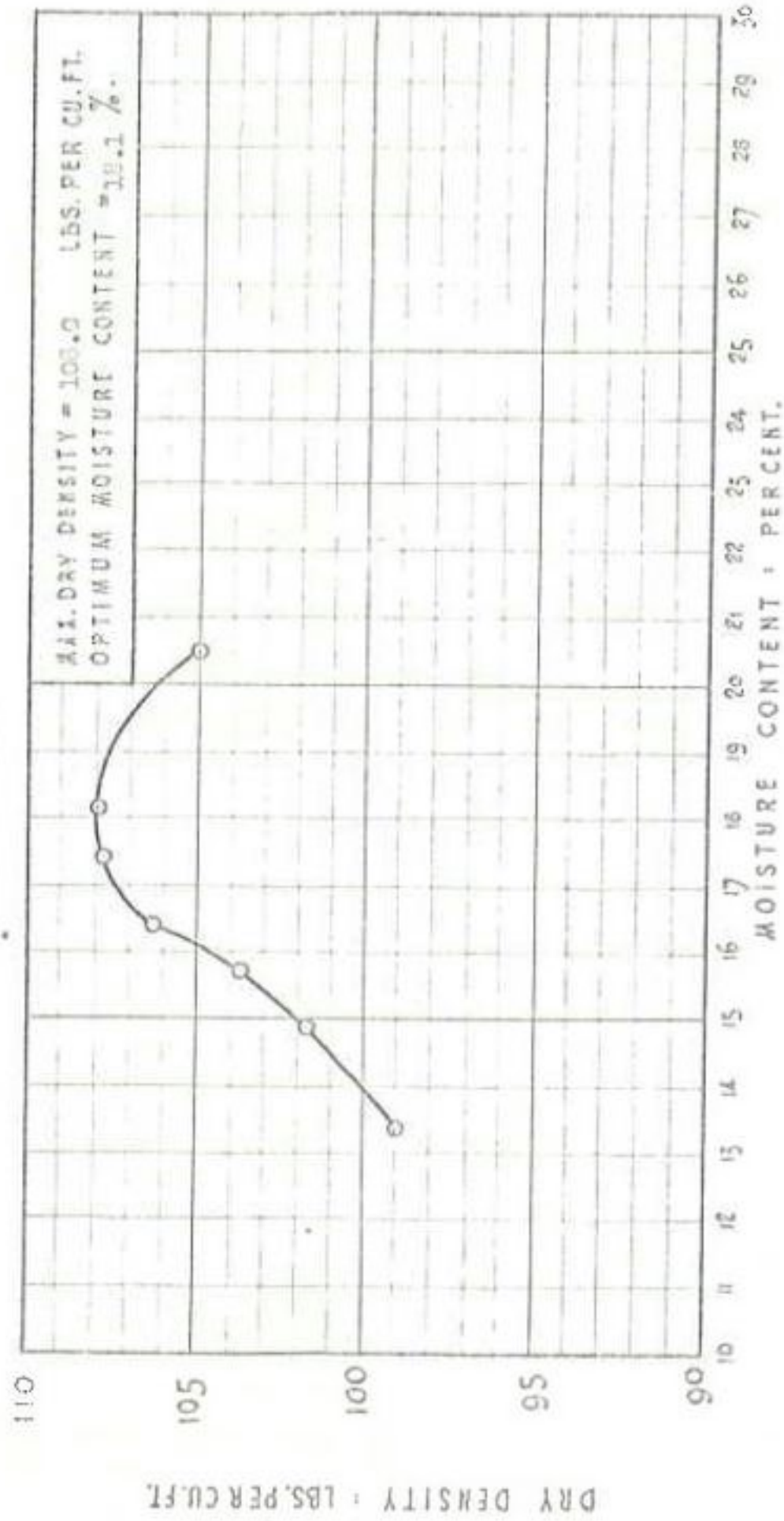
CONTRACT: Havent Thicket.
 DATE: January 1963.
 SAMPLE REF: Mixture of fragmentary samples 0 - 10 ft. B.S. in Dore 12.
 DESCRIPTION: Brown and grey sandy silty clay with roots.



PROCTOR COMPACTION TEST

CONTRACT: Havant Thicket.
 SAMPLE REF: Tube No. 226, Bore No. 15, Depth 12'0" - 13'0" B.S.
 DESCRIPTION: Gray and dark red mottled clay.

DATE: January 1963.



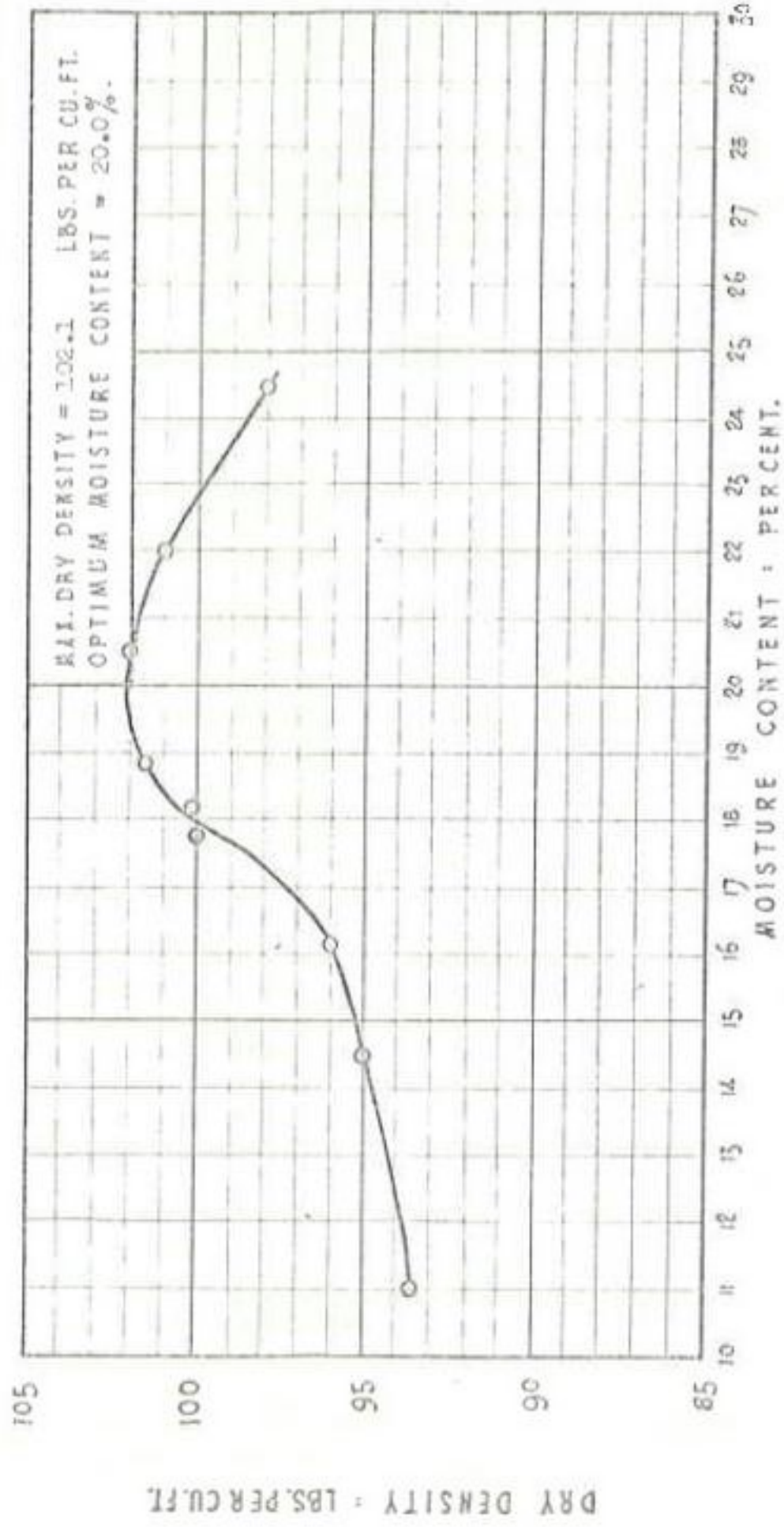
PROCTOR COMPACTION TEST

CONTRACT: Havant Thicket.

DATE: January 1963.

SAMPLE REF: Mixture of fragmentary samples 0 - 10 ft. B.S. in Boro 16.

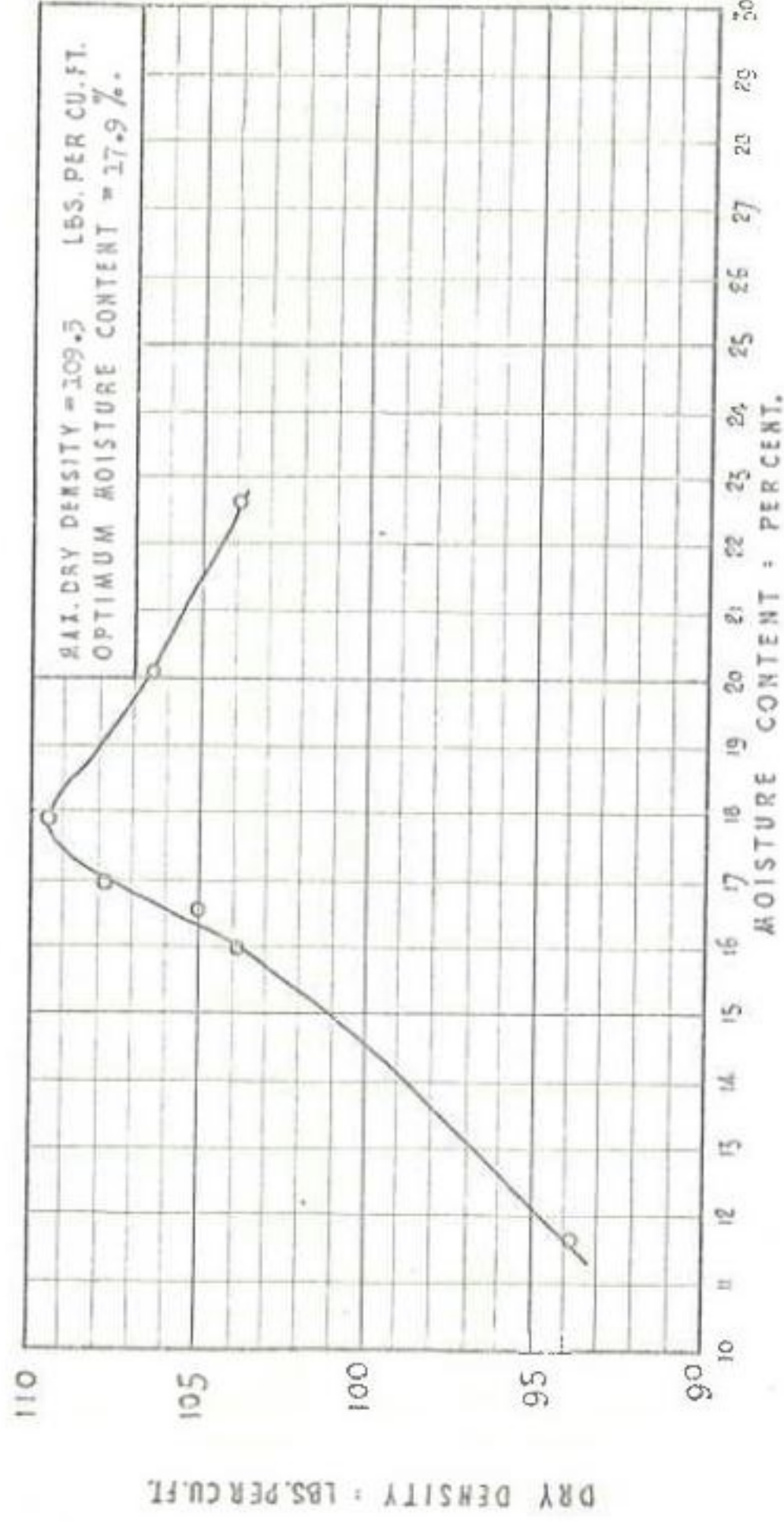
DESCRIPTION: Brown, orange, blue and dark grey mottled clay with a few particles of black gravel.



PROCTOR COMPACTION TEST

CONTRACT: Havant Thicket.
 SAMPLE REF: Tube No. 225, Bore No. 20, Depth 17'0" - 18'6" B.S.
 DESCRIPTION: Light blue grey, red and yellow mottled clay.

DATE: January 1963.



INDEX PROPERTIES.

Borehole 9 (Mixture of fragmentary samples
0-10 ft. depth).

Liquid limit	"	43.3%
Plastic limit	"	17.9%
Plasticity Index	"	25.4%
Liquidity Index	"	0.398

Cassagrande Classification : 'CI' -Medium Plastic clay.

Borehole 12 (Mixture of fragmentary samples
0 -10 ft. depth).

Liquid limit	"	75.0%
Plastic limit	"	26.4%
Plasticity Index	"	48.6%
Liquidity Index	"	0.132

Cassagrande Classification : 'CH' -Inorganic clay of high
plasticity.

Borehole 16 (Mixture of fragmentary samples
0 -10ft. depth).

Liquid limit	"	67.2%
Plastic limit	"	22.2%
Plasticity Index	"	45.0%
Liquidity Index	"	0.200

Cassagrande Classification : 'CH' -Inorganic clay of high
plasticity.

Tube 226: Borehole 15, depth 12'0" -13'0" B.S.

Liquid limit	"	55.7
Plastic limit	"	18.1
Plasticity Index	"	37.6
Liquidity Index	"	0.021

Cassagrande Classification: 'CH' -Inorganic clay of high
plasticity.

Tube 225: Borehole 20, Depth 17'0" - 18'6" B.S.

Liquid limit	"	60.1
Plastic limit	"	21.6
Plasticity Index	"	38.5
Liquidity Index	"	negative.

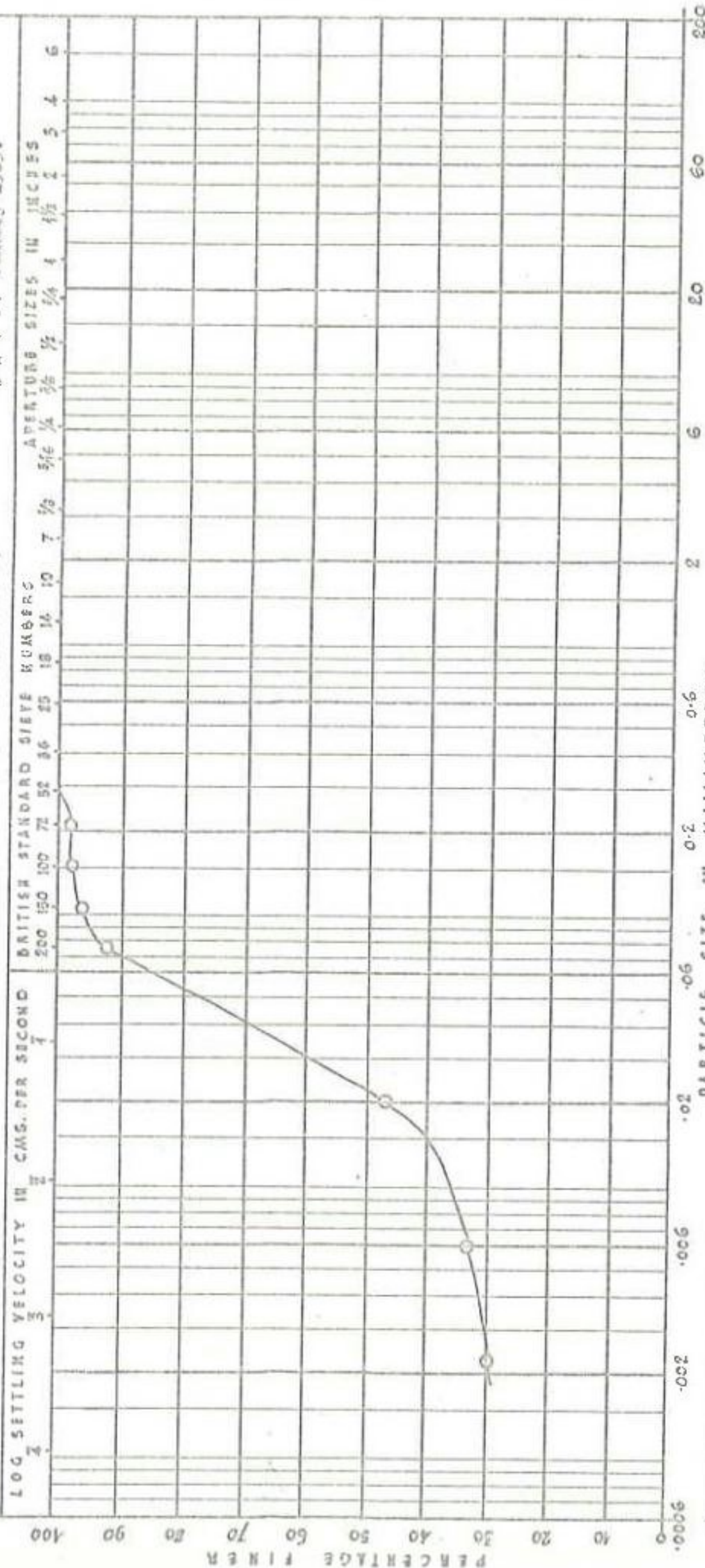
Cassagrande Classification. 'CH' -Inorganic clay of high
plasticity.

PARTICLE SIZE DISTRIBUTION

CONTRACT: Havent Thicket.

SAMPLE: 0 - 10 ft. in Dore 9

DATE: January 1953.



CLAY FRACTION	SAND			GRAVEL			PRE PILING SURVEYS LTD. WARE WORKS. PETTERBOROUGH.
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	

PARTICLE SIZE DISTRIBUTION

C O M T R A C T: Havant Thicket.

5 A M P L E Tube 226: Core 15, Depth 12'6" B.S. DATA: January 1963.

LOG SETTLING VELOCITY IN CMS. PER SECOND

BRITISH STANDARD SIZE NUMBERS

APERTURE SIZES IN MICRONS



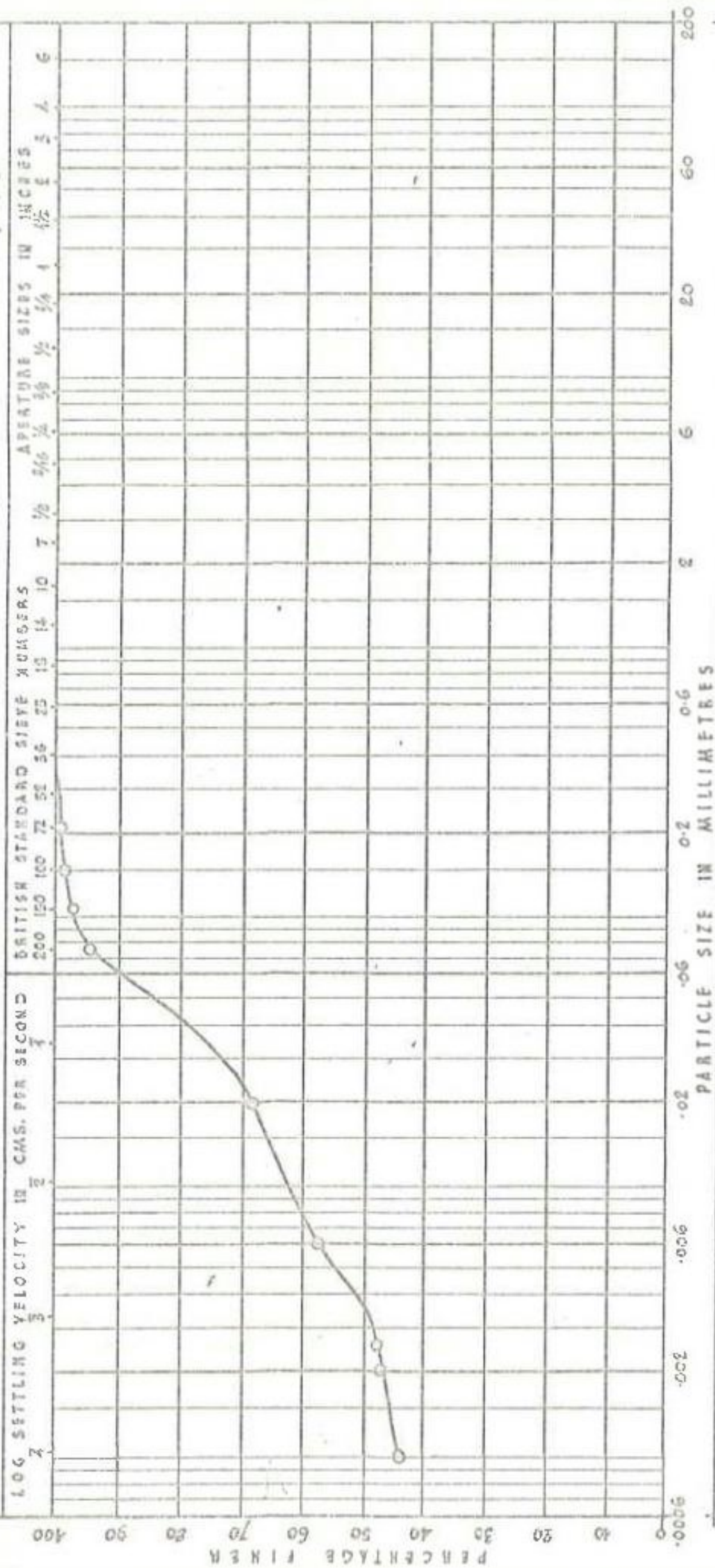
PARTICLE SIZE IN MILLIMETRES							PRE PILING SURVEYS LTD. WHARF WORKS, PETERBOROUGH.
CLAY FRACTION	FINE	MEDIUM	COARSE	FINE	MEDIUM	GRAVEL	
	SILT FRACTION			SAND			

PARTICLE SIZE DISTRIBUTION

CONTRACT: Havant District.

SAMPLE : 0 - 1026, S.S., in Box 16.

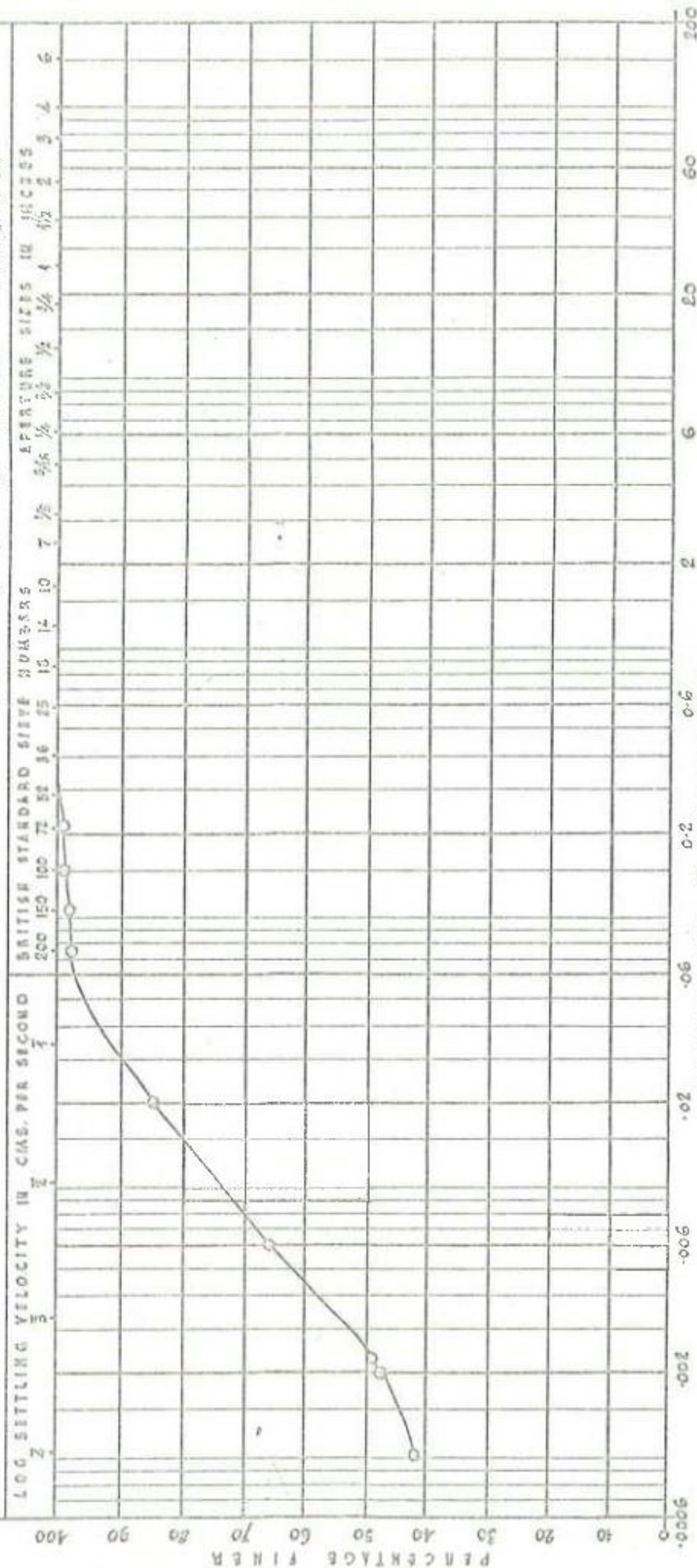
DATE: January 1963.



S A M P L E : Tube 225, Core 20, Depth 17'9" P.S. D A T E : January 1955.

CONTRACT: Havant Thicot.

S A M P L E : Tube 225, Core 20, Depth 17'9" P.S. D A T E : January 1955.



CLAY FRACTION	FINE			MEDIUM			COARSE			FINE			MEDIUM			PRE PILING SURVEYS LOG WARF WORKS, DETROIT BOUGH.
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE				
	SAND												GRAVEL			

RESULTS OF TRIAXIAL TESTS

FOR

PROPOSED RESERVOIR,

HAVANT TRICKET,

HAMPSHIRE

FOR

PORTSMOUTH AND GOSPORT WATER COMPANY,

26 & 28 COMMERCIAL ROAD,

PORTSMOUTH,

HAMPSHIRE

PRE-PILING SURVEYS LTD.,
WHARF WORKS,
PETERBOROUGH,
NORTHAMPTONSHIRE.

EDGAR HORTON & PARTNER,
CONSULTING ENGINEERING
GEOLOGISTS,
STYERSON HOUSE,
ADLINGTON,
MACCLESFIELD,
CHESHIRE.

