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REPORT ON A GROUND INVESTIGATION
SKATE RAMP
FERNIE CLOSE
NEWBOROUGH
PETERBOROUGH

Report Reference No. 116725

On behalf of:-

Newborough & Borough Fen Parish Council
5 Blenheim Road
Ramsey
PE26 1AL

July 2024

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Newborough & Borough Fen Parish Council
5 Blenheim Road
Ramsey
PE26 1AL

31st July 2024
Our Ref: AJM/116725

Dear Sirs,

Report on a Ground Investigation – Skate Ramp, Fernie Close, Newborough

Introduction

Newborough and Borough Fen Parish Council, the client, intend to construct a skate ramp within the play area off Fernie Close in Newborough. It is understood that the proposed 15m long and 5m wide skate ramp will be comprised of a 150mm thick reinforced concrete slab cast upon mounded, well compacted MOT Type 1 in 300mm layers. The compacted Type 1 is to be based at 0.40m below ground level and founded upon sub-grade compacted to highway specifications.

A borehole was drilled to 10m depth at the proposed skate ramp position by Hutson Drilling on 2nd July 2024.

Lucion Ground Engineering Limited were instructed by the client to undertake geotechnical laboratory testing and provide comments on the ground conditions found by the borehole, in relation to foundation design and construction.

Introduction, Topography and Geology

The play area is located off the southern side of Fernie Close with the village of Newborough, some 7.3km north of Peterborough Cathedral. The proposed skate ramp is to be located in the south-eastern corner of the play area and is centred at National Grid Reference TF 20600 05870. A site location plan is presented at the rear of this report.

The rectangular play area comprises an approximately 60m wide and 135m long area to the south of properties on the southern side of Fernie Close. The site is bounded by fields to the east and south; and by a playing field to the west.

In July 2024 the site area comprised ‘hummocky’ grass. Deciduous trees were located around the periphery of the play area.

The site stands at an approximate elevation of 2mOD within the low lying ground of Newborough Fen.

The 1984 geological map for the area at 1:50,000 scale, Sheet 158, shows the site to be covered by superficial Nordelph Peat and underlain by the solid geology of the Oxford Clay Formation.

A limited ground investigation was undertaken by Ground Engineering Limited in June 2023 and found topsoil over a thin layer of peat (remnant Nordelph Peat) and then soft clay to at least 1.00m depth. A seepage was recorded at 0.95m depth and rose to 0.85m below ground level.

Site Work

A 10m deep borehole was undertaken by Hutson Drilling on 2nd July 2024. A copy of the driller's record is included in Appendix 1 at the rear of this report.

Laboratory Geotechnical Testing

The samples recovered from the 10m deep borehole were inspected in the laboratory and assessments of the soil characteristics have been taken into account in regard to the ground conditions. The soil sample descriptions are in accordance with BS5930:2015+A1:2020.

The geotechnical tests were conducted to BS1377:1990, 2016 & 2022 and other industry standards, and the results are presented at the rear of this report in Appendix 2.

The moisture content and index properties of selected soil samples was determined as a guide to soil classification and behaviour. The liquid limit was determined by the cone penetrometer method.

The particle size distributions of a selected sample was obtained by sieve analysis. Results of these tests are given as particle size distribution curves at the end of this report.

An indication of the settlement characteristics of selected undisturbed samples was obtained from tests in the consolidation apparatus or oedometer. The tests were performed on a 75mm diameter sample, about 19mm thick, contained in a steel ring. The sample was saturated and the swelling pressure balanced prior to applying a constant load with drainage at both ends. When primary compression was complete, the load was increased and this repeated for three increments of load. The sample was then unloaded in a single stage. The rate and total amount of consolidation were continually monitored using a computer controlled E.L.E. Datasystem 7 Unit. The results were plotted and analysed by the computer for each increment of load to obtain the coefficients of compressibility (m_v), and of consolidation (c_v), which govern the amount and rate of settlement, respectively.

