Pile Foundation Design



Document Title:	**Bearing Pile Design Calculations**
Site:	**South Norwood - 53 Warminster Road**
Date:	**04/02/2026**
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NFS piling contractors

Document Control

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Contents

1.0 Introduction 1
2.0 Information Provided 2
2.1 Engineering Documentation 2
2.2 Ground Investigation 2
2.3 Specification Documentation 2
2.4 Design Scope & Further Information 3
3.0 Ground Conditions 4
3.1 Ground Investigation 4
3.2 Geotechnical Assessment 4
3.3 Ground Model 5
3.4 Design Parameters 5
4.0 Geotechnical Design Methodology 7
4.1 Axial Design Philosophy 8
4.2 Design Actions 8
5.0 Geotechnical Design 9
5.1 Axial Pile Load 9
6.0 Structural Analysis 12
6.1 Axial Structural Analysis 12
6.2 Pile Reinforcement 12
6.3 Pile Reinforcement Projection 13
6.4 Buried Concrete Requirements 13
7.0 Summary 14

1.0 Introduction

These calculations are for the design of the bearing piles only and It is understood that the proposed development will comprise of construction of two new dwellings/extensions at 53 Warminster Road, South Norwood, Croydon, which will be found on bearing piles.

The site is centred at approximately National Grid Reference TQ 34172 68884, which is roughly rectangular-shaped. The site is located within a well-established residential area, bounded by residential buildings to the north and south, with Westminster Road forming the western boundary and Pittville Gardens defining the eastern boundary. There are trees at immediate west and east side of the site and there is a railway at far east side of the site. Topography of the site is generally level/flat, an aerial photograph of the site and surrounding area is presented in Figure 1 below.



Figure 1 - Site Location Plan (Google Maps 2026)

Pile loadings have been provided on drawings provided by Alpha Structural Engineers who the structural engineers for the project. The drawings show pile locations and axial loads.

The design has been carried out in general accordance with BS EN 1997 and other relevant documents. All loads have been converted into Eurocode design actions and a pile design is based upon these actions.

Piledesigns Limited (PDL) has been appointed by Neil Foundation Systems Limited to undertake the detailed 'element' design for the bearing pile foundations.

2.0 Information Provided

The main documents that have been consulted in preparing these calculations are summarised below. Any subsequent revisions to these documents should be forwarded for review.

2.1 Engineering Documentation

The following engineering documentation relevant for the design have been produced and utilised for the project:

Table 1 – Design Documents

Reference	Rev	Title
Author: Alpha Structural Engineers		
24706/A99	-	Important Notes
24706/A100	-	Proposed Foundation Plan
24706/101-DET5	-	Ring Beam Detail
24706/101-DET6	-	Bending Schedule For Ground Beam and Pile Schedule
24706/100-DET13	-	Structural Notes

2.2 Ground Investigation

Table 2 - Ground Investigation Report

Author	Reference	Rev	Title	Date
K F Geotechnical	G/022585/001	-	Factual Report of Investigation	27/02/ 2025

2.3 Specification Documentation

Where no specific project specification has been provided, reference has been made to the Institute of Civil Engineers publication, ICE Specification for Piling and Embedded Retaining Walls, SPERW, Third Edition published 2017. This is an administrative document for good working practice of piling works and the design has been carried out in general accordance with this document.

2.4 Design Scope & Further Information

The design herein is for the bearing piles to the loads provided within the documents referenced above.

- It is proposed to use 300mm diameter auger piles.
- The design has been carried out to BS EN 1997 (EC7) and other appropriate documents.
- Vertical loads have been provided by engineer as unfactored safe working load (SWL), therefore we have applied 80/20% dead/live loads split to calculate Eurocode actions. The vertical/axial load has been taken as a compression load only, and there is no allowance for lateral and tension loads. This should be checked prior construction.
- These loads have been taken as applied at cut-off level (COL).
- No piling commencement levels have been given; therefore, a single Piling Platform Level (PPL) of approximately existing ground has been taken. For design purposes PPL has been assumed to be circa 1.0m above cut of level. Piling levels to be confirmed by the principle contractor.
- In the absence of a settlement criteria the design will not consider serviceability limit states except by the use of the factor of safety applied.
- Design only considers the element design of the bored augured piles / continuous flight auger piles based on the specified loads.
- Most of the pile positions have been taken/assumed as tied, either by a slab, ground beams and/or within a pile cap. Such piles have been taken as fixed and effectively restrained in two directions by the above structure.

3.0 Ground Conditions

This section describes ground conditions, based upon the available ground information, and provides a ground model for use within the design and comments on the geotechnical parameters taken.

3.1 Ground Investigation

Information on ground conditions have been based on a geotechnical investigation data noted in table 2. This contained the following information:

- Two boreholes to a maximum depth of 12.0mBGL (metres below ground level).

No borehole commencement levels were provided for the boreholes and it has been assumed they were carried out from approximately existing ground level.

These records show that the site is underlain by Made Ground and in turn London Clay Formation with depth.

Reference was also made to the British Geological Survey (BGS) Website's (GeoIndex) 1:50 000 Map series, which shows that the site is directly underlying by London Clay Formation, BGS described the geology of the site as follows.

London Clay Formation was described as mainly comprises bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. These sedimentary rocks are marine in origin. They are detrital and comprise coarse- to fine-grained slurries of debris from the continental shelf flowing into a deep-sea environment, forming distinctively graded beds.