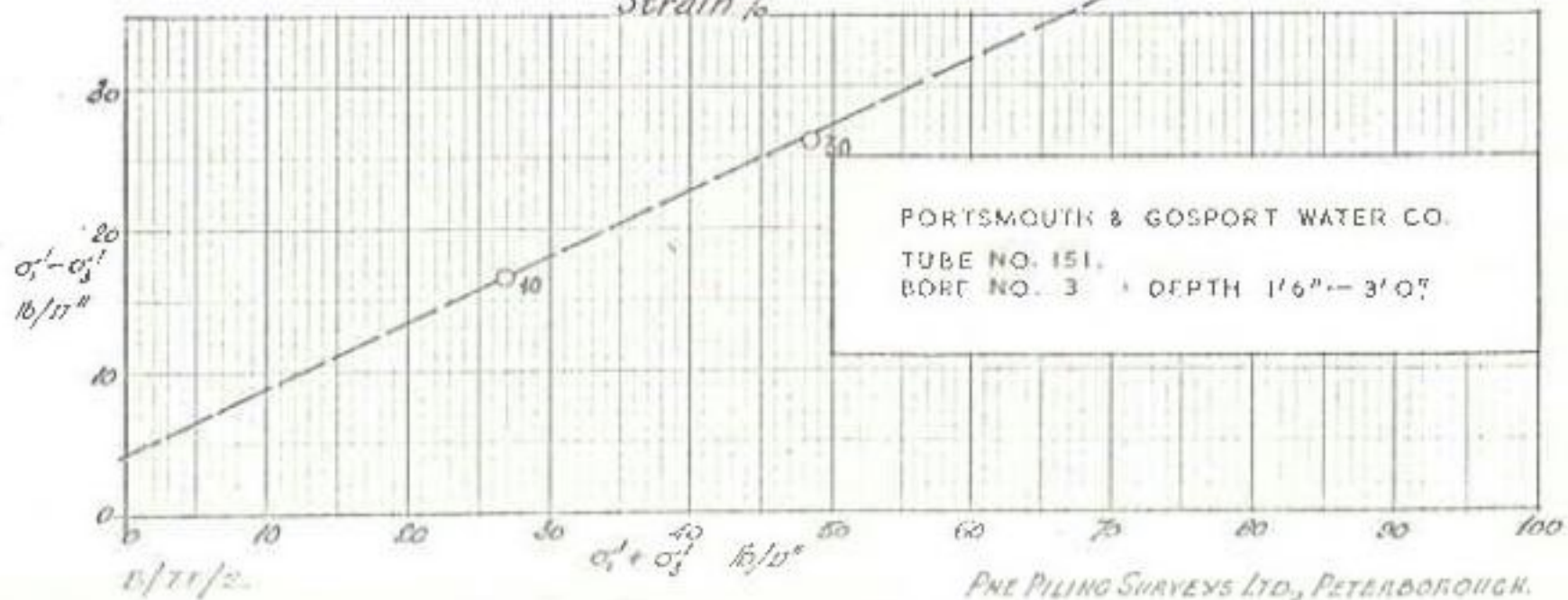
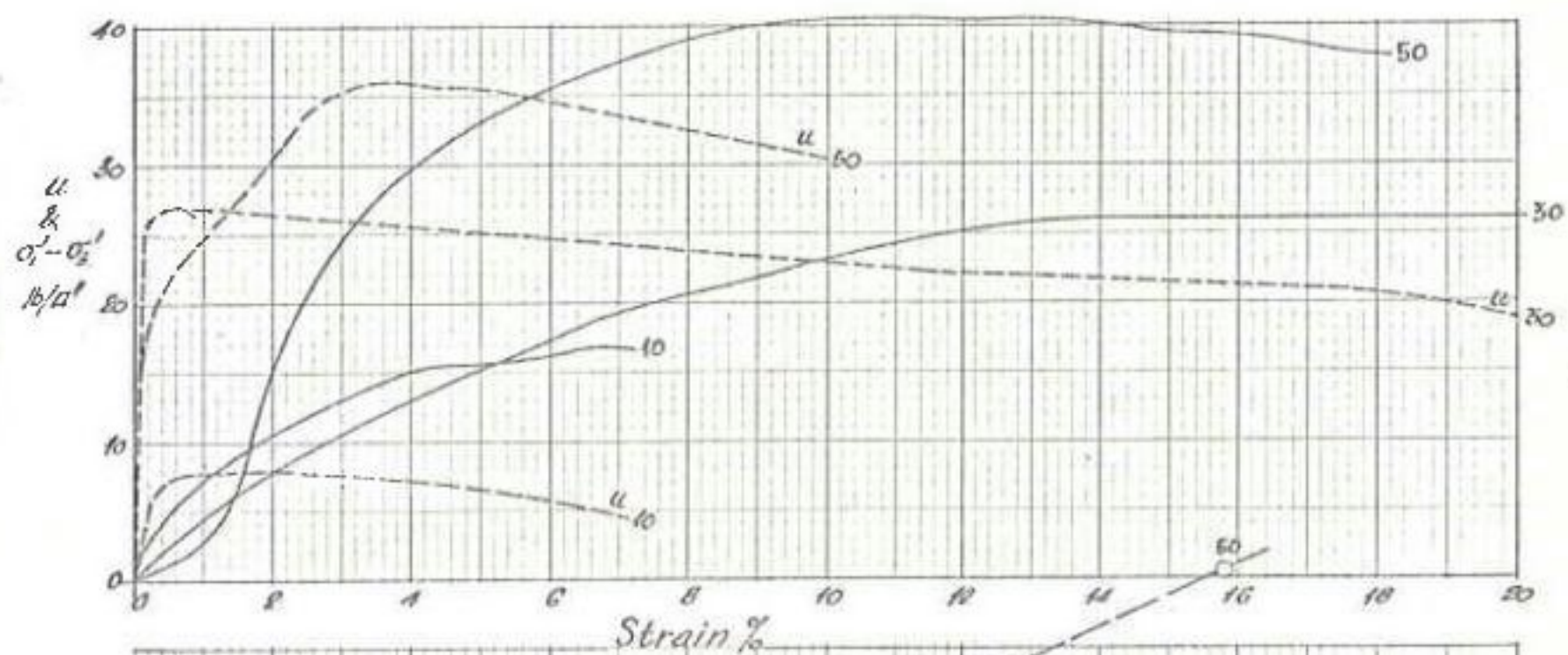
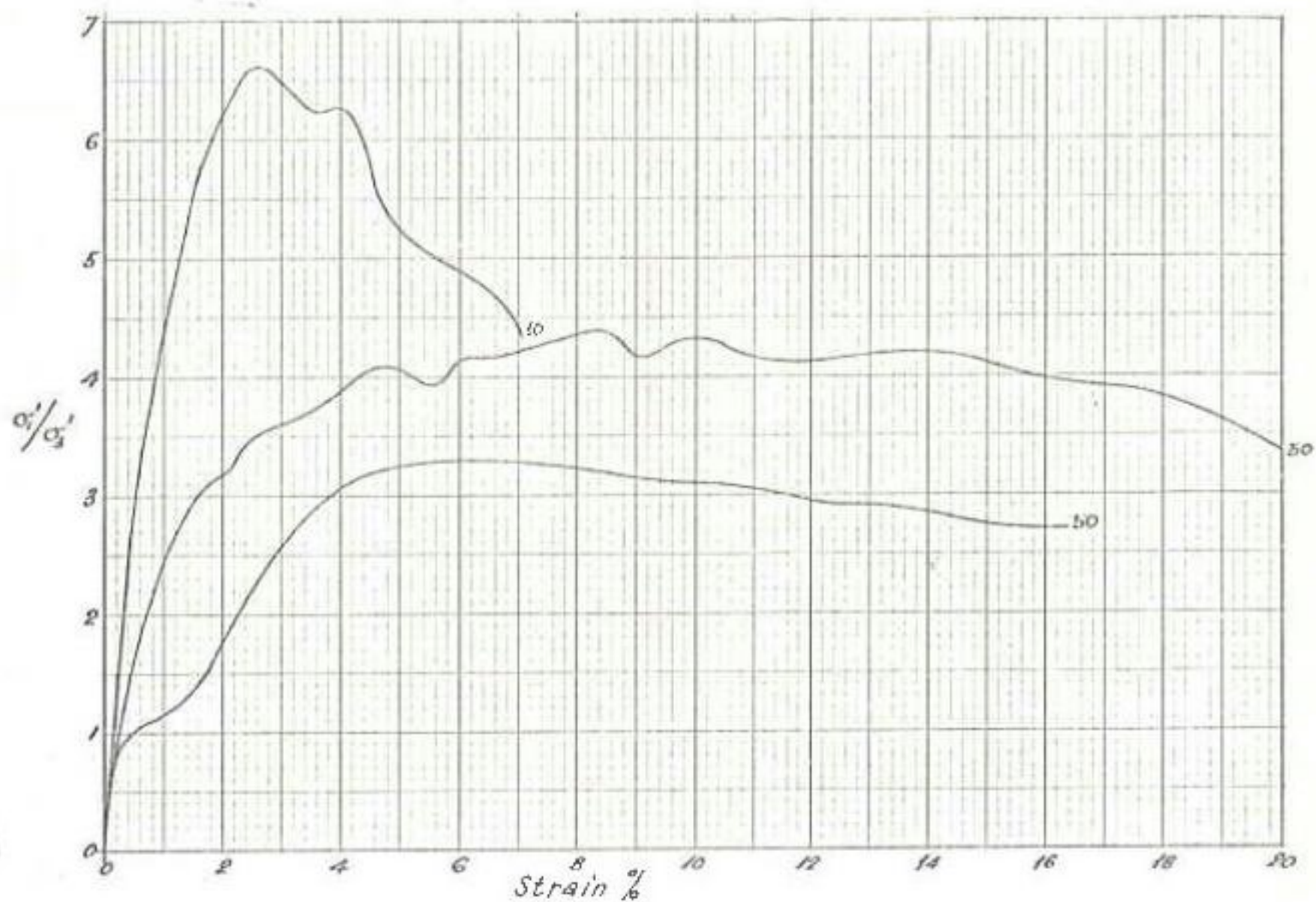
PORTSMOUTH & GOSPORT WATER CO.
HAVANT THICKET
SUMMARY OF TRIAXIAL TEST RESULTS

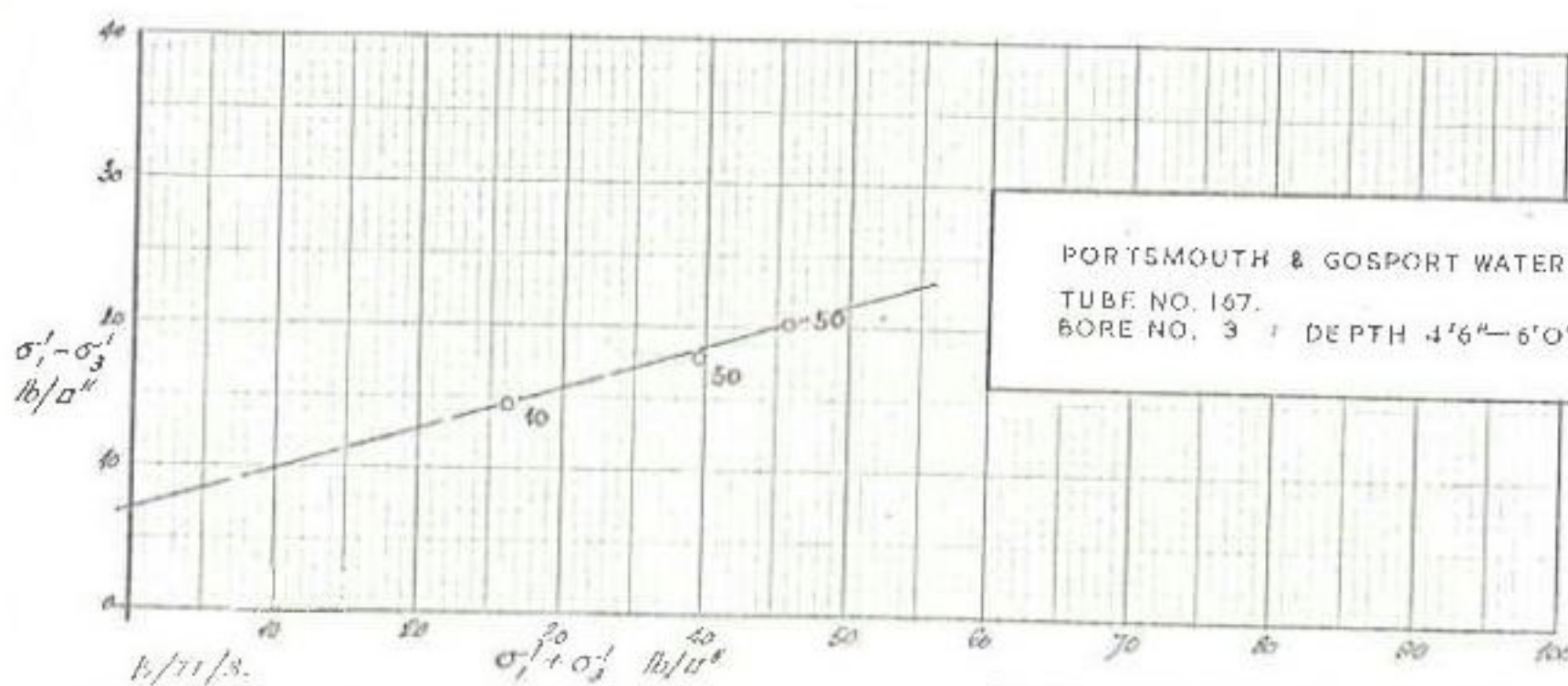
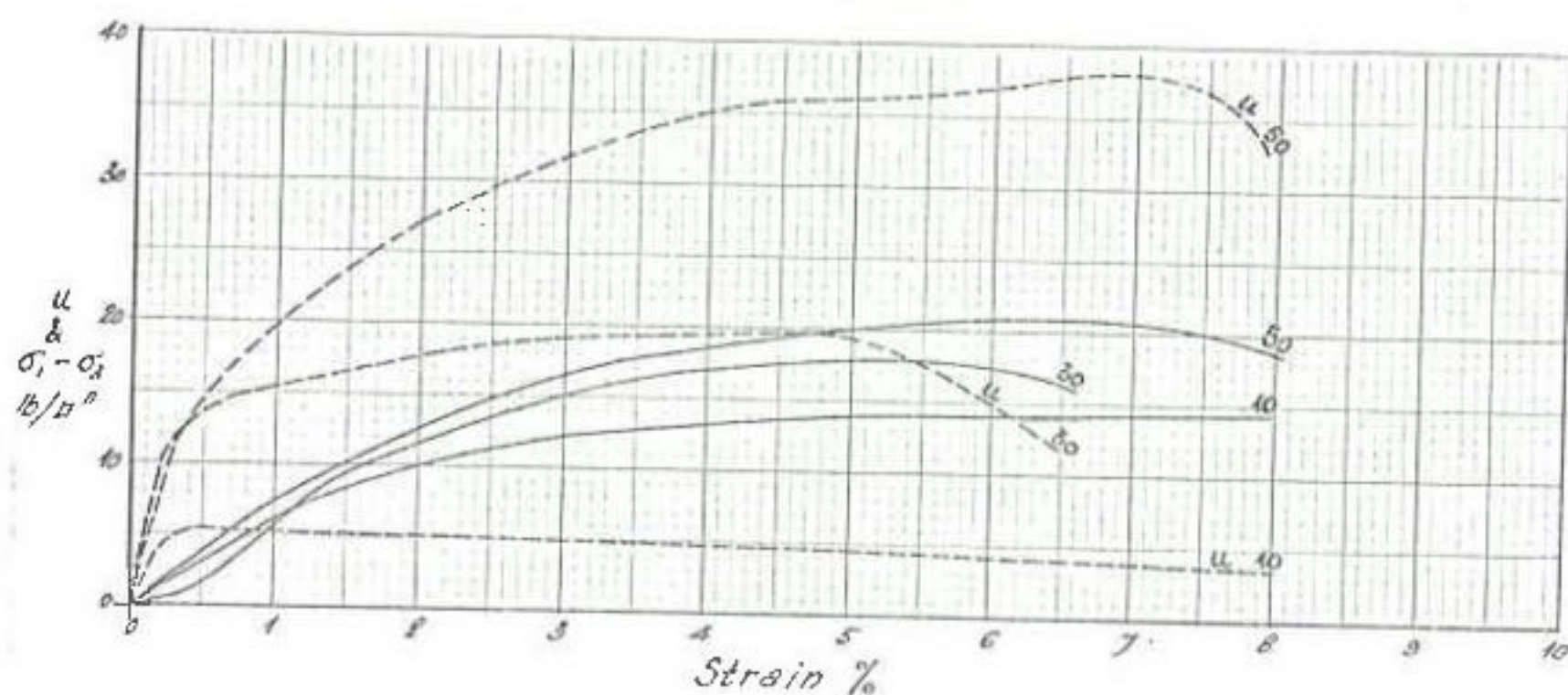
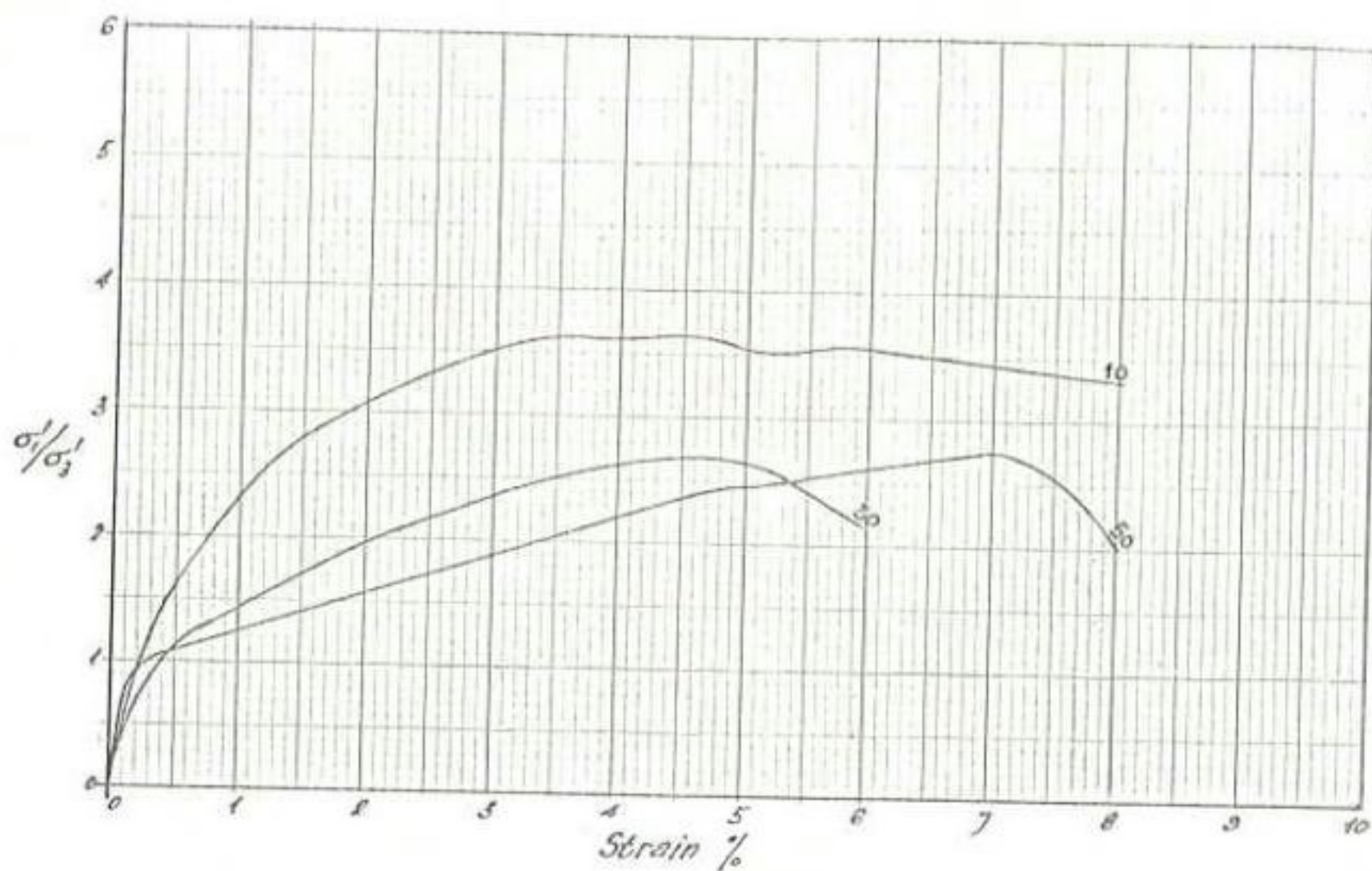
BORE	TUBE NO.	DEPTH	MOISTURE CONT. %	BULK DENSITY LBS/CU.FT.	DRY DENSITY LBS/CU.FT.	TRUE COHESION LBS/SQ.FT.	ϕ°	DESCRIPTION
3	151	1'6" -3'0" B.S.	20.15	128.4	102.9	605	24½	GREY & BROWN MOTTLED CLAY WITH WATER-WORN PEBBLES.
3	167	4'6" -6'0" B.S.	32.0	115.6	88.4	1008	16	LIGHT BROWN & GREY MOTTLED CLAY, WITH SELENITE CRYSTALS & ROOTS.
3	173	7'6" -9'0" B.S.	35.6	115.4	85.1	NIL	27	LIGHT BROWN MOTTLED CLAY.
3	176	10'6" -12'0" B.S.	26.9	121.6	95.9	720	28½	GREY-BLACK CLAY WITH POCKETS OF FINE SAND.
3	162	13'6" -15'0" B.S.	28.0	122.0	95.4	980	23	DARK GREY-BROWN HIGHLY FISSURED CLAY. TRACES OF FINE SAND & CRYSTALS.
3	179	16'6" -18'0" B.S.	26.5	122.3	96.8	NIL	34	DARK GREY-BROWN FISSURED CLAY. TRACE OF SILT.
3	174	25'6" -27'0" B.S.	24.5	125.7	100.9	1585	29	HIGHLY FISSURED BROWN CLAY WITH TRACES OF BLACK SILT.
3	183	28'6" -30'0" B.S.	18.0	125.2	106.0	NIL	34	SLIGHTLY FISSURED GREY-BROWN CLAY WITH SILT & FINE SAND DEPOSITS.
3	206	37'6" -39'0" B.S.	10.4	140.4	127.3	2740	19	BLUE-GREY & PINK MOTTLED CLAY. VIEWS OF RED-BROWN SANDY CLAY.
4	194	16'6" -18'0" B.S.	30.3	121.8	93.5	720	26½	HIGHLY FISSURED GREY-BROWN CLAY. SMALL SELENITE CRYSTALS.
4	193	25'6" -27'0" B.S.	25.9	122.4	97.3	1370	24	SLIGHTLY FISSURED GREY CLAY WITH TRACE OF SILT.
5	199	1'6" -3'0" B.S.	33.3	111.8	84.0	950	14	LIGHT BLUE, GREY & BROWN MOTTLED CLAY WITH ROOTS.
5	172	11'6" -13'0" B.S.	29.8	116.8	89.9	NIL	31	HIGHLY FISSURED FRIABLE GREY-BROWN CLAY, WITH PERIODS DISCOLOURATION.
5	188	16'6" -18'0" B.S.	28.4	120.1	93.5	NIL	31	DARK GREY FISSURED CLAY WITH SLIGHT SILT CONTENT.

NOTE: MOISTURE CONTENT AND BULK DENSITY ARE BASED ON THE AVERAGE OF THREE SAMPLES. COHESION AND ϕ VALUES ARE TAKEN FROM THE RESULT SHEETS; ALLOWANCE IS THEREFORE MADE FOR PORE WATER PRESSURE.

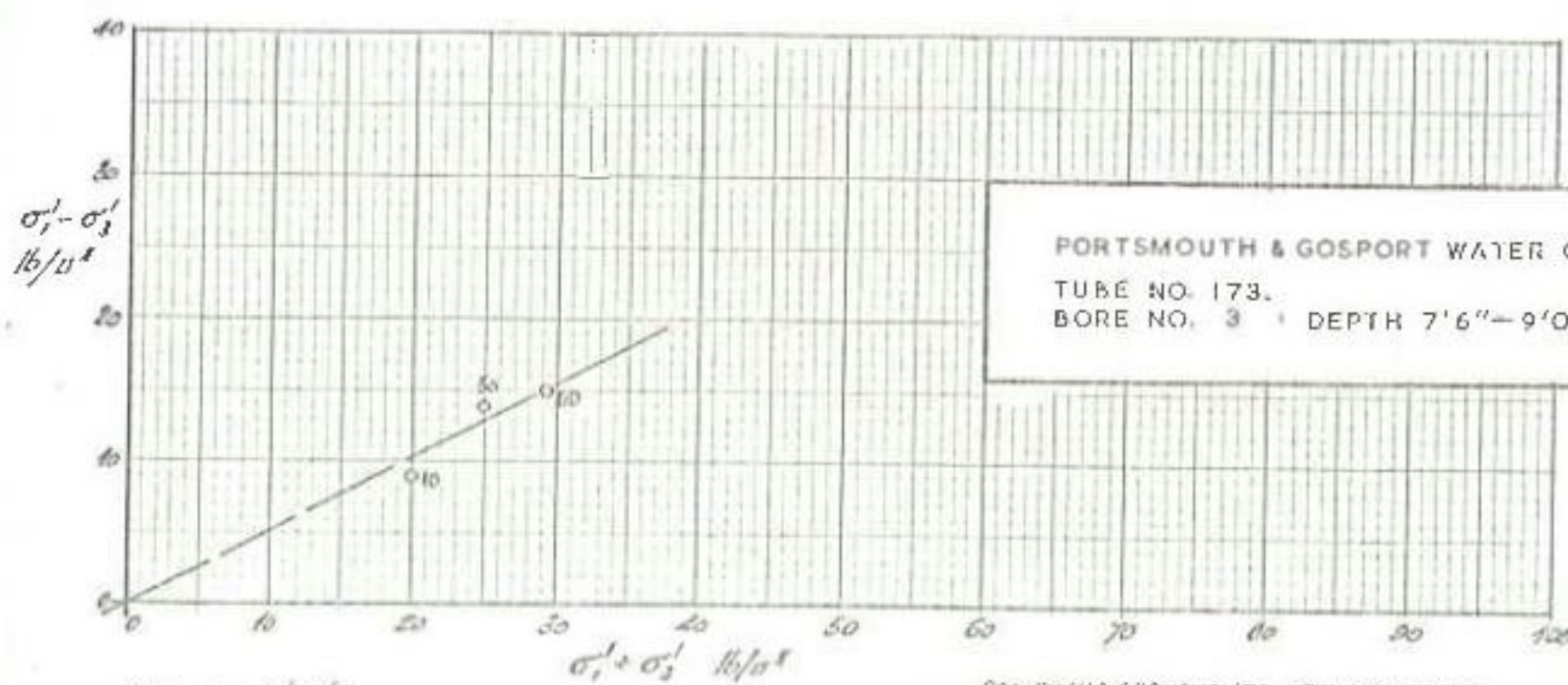
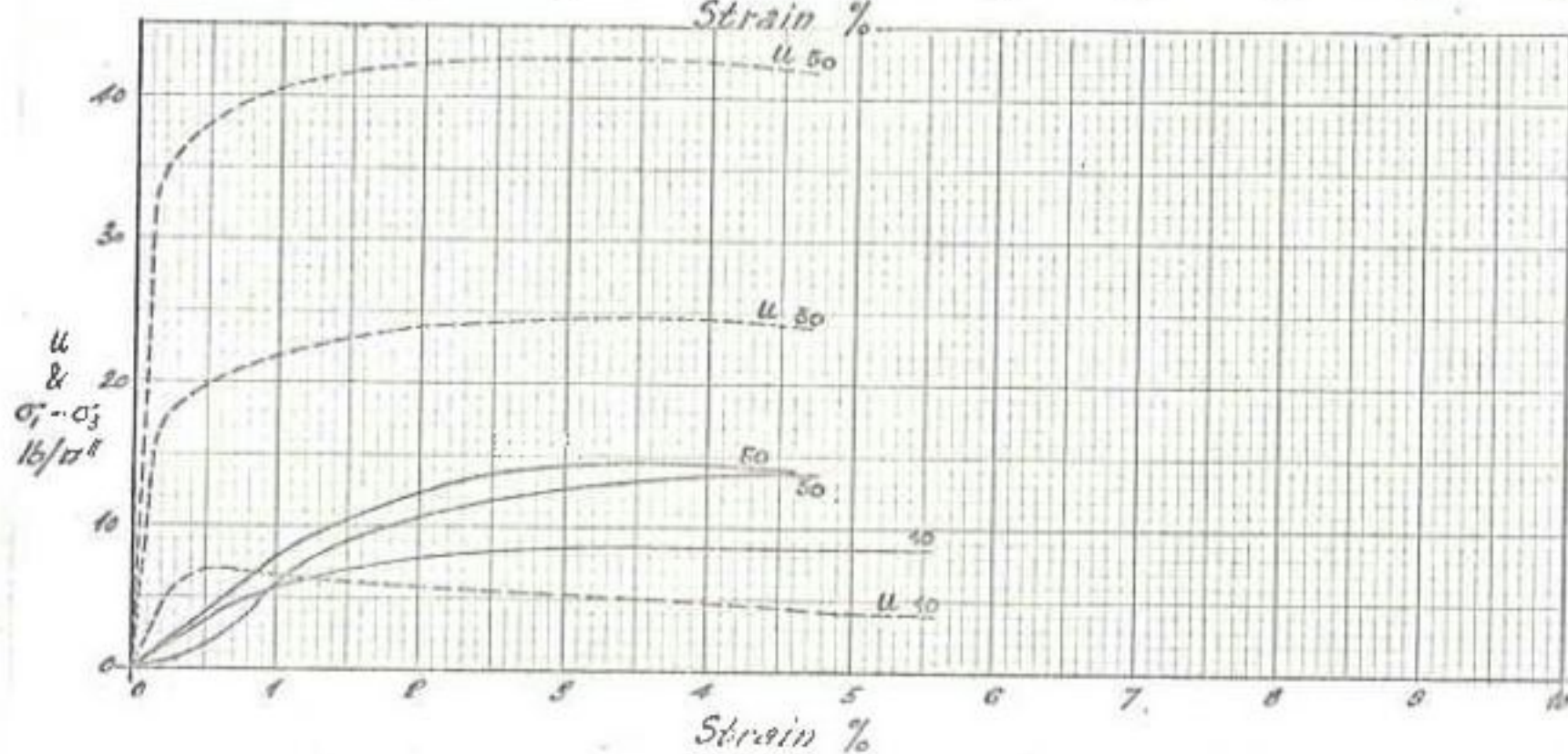
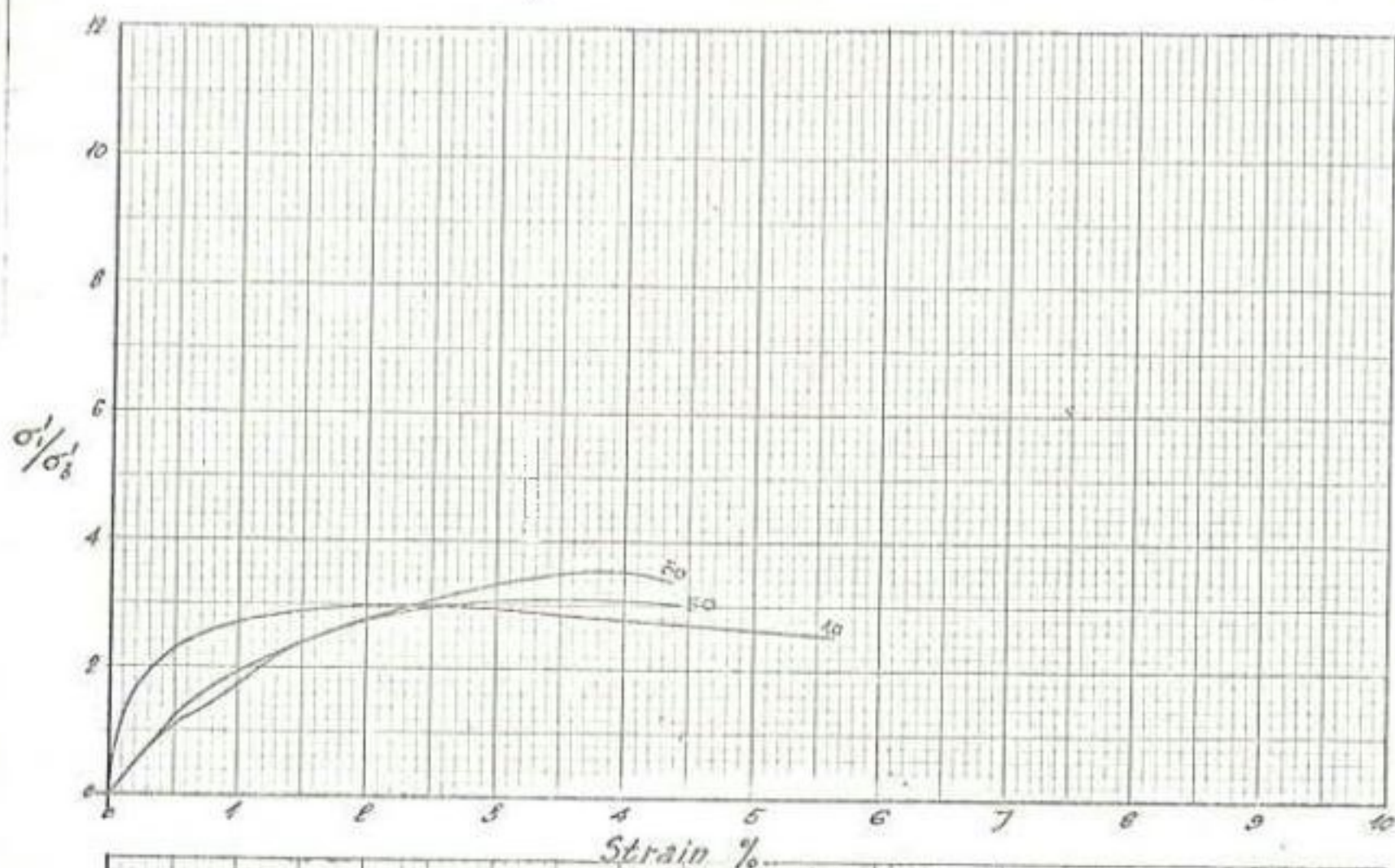
IN THE RESULT SHEETS THE FOLLOWING SYMBOLS ARE USED:-

u = PORE WATER PRESSURE. σ_1' = DEVIATOR STRESS MINUS PORE WATER PRESSURE
 σ_1 = DEVIATOR STRESS. σ_3' = CELL PRESSURE " " "
 σ_3 = CELL PRESSURE.