A California Bearing Ratio (CBR) test was undertaken on a selected near surface sample. The test consisted of jacking into the remoulded soil a cylindrical plunger with a cross sectional area of 1935mm^2. A force of 50N was applied initially to seat the plunger on the soil surface and then the plunger was made to penetrate the soil at a uniform rate of 1mm/min. Readings of force were taken at intervals of penetration of 0.25mm to a penetration not exceeding 7.50mm. The CBR value is the ratio of the force required to achieve 2.50mm or 5.00mm penetration to standard forces expressed as a percentage.

Ground Conditions

The site was underlain by topsoil mantling Tidal Flat Deposits, and was underlain by the solid geology of the Oxford Clay Formation. Based on the samples and depths provided by the driller, the Oxford Clay Formation was met at 2.50m depth and found to at least the base of the borehole at 10.00m below ground level.

Table 1 below shows Lucion Ground Engineering Limited's descriptions of strata encountered based on the depths and samples received from the cable percussion borehole.

Depth	Description
0.00m to 0.50m	TOPSOIL – Stiff, friable, dark brown, slightly sandy, silty, organic CLAY.
0.50m to 1.40m	Very soft, grey, slightly sandy, clayey, organic SILT with occasional layers of very soft, dark brown, clayey, amorphous peat. (TIDAL FLAT DEPOSIT)
1.40m to 2.50m	Medium dense, becoming very loose, brown, slightly gravelly, clayey, fine and medium SAND. Gravel of sub-rounded flint. (TIDAL FLAT DEPOSIT)
2.50m to 3.50m	Soft, becoming firm, brown and grey, slightly sandy, silty CLAY with occasional crinoid fossil fragments. (WEATHERED OXFORD CLAY FORMATION)
3.50m to 8.00m	Stiff, closely fissured, grey, silty CLAY with rare fossil shell fragments and fossilised pyritised wood. (OXFORD CLAY FORMATION)
8.00m to 10.00m	Very stiff, closely fissured, grey brown, silty CLAY with frequent fossil shell fragments. (OXFORD CLAY FORMATION)

The borehole was noted as being damp below 2.50m depth, at the base of the Tidal Flat Deposits. The borehole was cased to 3.00m depth, which may have obscured the groundwater level within the Tidal Flat Deposits.

Comments on the Ground Conditions in Relation to Skate Ramp Design and Construction

Based on the records and samples provided by the driller, the site is covered by a surface topsoil of organic clay, mantling very soft Tidal Flat Deposit silt and peat, and then medium dense becoming very loose Tidal Flat Deposit sand. The site is underlain by the solid geology of the Oxford Clay Formation at 2.50m depth, which was initially weathered to soft, but became stiff with depth. Although groundwater was not recorded, the borehole became damp below 2.50m depth, which is considered to reflect a seepage at the base of the Tidal Flat Deposits.

It is proposed that the new skate ramp will be constructed on mounded material with a layer of concrete surfacing and will be up to 1.4m high. It is intended to base the mounded material at 0.40m depth upon sub-grade compacted to highway specifications.

The sub-grade across this site comprises Tidal Flat Deposit clayey silt with a plasticity index of 48%. Although the laboratory testing gave CBR results of 2.6% and 2.8%, TRRL 1132 (1984), as referenced in CD225 (2020), recommends a design CBR value of 1.0% for thin pavement on silt soils, a low water table and average construction conditions. It should be noted that silt is a potentially frost susceptible soil and where this is the case a minimum pavement construction thickness of 450mm should be adopted in order to avoid the worst effects of frost action.

At and below the minimum depth of 0.45m the samples recovered from the borehole indicate the presence of layers of peat within the Tidal Flat Deposit clayey silt. Soils which contain peat are listed as an unacceptable material for compaction within Clause 2(i)(b) of the Manual of Contract Documents for Highway Works, Specifications for Highway Works: Volume 1: 1998 (SHW). As such, compaction of the sub-grade to highway specifications would not be achievable.