3.2 Geotechnical Assessment

This section details the derivation of geotechnical properties from field and/or laboratory test data, empirical correlation, theoretical conversions and/or reference to design codes. The following soil descriptions below have been taken from the site investigation reports and our previous experience in the area.

3.2.1 Made Ground

Made Ground was encountered from existing ground level to a maximum depth of 0.7mBGL within the exploratory holes. It was described as comprising dark grey/brown, slightly gravelly, silty clay with ash, brick and lime fragments/concrete. No Standard Penetration Tests (SPT) have been done on this stratum.

For design purposes a maximum depth of 3.0mBGL have been discounted for positive skin friction and if encountered deeper than then the designer must be notified for review.

3.2.2 London Clay Formation

London Clay Formation was encountered below made ground to a maximum depth of investigation, it was found to comprise of very stiff grey/brown silty clay. Borehole 2 was terminated at 3.4m as probably there was an obstruction which is assumed to be Claystone. No Standard Penetration Tests (SPT) have been done on this stratum.

Atterberg limits have been carried out and indicate near surface cohesive soil (top 3m) has very high plasticity and high shrinkage potential.

3.2.3 Groundwater

Groundwater was not encountered during site investigation works and there is no monitoring data, therefore for design purposes groundwater has been modelled below pile toe level.

3.3 Ground Model

The geotechnical design data has been analysed and is presented within the appendices. The following tables present the various profiles that have been used within the design.

Table 3- Ground Profile [1]

Depth (mBGL)			Soil
PPL	-	3.0	Discounted Soil*
3.0	-	---	London Clay Formation

*Discounted soil includes made ground and desiccated Clay-with-Flints Formation.

3.4 Design Parameters

From the above the following design parameters will be adopted.

Table 4- Design Properties

Soil	γ [1] (kN/m³)	SPT (N-Value) [3]	Cu (kPa)	Phi (°)
Discounted Soil	18	n/a	n/a	28
London Clay Formation	20	n/a	90+9.17z[2]	28

[1] Bulk unit weights are based on material descriptions and bulk density testing.
[2] Z is depth with one meter increment
[3] SPT 'N-Value's are from our local experience and not from site investigation report, mentioned in table 2.

The figures are Service Limit State (SLS) values and have not had any partial factors applied. Please note where no direct testing has been undertaken to determine the specific design value(s) quoted in Table 4, the value has been based upon published correlations, engineering descriptions and engineering judgment.

Should ground conditions differ to that of the ground model and parameters be found during the piling works this should be relayed back to the designers.

4.0 Geotechnical Design Methodology

The design has been carried out in general in accordance with Eurocode (BS EN 1997-1:2004+A1:2013) with reference made to the UK National Annex and Execution Codes. This is an ultimate limit state design approach with partial factors applied to actions (A), materials (M) and resistances (R).

The main approach is to satisfy that the Design Effect of Actions, Ed is less than the Design Resistance, Rd. The Design Effect of Actions is a combination of actions (A) and or materials (M). Whereas the Design Resistance, Rd, is a combination of resistances (R) and or materials (M). Furthermore, elements will need to satisfy Serviceability Limit State (SLS) requirements which relates to settlements at working conditions.

Reference to typical actions (A), materials (M) & resistances (R) arrangements related to specific elements are presented below. Individual partial factors are presented in the table below, which have been taken from the UK National Annex.

Table 5 - Partial factor for GEO/STR Design Situations

Element	Design Approach 1	A1	A2	M1	M2	R1	R4
Axial Design	Combination 1	●		●		●	
	Combination 2		●	●			●
Lateral Design	Combination 1	●		●		●	
	Combination 2		●		●	●	

Table 7 - Partial factors on actions for the structural (STR) and geotechnical (GEO) limit states

Actions (A) [table NA.A1.2(B) in the NA to BS EN 1990]	Notation	A1	A2
Permanent Action (Unfavourable)	$G_{k.unfav}$	1.35	1.00
Permanent Action (Favourable)	$G_{k.fav}$	1.00	1.00
Variable Action (Unfavourable)*	$Q_{k.unfav}$	1.50	1.30
Variable Action (Favourable)	$Q_{k.fav}$	0.00	0.00
* Secondary variable actions are combined with an accompanying variable partial factor, taken from table NA.A1.1			

Table 8 - Partial factors for soil parameters for the STR and GEO limit states

Soil factors (M) [table A.NA.4 in the NA to BS EN 1997]	Notation	M1	M2
Effective angle of shearing resistance	tan Ø'	1.00	1.25
Effective cohesion	c'	1.00	1.25
Undrained shear strength	C_u	1.00	1.40

Table 9 - Partial factors for design resistance for the STR and GEO limit states

Resistances (R) [table A.NA.7 and A.NA.8 in the NA to BS EN 1997]	**Notation**	**R1**	**R4** without explicit verification of SLS	**R4** with explicit verification of SLS
Pile Base	γ_{bRe}	1.00	2.0	1.7
Pile Shaft (compression)	γ_{sRe}	1.00	1.6	1.4
Pile Shaft (tension)	γ_{tRe}	1.00	2.0	2.0
Model Factor	**Notation**	**R1**	**R4** without explicit verification of ULS	**R4** with explicit verification of ULS
Model Factor	γ_{mod}	n/a	1.4	1.2

4.1 Axial Design Philosophy

Pile lengths have been determined from the appropriate partial factors as detailed within Tables A.NA.3, A.NA.4 and A.NA.8. For this the combination summary detailed below.