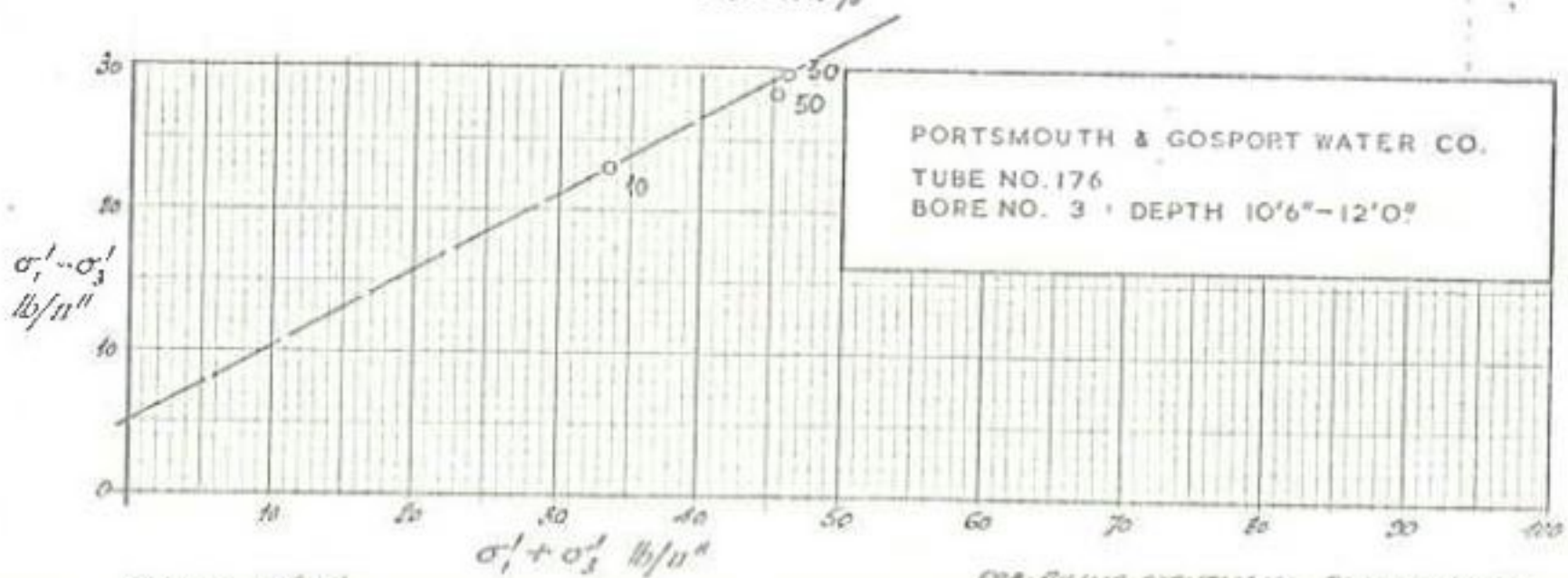
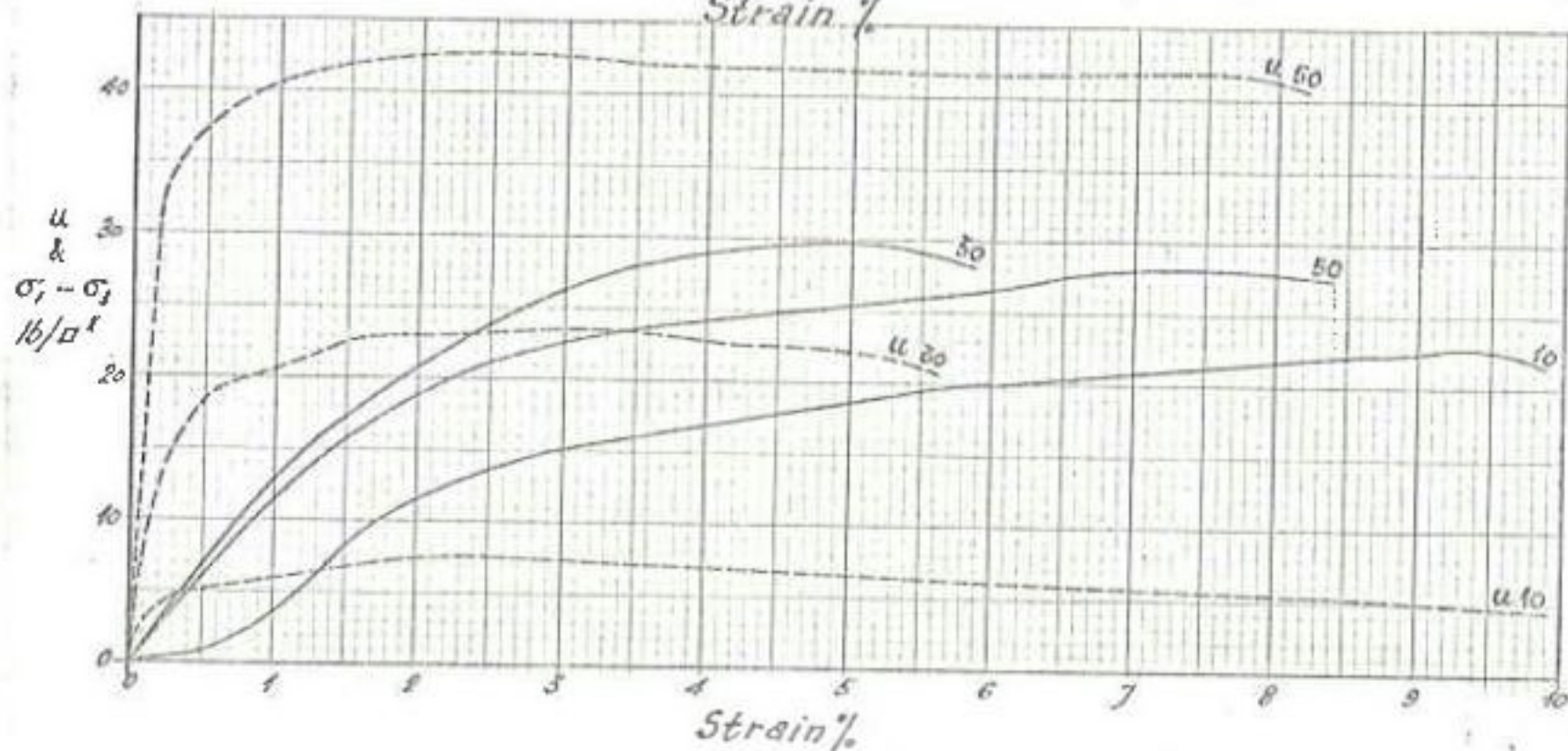
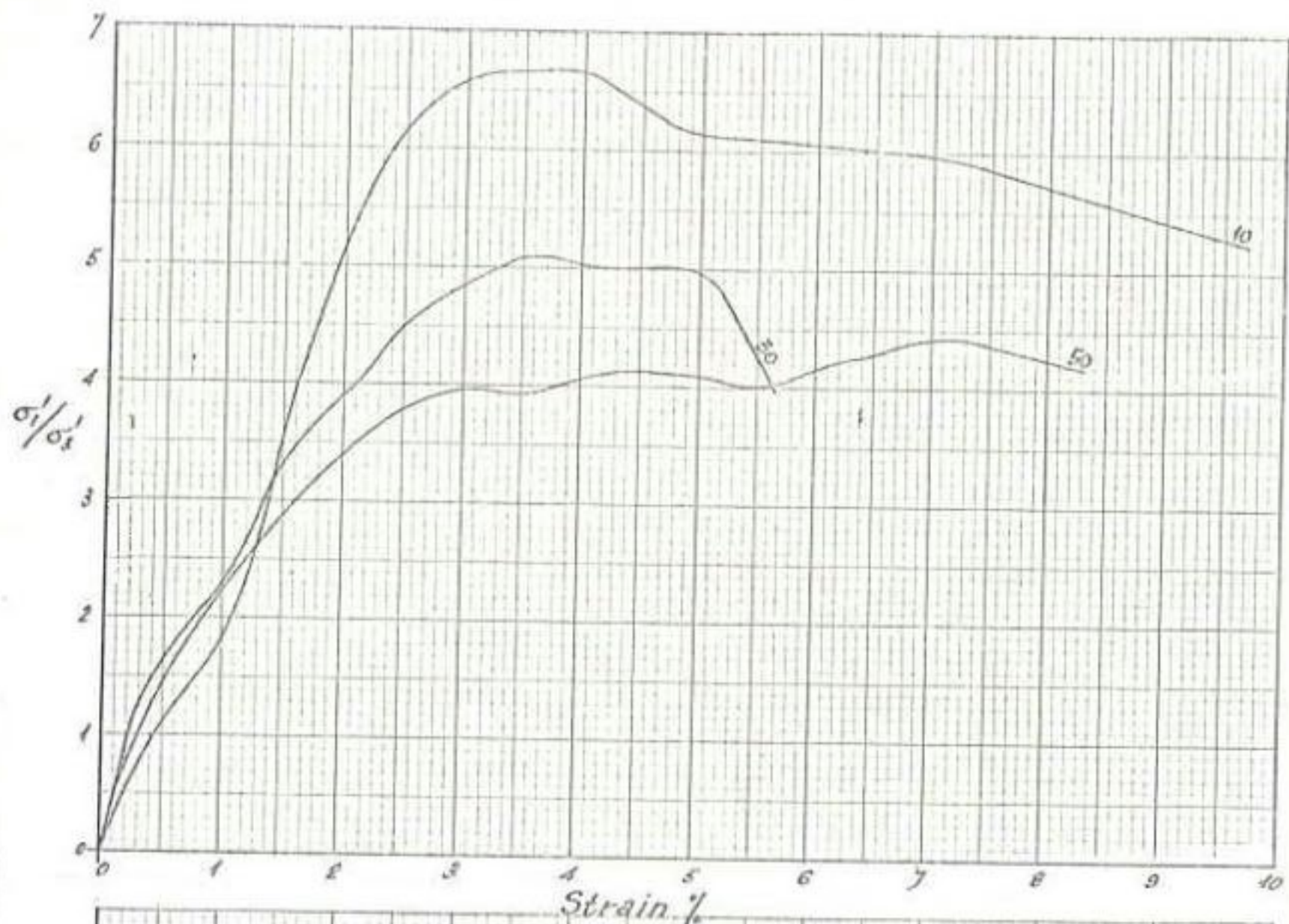




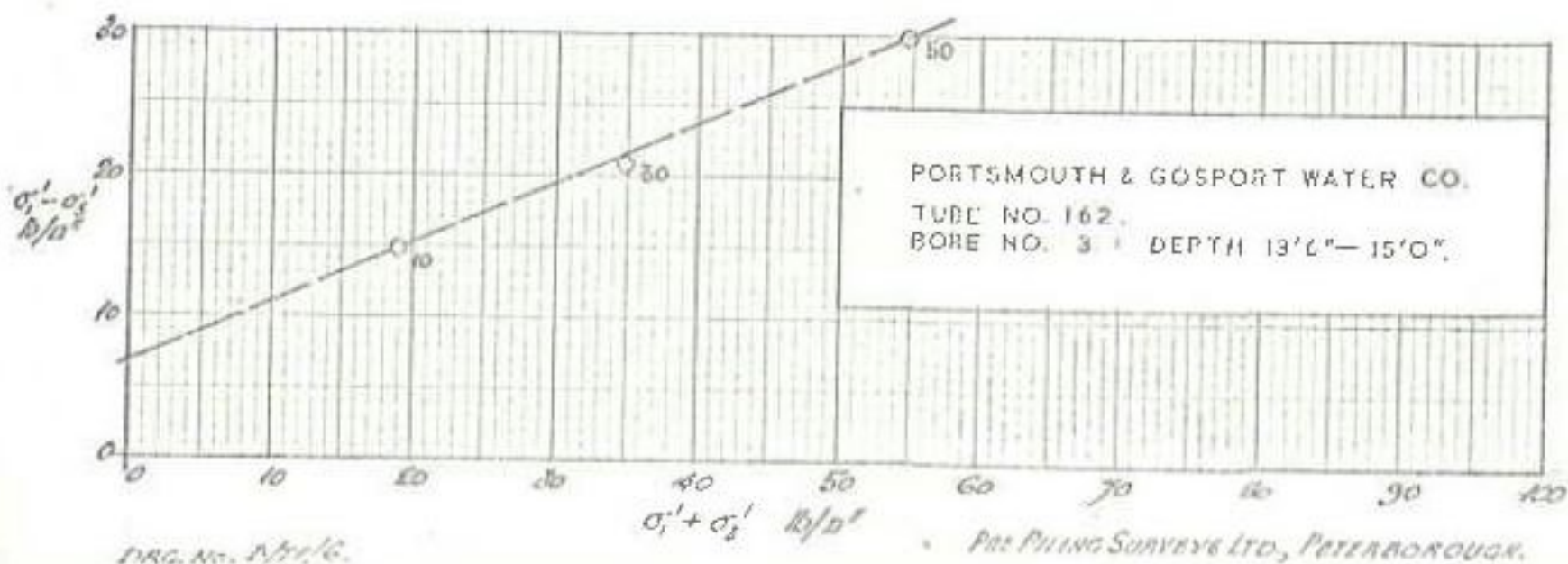
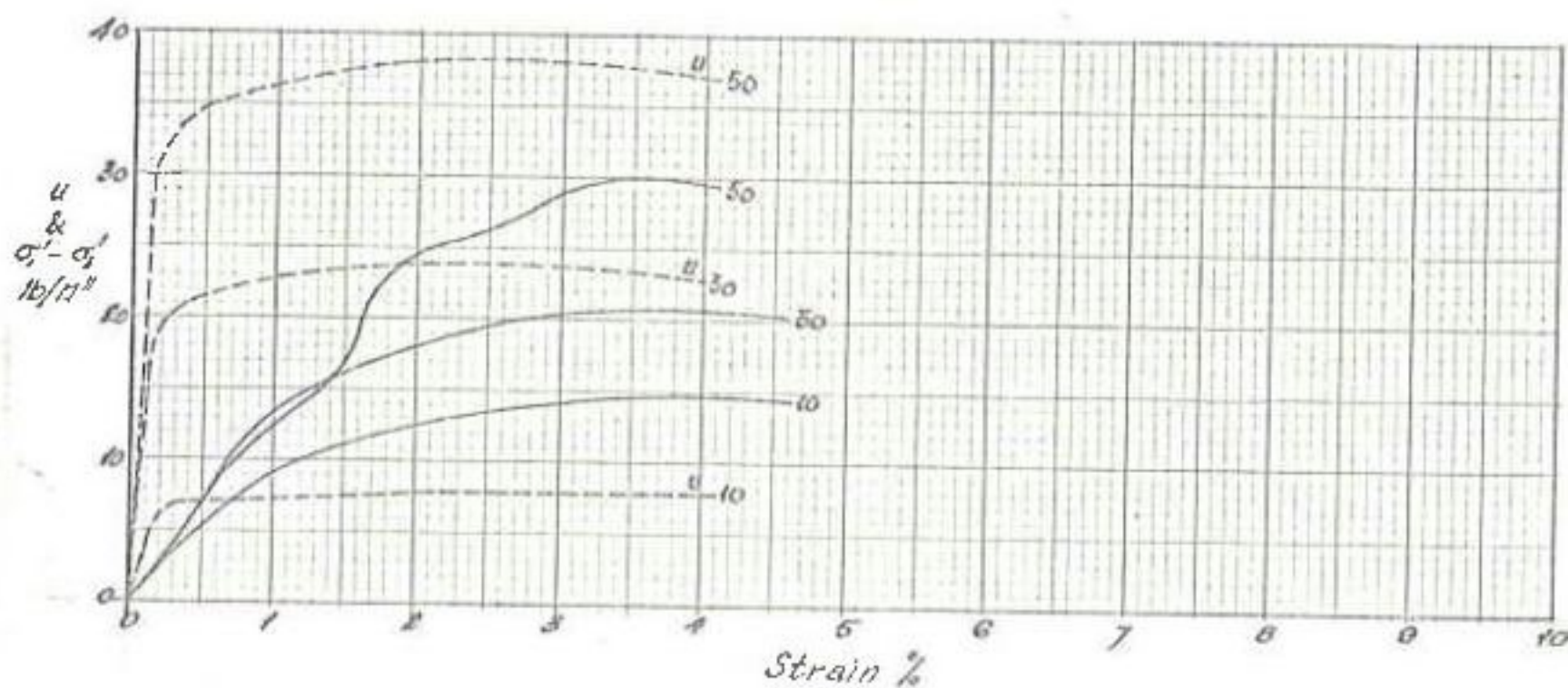
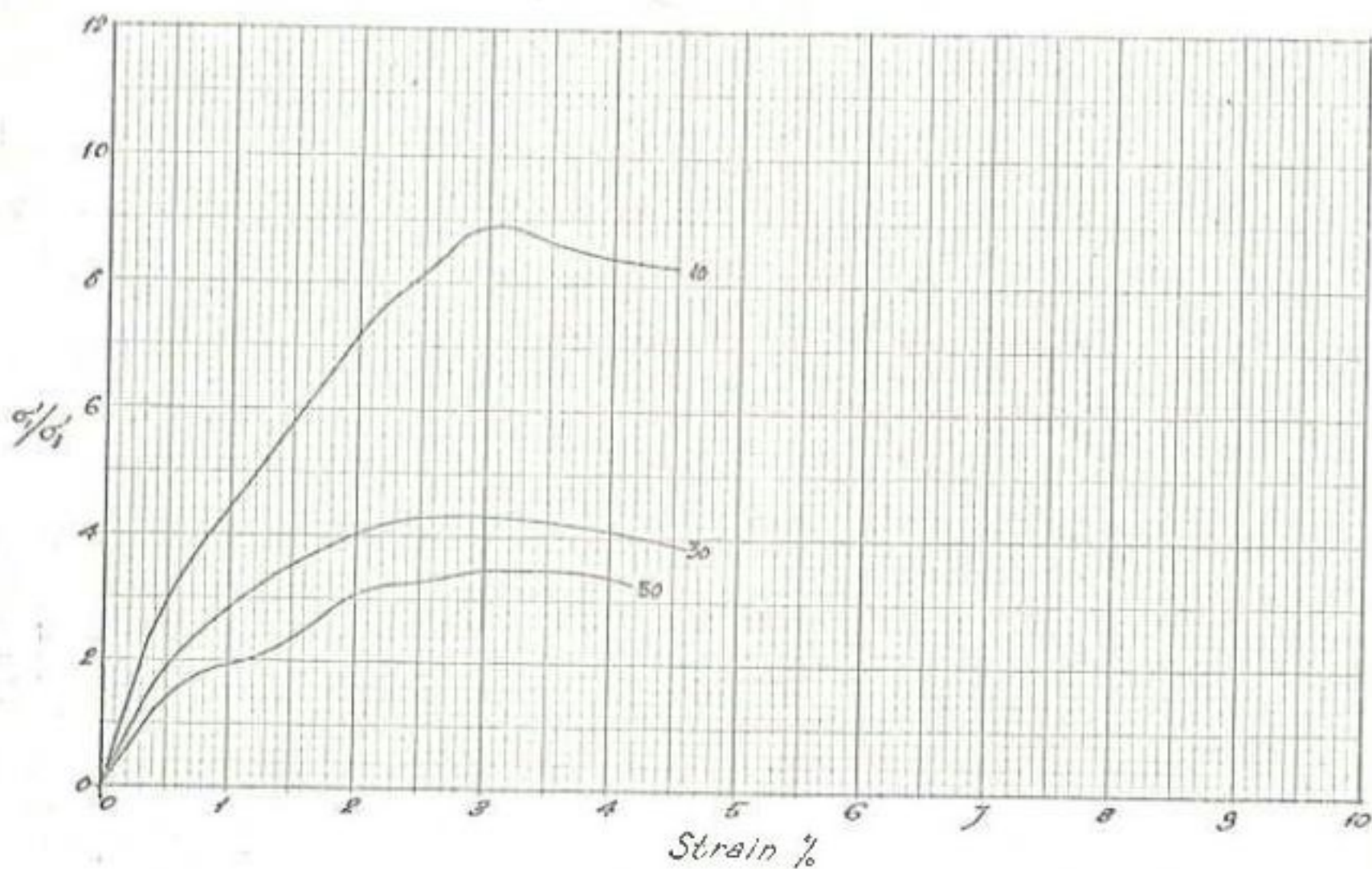
PORTSMOUTH & GOSPORT WATER CO.
TUBE NO. 167.
BORE NO. 3 : DEPTH 4'6" - 6'0"

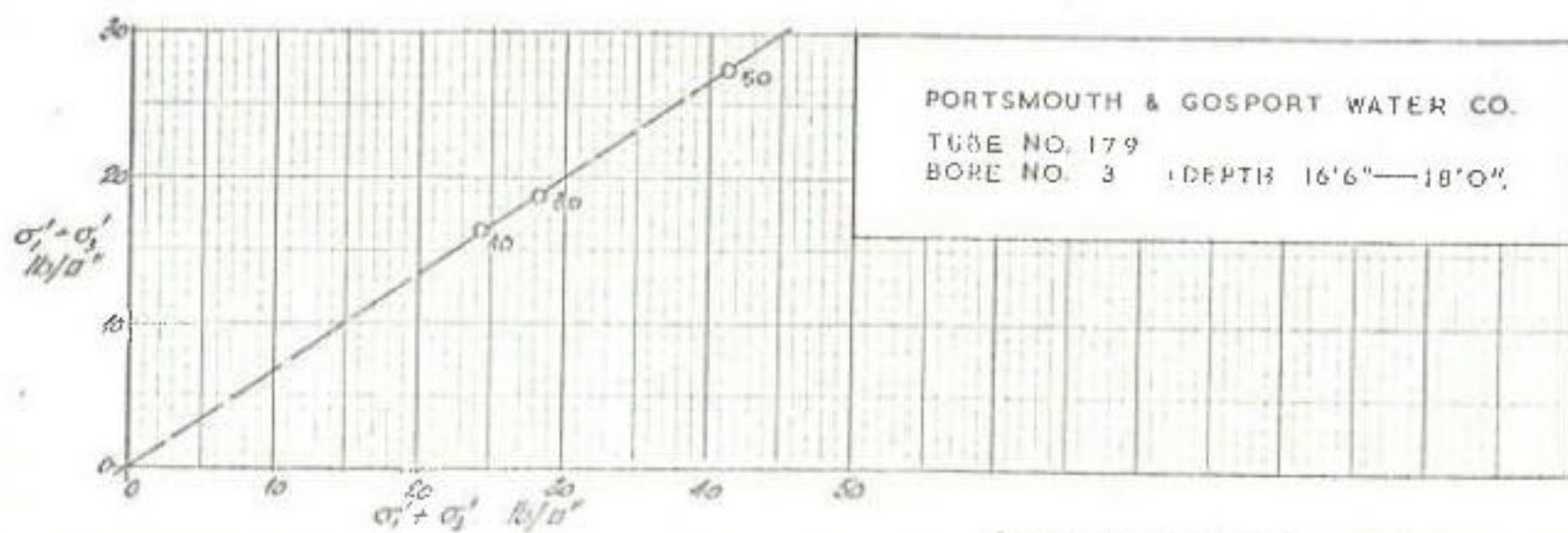
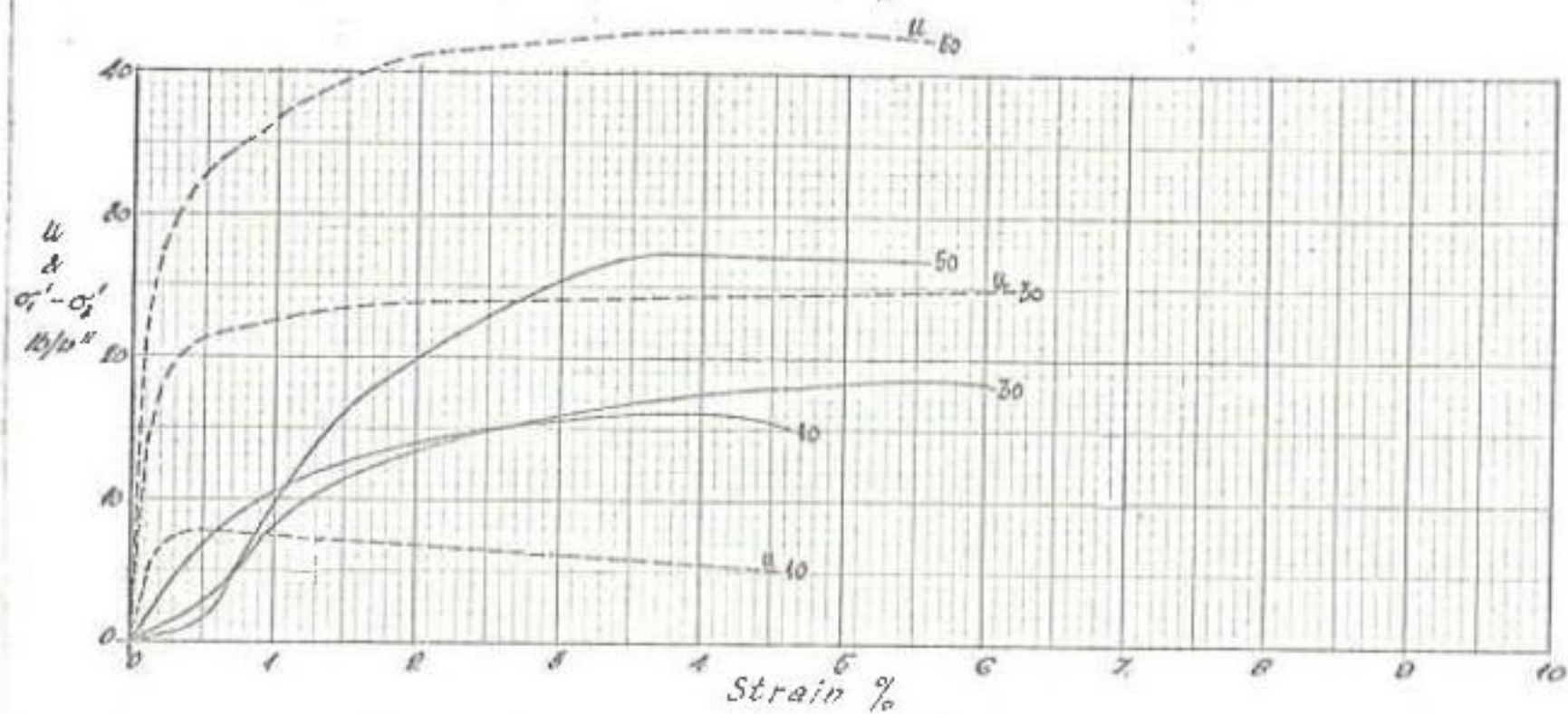
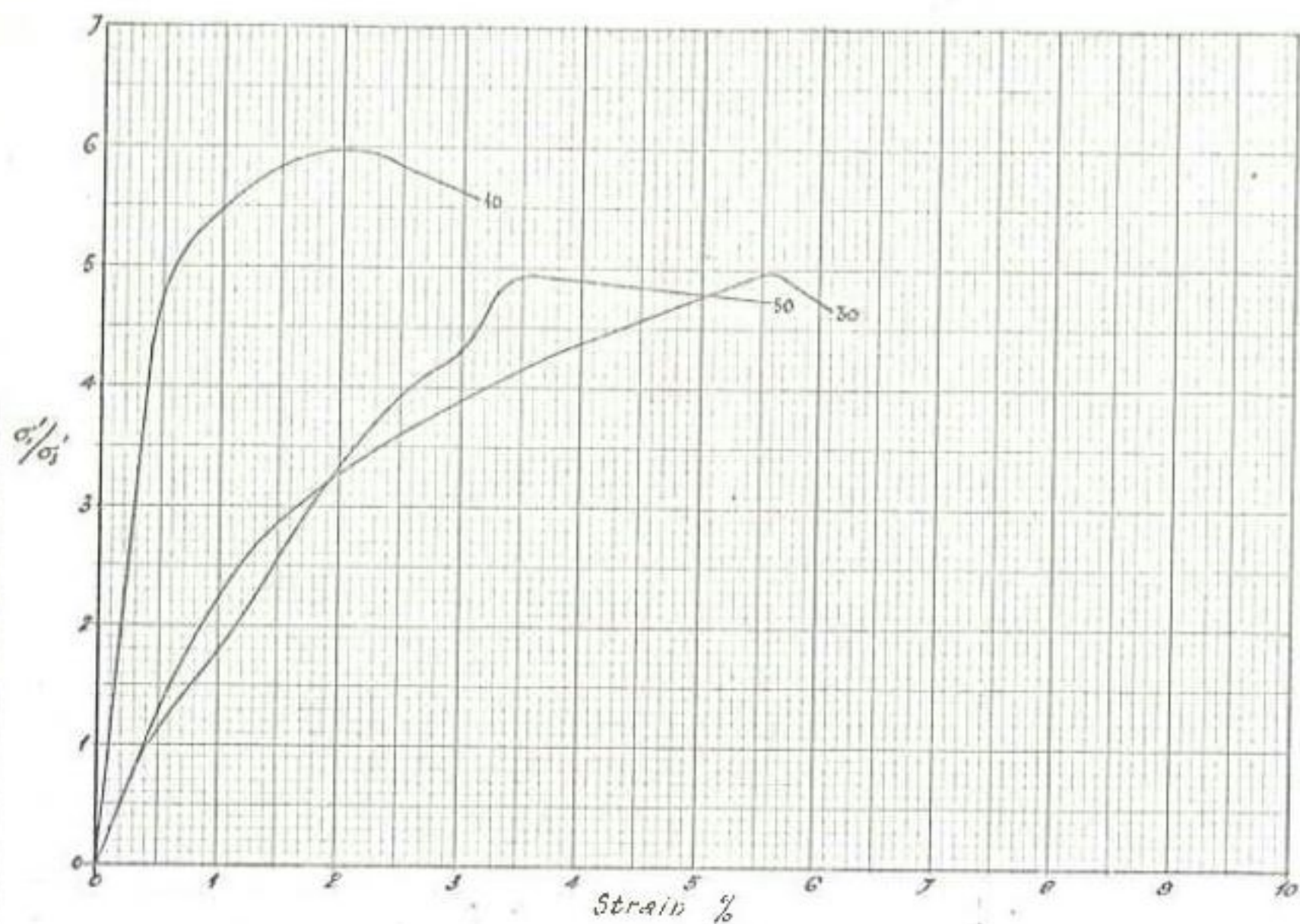