As the very soft clay beneath the site is unsuitable for compaction an alternative method should be adopted for design of the skate ramp. The skate ramp has a variable height of between about 0.1m and 1.4m above ground level and will impose an additional load upon the underlying soils. Any imported stone fill will also have a higher density than the underlying soils they replace, which will also increase loads. As such, additional loading across the skate ramp is expected to vary by 30kN/m^2.

The 0.50m thick surface layer of topsoil would not be a suitable bearing stratum for the skate ramp, as it will be highly sensitive to seasonal weather changes, which would likely result in unacceptable differential settlement. Foundations for the skate ramp should be extended through the topsoil and into the underlying naturally deposited soils.

The very soft Tidal Flat Deposits met at 0.50m depth had a modified plasticity index of 47%, and so would be considered to have a high volume change potential. According to modern building standards a minimum foundation depth of 1.00m would be required within high volume change potential soils.

Alternatively a raft foundation (the skate ramp) can be founded on coarse-grained fill placed and fully compacted in layers. This infill should not be less than 50% of the foundation depths determined previously, so about 0.50m deep based on the plasticity of the underlying soils. This infill will need to extend beyond the edge of the foundation by a distance equal to the natural angle of repose of the coarse-grained fill plus 0.50m.

The Tidal Flat Deposit silt soils at 0.50m depth would offer a net safe bearing capacity of 40kN/m^2, using a factory of safety of 3.0, for a concrete raft foundation (the skate ramp) 5m wide. At 0.50m depth the additional loads imposed by the skate ramp will be between 10kN/m^2 and 40kN/m^2. The Tidal Flat Deposit silt at 1.00m depth would offer a similar net bearing capacity, whilst additional load would be imposed by the replaced soils.

Long term consolidation settlement beneath such loads will largely be confined to the Tidal Flat Deposit soils encountered at shallow depth, and be limited by presence of the underlying sand soils. Consolidation settlement for the different imposed loads across the skate ramp at 0.50m depth (10kN/m^2 to 40kN/m^2) would vary between 5mm and 15mm, which may be within tolerable limits for a heavily reinforced slab. The amount of settlement will also depend upon the presence and thickness of peat layers within the Tidal Flat Deposit silt soils. Such settlement could comprise 50% of the thickness of peat soils within the Tidal Flat Deposits, i.e. 50mm for a 0.10m thickness of peat. The 15m long skate ramp may have variable thicknesses of peat beneath it, with even a small change in the thickness of peat resulting in unacceptable increased amounts of differential settlement.

The proposed design for a relatively thin concrete surface laid upon mounded soil, may be unable to resist large scale differential settlements resulting from the presence of variable thicknesses of peat beneath the site. Additional shallow exploratory holes/probing could be undertaken to determine the presence or absence of significant peat layers beneath the ramp footprint. An alternative would be to extend the stone fill through the Tidal Flat Deposit silt and into the underlying sand.

The medium dense, becoming very loose Tidal Flat Deposit sand would offer an allowable bearing pressure of 40kN/m^2 for up to 25mm of immediate settlement beneath a raft foundation (the skate ramp) at 1.50m depth. Construction of the engineering stone fill will result in immediate settlement within the underlying sand as layers are added and compaction is

undertaken. The addition of the concrete following mound construction should result in minimal remaining settlement, which could be mitigated with the incorporation of steel reinforcement.

Results of consolidation settlement testing of undisturbed samples recovered from the borehole indicate that there would be minimal consolidation settlement expected within the underlying Oxford Clay Formation.

Statutory safety precautions should not be neglected and excavations especially those where personnel are to enter, will need to be supported, or have battered sides where space permits. All excavations should be undertaken in accordance with CIRIA Report 97 '*Trenching Practice*'.

The base of excavations should be inspected on completion to ensure that the condition of the soil complies with that assumed in design. Should pockets of inferior material be present, they should be removed and replaced with well-graded hardcore or lean mix concrete. Any buried services or drains crossing the site, should be grubbed out, removed and re-routed.