- Combination 1 (DA1-1): A1 + M1 + R1
- Combination 2 (DA1-2): A2 + M1 + R4

4.2 Design Actions

From section 2 the piles are to be designed for axial compressive loads only, and there is no allowance for tension and lateral loads. Loads have been provided by the engineer as an unfactored SWL which have been used to calculate EC7 design actions.

- Permanent Action, G_k = F.rep x 80%
- Variable Action, Q_k = F.rep x 20%
- F.rep.min = G_k x 1.0
- F.rep.max = [G_k x 1.0] + [$Q_{k.imp}$ x 1.0]
- DA1-1min = G_k x 0.9
- DA1-1max = [G_k x 1.35] + [$Q_{k.imp.}$ x 1.5]
- DA1-2min = G_k x 1.0
- DA1-2max = [G_k x 1.0] + [$Q_{k.imp}$ x 1.3]

5.0 Geotechnical Design

Design for bearing piles to BS EN 1997. The bearing piles are detailed are within the drawings referenced within Table 1.

During the design process if it proposed to utilise 300mm diameter piles and the design herein is based upon this. For design purposes we have assumed the bearing piles will be installed from approximately existing ground level, which is understood to coincide with borehole commencement level.

5.1 Axial Pile Load

The ultimate design resistance of a bearing pile is calculated from the sum of resistance gained on the pile shaft and the base, as detailed below.

For this site it is understood that neither preliminary nor working tests are proposed. Therefore, the piles have been designed to factors that do not require validation by testing. These calculations consider a model factor of 1.4 and partial factors of 1.6 and 2.0 applied to shaft and base resistances respectively.

In addition to the γ_b and γ_s partial factors which vary for combination 1 and 2 and are defined in NA to BS EN 1997-1 (2004), a further check against the shaft friction will also be made to maintain pile performance on the shaft element, this partial factor, $\gamma_{s.SLS}$ has been taken as 1.5 and is reviewed against the representative action, F.rep. Therefore, the pile length is governed by the following conditions.

$$R_{cd} = \frac{R_{bk}}{\gamma_b \cdot \gamma_{mod}} + \frac{R_{sk}}{\gamma_b \cdot \gamma_{mod}}$$

$$F_{rep.max} \leq \frac{R_{sk}}{\gamma_{s.SLS}}$$

5.1.1 Characteristic Shaft Adhesion, R.sk

The shaft resistance contribution from the Made Ground has been ignored, furthermore material above pile cut off level has also been discounted. The characteristic shaft resistance for the relevant strata's has been calculated as follows;

In Cohesive Material;

$$Rsk = C_{u.ave} * \alpha * As$$

where, $C_{u.ave}$ = shear strength along the length of the pile as shown in Table 4

α = adhesion factor taken as 0.5

As = Area of pile shaft

5.1.2 Characteristic End Bearing, R.bk

All Piles will be found in the London Clay Formation, therefore the base resistance for the overlying materials have been ignored for base resistance. The characteristic base resistance for the relevant strata's has been calculated as follows;

In Cohesive Material;

$$R.bk = C_{u.base} * Nc * Ab$$

where, $C_{u.base}$ = Shear strength at pile base as shown in Table 4

Nc = Bearing capacity factor, taken as 9 for circular piles in clay

Ab = Area of pile base

5.1.3 Heave

The near surface soils are potentially desiccated and could be subject to high volume change. Calculate the potential uplift force from this material based upon an affective zone of influence of up to 3.0mBGL.

$$Tk.heave.pile = 45kN/m^2 * Ø\pi * 2.0m$$

$$Tk.heave.pile = 85kN$$

Plus, an allowance for voidformer, Tk.heave.voidformer, assumed as 20kN. Therefore, the total heave force, Tk.heave.total is as follows.

$$Tk.heave.Total = Tk.heave.pile + Tk.heave.voidformer$$

$$Tk.heave.total = 85kN + 20kN = 105kN$$

Review required anchorage resistance for Tk.heave.design. From calculations above for vertical pile capacity for ultimate skin friction has been compared against a satisfactory safety factor on possible heave is in excess of 1.5 and reinforced respectively.

5.1.4 Pile Length

The above calculations have been carried out using the OASYS Pile program, version 19.7 which allows the appropriate partial factors to be applied to the soil parameters. The results are given in the appendices which includes a summary table of the design resistances calculated.

6.0 Structural Analysis

Pile section design has been carried out on the basis of the reinforced concrete design code BS EN 1992-1-1:2004 (Eurocode 2) using the following parameters.

Pile Diameter, d_{nom}	=	300mm
Design Concrete strength, fck	=	28N/mm^2 {fcu = 35N/mm^2 (C28/35)}
Streel fyk	=	500 N/mm^2 [high yield] (BS EN 1992-1-1:2004)
Design Concrete Cover	=	75mm

6.1 Axial Structural Analysis

The axial compressive stress of concrete has been checked in accordance with BS EN 1992-1-1:2004 where the value of design compressive strength, fcd, of concrete is defined as:

fcd	=	$(\alpha_{cc} \cdot f_{ck}) / (\gamma_c \cdot k_f)$
Where, α_{cc}	=	0.6 for unreinforced section
γ_c	=	1.5
k_f	=	1.1

Considering C28/35 grade concrete, and axial compressive resistance of 720kN for 300mm diameter piles has been calculated. This is greater than the maximum STR on the associated pile diameters.