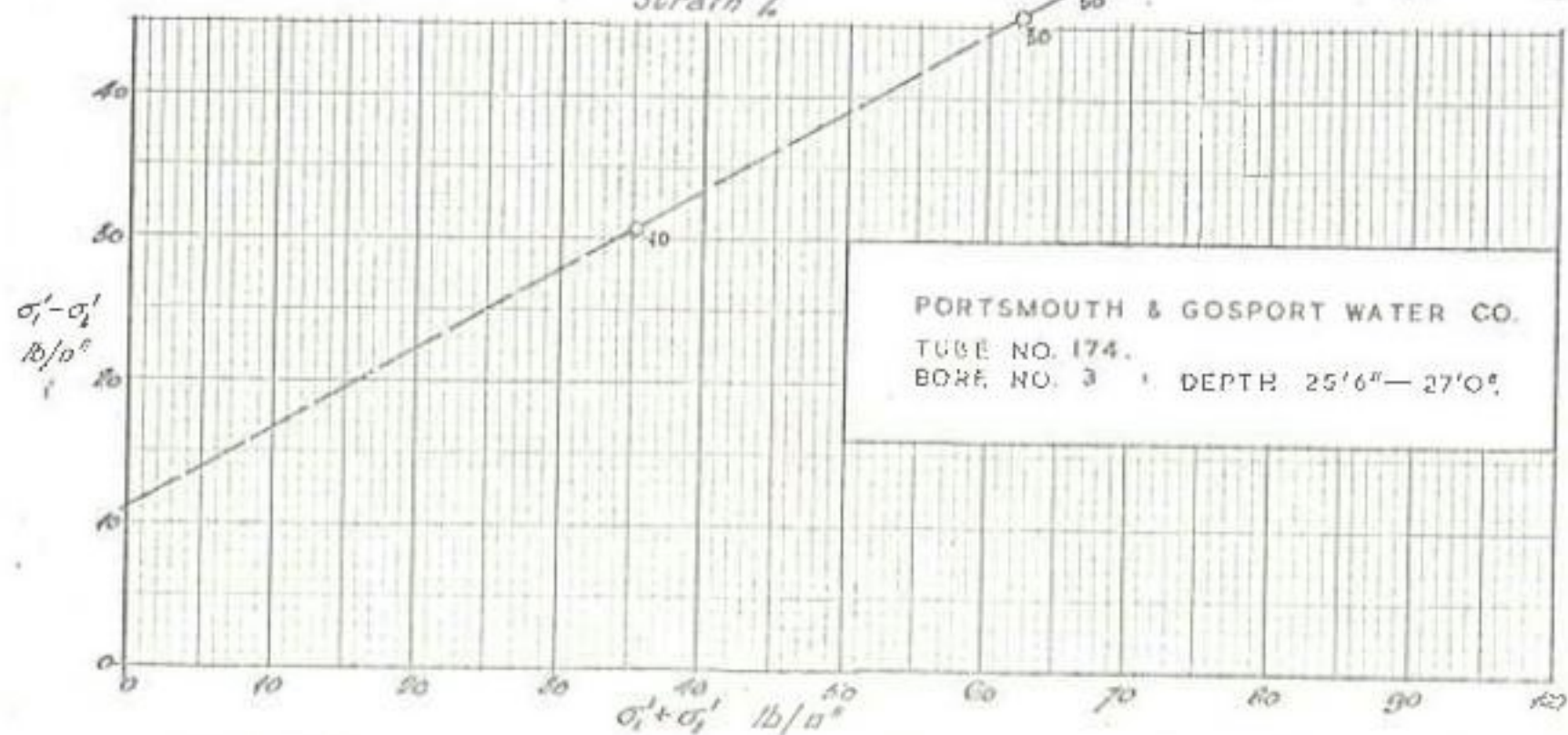
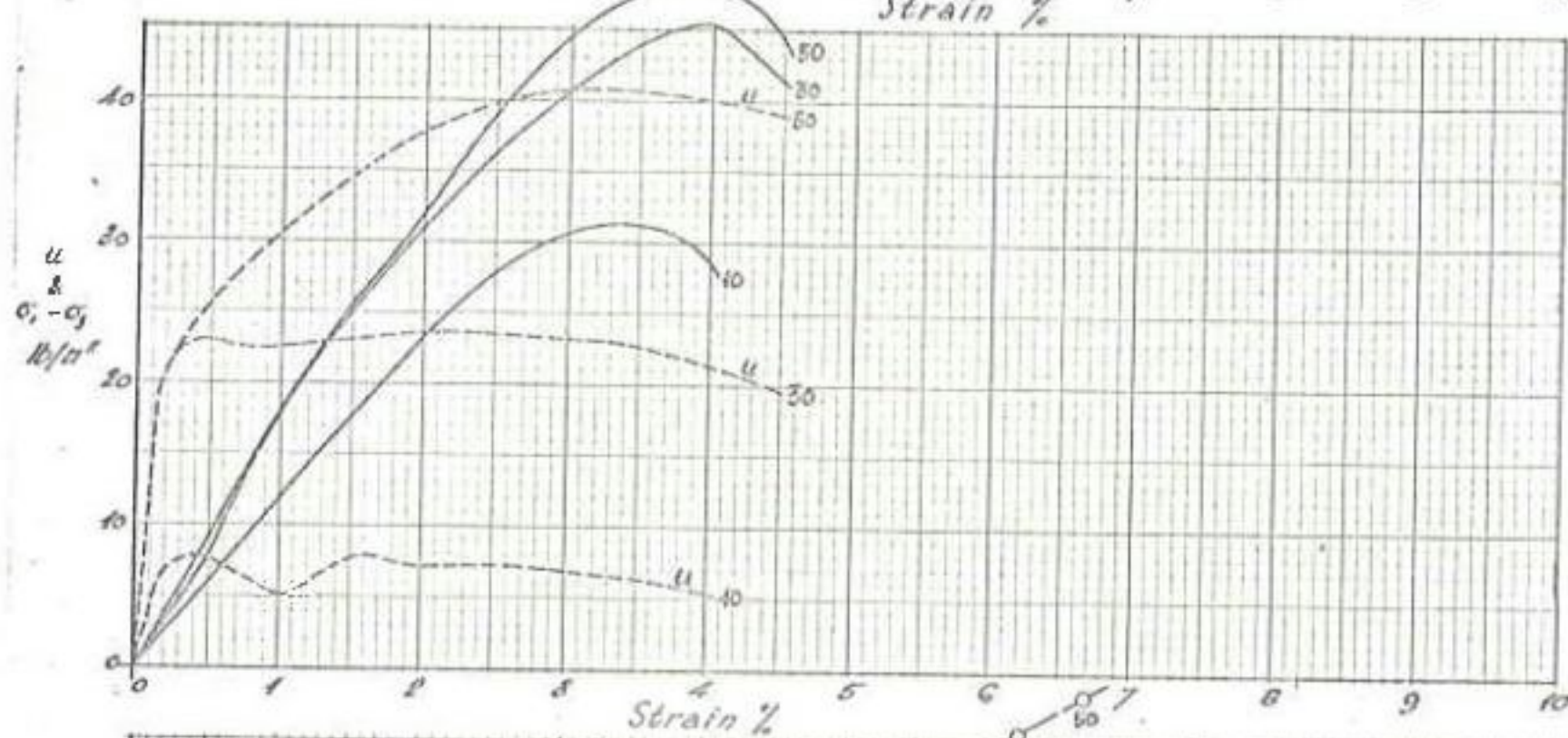
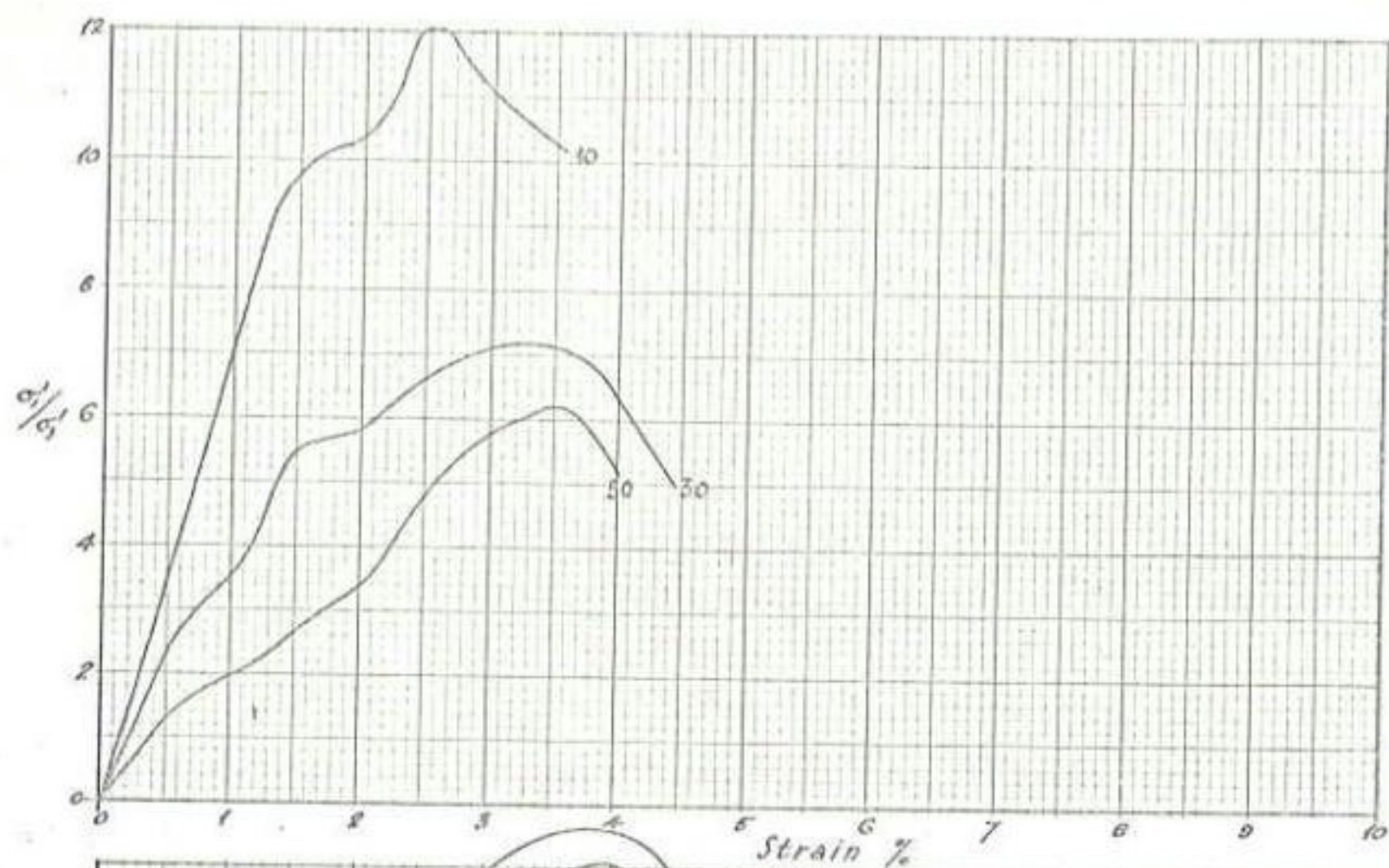
PORTSMOUTH & GOSPORT WATER CO.
TUBE NO. 173.
BORE NO. 3 : DEPTH 7'6" - 9'0"



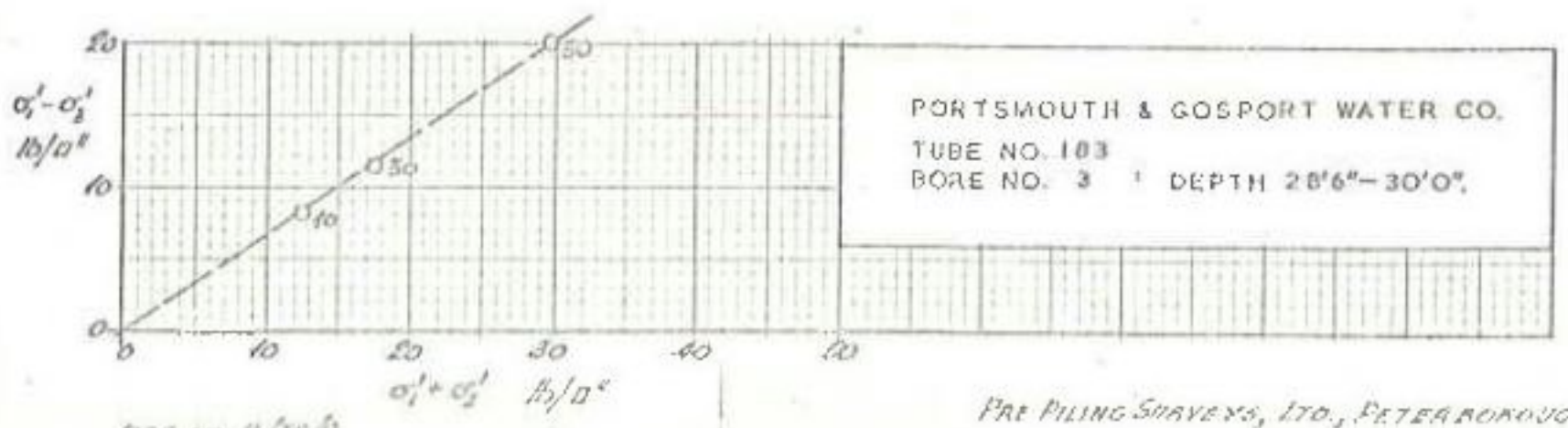
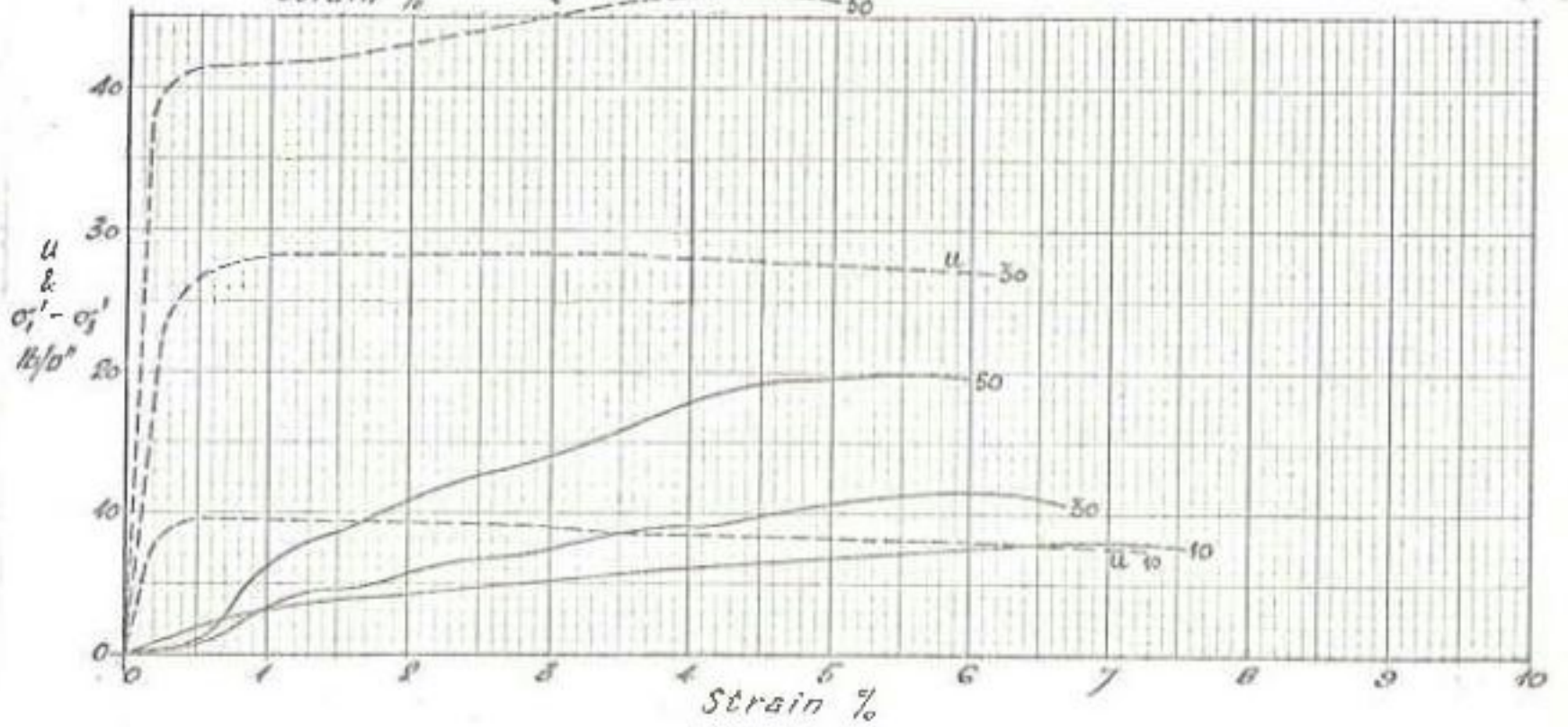
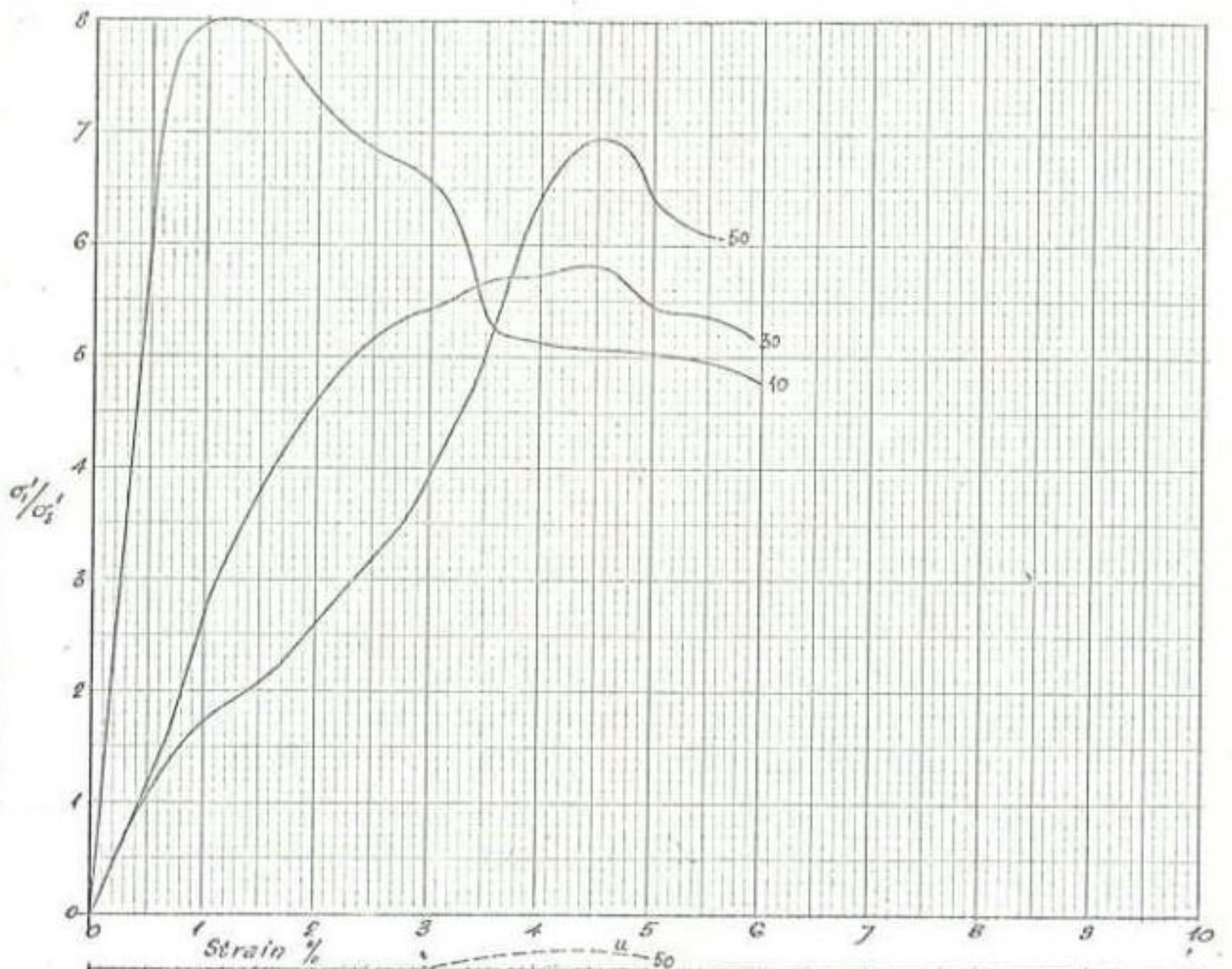
PORTSMOUTH & GOSPORT WATER CO.
TUBE NO. 176
BORE NO. 3 : DEPTH 10'6" - 12'0"



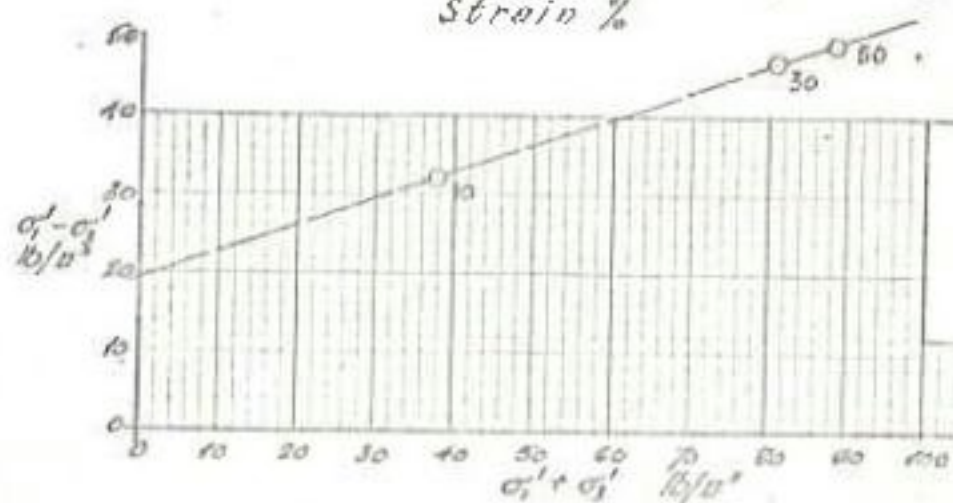
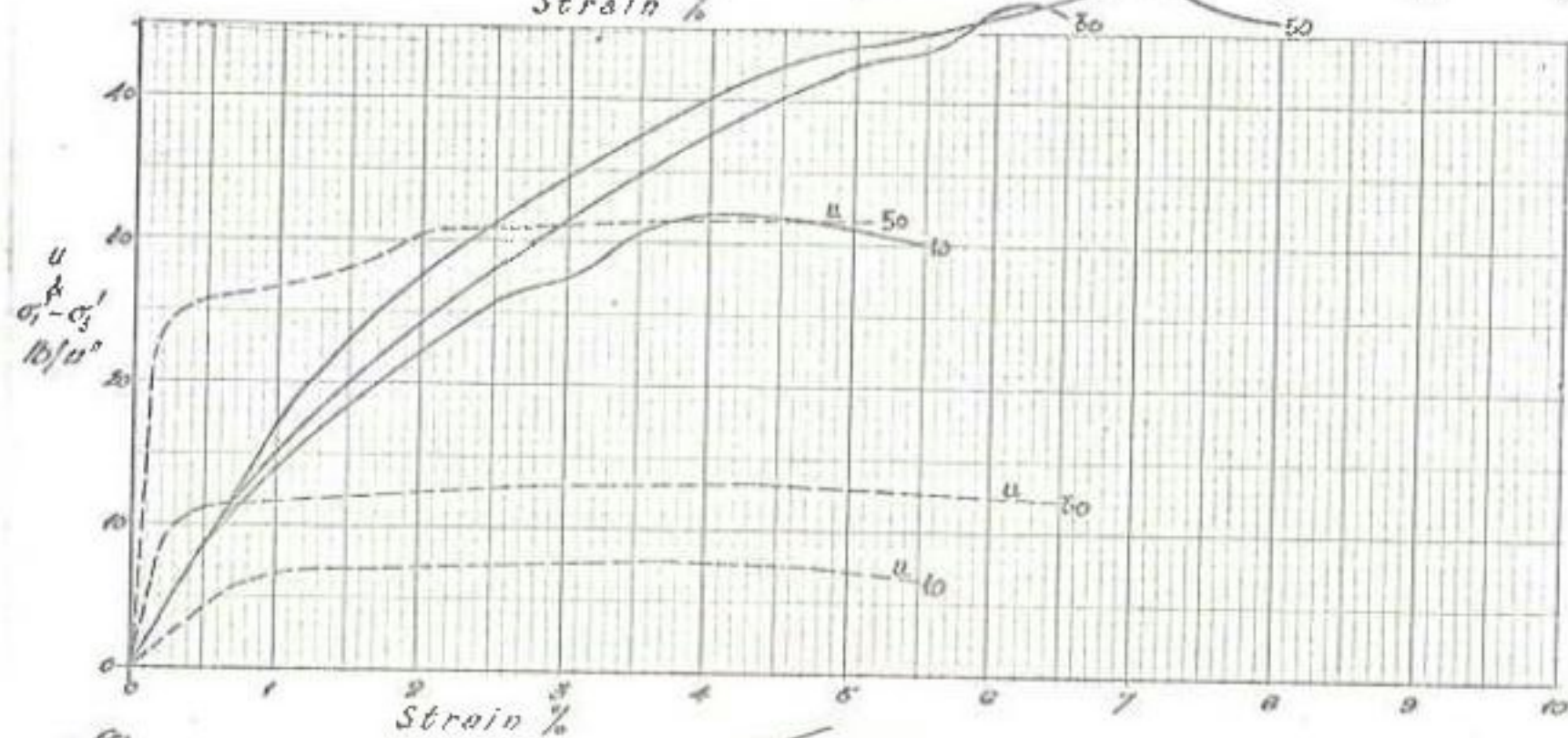
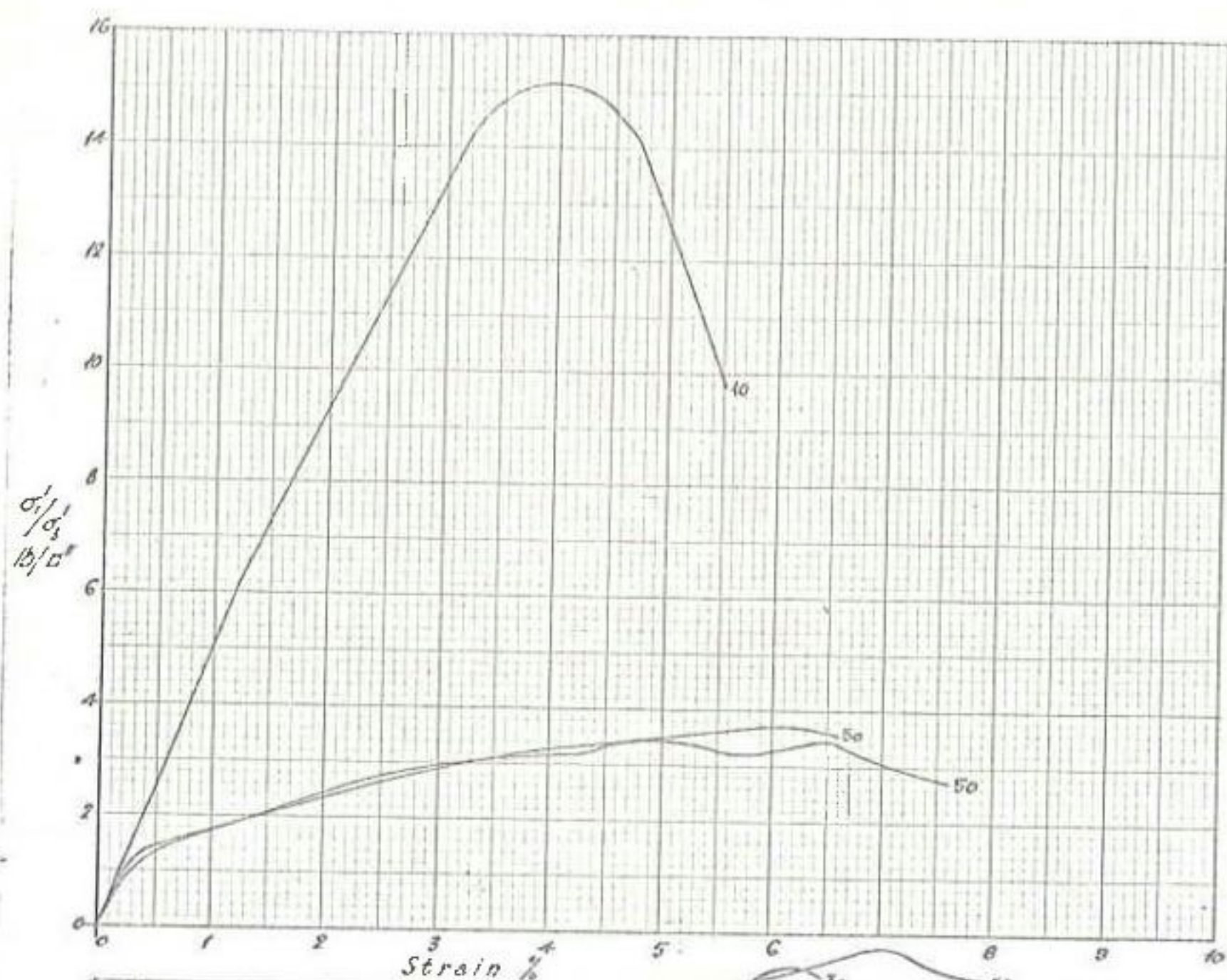