The borehole became damp at 2.50m depth, indicating a seepage at the base of the Tidal Flat Deposits. Previous work by Ground Engineering Limited in June 2023 met water at 0.95m depth, which rose to 0.85m below ground level. If groundwater is met within foundation excavations, screened sump pumping techniques would be necessary so that excavations could be constructed in the dry.

Conclusion

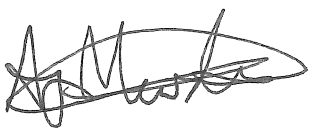
In summary, the sub-structure of the skate ramp should be extended through the surface layers of topsoil. The underlying Tidal Flat Deposit silt would be unsuitable for compaction due to the presence of layers of peat. It the skate ramp and its sub-structure were to be treated like a raft foundation then the Tidal Flat Deposit silt may provide a suitable bearing stratum. In such a case additional exploratory holes would be recommended to confirm the extent of peat layers beneath the site.

Alternatively, the sub-structure of the skate ramp could be extended into the underlying Tidal Flat Deposit sand. This would provide a suitable bearing stratum for engineering stone fill, with immediate settlement, allowing the concrete surface of the skate ramp to be constructed.

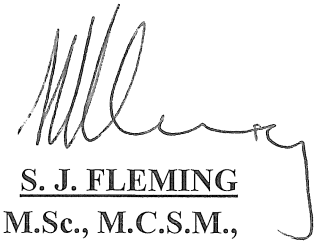
For and on behalf of Lucion Ground Engineering Limited.

Yours faithfully,

LUCION GROUND ENGINEERING LIMITED



A. J. MURDOCH
M.Geol., F.G.S.
Senior Geo-Environmental Engineer



S. J. FLEMING
M.Sc., M.C.S.M.,
C.Geol., F.G.S.,
Ground Engineering Director

Site Location Plan

Project : Skate Ramp - Newborough

Client : Newborough & Borough Fen Council

Lucion
Protecting people and planet

LUCION GROUND ENGINEERING LIMITED
Peterborough Tel : 01733 566566

Project No.
116725

APPENDIX 1

DRILLER'S LOG

DAILY SITE REPORT

m (T) w th f s su 2 7 24

SITE NAME, ADDRESS, JOB NUMBER: NEWBOROUGH SH1

BOREHOLE NO.: 01

GROUND CONDITIONS ENCOUNTERED

from	to	consistency or density / colour / type
GL	0.5	Grass Type over Brown Stoney Topsoil
0.5	1.4	Soft Brown Silty Peaty Clay
1.4	2.5	Brown & Grey Silty Sand
2.5	3.5	firm Brown & Grey Silty Sandy Clay
3.5	8.0	Stiff Hard Grey Silty Clay
8.0	10.0	Stiff Hard Grey Silty Clay with Shells

DISTURBED SAMPLES

no.	depth
D 1	1.1
D 2	1.8
D 3	2.7
D 4	3.7
D 5	4.5
D 6	4.8
D 7	6.0
D 8	7.5
D 9	8.5
D 10	9.0
D 11	10.0
D 12	
D 13	
D 14	
D 15	
D 16	
D 17	
D 18	
D 19	
D 20	

UNDISTURBED SAMPLES

no.	depth	length	blows
U 1	4.0	f	75
U 2	8.0	f	90
U 3			
U 4			
U 5			
U 6			
U 7			
U 8			
U 9			
U 10			
U 11			
U 12			
U 13			
U 14			
U 15			

PENETRATION TESTS

type/no.	depth	75	75	75	75	75	75
S/C 1	1.2	2	1	2	3	3	3
S/C 2	2.0	2	1	2	1	1	2
S/C 3	3.0	2	2	1	2	2	2
S/C 4	5.0	5	5	8	8	8	10
S/C 5	6.5	5	6	7	7	10	11
S/C 6	9.5	6	8	9	10	12	12
S/C 7							
S/C 8							
S/C 9							
S/C 10							
S/C 11							
S/C 12							
S/C 13							
S/C 14							
S/C 15							