6.2 Pile Reinforcement

For piles under vertical actions only supply nominal reinforcement. The cages will be installed in a nominal helical binder, as detailed below.

- 300mm Dia, 0.5% Ast = 4B12/B8@150mmc/c x 7.0m long

By inspection this is greater than the minimum requirements and is acceptable to provide a nominal level of robustness during construction of the foundation

6.2.1 Pile Tension Reinforcement

From section 5.1.3 pile reinforcement to be designed for the tensile actions due to potential soil heave forces. A partial factor of, γf, 1.5 is applied for ULS reinforcement design to the tension force on pile element, Tk.heave.design. The required area of steel, A.st, to cater for tension load will be calculated as follows, where γs, is 1.15.

A.st.max	=	(Tk.heave.design. γf) / (fyk / γs)

The main radial reinforcement will be supplied to the depth required. Construction technique may not allow the radial reinforcement to the length required therefore a central reinforcement bar to cater for the tension load at depth could be used. The centre bar would be sized using the same approach as above.

6.3 Pile Reinforcement Projection

The radial cage has been designed to cater for all loadings at cut off level, the Basic Anchorage Length has been calculated in accordance with EC2 cl. 8.4.3. This generates a design tension anchorage, *lbd*, of 375mm for 12mm diameter reinforcement. This is the minimum anchorage that is to be supplied for the radial cages.

6.4 Buried Concrete Requirements

C28/35 concrete has been used in the structural analysis and is sufficient for the pile actions. From site investigation report sulphate class ACEC class AC-1 is given. This would equate to DC-1.

For the design allow for, C28/35 DC-1, with 75mm cover.

7.0 Summary

The design herein is for the bearing pile element only, issued for approval from the professional team and relevant third-party bodies.

If any works proceed on site prior to receiving approval from any warranty provider, approved inspector or insurance provider (e.g. NHBC, Premier Guarantee, LABC) that may impact the final design and/or details the contractor/client are proceeding at their own risk.

- All piles to be constructed in accordance with the piling schedule issued separately.
- Design in general accordance with Eurocode (EC7) and other relevant documents.
- Design only considers the element design of the bored augured pile based on the specified loads only.
- Refer to pile load schedule for individual pile actions, pile length and reinforcement.
- Piling levels to be confirmed by the principle contractor, design currently based upon a PPL of approximately existing ground level.
- Piles have been designed to the loads given in the relevant drawings.
- Pile loads have been taken as acting at cut-off level.
- C28/35 DC-1 concrete with 75mm cover to all bearing piles.

APPENDIX A
DESIGNERS RISK ASSESSMENT

STATEMENT ON CDM REGULATIONS (2015) AND RESIDUAL RISKS

CDM Regulations (2015)

The Client and Designer for this project are subject to certain duties under the CDM (2015) Regulations. It is the duty of the Designer to ensure that the client is aware of these duties prior to commencing the design. Piledesigns Ltd are responsible for an 'elemental' part of the design only and are not the 'overall' scheme designer. This 'elemental' design has been undertaken on the premise that this duty has been carried out by the scheme designer, and that no separate approach, in respect of this elemental design, by Piledesigns Ltd is required.

Residual Risks – In accordance with the CDM Regulations (2015) any specific residual design risks and construction sequences relevant to this design are given below. As stated in the CDM Regulations (2015), whilst we have assessed the design risks for our works, we have only listed the risks we consider significant to the design and which we consider are not likely to be obvious to a competent contractor or other designer. It does not constitute or remove the need for task related risk assessments for the activities carried out in the implementation of the design. Furthermore, it is the responsibility of the client and principal designer to ensure a competent principal contractor is appointed for these works.

The residual risks below should be added to any relevant construction drawing or method statements and copied to relevant designers and contractors on site.

Item No	Risk	Potential Effects	Risk Management / Mitigation
1	Unforeseen ground conditions	Pile performance could be compromised.	Ground conditions encountered during pile construction should be logged and checked against the assumed design profile and any variations from that assumed in the design must be reported immediately to the designer.
2	Services	Injury to site operatives / public and damage to equipment	No works should be carried out until a permit to work has been provided to the piling contractor by the Principle Contractor. Where it is necessary to carry out works close to any services the main contractor must positively locate (visually) the service or divert and decommission the service prior to the commencement of any piling works.
3	Working Platform	Rig instability which could make unsafe	Ensure working platform is designed, constructed and maintained in accordance with published guidance or

Item No	Risk	Potential Effects	Risk Management / Mitigation
		working conditions for site personnel	other appropriate best practice. Construct platform according to specification, inspect regularly and maintain to original specification.
4	Obstructions	Unable to achieve proposed design lengths, damage to equipment.	Ensure all known existing obstructions are removed prior to piling works.
5	Unable to install reinforcement cages in CFA piles	Pile reinforcement does not achieve the required to level.	Reinforcement stated within the design is the minimum required. Reinforcement can be increased in bar diameter and number to increase cage stiffness for pile installation. to ensure adequate rigidity for temporary lifting and also provision of lifting etc.
6	Lifting reinforcement cages	Damage cages, injury to personnel	Ensure all lifting operations are carried out to an agreed method statement / lift plan. All reinforcement cages to have designed lifting points
7	Piling adjacent to neighbouring structures.	Damage to structures	Ensure all piling activities are agreed with the required third parties and the appropriate sign off have been completed before commencement.
8	Non-conformance of concrete	Compromised pile performance	Implement an agreed testing regime of concrete cubes and relay any non-conformances for checking at earliest opportunity
9	Risk of Cracking piles below pile cut off level during trimming	Compromised pile performance	Pile trimming to be undertaken carefully and de-bonding sleeves to be used. All piles should be subjected to integrity testing
10	Temporary exposed reinforcement from piles	Injury to site workers	Pile reinforcement to be terminated flush with piling platform level. Where reinforcement extends above piling platform level, these are to be clearly marked and mushroom caps will be required.