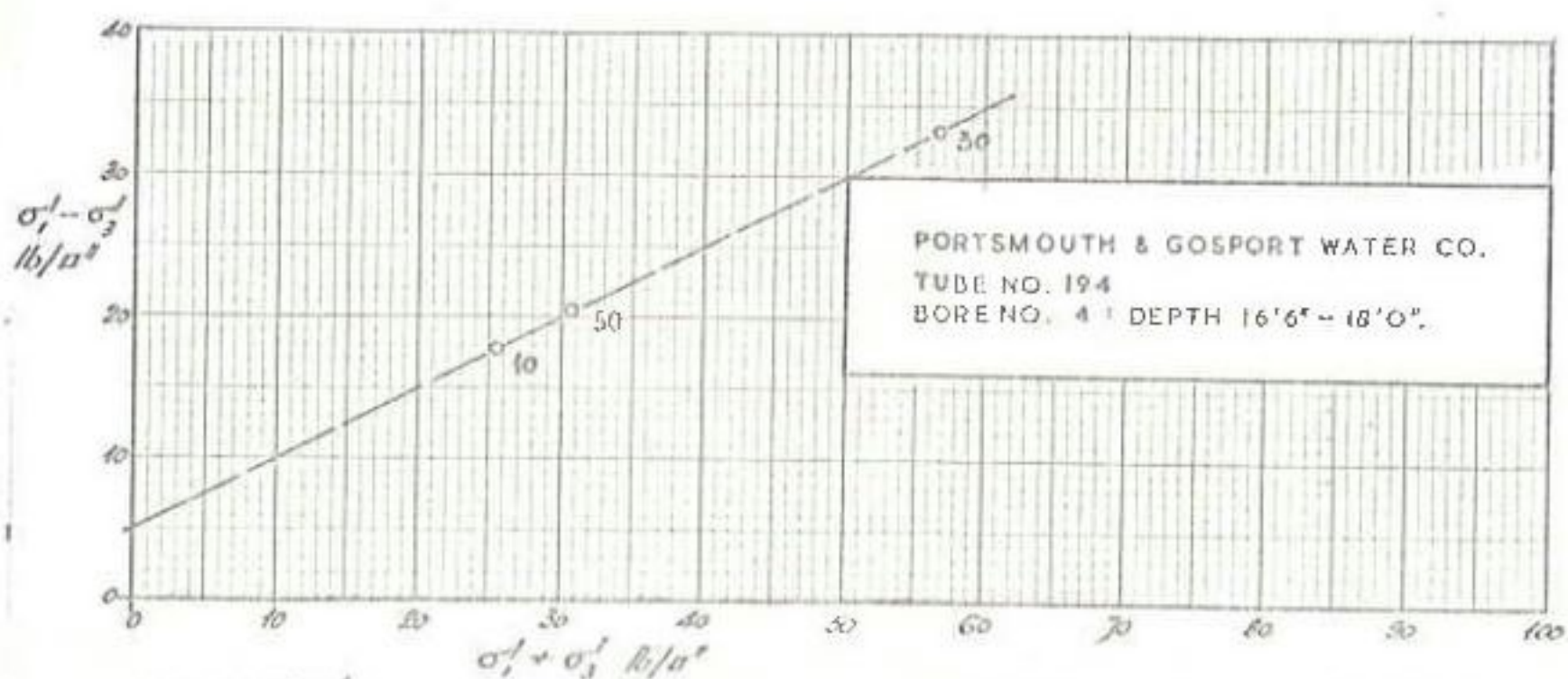
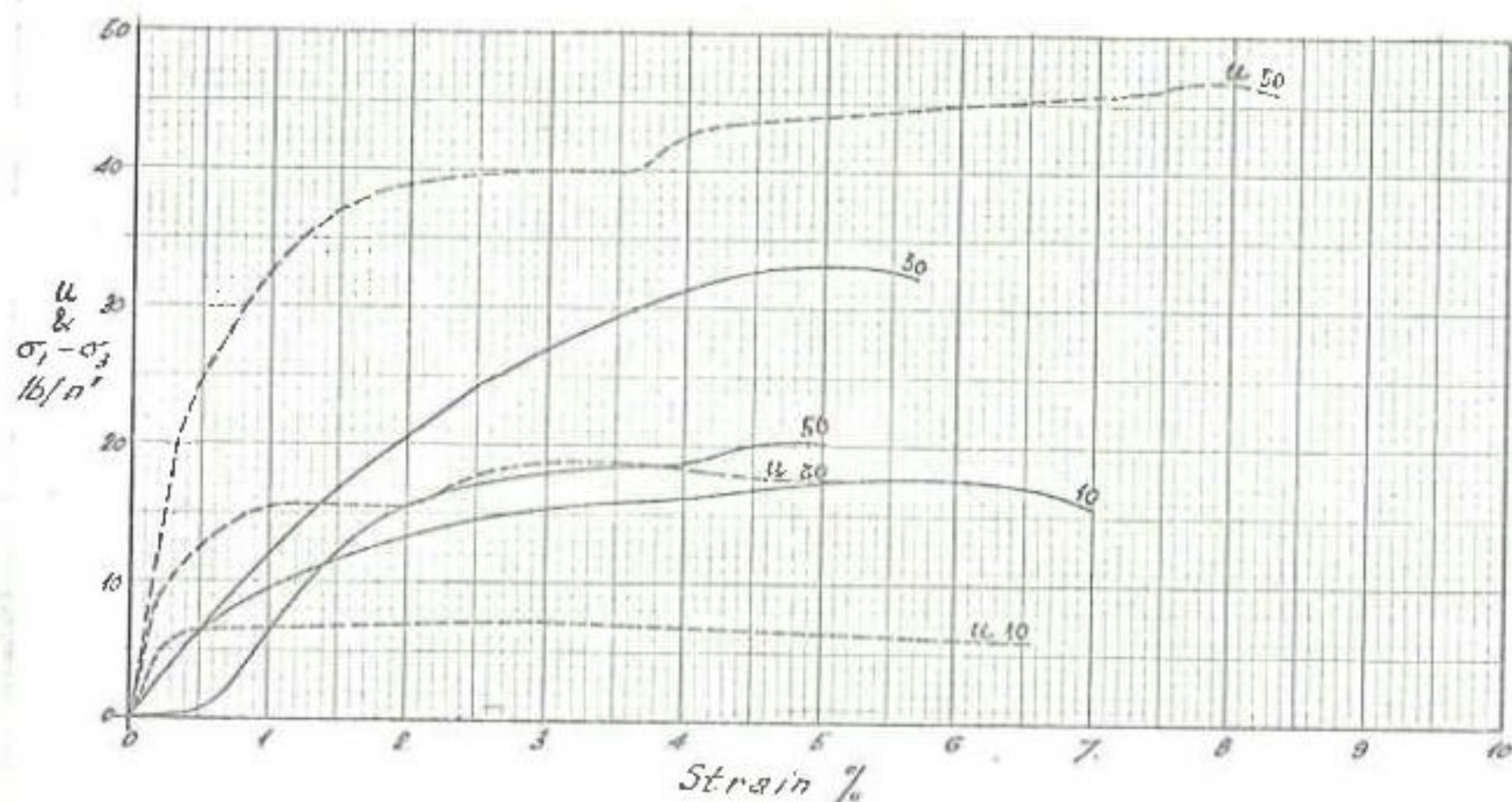
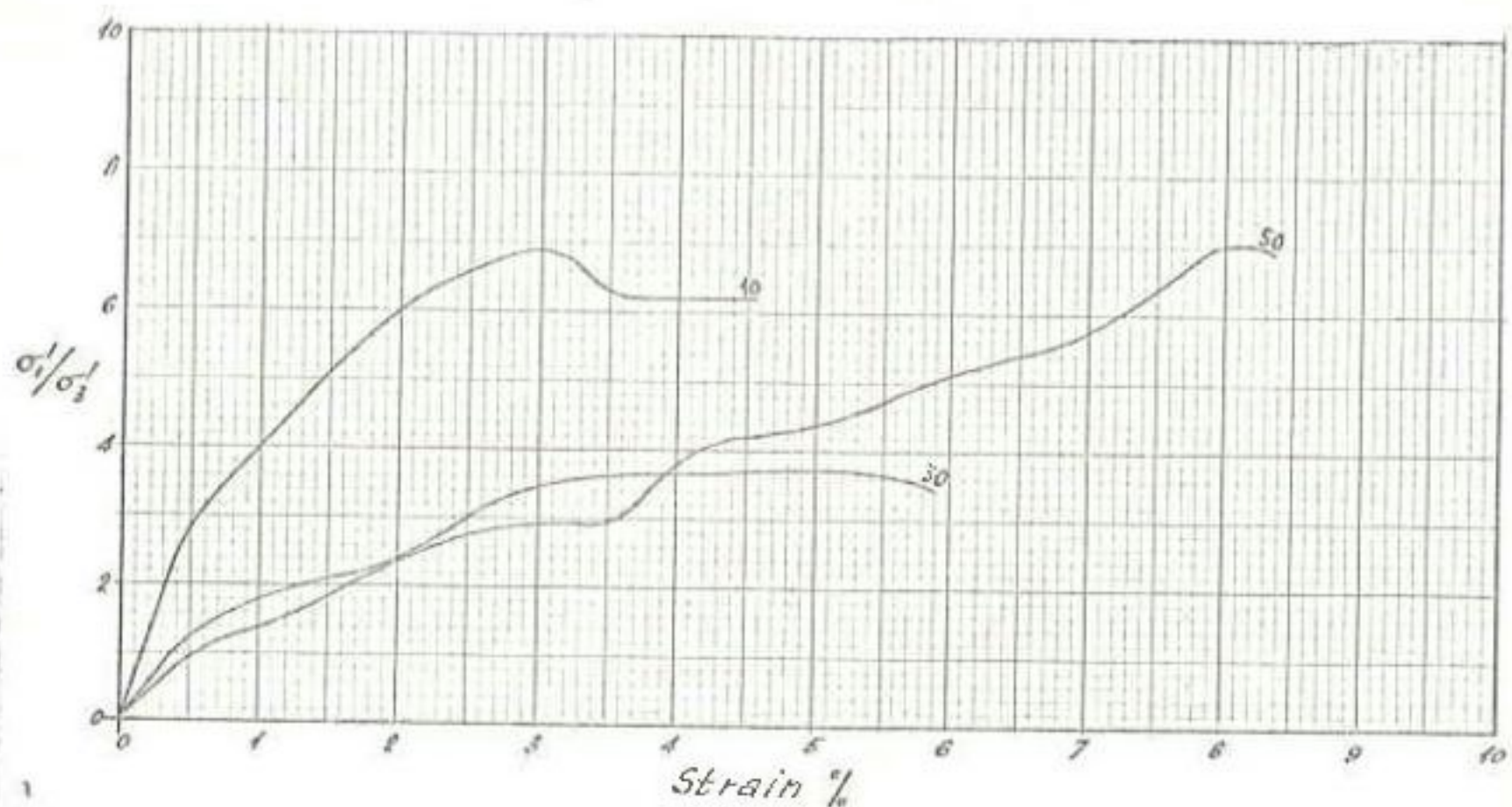
PORTSMOUTH & GOSPORT WATER CO.
TUBE NO. 174.
BORE NO. 3 : DEPTH 25'6" - 27'0".

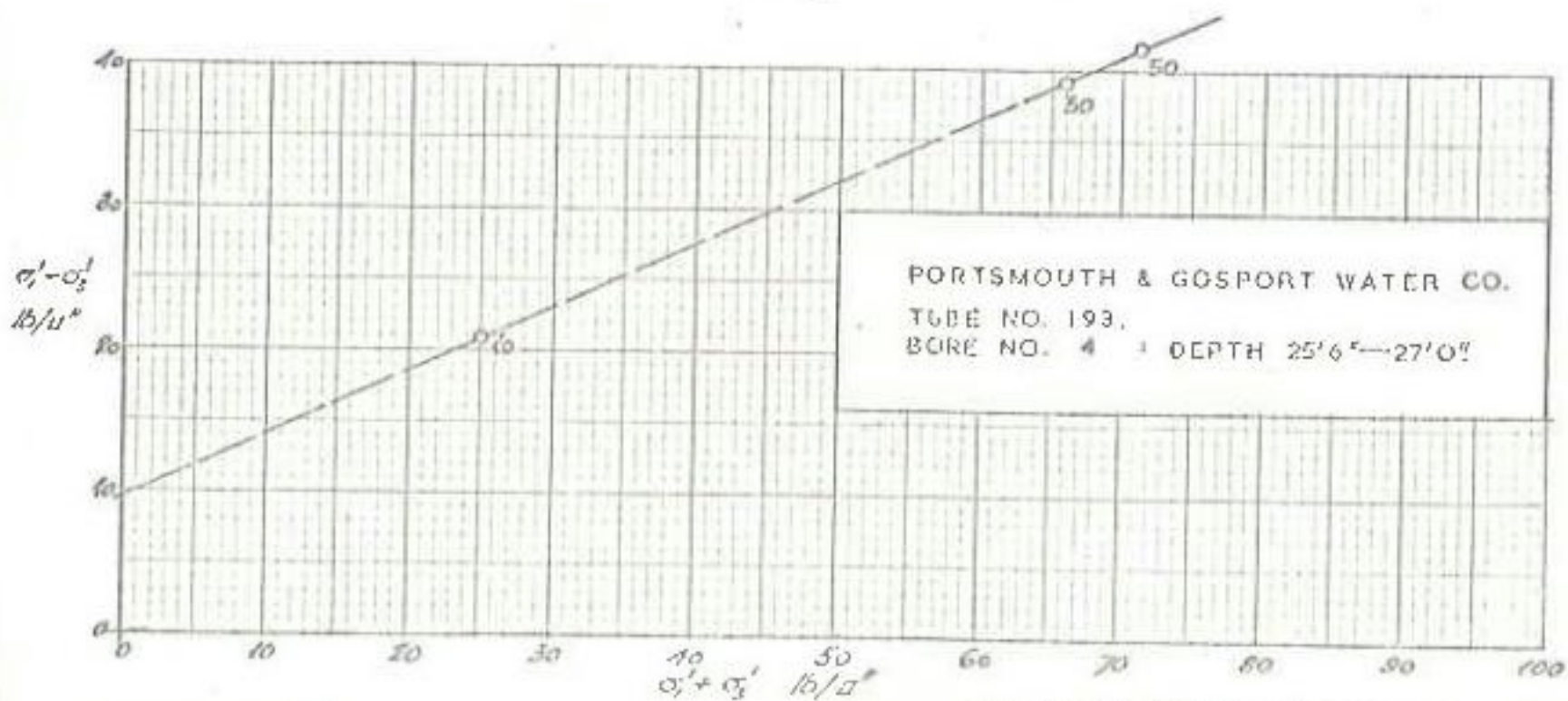
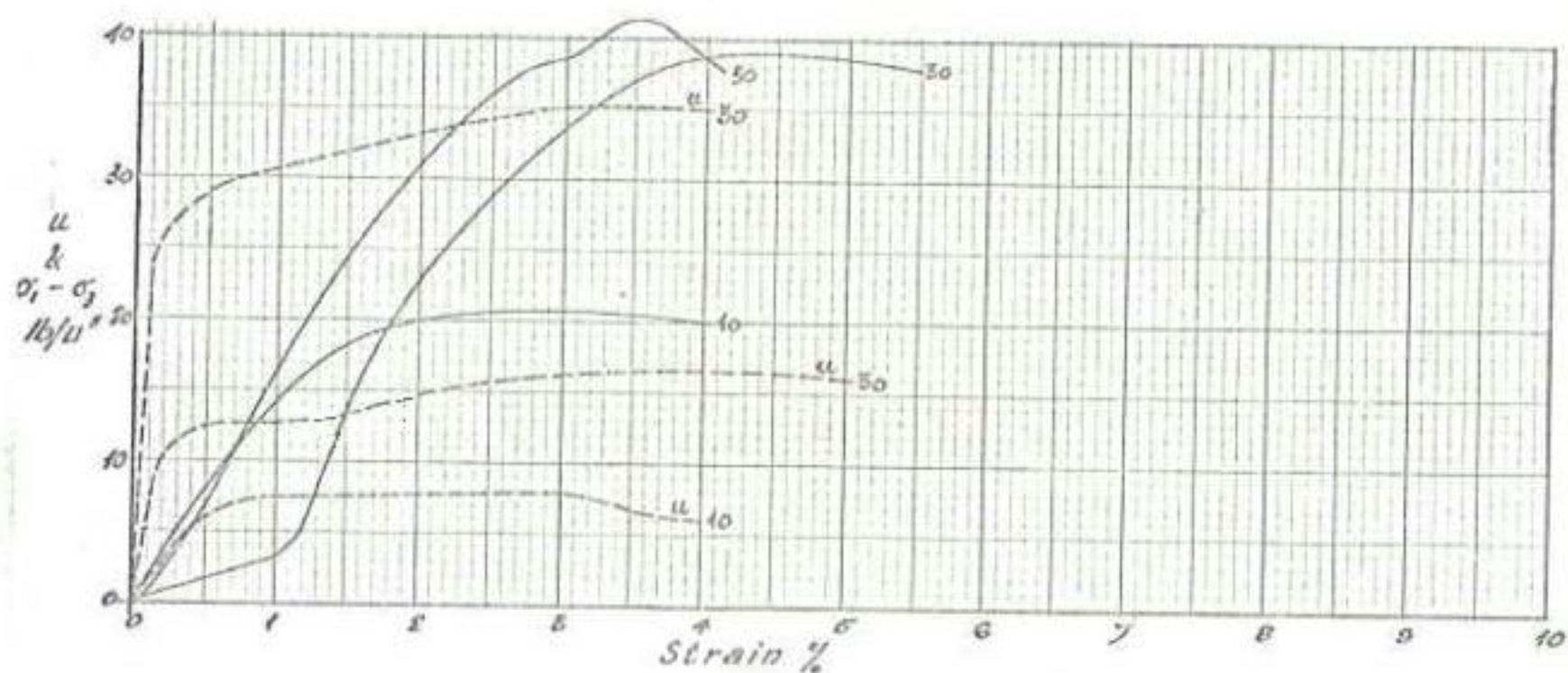
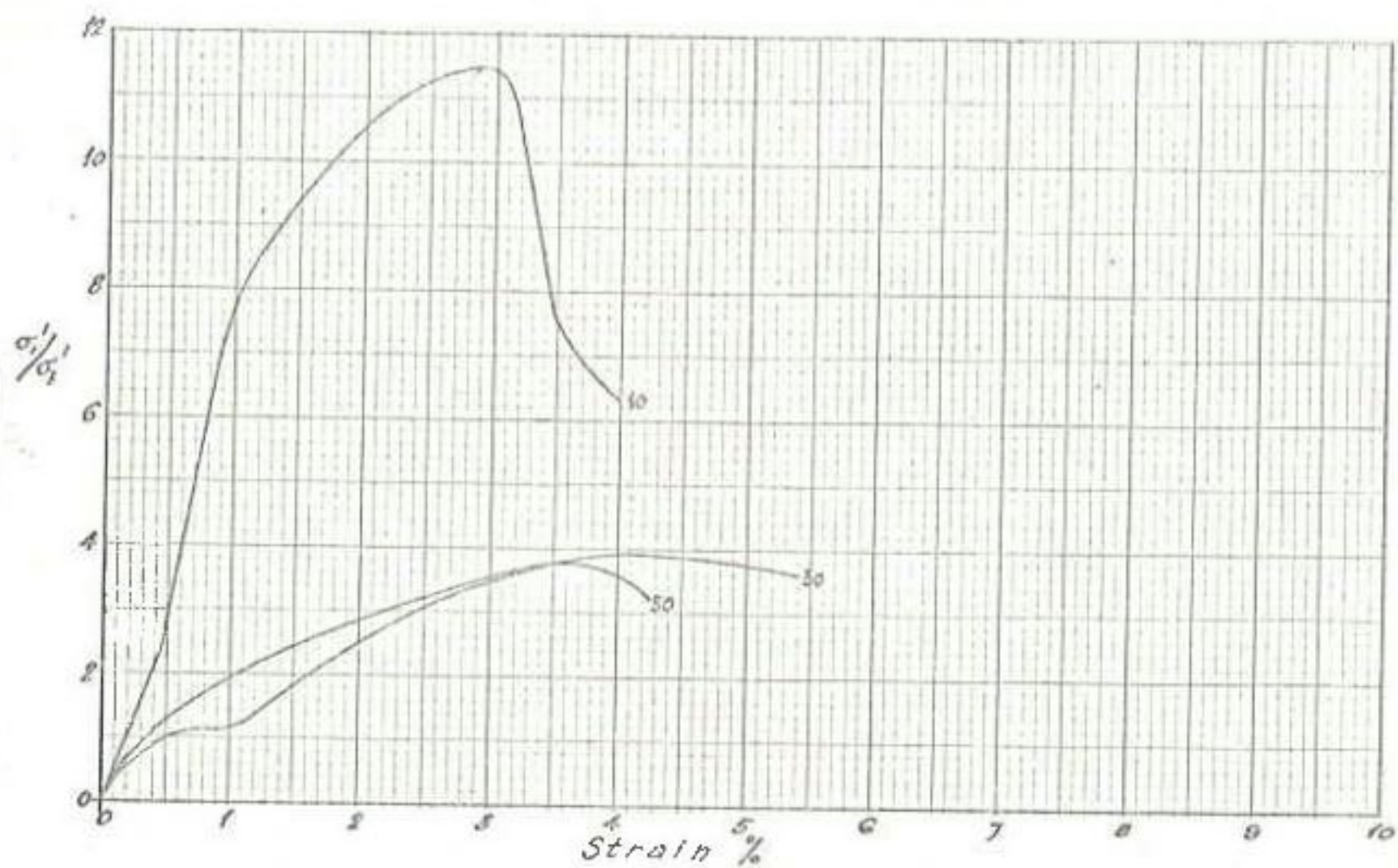


PORTSMOUTH & GOSPORT WATER CO.
TUBE NO. 103
BORE NO. 3 : DEPTH 28'6" - 30'0".

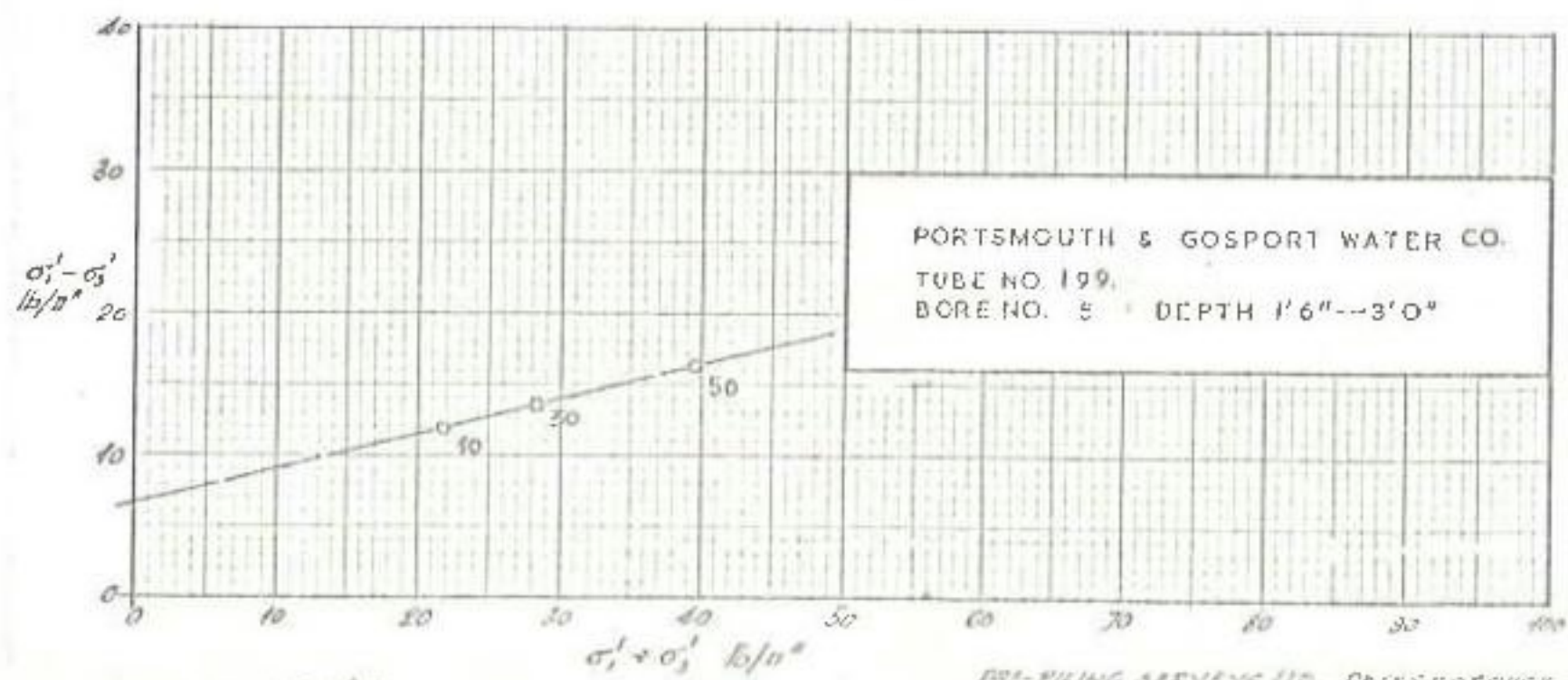
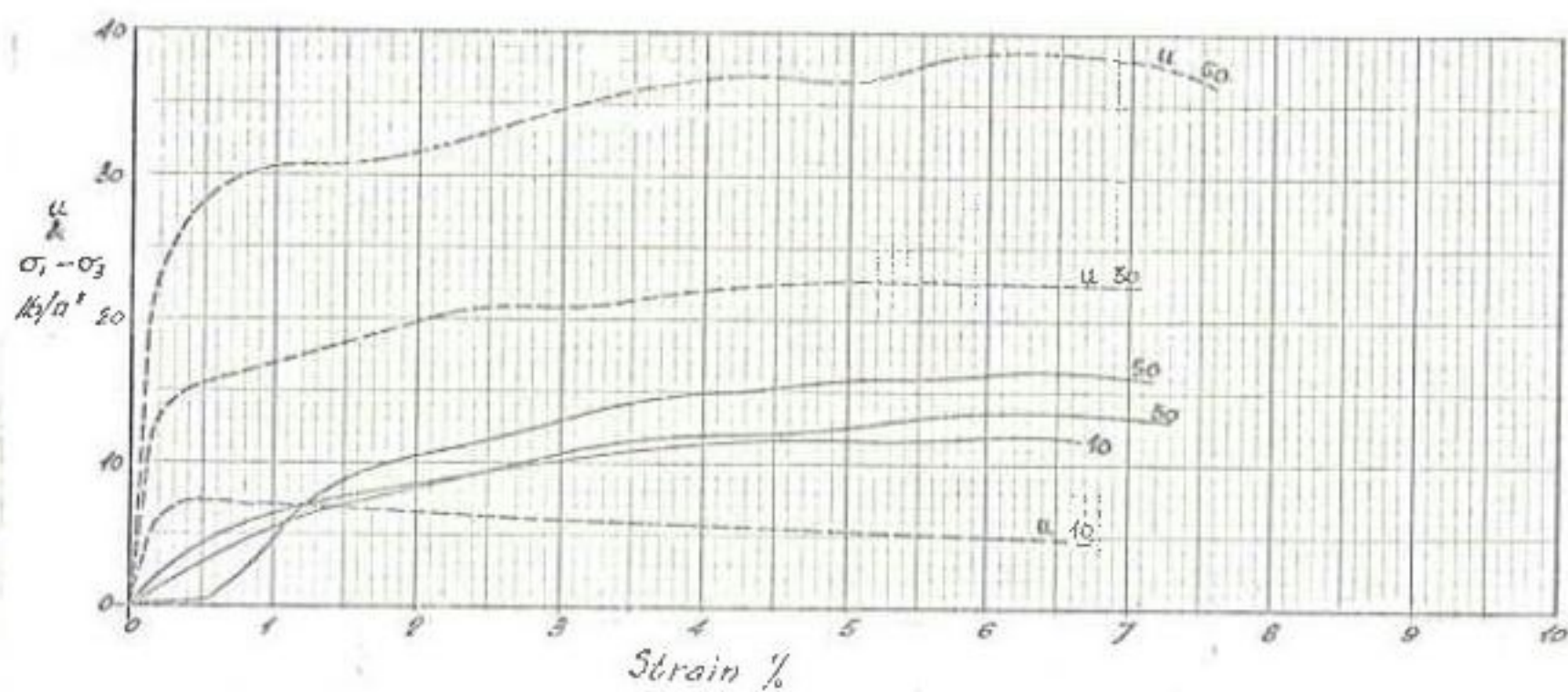
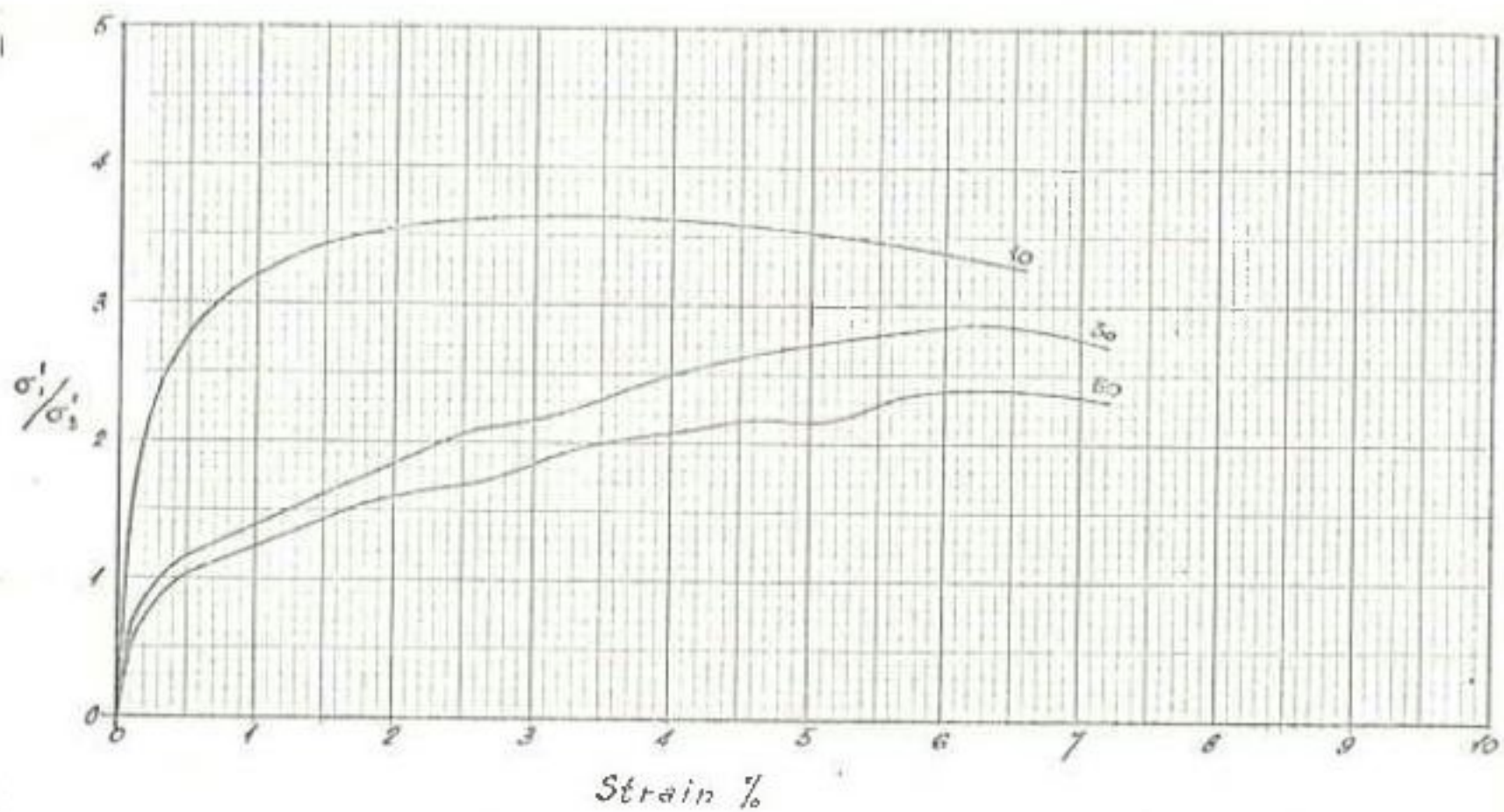