BULK SAMPLES

no	from	to
B 1	GL	0.5
B 2	0.5	1.0
B 3		
B 4		
B 5		
B 6		
B 7		
B 8		
B 9		
B 10		
B 11		

DETAILS OF GROUNDWATER ENCOUNTERED

depth struck			
casing depth	No		
inflow rate	Strike water		
rose to			
sealed out at			
sample no.	at Oak Dump		
sample depth	2.5		
water level at start of boring			
water level at finish of boring			
water level when casing removed			

driller

Borehole complete	(Yes)	No
Depth of borehole cased	3.0	
Piezometer/Standpipe?	depth	N/A

DRILLERS COMMENTS

CHISEL OR PIT

from	GL		
to	1.2		
hours	1 Hour		

DETAILS OF WATER ADDED

from			
to	N/A		
litres			

APPENDIX 2

GEOTECHNICAL LABORATORY

TEST RESULTS

LABORATORY TEST RESULTS

CONTRACT SKATE RAMP, NEWBOROUGH

Bore-hole	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO_4)				C.B.R.		Remarks
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m^3	Dry Mg/m^3	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Soil Total % Dry Wt.	Soil Aqueous Extract mg/l	Water mg/l	pH	Top %	Base %	
BH01	B2	0.50 - 1.00	97	49	48	63	1.50	0.91										2.6	2.8	SOIL CLASSIFICATION = ME 2% retained 425μm sieve 0% retained on 20mm sieve
	D3	2.70	57	20	37	27														SOIL CLASSIFICATION = CH 1% retained on 425μm sieve

U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

C.B.R. - CALIFORNIA BEARING RATIO

116725

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Tel: 01733-566566
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8180

GROUND ENGINEERING

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TEST CERTIFICATE

Determination of Particle Size Distribution

Tested in Accordance with BS 1377-2: 1990: Clause 9.2
Wet Sieving Method

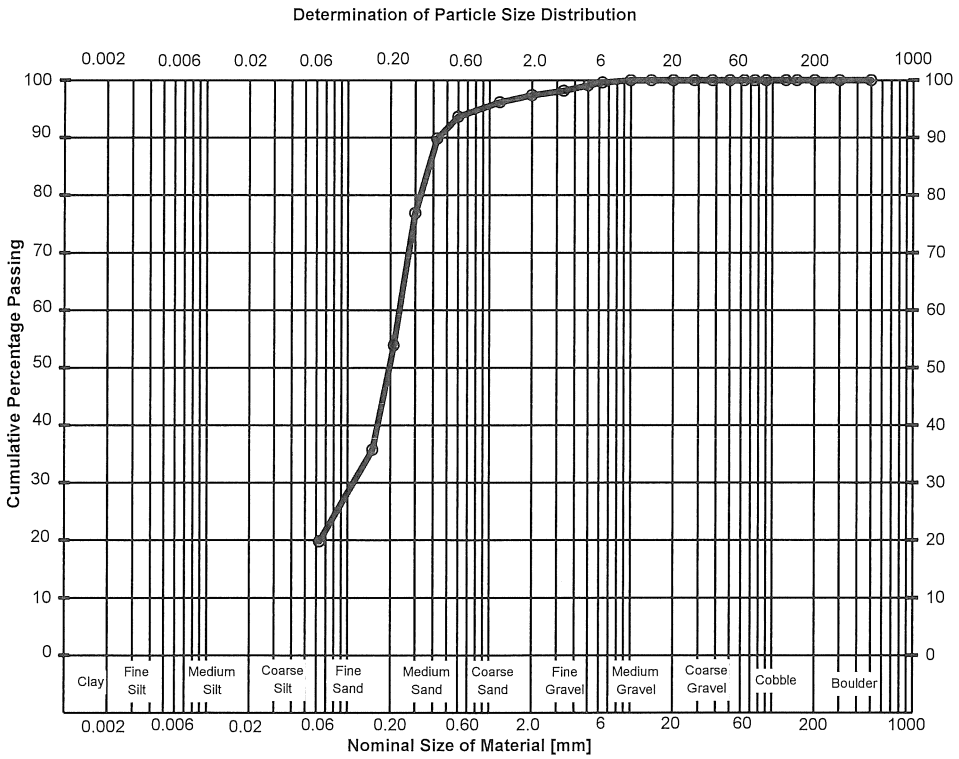
Client:	Lucion Ground Engineering Ltd	Certificate Number:	PL8694-1/4/710-2
Client Address:	Newark Road	Client Reference:	116725
	Peterborough	Lab Job Number:	PL8694-1
	PE1 5UA	Date Sampled:	Unknown
		Date Received:	17.07.2024
Contact:	Ashley Murdoch	Date Tested:	22.07.2024
		Certificate of Sampling:	N/A
Site Name:	Skate Ramp	Sampling Certificate No.:	N/A
Site Address:	Newborough	Sampled By:	Client