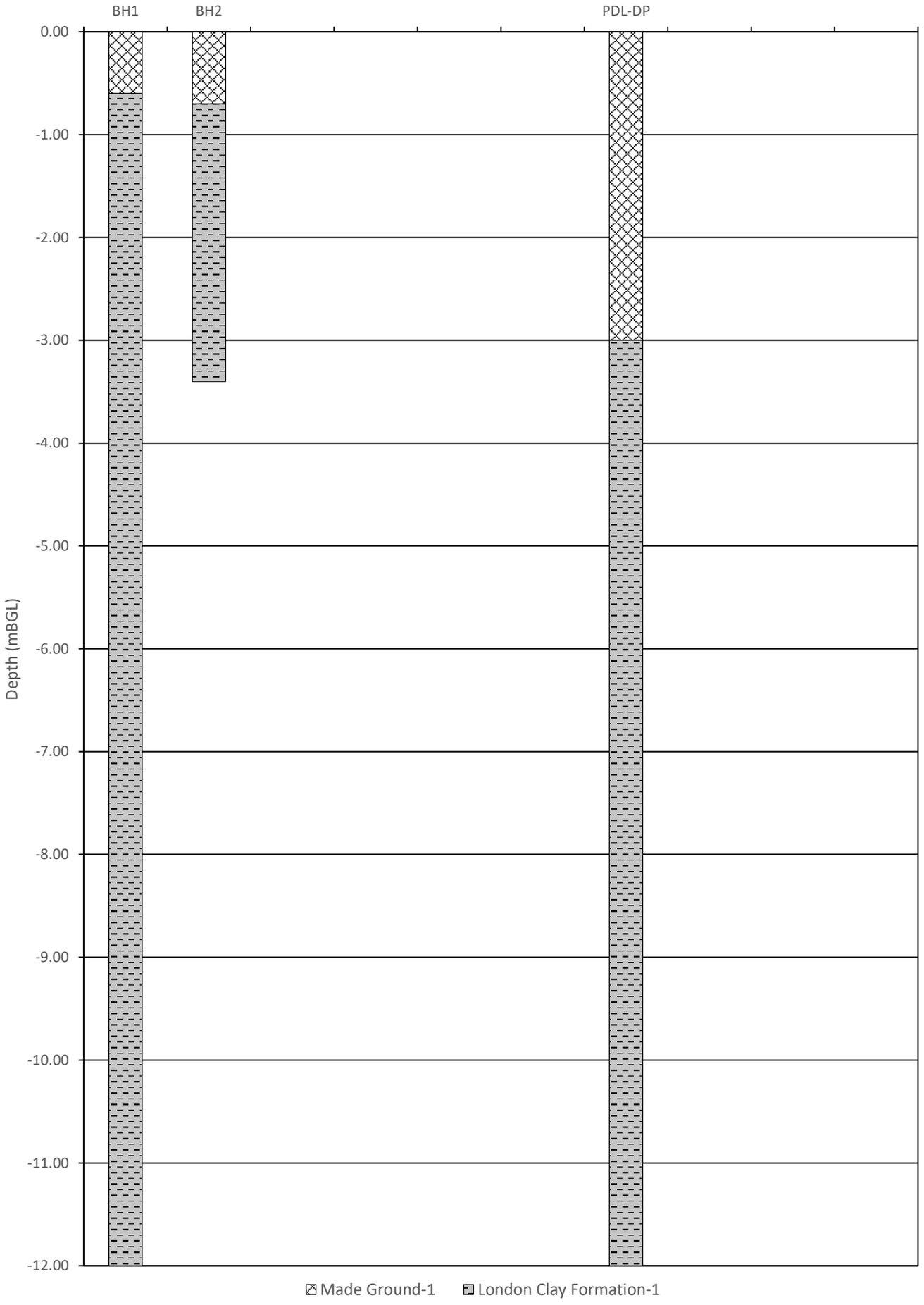
APPENDIX B

SOIL INFORMATION

PILEDESIGNS
GEOTECHNICAL EXPERTISE

Project Name: South Norwood - 53 Warminster Road **Date:** 28/01/2026
Project No. 28646 **Drawn by:** DG **Rev:** C0