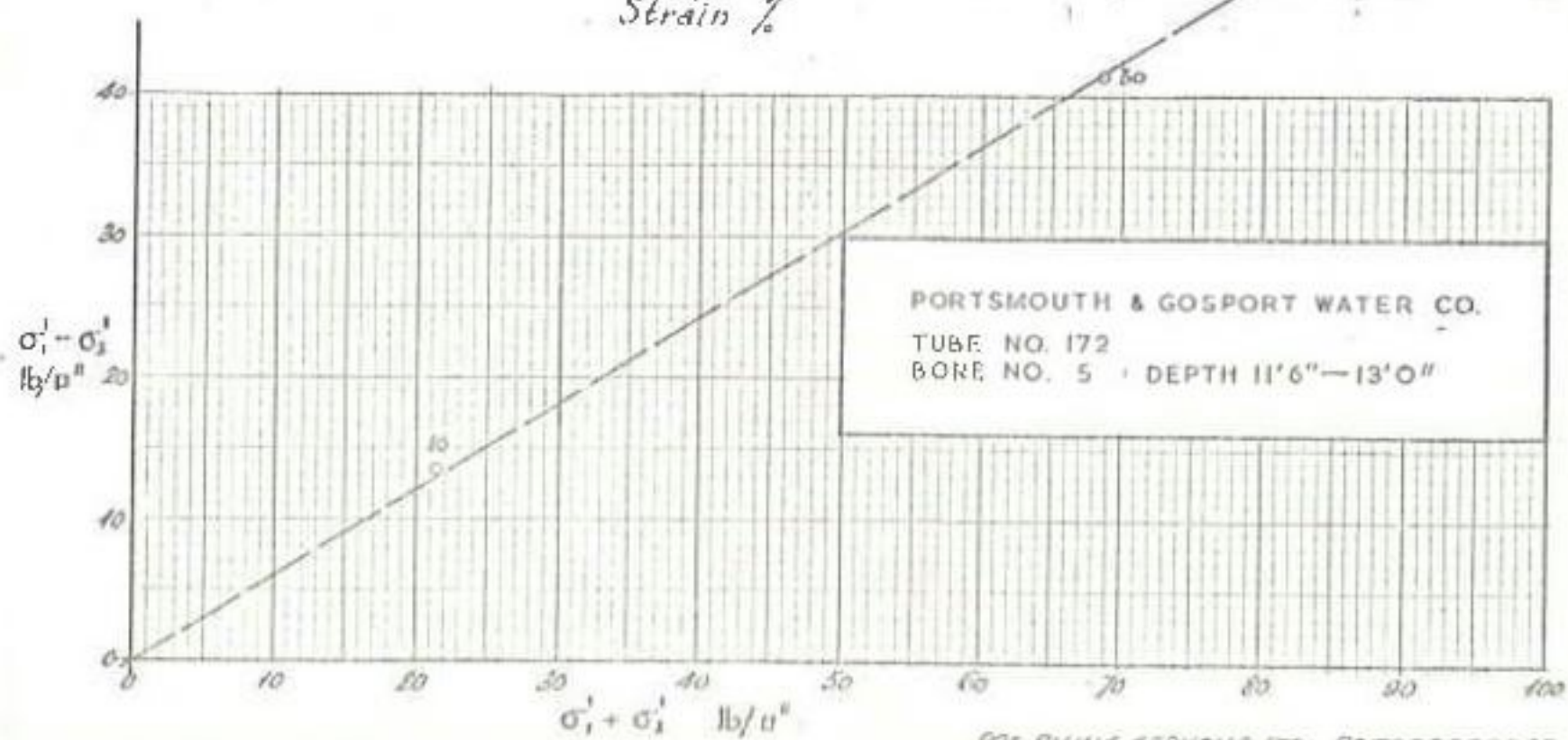
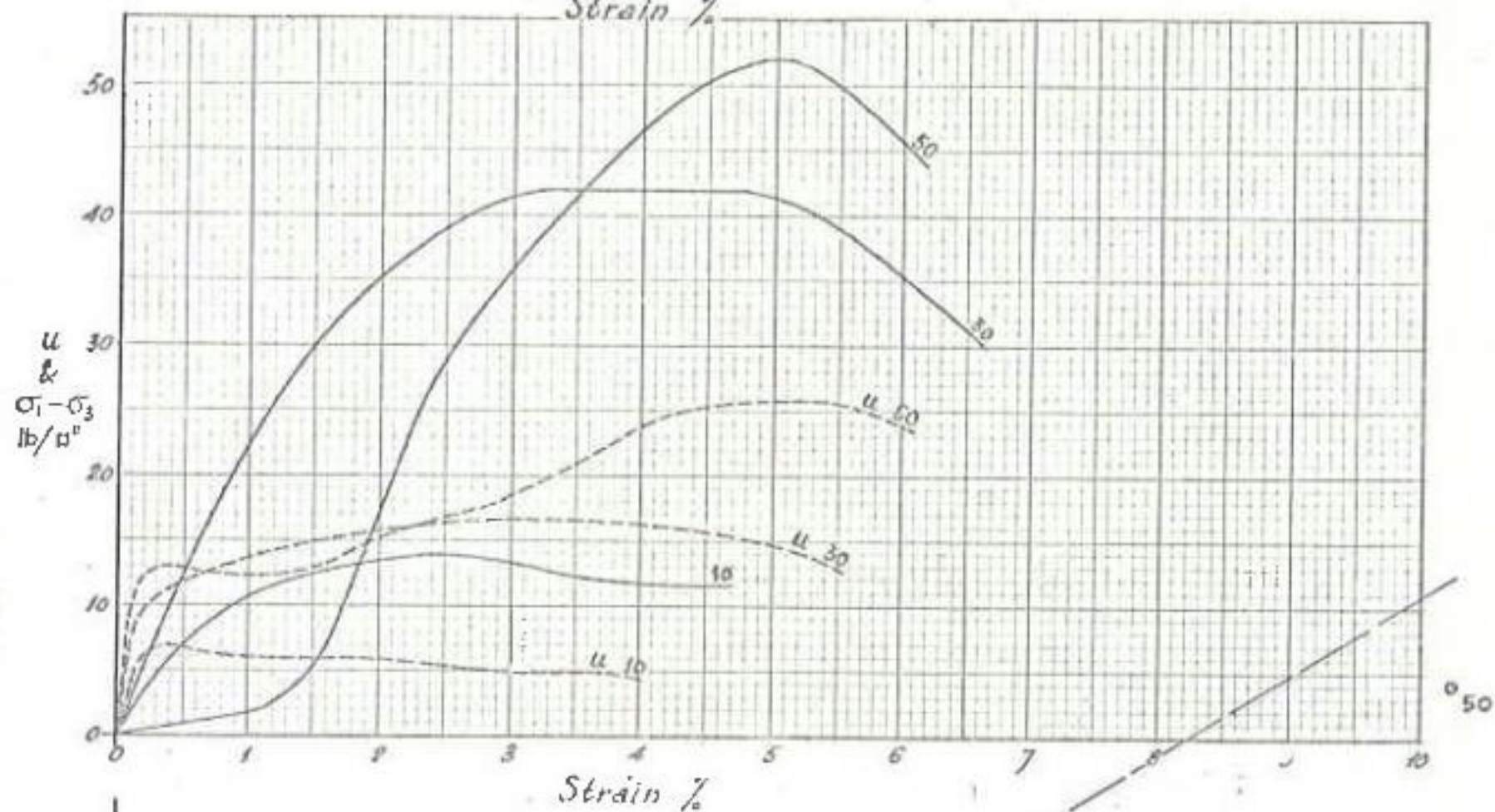
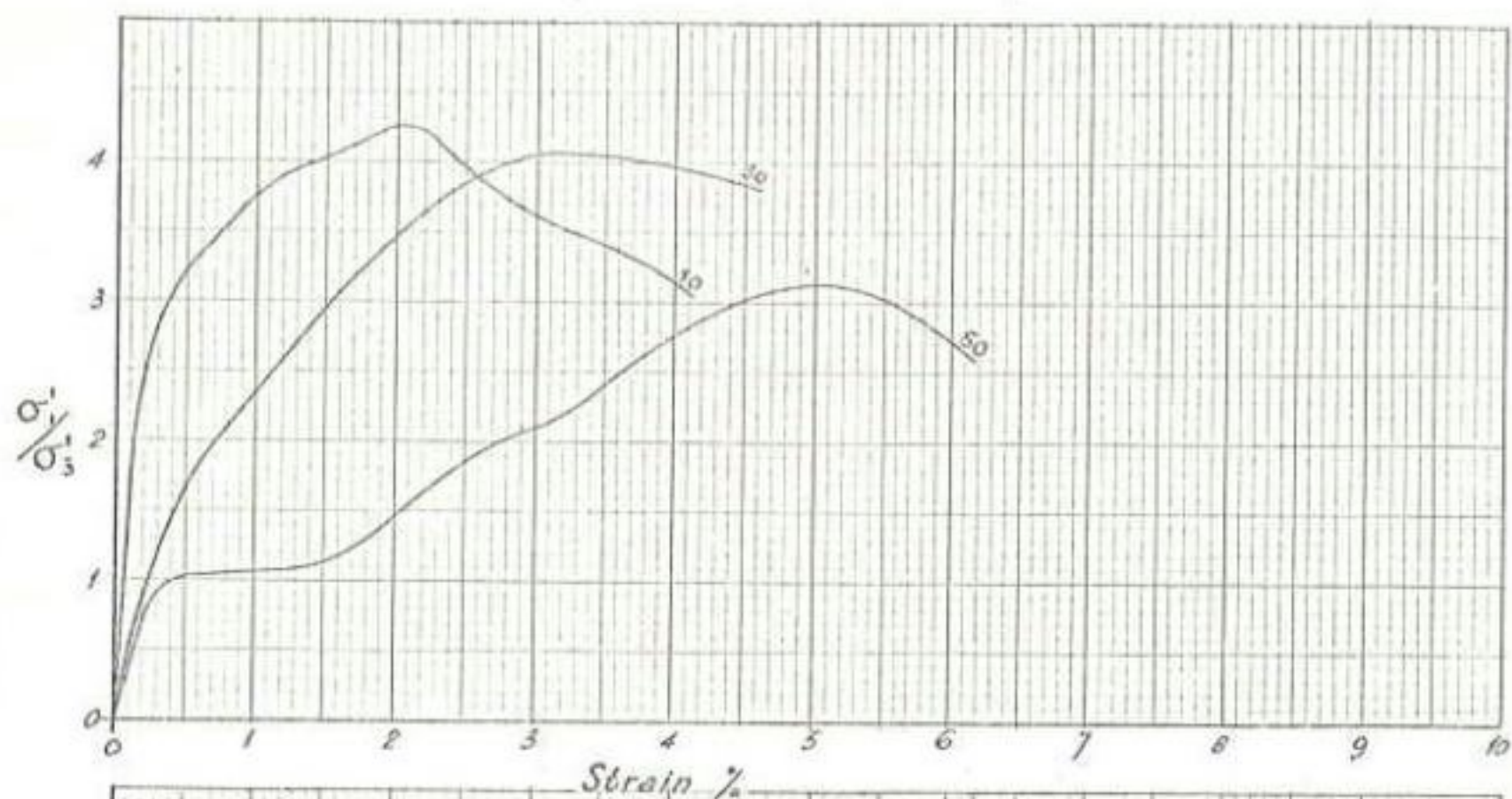
PORTSMOUTH & GOSPORT WATER CO.
TUBE NO. 206.
BORE NO. 3 - DEPTH 37'6"-39'0".

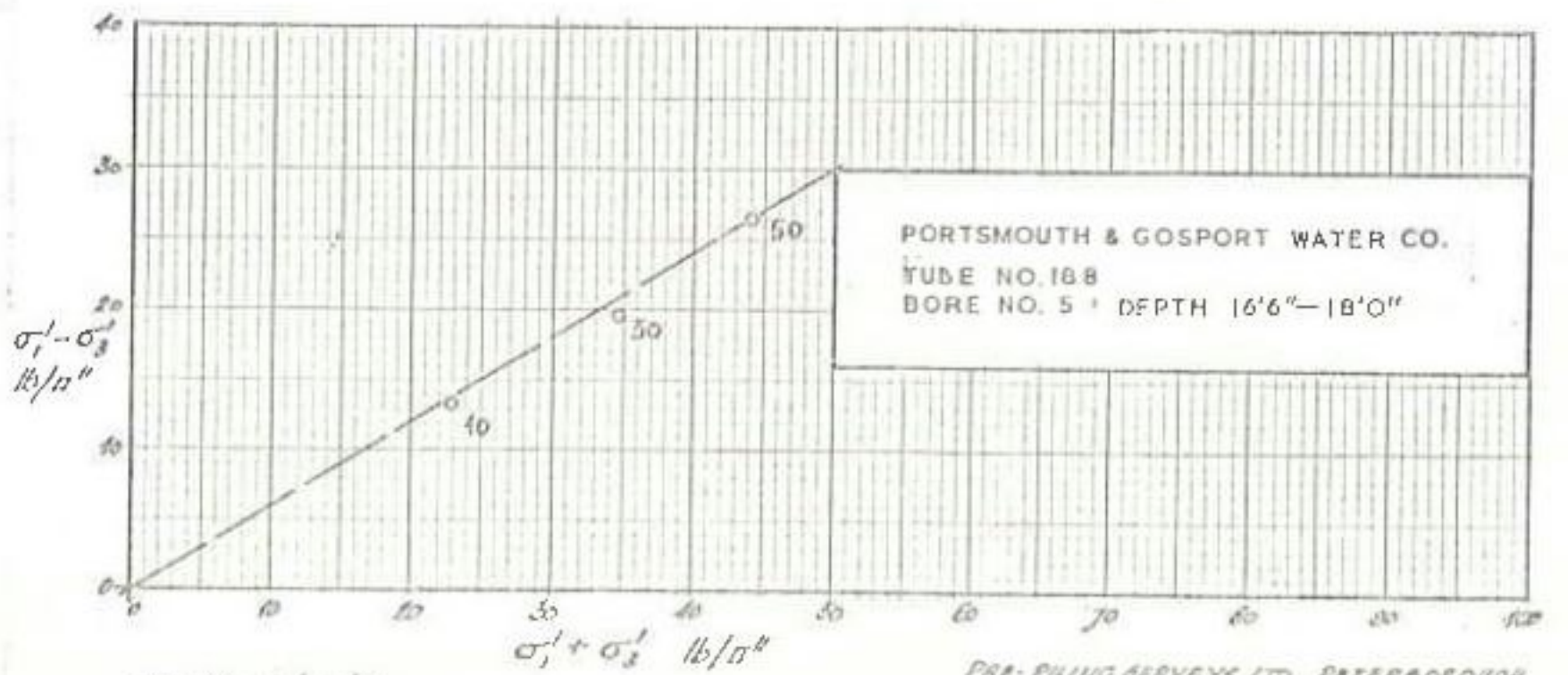
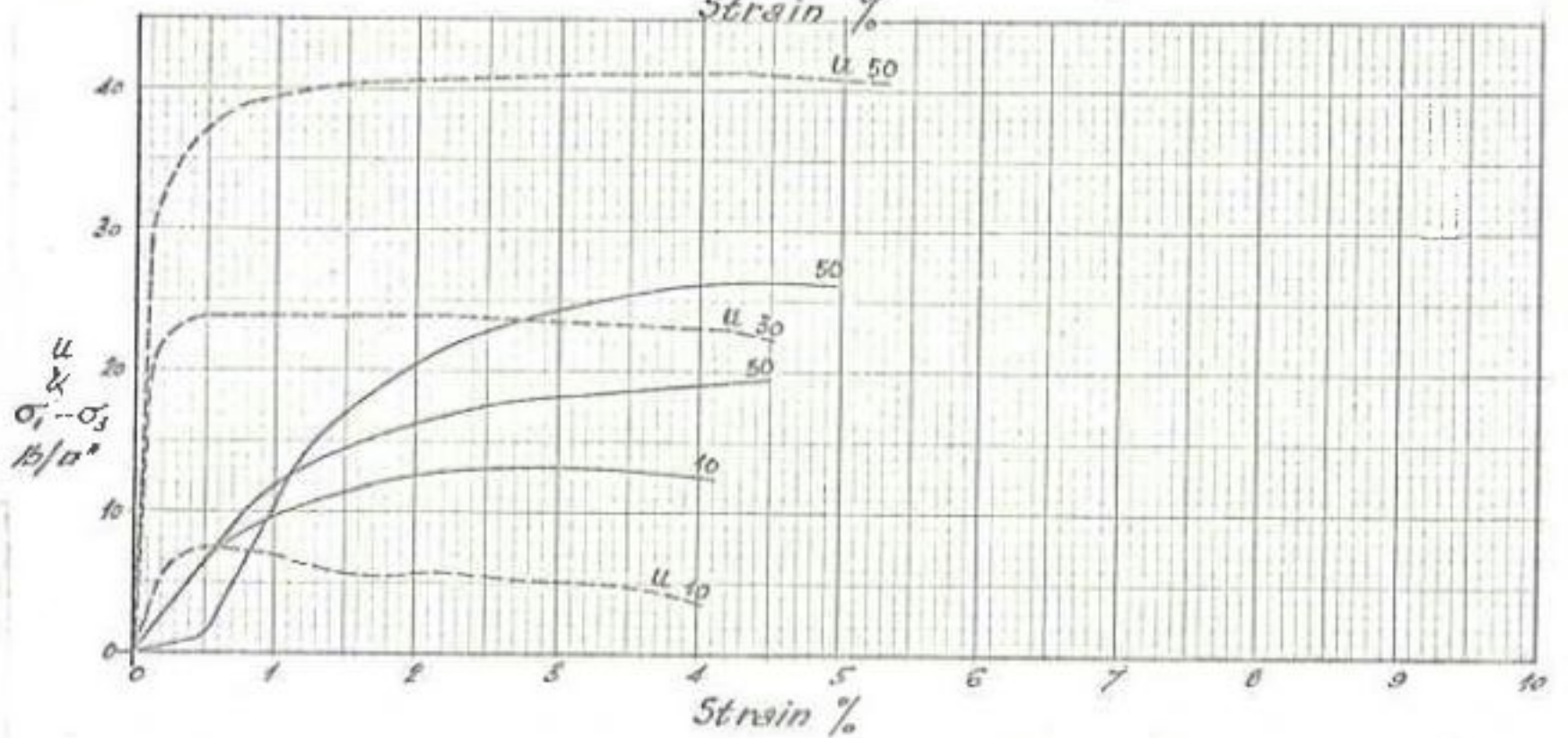
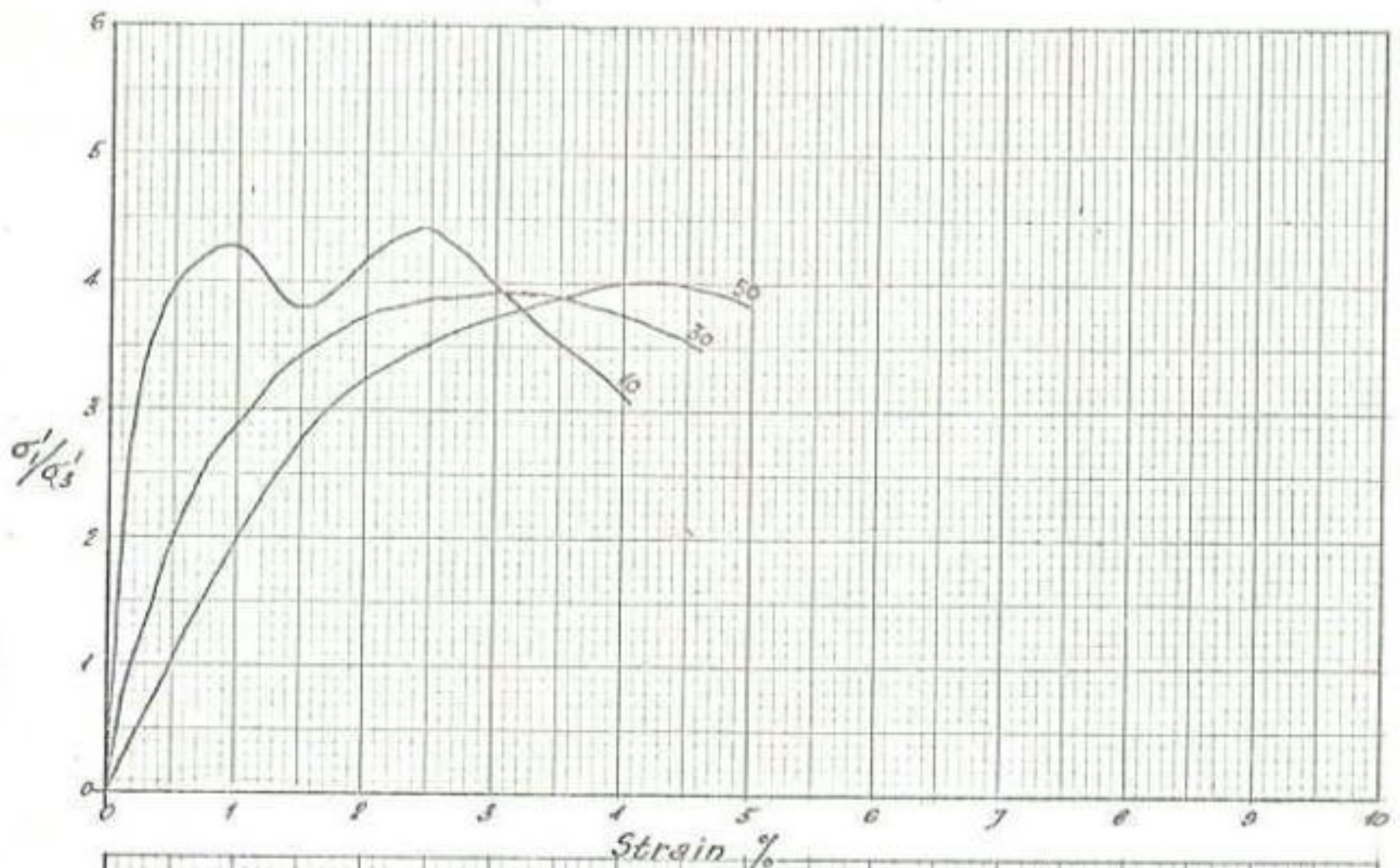




PORTSMOUTH & GOSPORT WATER CO.
TUBE NO. 193.
BORE NO. 4 : DEPTH 25'6" - 27'0"







EDGAR MORTON & PARTNER
CONSULTING ENGINEERING GEOLOGISTS

E. MORTON, H.S. ASSOC. I.C.E., F.A.I.W.E., M.A. H.D.
C. W. FISHERWOOD, B.Sc. (Tech.), A.M.I.C.E., F.A.I.W.E.

EDGAR MORTON & PARTNER
F. W. ROWE, D.Sc., F.R.S., F.A.I.C.E.

STYPERSON HOUSE,
ADLINGTON,
MACCLESFIELD, CHESHIRE.
TEL. BOLLINGTON 2170.

18th December 1962

THE CHAIRMAN AND DIRECTORS
THE PORTSMOUTH AND GOSPORT WATER COMPANY.

Gentlemen,

GEOLOGICAL REPORT ON THE PROPOSED
STORAGE RESERVOIR AT HAVANT THICKET.

Following a preliminary geological assessment of the site I recommended exploration by means of trial boreholes. I collaborated with Mr. S. R. Haffety and Mr. Hall in the preparation of the Tender documents and afterwards supervised, as necessary, the trial borehole programme.

I now have pleasure to report on the results of the trial boreholes, and three diagrams are appended.

I. GENERAL.

1. It is proposed to impound and store water up to an elevation of 120 ft. A.O.D. or preferably 125 ft. A.O.D. at Havant Thicket by means of a dam founded on the London Clay.
2. On the proposed centre line the maximum depth of water would be 50 ft. (or 55 ft. with the higher T.W.L.) and the maximum height of bank can be taken as about 55 ft., (or 60 ft. with the higher T.W.L.).
3. The storage provided would be largely filled by pumping and during dry seasons it is likely that the water level in the reservoir would be rapidly drawn down.
4. The major part of the reservoir basin including the immediate site of the intended dam lies on the outcrop of the London Clay. The underlying Reading Beds outcrop in the upper reaches of the various small streams which cross the site. The strata dip to the south-south-west at about 1 in 34 or about $1\frac{1}{2}^{\circ}$ (Plan C).

II. THE TRIAL BOREHOLES.

5. A total of 20 trial boreholes were sunk, 9 on the proposed centre line and 11 within or on the margin of the reservoir basin. A total of 85 4" undisturbed samples were taken, 24 being sent to Manchester and 61 to Pre-Piling Survey's laboratory. The testing of selected samples is still in progress, and when completed a separate report on the Soil Mechanics aspect of the scheme will be submitted.
6. The results of the trial boreholes and details of the strata as indicated by the disturbed samples are shown on Diagram A. This diagram is useful for correlation purposes since it is drawn in a NNE/SSW direction, approximately parallel to the true dip, and most of the boreholes have been projected on to the section in their relative positions.
7. The following generalisations regarding the strata can be made :

- (a) Superficial Deposits: Comprising residual soils, stony and silty clays, and, in places, thin alluvial deposits and 'hillwash'. Most of the superficial deposits examined contained a proportion of silty or clayey material although there was some evidence of interbedded coarser and more sandy material.
- (b) London Clay: Essentially grey silty clays having a tendency to lamination, sometimes with thin layers of fine silt between the laminae and with occasional beds of grey clayey silt. The upper part of the London Clay may be weathered to brown and grey mottled silty clays down to depths of about 15 ft. B.G.L. The bottom 2 to 6 ft. of the London Clay often comprises grey silty or sandy strata with or without stones and with some silty clay, or occasionally a silty clay with stones or gravel.
- (c) Reading Beds: Essentially red and grey clays, sometimes silty and occasionally with a subsidiary amount of sandy material (probably in patches or in very thin layers).

8. During drilling, casing was worked down continuously and ground water, where encountered, appeared to seep from the upper part of the hole, or occasionally from silty layers within the Clay. In the deeper holes, however, the basal beds of the London Clay contained free-flowing water under pressure (e.g. Nos. 3, 5 and 6). In No. 3, in the centre of the valley, water rose to 5'6" above ground level and this hole was converted into an observation hole. In No. 5 the water rose to within 1.7 feet of ground level.

III. THE PRACTICAL IMPLICATIONS OF THE TRIAL BOREHOLE DATA.

9. Generalised sections showing the geological structure of the proposed reservoir basin are shown on Diagram 'B' and Plan 'C' shows the area within which the Reading Beds and the London Clay outcrop.

10. On Plan C, the line A-A represents the outcrop of a plane within the London Clay located 10 ft. above its base. Below this plane are the more permeable basal beds having a thickness of about 2 ft. to 6 ft., and above it are the more impervious beds of the London Clay. Thus north of the line A-A the more pervious basal beds of the London Clay actually outcrop or are only thinly covered by impermeable clay, and south of the line the thickness of impermeable London Clay cover increases in a southerly direction (See Diagram B).

11. The basal beds of the London Clay require special consideration since they outcrop within the floor of the reservoir basin, where impounded water could gain access to them, and since also they outcrop at lower elevations outside the reservoir basin in the valley to the east at a distance of about 1500 yards from the reservoir. The head difference between these points would be about 30 to 40 ft., so that the average gradient would be low, and the amount of seepage probably negligible. Nevertheless this is a factor to be borne in mind.

12. The fact also that the basal beds of the London Clay pass at depth below the embankment, where they contain water under pressure, has to be considered in relation to the stability of the embankment. In order to prevent the development of uplift pressures beneath the downstream portion of the embankment it may be necessary to construct a number of relief wells

and for this purpose a pumping test may be required to assess the permeability of the basal beds and the number of such relief wells.

13. Since, however, much of the banking material will be excavated from within the reservoir basin it should be feasible to remove most of the basal beds and to blanket the newly-exposed edges of these beds with clay. By this means impounded water would be prevented from gaining access to these beds.