TEST RESULTS

Laboratory Reference: PL8694-1/4
Client Reference: D2
Pre-treatment for organic material: N/A

Sample Description: Brown grey orange-brown slightly clayey slightly silty SAND.

Material Specification: Not Required
Location: BH01
Source:
Depth: 1.80m
Supplier:



Sieve Analysis

Sieve mm	%Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	100
20	100
14	100
10	100
6.3	100
5.0	99
3.35	98
2.00	97
1.18	96
0.600	94
0.425	90
0.300	77
0.212	54
0.150	36
0.063	20
0.020	
0.006	
0.002	

Comments:

Approved Signatory: M. Hartnup - Laboratory Manager Signed:

for and on behalf of Lucion Ground Engineering Ltd

Date Reported: 26.07.2024 Page 1 of 1
Form Number: GELab/C/709-2 Version 59

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Newark Rd, Peterborough PE1 5UA

GROUND ENGINEERING LIMITED

Newark Road Peterborough

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e: admin@groundengineering.co.uk

TEST CERTIFICATE

One-Dimensional Consolidation Properties

(Tested in accordance with BS1377 : Part 5 1990)

Client:	Lucion Ground Engineering Ltd	Certificate Number:	PL8694-1-1/731
Client Address:	Newark Road	Client Reference Number:	116725
	Peterborough	Date Sampled:	Unknown
	Cambridgeshire	Date Received:	17.07.2024
Postcode:	PE1 5UA	Date Tested:	17.07.2024
Contact:	Ashley Murdoch	Sampling Certificate No:	N/A
Site Name:	Skate Ramp	Certificate of Sampling:	N/A
Site Address:	Newborough	Sampled By:	Client

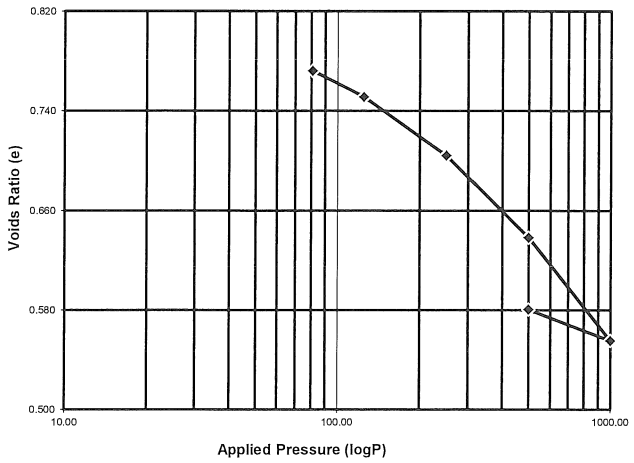
Test Details

Location:	BH01	
Sample Ref:	U1	
Sample Description:	Stiff and Very Stiff friable brown dark brown silty CLAY with shell fragments.	
Particle Density (Mg/m^3):	2.7	Assumed
Mean Lab Temp. (^oC):	22	
Variations from Standard:	None	
Lab Reference:	PL8694-1-1	
Depth:	4.05 m	