Borehole Profile



APPENDIX C

OASYS PILE

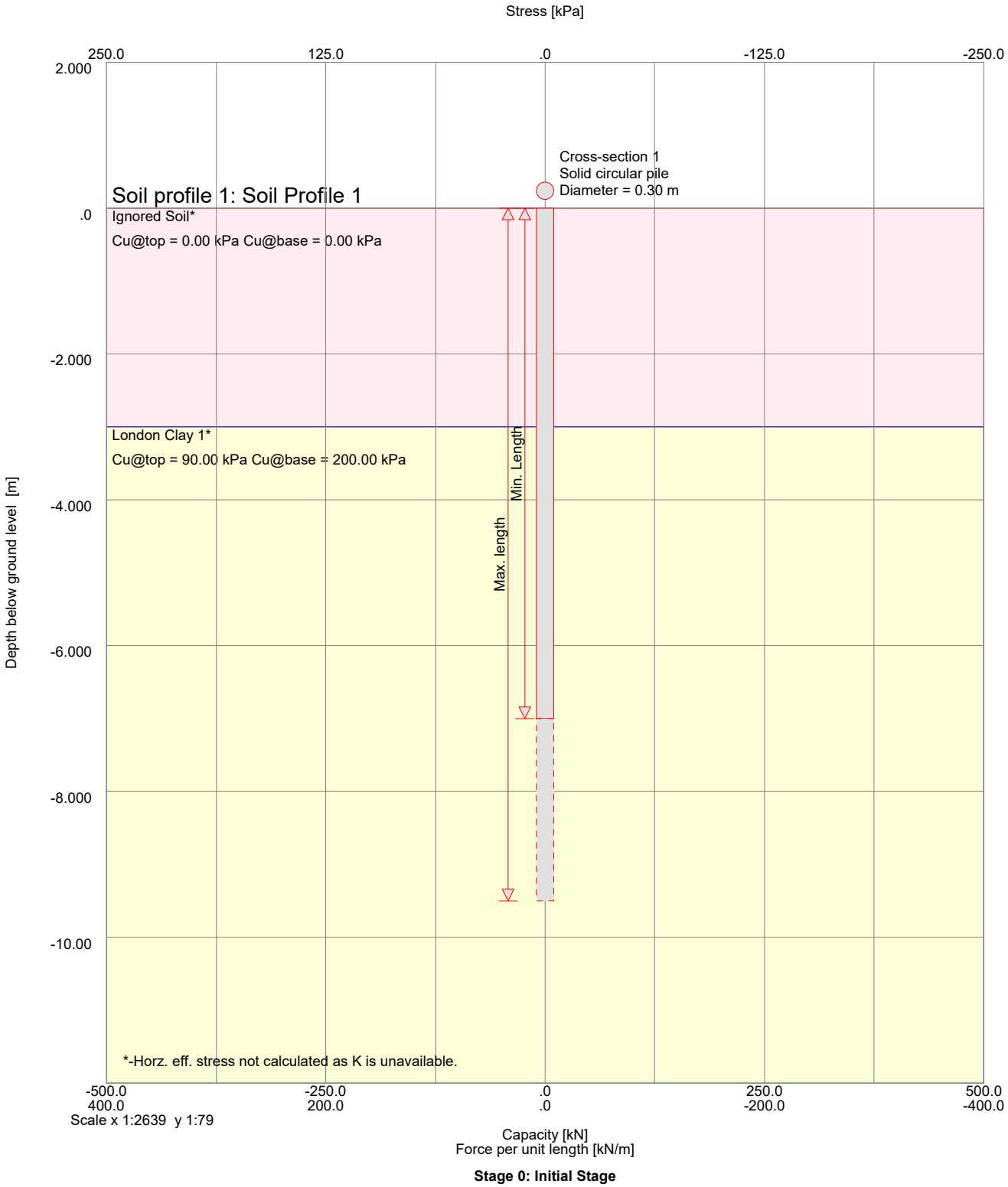
PILEDESIGNS
GEOTECHNICAL EXPERTISE

South Norwood - 53 Warminster Road
300mm diameter auger piles
EC7 (no testing required)

Job No.	Sheet No.	Rev.
28646		

Drg. Ref.

Made by	Date	Checked
DG		



Stage 0: Initial Stage

Analysis Options

Design approach:	DA1(C1 + C2)
Pile type:	CFA
Model factor:	1.40
Partial factor on negative skin friction - Set A1:	1.00
Partial factor on negative skin friction - Set A2:	1.00
Serviceability verified by load tests (preliminary/working) carried out on more than 1% of constructed piles to loads not less than 1.5 times the representative load for which they are designed?	No
Resistance verified by a maintained load test taken to the calculated, unfactored, ultimate resistance?	No
Is BS8004 SLS check enabled?	No
Datum type	Depth based
Effective stress profile	Calculated

Pile Properties

Pile type	Solid
Pile cross-section	Circular
Under-ream	No
Calculation profile	Range
Minimum pile length	7.0000 m
Maximum pile length	9.5000 m
Increment size	0.10000

Cross-section	Number of cross sections	Top Diameter [m]	Second Diameter location [m]	Second Diameter [m]	Third Diameter location [m]	Third Diameter [m]
Cross-section 1	1	0.30000				

Undrained Materials - General Data

No.	Material description	Bulk unit weight [kN/m³]	Cu material factor	Top Cu [kPa]	Base Cu [kPa]
1	Ignored Soil	18.000	NA	0.0	0.0
2	London Clay 1	20.000	NA	90.000	200.00
3	London Clay 2	20.000	NA	200.00	200.00

Undrained Materials - Skin Friction Data

No.	Material description	Skin friction computation	Alpha	q_s Top [kPa]	q_s Base [kPa]	$q_{s,lim}$ Spec.	$q_{s,lim}$ Value [kPa]
1	Ignored Soil	Alpha specified	0.0	NA	NA	No	NA
2	London Clay 1	Alpha specified	0.50000	NA	NA	No	NA
3	London Clay 2	Alpha specified	0.50000	NA	NA	No	NA