14. A full analysis of the London Clay, both as a constructional and a foundation material, is being made, and the results of the tests when completed will be included in the report by Professor Rowe on the Soil Mechanics aspect of the scheme. Although not wishing to anticipate that report, it is apparent that the bank will have to be built mainly of London Clay, and that any sand or gravel required for drainage blankets will have to be imported.

15. The type of construction which would seem to be appropriate for this site is a rolled clay core rather than a puddle clay core. The rolled clay core could be successfully keyed into the London Clay at a relatively shallow depth below the surface over the major portion of the length of the embankment. Any potential seepage around the two extremities of the dam would be obviated by extending the clay core (at reduced width) into the valley sides for a relatively short distance.

IV. CONCLUSIONS SUMMARISED.

16. The proposal to construct a reservoir at Havant Thicket is feasible, and the geology of the site as proved by the trial boreholes is unlikely to present any undue difficulties.

17. If the permeable basal beds of the London Clay which outcrop over the northern part of the reservoir basin are excavated for banking material and the newly-exposed edge of those beds blanketed with clay, there would be no need for a concrete cut-off and the clay core of the embankment could be founded at a relatively shallow depth in the London Clay.

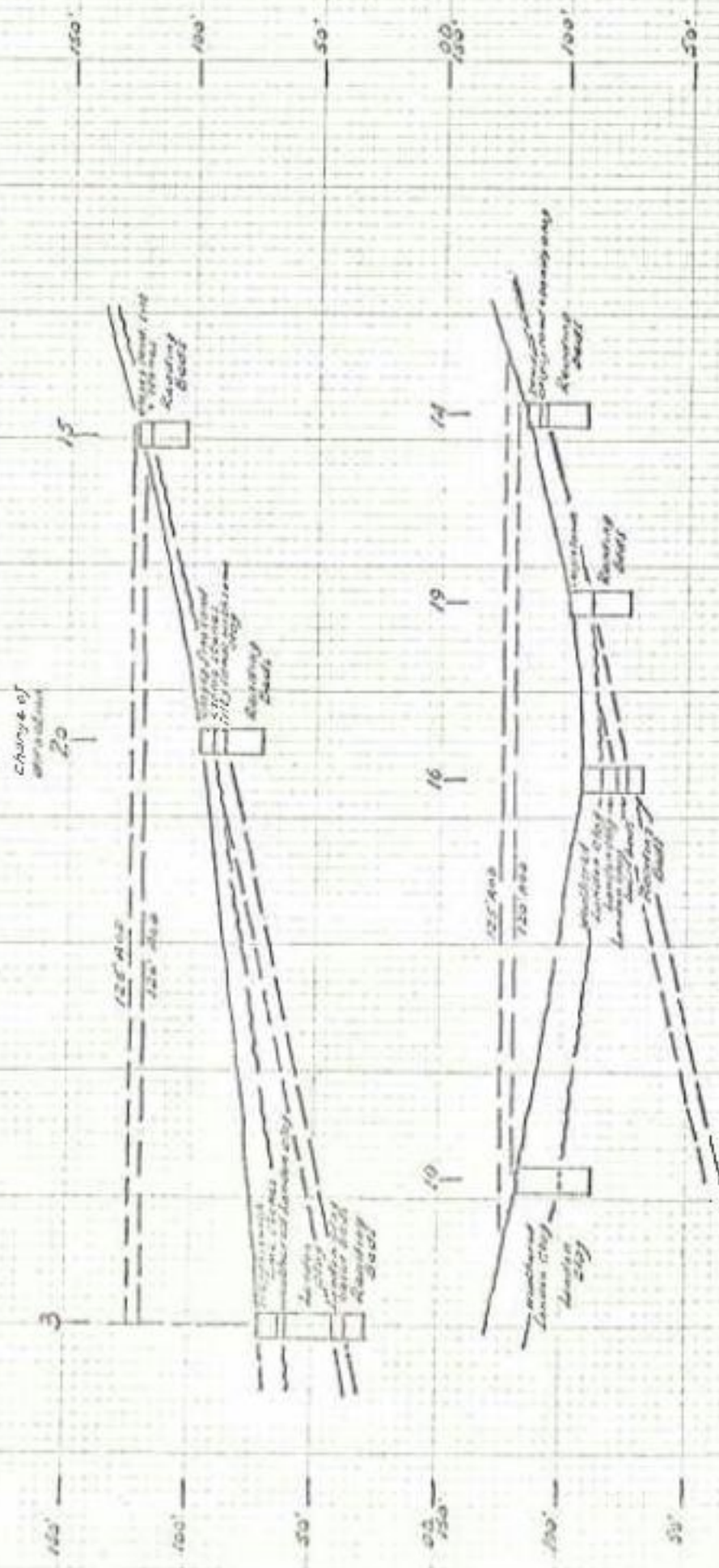
18. A pumping test on a small diameter borehole sunk into the basal beds at the downstream toe of the embankment would be advisable to determine whether or not relief wells are necessary and if so, how many.

I am, Gentlemen,

Yours faithfully,

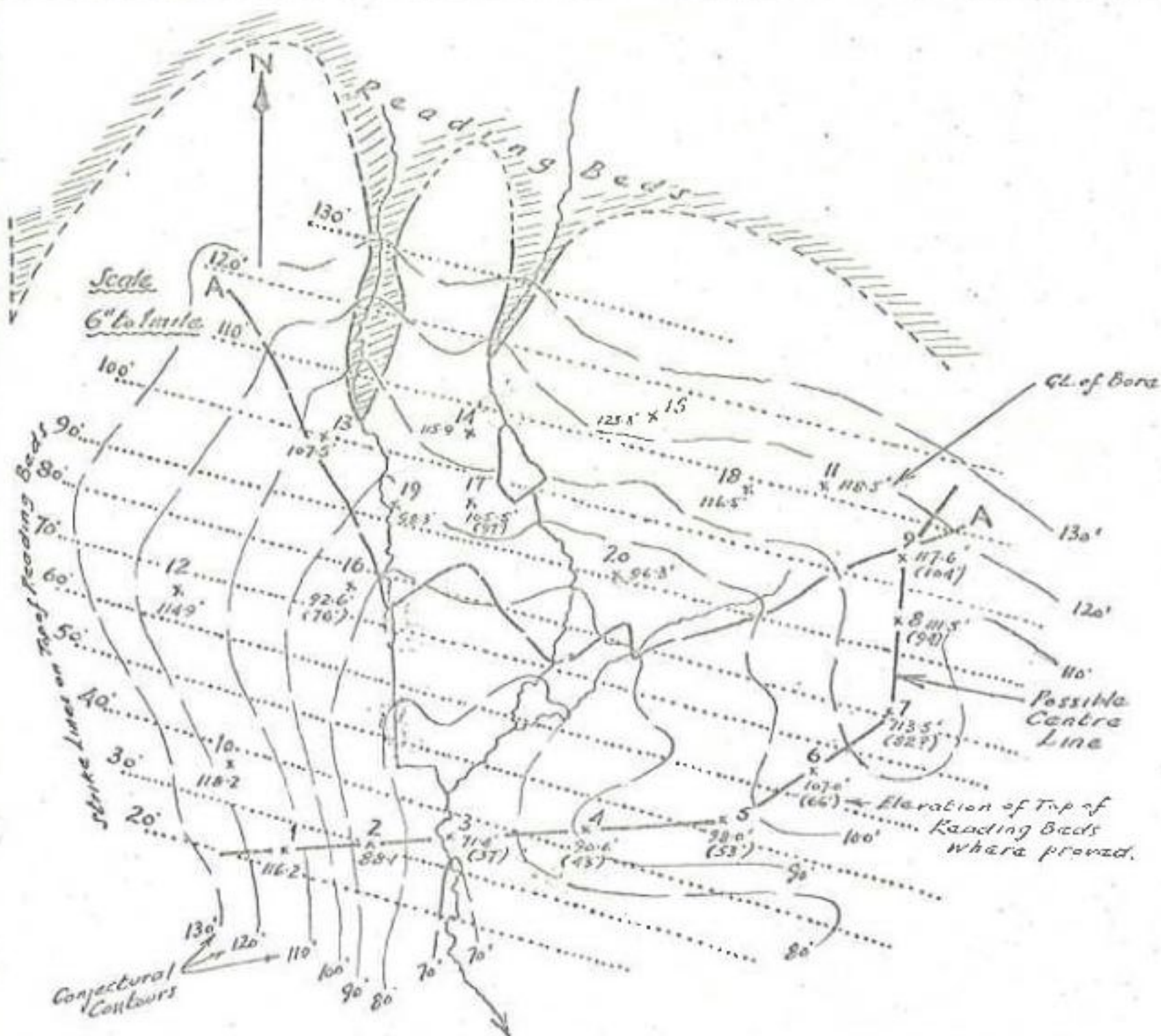
A large black rectangular redaction box covering the signature and name of the person who wrote the letter.

Horizontal Scale 1" = 400' Partly
Section drawn looking north (updr. m)



DIAG'S

Syntherisma



PLAN 'C'

Portsmouth and Gosport Water Company
- Harant Thicket -

Wm. Merlon & Partner
Consulting Engineering Geologists
Manchester, Nov. '02

DRILLING MACHINE CO.,
23, VICTORIA STREET,
LONDON, E.C.1.

TEL. ABERY 1925

CHART OF BOREHOLE NO. <u>1</u>		AT <u>Flavant</u>	
COMMENCED <u>13.5.62</u>		FINISHED <u>17.5.62</u>	
GROUND LEVEL <u>116.18' CD.</u>			
WATER LEVEL		R.M.	P.M.
BORING FROM		DESCRIPTION	
ft. ins.	ft. ins.		SAMPLE DEPTH No.
0.0	0.9	Topsoil & leaf mould	
0.9		Mottled grey and orange firm clay - some	10" 1
	5.0	Slight gravel to 16" B.S.	30" 2
5.0	10.3	Brown grey mottled orange firm clay	80" 3
10.3		Blue grey firm clay	110" 4
			110" 5
	25.9		210" 6
25.9		Blue grey firm clay - slightly shaly	210" 7
			310" 8
	38.0		360" 9
38.0	38.3	Claystone	380" 10
38.3		Blue grey firm clay - slightly shaly	410" 11
	50.0		460" 12
			500" 13

REMARKS:	U/D	No. 1 taken at 16" - 30"	Tube No. 12
"	"	2 " " 66" - 80"	" " 152
"	"	3 " " 116" - 130"	" " 153
"	"	4 " " 166" - 180"	" " 150
"	"	5 " " 266" - 280"	" " 187
"	"	6 " " 316" - 330"	" " 192
"	"	7 " " 366" - 380"	" " 184
"	"	8 " " 416" - 430"	" " 178
"	"	9 " " 466" - 480"	" " 159

U/D attempted at 216" - 230" - failed to hold - cleared hole and attempted another at 240" - 256" - also failed.

GROUND WATER DETAILS IN BOREHOLE

DEPTH WATER ENCOUNTERED.....'....." B.S.....

STANDING WATER LEVEL:-

<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>	<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>
13/5/1962	" B.S.	DRY " B.S.	17/5/1962	DRY " B.S.	DRY " B.S.
14/5/1962	DRY " B.S.	DRY " B.S.	/ /196	" B.S.	" B.S.
15/5/1962	DRY " B.S.	DRY " B.S.	/ /196	" B.S.	" B.S.
16/5/1962	26' 8" B.S.	DRY " B.S.	/ /196	" B.S.	" B.S.

RATE OF RECOVERY TEST

DATE.....TIME.....a.m./p.m.* DEPTH OF CASTING.....'....." B.S.
DEPTH BOREHOLE OPEN TO.....'....." B.S.
STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
LEVEL REDUCED TO.....'....." B.S. IN.....mins.

RECOVERY OF LEVEL

<u>TIME</u>	<u>WATER LEVEL</u>
1 min.....	'....." B.S.
2 mins.....	'....." B.S.
4 mins.....	'....." B.S.
6 mins.....	'....." B.S.
8 mins.....	'....." B.S.
10 mins.....	'....." B.S.
15 mins.....	'....." B.S.
20 mins.....	'....." B.S.
30 mins.....	'....." B.S.

<u>TIME</u>	<u>WATER LEVEL</u>
40 mins.....	'....." B.S.
60 mins.....	'....." B.S.
1½ hrs.....	'....." B.S.
2 hrs.....	'....." B.S.
2½ hrs.....	'....." B.S.
3 hrs.....	'....." B.S.
4 hrs.....	'....." B.S.
5 hrs.....	'....." B.S.

STATE OF TIDE AT TIME OF TEST (If applicable) :-

WEATHER CONDITIONS AT TIME OF TEST:-

WATER SAMPLES

No.....	Depth.....'....." B.S.	No.....	Depth.....'....." B.S.
No.....	Depth.....'....." B.S.	No.....	Depth.....'....." B.S.

REMARKS Water seepage encountered at 8'0"

Foreman. *L. Subhina*.....

RE-PIPING CHIMNEY 180",
23, VICTORIA STREET,
LONDON, S.W.1.

TEL. ABBEY 4925

CHART OF BOREHOLE NO. 10 AT Havant (Pulman & Co. Ltd. Co.)

COMPLETED 15-5-62 FINISHED 19-5-62

GROUND LEVEL 118.20' AOD

WATER LEVEL 118.20' AOD

BORING FROM		DESCRIPTION	SAMPLE	
ft. ins.	ft. ins.		DEPTH	No.
5-9		Light brown mottled clay	1'-3'	1
5-9	9-3	Medium brown sandy clay	5'-9'	2
9-3	12-0	Medium grey clay	9'-6"	3
12-0	12-9	Grey/blue shaly clay	12'-3"	4
12-9	19-6	Fine medium grey clay	16'-0"	5
			18'-6"	6
19-6	30-0	Fine blue/grey clay	20'-3"	7
			24'-0"	8
			30'-0"	9

REMARKS: UD samples at following depths:-
1 1'-6" to 3'-0" Tube No. 17.
2 6'-6" to 8'-0" Tube No. 19.
3 16'-6" to 18'-0" Tube No. 189.
4 21'-0" to 23'-0" Tube No. 97.
5 26'-6" to 28'-0" Tube No. 117.

GROUND WATER DETAILS IN BOREHOLE

DEPTH WATER ENCOUNTERED.....'....." B.S.....

STANDING WATER LEVEL:-

DATE	A.M.	P.M.	DATE	A.M.	P.M.
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.

RATE OF RECOVERY TEST

D'TE.....TIME.....a.m./p.m.⁺ DEPTH OF CASTING.....'....." B.S.
 DEPTH BOREHOLE OPEN TO.....'....." B.S.
 STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL REDUCED TO.....'....." B.S. IN.....mins.

RECOVERY OF LEVEL

TIME	WATER LEVEL
1 min.....	'....." B.S.
2 mins.....	'....." B.S.
4 mins.....	'....." B.S.
6 mins.....	'....." B.S.
8 mins.....	'....." B.S.
10 mins.....	'....." B.S.
15 mins.....	'....." B.S.
20 mins.....	'....." B.S.
30 mins.....	'....." B.S.

TIME	WATER LEVEL
40 mins.....	'....." B.S.
60 mins.....	'....." B.S.
1½ hrs.....	'....." B.S.
2 hrs.....	'....." B.S.
2½ hrs.....	'....." B.S.
3 hrs.....	'....." B.S.
4 hrs.....	'....." B.S.
5 hrs.....	'....." B.S.

STATE OF TIDE AT TIME OF TEST (If applicable) :-

WEATHER CONDITIONS AT TIME OF TEST:-

WATER SAMPLES

No.....	Depth.....'....." B.S.	No.....	Depth.....'....." B.S.
No.....	Depth.....'....." B.S.	No.....	Depth.....'....." B.S.

REMARKS

Water sample taken from the borehole (1' to 2' in diameter)
 Water sample after coming very slight (1' to 2' in diameter)

Foraman.....

REB-STEEL WORKS LTD.,
28, VICTORIA STREET,
LONDON, S.W.1.

TEL. ABBEY 4925

CHART OF BOREHOLE NO. 2 AT Fluvant

COMPLETED 22.5.62 FINISHED 26.5.62

GROUND LEVEL 88.09' AOD.

WATER LEVEL A.D. P.E.

BORING FROM

DESCRIPTION

SAMPLE

ft. ins. ft. ins.

DEPTH No.

0.0 0.3 Topsoil

2.3 3.0 Grey and yellow mottled firm clay 0'6" 1

3.0 5.6 Blue mottled orange brown firm clay 5'0" 2

5.6 Blue mottled brown clay containing white 8'0" 3

12.0 crystal substance

12.0 12.4 Claystone 12'0" 4

12.4 17.3 Firm blue grey mottled brown clay 15'0" 5

17.3 Firm blue clay 19'0" 6

31.0 23'0" 7

31.0 28'0" 8

31.0 Blue grey silty clay interspersed with 33'0" 9

47.6 38'0" 10

47.6 layers of silt 43'0" 11

47.6 Blue grey firm clay 48'0" 12

50.0 50'0" 13

REMARKS:

U/D sample No 1 taken at 1'6" - 3'0" Tube No. 155

" " " 2 " " 6'6" - 8'0" " " 156

" " " 3 " " 11'6" - 13'0" " " 157

" " " 4 " " 16'6" - 18'0" " " 160

" " " 5 " " 21'6" - 23'0" " " 154

" " " 6 " " 26'6" - 28'0" " " 164

" " " 7 " " 31'6" - 33'0" " " 168

" " " 8 " " 36'6" - 38'0" " " 182

" " " 9 " " 41'6" - 43'0" " " 175

" " " 10 " " 46'6" - 48'0" " " 171

GROUND WATER DETAILS IN BOREHOLE

DEPTH WATER ENCOUNTERED.....'....." B.S.....

STANDING WATER LEVEL:-

<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>	<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>
22/5/1962	1 " B.S.	DRY " B.S.	24/5/1962	3 6" B.S.	1 " B.S.
23/5/1962	DRY " B.S.	DRY " B.S.	/ /196	1 " B.S.	1 " B.S.
24/5/1962	SEEPAGE " B.S.	DRY " B.S.	/ /196	1 " B.S.	1 " B.S.
25/5/1962	SEEPAGE " B.S.	DRY " B.S.	/ /196	1 " B.S.	1 " B.S.

RATE OF RECOVERY TEST

D.T.P.....TIME.....a.m./p.m.+ DEPTH OF CASTING.....'....." B.S.
 DEPTH BOREHOLE OPEN TO.....'....." B.S.
 STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL REDUCED TO.....'....." B.S. IN.....mins.

RECOVERY OF LEVEL

<u>TIME</u>	<u>WATER LEVEL</u>	<u>TIME</u>	<u>WATER LEVEL</u>
1 min.....	1....." B.S.	40 mins.....	1....." B.S.
2 mins.....	1....." B.S.	60 mins.....	1....." B.S.
4 mins.....	1....." B.S.	1 1/2 hrs.....	1....." B.S.
6 mins.....	1....." B.S.	2 hrs.....	1....." B.S.
8 mins.....	1....." B.S.	2 1/2 hrs.....	1....." B.S.
10 mins.....	1....." B.S.	3 hrs.....	1....." B.S.
15 mins.....	1....." B.S.	4 hrs.....	1....." B.S.
20 mins.....	1....." B.S.	5 hrs.....	1....." B.S.
30 mins.....	1....." B.S.		

STATE OF TIDE AT TIME OF TEST (If applicable) :-

WEATHER CONDITIONS AT TIME OF TEST:-

WATER SAMPLES

No.....	Depth.....'....." B.S.	No.....	Depth.....'....." B.S.
No.....	Depth.....'....." B.S.	No.....	Depth.....'....." B.S.

REMARKS Water seepage encountered at 12'0" and from 31'0 m.

20/11

REPORT OF THE
13 VICTORIA STREET,
LONDON, E.C. 1.

TEL. ABBEY 1925

CURT OF NO. 4016 NO. 4 at Havant (Portsmouth & Gosport Water Co.)

COMPILED 22-5-62 BY A.S.G.

GROUND LEVEL 30.55' AOD

WATER LEVEL R.M. R.M.

BORING FROM		DESCRIPTION	SAMPLE	
Ft. Ins.	Ft. Ins.		DEPTH	No.

3		Top road		
3	4-0	Soft light brown-grey mottled clay	1'-3"	1
4-0	6-9	Soft medium brown-grey clay	4-3	2
6-9	10-3	Fine blue-grey brown mottled clay & claystone	7-6	3
10-3	16-0	Fine medium brown & grey clay with small crystalline deposit	12-0	4
16-0	24-3	Fine grey/blue clay	15-0	5
			18-0	6
			21-0	7
			24-0	8
			24-6	9
24-3	40-0	Fine medium grey clay interbedded with silty clay	24-0	10
			30-0	11
			33-0	12
			40-3	14
40-0	43-6	Medium grey silty clay & sand gravel	42-0	15
43-6	44-0	Grey silty clay	46-0	16
			48-0	17
44-0	53-6	Mottled blue-grey & red soil	52-0	18
			53-0	19

REMARKS: 17 samples at following depths:-

- | | |
|-------------------------------|----------------------------------|
| 1, 1'-6" to 3'-0" Tube No. 11 | 9, 31'-6" to 33'-0" Tube No. 196 |
| 2, 4'-6" to 6'-0" " 165 | 10, 34'-6" to 36'-0" " 197 |
| 3, 7'-6" to 9'-0" " 186 | 11, 37'-6" to 39'-0" " 191 |
| 4, 13'-6" to 15'-0" " 180 | 12, 40'-6" to 42'-0" " 190 |
| 5, 16'-6" to 18'-0" " 194 | 13, 43'-6" to 45'-0" " 158 |
| 6, 19'-6" to 21'-0" " 185 | 14, 46'-6" to 48'-0" " 195 |
| 7, 25'-6" to 27'-0" " 193 | 15, 49'-6" to 51'-0" " 198 |
| 8, 28'-6" to 30'-0" " 163 | 16, 52'-0" to 53'-6" " 170 |

GROUTING TESTS IN BORHOLES

DEPTH WATER RECOVERED....." B.S.....

STANDING WATER LEVEL:-

<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>	<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

RATE OF RECOVERY TEST

TIME.....a.m./p.m. DEPTH OF CASING....." B.S.
DEPTH BORHOLE OPEN TO....." B.S.
STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
LEVEL REDUCED TO....." B.S. IN.....mins.

RECOVERY OF LEVEL

TIME WATER LEVEL
 1 min....." B.S.
 2 mins....." B.S.
 4 mins....." B.S.
 6 mins....." B.S.
 8 mins....." B.S.
 10 mins....." B.S.
 15 mins....." B.S.
 20 mins....." B.S.
 30 mins....." B.S.

TIME WATER LEVEL
 40 mins....." B.S.
 60 mins....." B.S.
 1½ hrs....." B.S.
 2 hrs....." B.S.
 2½ hrs....." B.S.
 3 hrs....." B.S.
 4 hrs....." B.S.
 5 hrs....." B.S.

STATE OF FLOW AT END OF TEST (If applicable):-

FLOWING CONDITIONS AT END OF TEST:-

WATER SAMPLES

No.....	Depth.....	" B.S.	No.....	Depth.....	" B.S.
No.....	Depth.....	" B.S.	No.....	Depth.....	" B.S.

REMARKS

Water seepage observed at 1'-6"

FORWARDED.....

REL-PT-700 EXPLORER LTD.,
23, VICTORIA STREET,
LONDON, S.W.1.

TEL. ABBEY 8925

CHART OF BORING NO. 3 SE Mount

COMPLETED 31/5/63 FINISHED 16/6/63

GROUND LEVEL

WATER LEVEL C.M. D.M.

BORING FROM DESCRIPTION SAMPLE

ft. ins. ft. ins. DEPTH No.

NH	1 6	Brown mottled clay - dip. roots		
1 6	2 0	Red mottled clay - dip. roots	0'0"	1
2 0	2 0	Red mottled clay - dip. roots	6'0"	2
2 0	10 0	Blue mottled clay	8'0"	3
8'0"	10 0	Blue mottled clay	12'0"	4
10 0	29 6	Blue little clay	15'0"	5
10'0"	29'6"	Blue little clay	18'0"	6
			21'0"	7
			24'0"	8
			27'0"	9
29 6	33 6	Blue little compact sand	30'0"	10
2'6"	33'6"	Blue little compact sand	33'0"	11
33 6	42 0	Leading Red clay. nodules of grey clay.	36'0"	12
33'6"	42'0"	Leading Red clay. nodules of grey clay	39'0"	13
			42'0"	14

REMARKS: U/L Don't BAOW

NO	151	1'6" - 3'0"
"	167	4'6" - 6'0"
	173	7'6" - 9'0"
	176	10'0" - 12'0"
	162	13'6" - 15'0" - 09
	174	16'6" - 18'0" - 49
	177	19'6" - 21'0" - 58
	174	25'6" - 27'0" - 72
	181	28'6" - 30'0" - 68
	186	31'6" - 33'0" - 48
	161	34'6" - 36'0" - 95
	203	37'6" - 39'0" - 69
	205	40'6" - 43'0" - 69

GROUND WATER LEVELS IN BOREHOLE

DEPTH WATER ENCOUNTERED....." B.S.....

STANDING WATER LEVEL:-

DATE	A.M.	P.M.	DATE	A.M.	P.M.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

RATE OF RECOVERY TEST

DATE.....TIME.....a.m./p.m. DEPTH OF CASTING....." B.S.
 DEPTH BOREHOLE OPEN TO....." B.S.
 STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL REDUCED TO....." B.S. IN.....mins.

RECOVERY OF LEVEL

TIME	WATER LEVEL
1 min.....	" B.S.
2 mins.....	" B.S.
4 mins.....	" B.S.
6 mins.....	" B.S.
8 mins.....	" B.S.
10 mins.....	" B.S.
15 mins.....	" B.S.
20 mins.....	" B.S.
30 mins.....	" B.S.

TIME	WATER LEVEL
40 mins.....	" B.S.
60 mins.....	" B.S.
1½ hrs.....	" B.S.
2 hrs.....	" B.S.
2½ hrs.....	" B.S.
3 hrs.....	" B.S.
4 hrs.....	" B.S.
5 hrs.....	" B.S.

STATE OF TIDE AT TIME OF TEST (If applicable) :-

WEATHER CONDITIONS AT TIME OF TEST:-

WATER SAMPLES

No..... Depth....." B.S.
 No..... Depth....." B.S.

No..... Depth....." B.S.
 No..... Depth....." B.S.

REMARKS

Foreman.....

..... Havnat

..... 1-6-62 13-6-62

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.....

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.....

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..... 3 Top road

..... 3 4-3 Light brown mottled clay

1'-10" 1

..... 4-3 10-3 Medium brown mottled clay

6'-0" 2

..... 10-3 11-0 Medium brown mottled clay with crystalline spots 10'-3" 4

..... 11-0 16-0 Light grey & brown mottled clay

11'-10" 5

..... 16-0 40-3 Blue/grey fine clay interspersed with

16'-0" 6

..... layers of silty clay

23'-0" 7

..... 40-3 44-0 Grey silt

28'-0" 8

..... 44-0 65-0 Clay stone

33'-0" 9

..... 45-0 50-0 Light blue/grey & red clay (harding clay)

41'-0" 10

..... 50-0 13

40 samples

No 1 1'-6" to 3'-0" Talc No 199

No 2 11'-6" to 13'-0" 172

No 3 16'-6" to 18'-0" 188

No 4 21'-6" to 23'-0" 169

No 5 26'-6" to 28'-0" 166

No 6 31'-6" to 33'-0" 200

No 7 36'-6" to 38'-0" 201

No 8 46'-6" to 48'-0" 208

SHOULDER PUMP TEST - BOTTOM

DEPTH FROM SURFACE....." B.S.....

STANDARD TEST LABEL:-

DATE	A.M.	P.M.	DATE	A.M.	P.M.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

RATE OF DISCHARGE

3 in....." B.S. /p.m. DEPTH OF CHARGE....." B.S.
 DEPTH DRAINAGE OPEN TO....." A.S.
 STARTING WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL RISE TO....." B.S. IN.....mins.

RECTIFY LABEL

TIME	WATER LEVEL	TIME	WATER LEVEL
1 min....." B.S.		40 mins....." B.S.	
2 mins....." B.S.		60 mins....." A.S.	
4 mins....." B.S.		1½ hrs....." B.S.	
6 mins....." B.S.		2 hrs....." B.S.	
8 mins....." B.S.		2½ hrs....." B.S.	
10 mins....." B.S.		3 hrs....." B.S.	
15 mins....." B.S.		4 hrs....." B.S.	
20 mins....." B.S.		5 hrs....." B.S.	
30 mins....." B.S.			

CLASS OF TEST AT END OF TEST (If applicable) :-

STANDARD CONDITIONS AT END OF TEST:-

WATER SAMPLES

No..... Depth....." B.S. No..... Depth....." B.S.
 No..... Depth....." B.S. No..... Depth....." B.S.

REMARKS

No water encountered - bore until 45' 0"
 since between the completion and starting of bore
 water rose to 17½ BS

Form No.

TEL. MAY 1925

GROUND LEVEL

WATER LEVEL _____ R.M. _____ P.M.

BORING FROM

It. ins. It. ins.

DESCRIPTION

SAMPLES

DEATH No.

		DEPTH	No.
4-0	High brown mottled clay	1'-3"	1
4-0 14-9	Medium brown mottled clay (Fines)	4'-6"	2
14-9 15-6	Blue clay (Fines)	12'-0"	3
15-6 23-9	Gray silt	14'-9"	4
23-9 26-0	Medium gray clay	11'-0"	5
26-0 28-3	Gray silt + fines	24'-0"	6
28-3 30-0	Gray silty clay	27'-0"	7
		30'-0"	8

REMARKS:

U.D. Samples cont'd 4-6 starting at 3:00 P.M.

1	3'-0" to 14'-6"	Tube d^0	203	(57)
2	10'-6" to 12'-0"	Tube d^0	202	(73)
3	18'-0" to 19'-6"	Tube d^0	204	(121)
4	25'-0" to 27'-0"	Tube d^0	211	(219)

GROUND WATER DETAILS IN BOREHOLE

DEPTH WATER ENCOUNTERED.....⁹.....'.....⁶²....." B.S.....

STANDING WATER LEVEL:-

<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>	<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.

RATE OF RECOVERY TEST

DATE.....TIME.....a.m./p.m.⁺ DEPTH OF CASTING..²⁰¹⁶⁰....." B.S.
DEPTH BOREHOLE OPEN TO.....'....." B.S.
STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
LEVEL REDUCED TO.....'....." B.S. IN.....mins.