Specimen Details

	INITIAL	FINAL
Height (mm):	18.67	16.65
Bulk Density (Mg/m^3):	1.89	2.15
Moisture Content (%):	24	26
Dry Density (Mg/m^3):	1.52	1.71
Voids Ratio:	0.772	0.580
Degree of Saturation (%):	83.0	100.0
Diameter (mm):	74.98	N/A
Swelling Pressure (kPa):	81	N/A
Method of time fitting used:	Log Time	N/A

Voids Ratio against logarithm of Applied Pressure



Applied Pressure (kPa)	Coefficient of Compressibility m_v (m^2/MN)	Coefficient of Consolidation c_v (m^2/year)
81		
125	0.28	6.29
250	0.21	10.08
500	0.16	11.35
1000	0.10	18.82
500	0.03	---

Comments:

Approved Signatory: [x] M.Hartnup - Laboratory Manager
[ ] L.Petch - Team Leader

Signed:

for and on behalf of Ground Engineering Ltd

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Peterborough PE1 5UA

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TEST CERTIFICATE

One-Dimensional Consolidation Properties

(Tested in accordance with BS1377 : Part 5 1990)

Client:	Lucion Ground Engineering Ltd	Certificate Number:	PL8694-1-2/731
Client Address:	Newark Road	Client Reference Number:	116725
	Peterborough	Date Sampled:	Unknown
	Cambridgeshire	Date Received:	17.07.2024
Postcode:	PE1 5UA	Date Tested:	17.07.2024
Contact:	Ashley Murdoch	Sampling Certificate No:	N/A
Site Name:	Skate Ramp	Certificate of Sampling:	N/A
Site Address:	Stevenage	Sampled By:	Client

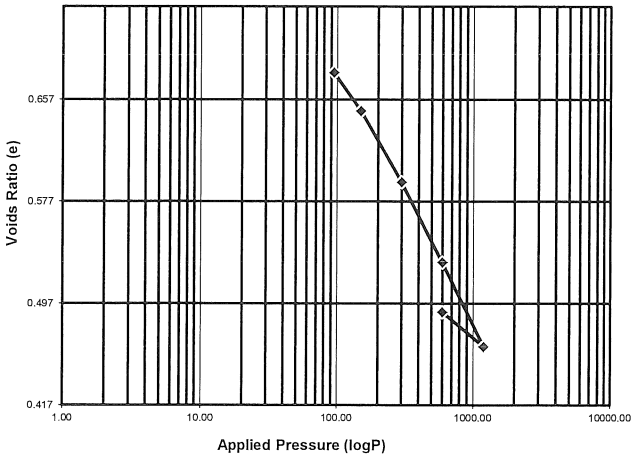
Test Details

Location:	BH01	
Sample Ref:	U2	
Sample Description:	Very Stiff friable brown grey-brown silty CLAY with shell fragments.	
Particle Density (Mg/m^3):	2.7	Assumed
Mean Lab Temp. (^oC):	22	
Variations from Standard:	None	
Lab Reference:	PL8694-1-2	
Depth:	8.10 m	

Specimen Details

	INITIAL	FINAL
Height (mm):	18.50	16.43
Bulk Density (Mg/m^3):	1.98	2.23
Moisture Content (%):	23	23
Dry Density (Mg/m^3):	1.61	1.81
Voids Ratio:	0.678	0.490
Degree of Saturation (%):	93.0	100.0
Diameter (mm):	75.00	N/A
Swelling Pressure (kPa):	95	N/A
Method of time fitting used:	Log Time	N/A

Voids Ratio against logarithm of Applied Pressure



Applied Pressure (kPa)	Coefficient of Compressibility m_v (m^2/MN)	Coefficient of Consolidation c_v (m^2/year)
95		
150	0.32	1.55
300	0.23	2.90
600	0.13	0.47
1200	0.07	0.81
600	0.03	---

Comments:

Approved Signatory: [x] M.Hartnup - Laboratory Manager
[ ] L.Petch - Team Leader

Signed:

for and on behalf of Ground Engineering Ltd

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