Undrained Materials - End Bearing Data

No.	Material description	End bearing computation	Nc	q_b Top [kPa]	q_b Base [kPa]	$q_{b,lim}$ Spec.	$q_{b,lim}$ Value [kPa]
1	Ignored Soil	Nc specified	0.0	NA	NA	No	NA
2	London Clay 1	Nc specified	9.0000	NA	NA	No	NA
3	London Clay 2	Nc specified	9.0000	NA	NA	No	NA

Undrained Materials - Material Factors (Code Based)

No.	Material description	Qs factors		Nc factors		Qb factors	
		M1	M2	M1	M2	M1	M2
1	Ignored Soil	N.A.	N.A.	1.0000	1.0000	N.A.	N.A.
2	London Clay 1	N.A.	N.A.	1.0000	1.0000	N.A.	N.A.
3	London Clay 2	N.A.	N.A.	1.0000	1.0000	N.A.	N.A.

Nq-Phi curve data

Curve 1 : Nq-Phi Curve 1

Nq	Phi' [deg]

STAGE SPECIFIC DATA

Stage 0 : Initial Stage

Groundwater

No.	Level [m]	Pressure [kPa]	Unit weight of water [kN/m³]
1	15.000	0.0	9.8100

Soil Profiles

Soil Profile 1: Soil Profile 1

No.	Depth [m]	Material description	Contributes to negative skin friction
1	0.0	Ignored Soil	No
2	3.0000	London Clay 1	No
3	15.000	London Clay 2	No

Soil Profile - Groundwater Map

No.	Soil Profile	Groundwater
1	Soil Profile 1	Groundwater Profile 1

Stage specific warnings

1 - Stage 0 - The bottom most layer in Soil Profile 1 is assigned "Total stress" material. For this layer the cohesion is assumed to be constant at "Cu-Top", i.e cohesion specified at the top of this layer. The user specified value of cohesion at the bottom of this layer, "Cu-Bottom" is ignored. (Material Properties)

CAPACITY RESULTS

Partial Resistance Factors Used:

DA1 C1

Shaft resistance factor for set R1 (Compression):	1.00
Base resistance factor for set R1:	1.00
Shaft resistance factor for set R1 (Tension):	1.00

DA1 C2

Shaft resistance factor for set R4 (Compression):	1.60
Base resistance factor for set R4:	2.00
Shaft resistance factor for set R4 (Tension):	2.00

No. Soil Profile Groundwater

Model factor: 1.40

Stress Profiles

Soil Profile 1: Soil Profile 1

Depth [m]	Density [kN/m³]	Undrained Cohesion [kPa]	Nq	Total vertical stress [kPa]	Porewater pressure [kPa]	Effective vertical stress [kPa]	Effective horizontal stress* [kPa]	Cumulative skin friction per unit perimeter [kN/m]
0.0	18.000	0.0	N.A.	0.0	0.0	0.0	NA	0.0
3.0000	18.000	0.0	N.A.	54.000	0.0	54.000	NA	0.0
3.0000	20.000	90.000	N.A.	54.000	0.0	54.000	NA	0.0
7.0000	20.000	126.67	N.A.	134.00	0.0	134.00	NA	216.67
7.1000	20.000	127.58	N.A.	136.00	0.0	136.00	NA	223.02
7.2000	20.000	128.50	N.A.	138.00	0.0	138.00	NA	229.43
7.3000	20.000	129.42	N.A.	140.00	0.0	140.00	NA	235.87
7.4000	20.000	130.33	N.A.	142.00	0.0	142.00	NA	242.37
7.5000	20.000	131.25	N.A.	144.00	0.0	144.00	NA	248.91
7.6000	20.000	132.17	N.A.	146.00	0.0	146.00	NA	255.49
7.7000	20.000	133.08	N.A.	148.00	0.0	148.00	NA	262.12
7.8000	20.000	134.00	N.A.	150.00	0.0	150.00	NA	268.80
7.9000	20.000	134.92	N.A.	152.00	0.0	152.00	NA	275.52
8.0000	20.000	135.83	N.A.	154.00	0.0	154.00	NA	282.29
8.1000	20.000	136.75	N.A.	156.00	0.0	156.00	NA	289.11
8.2000	20.000	137.67	N.A.	158.00	0.0	158.00	NA	295.97
8.3000	20.000	138.58	N.A.	160.00	0.0	160.00	NA	302.87
8.4000	20.000	139.50	N.A.	162.00	0.0	162.00	NA	309.82
8.5000	20.000	140.42	N.A.	164.00	0.0	164.00	NA	316.82
8.6000	20.000	141.33	N.A.	166.00	0.0	166.00	NA	323.87
8.7000	20.000	142.25	N.A.	168.00	0.0	168.00	NA	330.96
8.8000	20.000	143.17	N.A.	170.00	0.0	170.00	NA	338.09
8.9000	20.000	144.08	N.A.	172.00	0.0	172.00	NA	345.27
9.0000	20.000	145.00	N.A.	174.00	0.0	174.00	NA	352.50
9.1000	20.000	145.92	N.A.	176.00	0.0	176.00	NA	359.77
9.2000	20.000	146.83	N.A.	178.00	0.0	178.00	NA	367.09
9.3000	20.000	147.75	N.A.	180.00	0.0	180.00	NA	374.46
9.4000	20.000	148.67	N.A.	182.00	0.0	182.00	NA	381.87
9.5000	20.000	149.58	N.A.	184.00	0.0	184.00	NA	389.32

* Effective horizontal stress not calculated for "Total Stress" materials and for Beta Method.