RECOVERY OF LEVEL

<u>TIME</u>	<u>WATER LEVEL</u>	<u>TIME</u>	<u>WATER LEVEL</u>
1 min.....	'....." B.S.	40 mins.....	'....." B.S.
2 mins.....	'....." B.S.	60 mins.....	'....." B.S.
4 mins.....	'....." B.S.	1½ hrs.....	'....." B.S.
6 mins.....	'....." B.S.	2 hrs.....	'....." B.S.
8 mins.....	'....." B.S.	2½ hrs.....	'....." B.S.
10 mins.....	'....." B.S.	3 hrs.....	'....." B.S.
15 mins.....	'....." B.S.	4 hrs.....	'....." B.S.
20 mins.....	'....." B.S.	5 hrs.....	'....." B.S.
30 mins.....	'....." B.S.		

STATE OF TIME AT END OF TEST (If applicable) :-

WEATHER CONDITIONS AT TIME OF TEST:-

WATER SAMPLES

No.....	Depth.....'	" B.S.	No.....	Depth.....'	" B.S.
No.....	Depth.....'	" B.S.	No.....	Depth.....'	" B.S.

REMARKS

PLANNING BOARD, 1904,
23, VICTORIA STREET,
LONDON, E.C. 1.

TILL. ARMY 1925

CHART OF BORING NO. 6 17 HUMANT

COLLECTED 10/8/02 FIELD 29/8/02

GROUND LEVEL

WATER LEVEL 8.12 8.12

BORING FROM

DEPTH		DESCRIPTION	SAMPLE	
ft.	ins.		DEPTH	No.
11.4	9.6	Light Brown mottled clay	0.0	
			19.4	202
			20.0	210
			30.9	203
9.6	14.6	Light Brown mottled clay	15.0	204
14.6	23.0	Blue clay with patches of silty sand	18.0	212
23.0	25.0	Blue clay from 2-7 ft. clay	23.0	213
25.0	32.6	Blue clay with patches of silt	28.0	214
32.6	36.10	Silty sand & gravel	33.0	215
36.10	37.4	Sandstone Boulder		
37.4	40.6	Blue silty sandy clay	39.3	
40.6	40.9	Leading. Brk. L.L. with nodules of grey clay	40.9	219
40.9	50.0	Leading. Brk. clay with nodules of grey clay		
		Hard claystone through it		

REMARKS:

TAKEN SAMPLES			
N ^o	DEPTH	N ^o	DEPTH
1	4.6	8	36.0
2	9.6	9	37.0
3	14.6	10	40.0
4	19.6	11	40.9
5	23.10	12	50.0
6	29.8		
7	34.6		

GROUND WATER DETAILS IN BOTTLES

DEPTH WATER MOUNTAIN...35'.....6" B.S.....

STANDING WATER LEVEL:-

DATE	A.M.	P.M.	DATE	A.M.	P.M.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

RECOVERY TEST

DATE.....TIME.....a.m./p.m. DEPTH OF CASTING.....'....." B.S.
 DEPTH BOTTLES OPEN TO.....'....." B.S.
 STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL REDUCED TO.....'....." B.S. IN.....mins.

RECOVERY OF LEVEL

TIME	WATER LEVEL	TIME	WATER LEVEL
1 min.....'....." B.S.		40 mins.....'....." B.S.	
2 mins.....'....." B.S.		60 mins.....'....." B.S.	
4 mins.....'....." B.S.		1½ hrs.....'....." B.S.	
6 mins.....'....." B.S.		2 hrs.....'....." B.S.	
8 mins.....'....." B.S.		2½ hrs.....'....." B.S.	
10 mins.....'....." B.S.		3 hrs.....'....." B.S.	
15 mins.....'....." B.S.		4 hrs.....'....." B.S.	
20 mins.....'....." B.S.		5 hrs.....'....." B.S.	
30 mins.....'....." B.S.			

STATE OF TIDE AT TIME OF TEST (If applicable) :-

WINDY CONDITIONS AT TIME OF TEST:-

WATER SAMPLES

No..... Depth.....'....." B.S.	No..... Depth.....'....." B.S.
No..... Depth.....'....." B.S.	No..... Depth.....'....." B.S.

REMARKS

22-PI-1.6 BAYLYS LTD.,

TEL. 4232Y 4925

23. VICTORIA STREET,

LONDON, S.W.1.

CHART OF BORINGS NO. 9 AT Havant (Havant & District Water Co.)

CONTINUED 21-6-62 FINISHED 22-6-62

GROUND LEVEL

WATER LEVEL a.m. p.m.

BORING FROM DESCRIPTION SAMPLE

ft. ins. ft. ins. DEPTH No.

5-6 Light brown mottled clay 1'-6" 1.

5-6 9-3 Light brown mottled clay & medium sand 6'-3" 2.

9-3 11-0 Brown sandy clay (silty) 9'-6" 3.

11-0 14-9 Grey silt 11'-3" 4.

14-9 25-0 Light blue/grey & red mottled clay (Filt.) 15'-0" 5.

(Leaching clay) 21'-6" 6.

25'-0" 7.

REMARKS:

UD Sample taken in leaching clay at 20'-0" to 21'-6".
Tube No. 216. No. of blows 125.

Perman. Robert D. F.

GROUND WATER DETAILS IN BOREHOLE

DEPTH WATER ENCOUNTERED.....9.....0....." B.S.....

STANDING WATER LEVEL

DATE	A.M.	P.M.	DATE	A.M.	P.M.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

TIME OF RECOVERY TEST

D.T. TIME a.m./p.m. DEPTH OF CASTING 24.1.0" B.S.
 DEPTH BOREHOLE OPEN TO " B.S.
 STANDING WATER LEVEL AT BEGINNING OF TEST B.S.
 LEVEL REDUCED TO " B.S. IN mins.

RECOVERY OF LEVEL

TIME	WATER LEVEL	TIME	WATER LEVEL
1 min.....	" B.S.	40 mins.....	" B.S.
2 mins.....	" B.S.	60 mins.....	" B.S.
4 mins.....	" B.S.	1½ hrs.....	" B.S.
6 mins.....	" B.S.	2 hrs.....	" B.S.
8 mins.....	" B.S.	2½ hrs.....	" B.S.
10 mins.....	" B.S.	3 hrs.....	" B.S.
15 mins.....	" B.S.	4 hrs.....	" B.S.
20 mins.....	" B.S.	5 hrs.....	" B.S.
30 mins.....	" B.S.		

STATE OF TIDE AT TIME OF TEST (If applicable) :-

WEATHER CONDITIONS AT TIME OF TEST:-

WATER SAMPLES

No..... Depth....." B.S.	No..... Depth....." B.S.
No..... Depth....." B.S.	No..... Depth....." B.S.

REMARKS

PNE-FIELDING SURVEYS LTD.,
26, VICTORIA STREET,
LONDON, S.W.1.

TEL. ABBEY 1925

CHART OF BORING NO. 8 AT HOVEDALE

CONTINUED 26/6/62 FINISHED 28/6/62

GROUND LEVEL

WATER LEVEL a.m. p.m.

BORING FROM		DESCRIPTION	SAMPLES	
ft. ins.	ft. ins.		DEPTH	No.
1	6"	Top. soil.		
6	9' 9"	light brown clay	1' 6"	1
9	9' 11' 0"	hard silty sand with clay gravel	6' 6"	2
11	0' 15' 6"	blue silty	10' 3"	3
15	6' 16' 8"	Rock	12' 0"	4
16	8' 25' 8"	Reading bed clay	16' 3"	5
"	"	"	18' 9"	6
"	"	"	25' 0"	7

REMARKS: W/D

NO	DEPTH	DOWN BLOWS
222	30'-4'6"	(3/4)
228	25'-24'6"	(25)

Foreman J. A. Williams

GROUT WATER DETAILS IN BORHOLE

DEPTH WATER ENCOUNTERED.....'.....'....." B.S.....

STANDING WATER LEVEL:-

<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>	<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

RATE OF RECOVERY TEST

DATE.....TIME.....a.m./p.m. * DEPTH OF CASTING.....'....." B.S.
DEPTH BORHOLE OPEN TO.....'....." B.S.
STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
LEVEL REDUCED TO.....'....." B.S. IN.....mins.

RECOVERY OF LEVEL

<u>TIME</u>	<u>WATER LEVEL</u>	<u>TIME</u>	<u>WATER LEVEL</u>
1 min.....	" B.S.	40 mins.....	" B.S.
2 mins.....	" B.S.	60 mins.....	" B.S.
4 mins.....	" B.S.	1½ hrs.....	" B.S.
6 mins.....	" B.S.	2 hrs.....	" B.S.
8 mins.....	" B.S.	2½ hrs.....	" B.S.
10 mins.....	" B.S.	3 hrs.....	" B.S.
15 mins.....	" B.S.	4 hrs.....	" B.S.
20 mins.....	" B.S.	5 hrs.....	" B.S.
30 mins.....	" B.S.		

STATE OF FIRM AT END OF TEST (If applicable) :-

WATER CONDITIONS AT END OF TEST:-

WATER SAMPLES

No.....	Depth.....'....." B.S.	No.....	Depth.....'....." B.S.
No.....	Depth.....'....." B.S.	No.....	Depth.....'....." B.S.

REMARKS

18¹/₂° 19¹/₂° 50 223

GROUND WATER LEVELS IN PONDING

DEPTH WATER ACCOUNTED....." B.S.....

STANDING WATER LEVEL:-

DATE	A.M.	P.M.	DATE	A.M.	P.M.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

RATE OF RECOVERY TEST

TIME.....a.m./p.m." DEPTH OF SINKING....." B.S.
 DEPTH BOREHOLE OPEN TO....." B.S.
 STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL REDUCED TO....." B.S. IN.....mins.

RECOVERY OF LEVEL

TIME	WATER LEVEL
1 min.....	" B.S.
2 mins.....	" B.S.
4 mins.....	" B.S.
6 mins.....	" B.S.
8 mins.....	" B.S.
10 mins.....	" B.S.
15 mins.....	" B.S.
20 mins.....	" B.S.
30 mins.....	" B.S.

TIME	WATER LEVEL
40 mins.....	" B.S.
60 mins.....	" B.S.
1½ hrs.....	" B.S.
2 hrs.....	" B.S.
2½ hrs.....	" B.S.
3 hrs.....	" B.S.
4 hrs.....	" B.S.
5 hrs.....	" B.S.

STATE OF WATER AT END OF TEST (If applicable) :-

TESTING CONTINUED.....

WATER SAMPLES:

No..... Depth....." B.S.
 No..... Depth....." B.S.

No..... Depth....." B.S.
 No..... Depth....." B.S.

REMARKS

For use.....

RED-STAR DRILLING LTD.,
23, VICTORIA STREET,
LONDON, S.W.1.

TEL. 1936Y 42

CHART OF BORING NO. 15 AT *House*

COMPLETED 3/7/62 INITIATED 1/7/62

GROUND LEVEL 123.80' AOD.

WATER LEVEL S.M. T.M.

BORING FROM

DESCRIPTION

SAMPLE

ft. ins. ft. ins.

DEPTH ft.

4	10	Brown mottled sand clay with gravel	2	6"	1		
4	10	20	0	Red and light blue mottled clay	5	6"	2
"	"	"	"	Beetling sand clay	10	6"	3
"	"	"	"	"	12	6"	4
"	"	"	"	"	14	6"	5

REMARKS:

U/D

NO DEPTH BLOWS

226 12'0" - 13'6" (143)

NO WATER ENCOUNTERED

GROUND WATER DETAILS IN BOREHOLE

DEPTH WATER ENCOUNTERED....." B.S.....

STANDING WATER LEVEL:-

DATE	A.M.	P.M.	DATE	A.M.	P.M.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

RATE OF RECOVERY TEST

DATE.....TIME.....a.m./p.m. DEPTH OF CASING....." B.S.
 DEPTH BOREHOLE OPEN TO....." B.S.
 STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL REDUCED TO....." B.S. IN.....mins.

RECOVERY OF LEVEL

TIME	WATER LEVEL	TIME	WATER LEVEL
1 min....." B.S.		40 mins....." B.S.	
2 mins....." B.S.		60 mins....." B.S.	
4 mins....." B.S.		1½ hrs....." B.S.	
6 mins....." B.S.		2 hrs....." B.S.	
8 mins....." B.S.		2½ hrs....." B.S.	
10 mins....." B.S.		3 hrs....." B.S.	
15 mins....." B.S.		4 hrs....." B.S.	
20 mins....." B.S.		5 hrs....." B.S.	
30 mins....." B.S.			

STATE OF CLAY AT TOP OF CASE (If applicable) :-

WATER SAMPLES

No..... Depth....." B.S.
 No..... Depth....." B.S.
 No..... Depth....." B.S.
 No..... Depth....." B.S.

REMARKS

Foreman.....

TEL. 733Y 8925

COPIED 5/17/62 INDEXED 7/17/62

CACUND 1872L 115.94' AOD.

MAISON LEONARD 8.10. 2.11.

227 20° 0' - 216° (17)

Only water encountered ground surface at 5' 6"

GROUND WATER DATA IN BRUNNEN

DEPTH WATER MEASURED....." B.S.....

STANDING WATER LEVEL:-

DATE	A.M.	P.M.	DATE	A.M.	P.M.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

DATE OF RECOVERY TEST

D.T. a.m./p.m. DEPTH OF Casing....." B.S.

DEPTH BOREHOLE FROM TO....." B.S.

STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.

LEVEL LOCATED TO....." B.S. IN.....mins.

RECOVERY TEST

TIME	WATER LEVEL
1 min.....	" B.S.
2 mins.....	" B.S.
4 mins.....	" B.S.
6 mins.....	" B.S.
8 mins.....	" B.S.
10 mins.....	" B.S.
15 mins.....	" B.S.
20 mins.....	" B.S.
30 mins.....	" B.S.

TIME	WATER LEVEL
40 mins.....	" B.S.
60 mins.....	" B.S.
1½ hrs.....	" B.S.
2 hrs.....	" B.S.
2½ hrs.....	" B.S.
3 hrs.....	" B.S.
4 hrs.....	" B.S.
5 hrs.....	" B.S.

STATE OF THE AT TIME OF TEST (If applicable) :-

WEATHER CONDITIONS AT TIME OF TEST:-

WIND SAMPLE

No..... Direction....." B.S.

No..... Direction....." B.S.

No..... Direction....." B.S.

No..... Direction....." B.S.

REMARKS

TAL. ABBEY 1925

COINTEGRATED 6/17/64 FINISHED 8/17/64

GROUND LEVEL 116.53' AOD.

WATER LEVEL		G.M.	P.M.
1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
25	26	27	28
29	30	31	32
33	34	35	36
37	38	39	40
41	42	43	44
45	46	47	48
49	50	51	52
53	54	55	56
57	58	59	60
61	62	63	64
65	66	67	68
69	70	71	72
73	74	75	76
77	78	79	80
81	82	83	84
85	86	87	88
89	90	91	92
93	94	95	96
97	98	99	100

REMARKS:

200' - 216' 220

N ^o 1 -	6'
N ^o 2 -	5' 0"
N ^o 3 -	8' 6"
N ^o 4 -	10' 0"
N ^o 5 -	15' 0"
N ^o 6 -	20' 0"
N ^o 7 -	21' 6"
N ^o 8 -	25' 0"

GROUND WATER DETAILS IN BOREHOLE

DEPTH WATER ENCOUNTERED.. *N/A*.....'....." B.S.....

STANDING WATER LEVEL:- *N/A*

<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>	<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.
/ /196	' " B.S.	' " B.S.	/ /196	' " B.S.	' " B.S.

RATE OF RECOVERY TEST

DATE.....TIME.....a.m./p.m.⁺ DEPTH OF CASTING.....'....." B.S.

DEPTH BOREHOLE OPEN TO.....'....." B.S.

STANDING WATER LEVEL AT BEGINNING OF TEST.....B.S.

LEVEL REDUCED TO.....'....." B.S. IN.....mins.

RECOVERY OF LEVEL

<u>TIME</u>	<u>WATER LEVEL</u>
1 min.....	'....." B.S.
2 mins.....	'....." B.S.
4 mins.....	'....." B.S.
6 mins.....	'....." B.S.
8 mins.....	'....." B.S.
10 mins.....	'....." B.S.
15 mins.....	'....." B.S.
20 mins.....	'....." B.S.
30 mins.....	'....." B.S.

<u>TIME</u>	<u>WATER LEVEL</u>
40 mins.....	'....." B.S.
60 mins.....	'....." B.S.
1½ hrs.....	'....." B.S.
2 hrs.....	'....." B.S.
2½ hrs.....	'....." B.S.
3 hrs.....	'....." B.S.
4 hrs.....	'....." B.S.
5 hrs.....	'....." B.S.

STATE OF TIDE AT TIME OF TEST (If applicable) :-

WEATHER CONDITIONS AT TIME OF TEST:-

WATER SAMPLES

No..... Depth.....'....." B.S.
No..... Depth.....'....." B.S.

No..... Depth.....'....." B.S.
No..... Depth.....'....." B.S.

REMARKS

Foreman.. *D. J. ...*.....

15L. FEB. 1925

CHART OF NO. 1016 NO. 16

COLLECTED 11/22/62 FINISHED 13/26/62

GROUND 13.7% 92.61' ACD

DATE: 10/10/2001

DESCRIPTION

5412

rt. ins. rt. ins.

DE. TH. No.

						DEPTH	No.
1	6	6		Brown and blue sandstone clay	1'	6"	1
2	5	8	6	Brown and blue sandstone, argillaceous silty sand	5'	0"	2
8	6	13	6	Blue gray hornstone clay	11'	0"	3
13	6	19	3	Blue silt with gravel	16'	0"	4
16	3	26	0	Red and blue sandstone clay Bedding Red clay	17'	0"	5
				clay	21'	0"	

11/10
N/E DEATH BLOW
221 240-260 (75)

GROUND WATER DETAILS IN BOREHOLE

DEPTH WATER ENCOUNTERED.....4'.....0.1" B.S.....

STANDING WATER LEVEL:-

DATE	A.M.	P.M.	DATE	A.M.	P.M.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

TYPE OF RECOVERY TEST

D IN.....TIME.....a.m./p.m.+ DEPTH OF CLOSING....." B.S.
 BIRTH BOREHOLE OPEN TO....." B.S.
 STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL REDUCED TO....." B.S. IN.....mins.

RECOVERY OF LEVEL

TIME	WATER LEVEL	TIME	WATER LEVEL
1 min.....	" B.S.	40 mins.....	" B.S.
2 mins.....	" B.S.	60 mins.....	" B.S.
4 mins.....	" B.S.	1½ hrs.....	" B.S.
6 mins.....	" B.S.	2 hrs.....	" B.S.
8 mins.....	" B.S.	2½ hrs.....	" B.S.
10 mins.....	" B.S.	3 hrs.....	" B.S.
15 mins.....	" B.S.	4 hrs.....	" B.S.
20 mins.....	" B.S.	5 hrs.....	" B.S.
30 mins.....	" B.S.		

STATE OF GROUND AT END OF TEST (If applicable) :-

WATER CONDITIONS AT END OF TEST:-

WATER SAMPLES

No..... Depth....." B.S.	No..... Depth....." B.S.
No..... Depth....." B.S.	No..... Depth....." B.S.

REMARKS

Foreman.....*J. D. Roberts*.....

TEL. AREA 4925

CO. 11174 D 18/7/52 FINISHED 20/7/52

GROUND LEVEL 105.54' ACD

NAME L. M. N/A R.#. 7.6

BOILING INCH

DESCRIPTION

SAMPLING

$$\frac{f^{\text{th}}t}{\text{min}} \cdot \frac{1 \text{ min}}{60 \text{ s}} \cdot \frac{f^{\text{th}}t}{\text{min}} \cdot \frac{1 \text{ min}}{60 \text{ s}}$$

5003

DEPT. No.

N14	1'6"	Light Brown weathered sandy clay & gravel	1'0"	1'
-----	------	---	------	----

1'6" 1'6" *land* 9'0"

4'6"	5'6"	Sandstone with pebbles	5'0"	3
------	------	------------------------	------	---

5'6"	8'6"	Light Brown Mottled Grey with glaucous	7'6"	4
------	------	--	------	---

8'6"	25'0"	Riding 3rd story	10'0" 5'
------	-------	------------------	----------

15'0" 6

20.00 ?

236 8

25'0" 9

MARKS:

U/H BLOND NO
10'0"-12'6" 92 17

STRENGTH

FORUMAN.....

GROUT WATER DETAILS IN BOREHOLE

DEPTH WATER ENCOUNTERED.....'....." B.S.....

STANDING WATER LEVEL:-

<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>	<u>DATE</u>	<u>A.M.</u>	<u>P.M.</u>
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.
/ /196	" B.S.	" B.S.	/ /196	" B.S.	" B.S.

RATE OF RECOVERY TEST

DATE.....TIME.....a.m./p.m.⁺ DEPTH OF CASTING.....'....." B.S.
DEPTH BOREHOLE OPEN TO.....'....." B.S.
STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
LEVEL REDUCED TO.....'....." B.S. IN.....mins.

RECOVERY OF LEVEL

<u>TIME</u>	<u>WATER LEVEL</u>	<u>TIME</u>	<u>WATER LEVEL</u>
1 min.....	'....." B.S.	40 mins.....	'....." B.S.
2 mins.....	'....." B.S.	60 mins.....	'....." B.S.
4 mins.....	'....." B.S.	1½ hrs.....	'....." B.S.
6 mins.....	'....." B.S.	2 hrs.....	'....." B.S.
8 mins.....	'....." B.S.	2½ hrs.....	'....." B.S.
10 mins.....	'....." B.S.	3 hrs.....	'....." B.S.
15 mins.....	'....." B.S.	4 hrs.....	'....." B.S.
20 mins.....	'....." B.S.	5 hrs.....	'....." B.S.
30 mins.....	'....." B.S.		

STATE OF TIDE AT TIME OF TEST (If applicable) :-

WEATHER CONDITIONS AT TIME OF TEST:-

WATER SAMPLES

No.....	Depth.....	'....." B.S.	No.....	Depth.....	'....." B.S.
No.....	Depth.....	'....." B.S.	No.....	Depth.....	'....." B.S.

REMARKS

Foreman.....*D. Jester*.....

REPORT OF SURVEY NO. 12
 23. VICTORIA S. CO.,
 LONDON, N. I.

TEL. 1925

CHART OF HO. No. 12

COASTED 121212 121212 121212

GROUND LEVEL 114 91 100

WATER LEVEL 100 100 100

WINDING FROM

DESCRIPTIVE

DE. JH. No.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

STANDARD TESTS IN PORTLAND

DEPTH WITH STANDARD....." B.S.....

STANDARD WATER.....

| DATE | A.M. | P.M. | DATE | A.M. | P.M. |
|--------|--------|--------|--------|--------|--------|
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |

RATE OF RECOVERY TEST

DEPTH....." B.S. DEPTH OF CHIPPING....." B.S.
 DEPTH NORMALLY OBTAINED....." B.S.
 STANDARD WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL RECOVERED TO....." B.S. IN.....mins.

RECOVERY TEST

| TIME | WATER LEVEL |
|--------------|-------------|
| 1 min..... | " B.S. |
| 2 mins..... | " B.S. |
| 4 mins..... | " B.S. |
| 6 mins..... | " B.S. |
| 8 mins..... | " B.S. |
| 10 mins..... | " B.S. |
| 15 mins..... | " B.S. |
| 20 mins..... | " B.S. |
| 30 mins..... | " B.S. |

| TIME | WATER LEVEL |
|--------------|-------------|
| 40 mins..... | " B.S. |
| 60 mins..... | " B.S. |
| 1½ hrs..... | " B.S. |
| 2 hrs..... | " B.S. |
| 2½ hrs..... | " B.S. |
| 3 hrs..... | " B.S. |
| 4 hrs..... | " B.S. |
| 5 hrs..... | " B.S. |

STATE OF TEST AT END OF TEST (If applicable) :-

STANDARD WATER.....

STANDARD WATER.....

No..... Depth....." B.S.
 No..... Depth....." B.S.

No..... Depth....." B.S.
 No..... Depth....." B.S.

REMARKS

For use of.....

TEL. AREA 8925

COPIED 20/7/42 REPTED 23/7/42

1725-1800. 1725-1800. 1725-1800. 1725-1800. 1725-1800.

501 MC 2404

DESCRIPTI...

SLIDE

St. In. yth Ins.

DE 24 No.

N. 16 7' 6" LIGHT BROWN POTTERY CLAY

50. 1

2.6... 25.0 Reading Bed clay

10.0 2

15.0 3

200 4

216 {

2-1-6

5250

200 210

3105

No

76

85

GROUND WATER DETAILS IN BOREHOLE

DEPTH WATER ENCOUNTERED...*N/A*....." B.S.....

STANDING WATER LEVEL:- *N/A*

| DATE | A.M. | P.M. | DATE | A.M. | P.M. |
|--------|--------|--------|--------|--------|--------|
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |

RATE OF RECOVERY TEST

DATE.....TIME.....a.m./p.m. DEPTH OF CASTING....." B.S.
 DEPTH BOREHOLE OPEN TO....." B.S.
 STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL REDUCED TO....." B.S. IN.....mins.

RECOVERY OF LEVEL

| TIME | WATER LEVEL |
|--------------|-------------|
| 1 min..... | " B.S. |
| 2 mins..... | " B.S. |
| 4 mins..... | " B.S. |
| 6 mins..... | " B.S. |
| 8 mins..... | " B.S. |
| 10 mins..... | " B.S. |
| 15 mins..... | " B.S. |
| 20 mins..... | " B.S. |
| 30 mins..... | " B.S. |

| TIME | WATER LEVEL |
|--------------|-------------|
| 40 mins..... | " B.S. |
| 60 mins..... | " B.S. |
| 1½ hrs..... | " B.S. |
| 2 hrs..... | " B.S. |
| 2½ hrs..... | " B.S. |
| 3 hrs..... | " B.S. |
| 4 hrs..... | " B.S. |
| 5 hrs..... | " B.S. |

STATE OF TIDE AT TIME OF TEST (If applicable) :-

WEATHER CONDITIONS AT TIME OF TEST:-

WATER SAMPLES

No..... Depth....." B.S.
 No..... Depth....." B.S.

No..... Depth....." B.S.
 No..... Depth....." B.S.

REMARKS

Foreman..

SULLIVAN 5872

HENRIETTA STODOLSKA
 26 PROSPECT STREET,
 NEW YORK, N.Y.

| | | | |
|-----------------------|-------------|----------|---------|
| CHART OF BOREHOLE NO. | 19 | AT | HAUANT |
| COMMENCED | 25/7/62 | FINISHED | 27/7/62 |
| GROUND LEVEL | 98.28' ACD. | | |
| WATER LEVEL | NIL | A.M. | P.M. |

[illegible]

SYNOPSIS:

| U/A | BLONS | NO |
|---------|-------|----|
| 160-176 | 69 | 85 |

GENERAL WATER PUMPING TESTS IN BORHOLES

DEPTH WATER ENCOUNTERED.....*N/A*....." B.S.....

STANDING WATER LEVEL:- *N/A*

| <u>DATE</u> | <u>A.M.</u> | <u>P.M.</u> | <u>DATE</u> | <u>A.M.</u> | <u>P.M.</u> |
|-------------|-------------|-------------|-------------|-------------|-------------|
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |
| / /196 | " B.S. | " B.S. | / /196 | " B.S. | " B.S. |

RATE OF RECOVERY TEST

" T.....TIME.....a.m./p.m.⁺ DEPTH O' C STRING....." B.S.
 DEPTH BORHOLE OPEN TO....." B.S.
 STANDING WATER LEVEL AT BEGINNING OF TEST..... B.S.
 LEVEL RECOVERED TO....." B.S. IN.....mins.

RECOVERY OF LEVEL

| <u>TIME</u> | <u>WATER LEVEL</u> | <u>TIME</u> | <u>WATER LEVEL</u> |
|--------------|--------------------|--------------|--------------------|
| 1 min..... | " B.S. | 40 mins..... | " B.S. |
| 2 mins..... | " B.S. | 60 mins..... | " B.S. |
| 4 mins..... | " B.S. | 1½ hrs..... | " B.S. |
| 6 mins..... | " B.S. | 2 hrs..... | " B.S. |
| 8 mins..... | " B.S. | 2½ hrs..... | " B.S. |
| 10 mins..... | " B.S. | 3 hrs..... | " B.S. |
| 15 mins..... | " B.S. | 4 hrs..... | " B.S. |
| 20 mins..... | " B.S. | 5 hrs..... | " B.S. |
| 30 mins..... | " B.S. | | |

STATE OF FLOW AT END OF TEST (If applicable) :-

WATER CONDUCTIVITY AT END OF TEST:-

WATER SAMPLES

| | |
|--------------------------|--------------------------|
| No..... Depth....." B.S. | No..... Depth....." B.S. |
| No..... Depth....." B.S. | No..... Depth....." B.S. |

REMARKS

Foreman.....*D. J. G. S.*.....

SULLIVAN 5872

[illegible][illegible]

| U/L | BLOWS | NO |
|---------------|-------|-----|
| 17'0" - 18'6" | 82 | 225 |

DATE OF TEST..... B.S.....
 SYMBOL.....

| DATE | TIME | DEPTH | TIME | DEPTH | TIME | DEPTH |
|---------|--------|--------|---------|--------|--------|--------|
| / / 196 | " B.S. | " B.S. | / / 196 | " B.S. | " B.S. | " B.S. |
| / / 196 | " B.S. | " B.S. | / / 196 | " B.S. | " B.S. | " B.S. |
| / / 196 | " B.S. | " B.S. | / / 196 | " B.S. | " B.S. | " B.S. |
| / / 196 | " B.S. | " B.S. | / / 196 | " B.S. | " B.S. | " B.S. |

REMARKS

.....
 BATH THERMOMETER.....
 CORRECTION.....
 LEVEL.....

RECORD OF TEST

TIME.....
 1 min.....
 2 min.....
 4 min.....
 6 min.....
 8 min.....
 10 min.....
 15 min.....
 20 min.....
 30 min.....

TIME.....
 40 min.....
 60 min.....
 1 1/2 hr.....
 2 hr.....
 3 hr.....
 4 hr.....
 5 hr.....

STATE OF..... AT END OF TEST (If applicable) :-

.....

No.....
 No.....

No..... Depth.....
 No..... Depth.....

.....

Foraman.....