Cross-section 1 results:

Uniform pile with top shaft diameter = 0.30 m

Results - Compression

Soil Profile 1: Soil Profile 1

Depth [m]	Pile length [m]	Ultimate base capacity (Q_b) [kN]	Cumulative external Friction (Q_s) [kN]	Negative skin friction (Q_{nsf}) [kN]	Net ultimate resistance [kN]
7.0000	7.0000	80.582	204.20	0.0	284.79
7.1000	7.1000	81.165	210.19	0.0	291.36
7.2000	7.2000	81.748	216.23	0.0	297.98
7.3000	7.3000	82.331	222.31	0.0	304.64
7.4000	7.4000	82.914	228.43	0.0	311.34
7.5000	7.5000	83.498	234.59	0.0	318.09
7.6000	7.6000	84.081	240.80	0.0	324.88
7.7000	7.7000	84.664	247.05	0.0	331.71
7.8000	7.8000	85.247	253.34	0.0	338.59
7.9000	7.9000	85.830	259.67	0.0	345.50
8.0000	8.0000	86.413	266.05	0.0	352.47
8.1000	8.1000	86.997	272.48	0.0	359.47
8.2000	8.2000	87.580	278.94	0.0	366.52
8.3000	8.3000	88.163	285.45	0.0	373.61
8.4000	8.4000	88.746	292.00	0.0	380.75

Depth	Pile length	Ultimate base capacity (Q_b)	Cumulative external Friction (Q_s)	Negative skin friction (Q_{nsf})	Net ultimate resistance
8.5000	8.5000	89.329	298.60	0.0	387.93
8.6000	8.6000	89.912	305.24	0.0	395.15
8.7000	8.7000	90.496	311.92	0.0	402.41
8.8000	8.8000	91.079	318.64	0.0	409.72
8.9000	8.9000	91.662	325.41	0.0	417.07
9.0000	9.0000	92.245	332.22	0.0	424.47
9.1000	9.1000	92.828	339.08	0.0	431.91
9.2000	9.2000	93.411	345.98	0.0	439.39
9.3000	9.3000	93.994	352.92	0.0	446.91
9.4000	9.4000	94.578	359.90	0.0	454.48
9.5000	9.5000	95.161	366.93	0.0	462.09

Depth	Pile length	Design resistance		Combination with least resistance #	Factored load*	
		DA1-C1	DA1-C2		DA1-C1	DA1-C2
[m]	[m]	[kN]	[kN]		[kN]	[kN]
7.0000	7.0000	203.42	119.94	2	0.0(C)	0.0(C)
7.1000	7.1000	208.11	122.82	2	0.0(C)	0.0(C)
7.2000	7.2000	212.84	125.73	2	0.0(C)	0.0(C)
7.3000	7.3000	217.60	128.65	2	0.0(C)	0.0(C)
7.4000	7.4000	222.39	131.59	2	0.0(C)	0.0(C)
7.5000	7.5000	227.20	134.55	2	0.0(C)	0.0(C)
7.6000	7.6000	232.05	137.53	2	0.0(C)	0.0(C)
7.7000	7.7000	236.94	140.53	2	0.0(C)	0.0(C)
7.8000	7.8000	241.85	143.54	2	0.0(C)	0.0(C)
7.9000	7.9000	246.79	146.58	2	0.0(C)	0.0(C)
8.0000	8.0000	251.76	149.64	2	0.0(C)	0.0(C)
8.1000	8.1000	256.77	152.71	2	0.0(C)	0.0(C)
8.2000	8.2000	261.80	155.81	2	0.0(C)	0.0(C)
8.3000	8.3000	266.87	158.92	2	0.0(C)	0.0(C)
8.4000	8.4000	271.96	162.05	2	0.0(C)	0.0(C)
8.5000	8.5000	277.09	165.21	2	0.0(C)	0.0(C)
8.6000	8.6000	282.25	168.38	2	0.0(C)	0.0(C)
8.7000	8.7000	287.44	171.57	2	0.0(C)	0.0(C)
8.8000	8.8000	292.66	174.78	2	0.0(C)	0.0(C)
8.9000	8.9000	297.91	178.01	2	0.0(C)	0.0(C)
9.0000	9.0000	303.19	181.26	2	0.0(C)	0.0(C)
9.1000	9.1000	308.50	184.53	2	0.0(C)	0.0(C)
9.2000	9.2000	313.85	187.81	2	0.0(C)	0.0(C)
9.3000	9.3000	319.22	191.12	2	0.0(C)	0.0(C)
9.4000	9.4000	324.63	194.45	2	0.0(C)	0.0(C)
9.5000	9.5000	330.06	197.79	2	0.0(C)	0.0(C)

Limiting criteria :
1 : DA1 C1
2 : DA1 C2
*(C)-> Compression load, (T)-> Tension load
Note: Design resistance does not include any consideration of negative skin friction.

Nq Calculation Details

Soil Profile 1: Soil Profile 1 - Material Factor Set - 1

There are no pile toe levels in any drained material(with Berezantzev/Bolton option) in the given soil profile.

Soil Profile 1: Soil Profile 1 - Material Factor Set - 2

There are no pile toe levels in any drained material(with Berezantzev/Bolton option) in the given soil profile.

END OF CALCULATIONS