

Pile Design



CHS Civils	Embassy Village, Salford	01/05/2024
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Introduction

Pile Type	168mm Cast In-Situ mini piles
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This design is generally in accordance with BS 8004: 2020 and BS EN 1997:2004 (E7). It consists of several parts, all of which must be considered together not in isolation.

1. Set Calculation using know hammer parameters.
2. Re-strike Set to verify that relaxation has not taken place.
3. Geotechnical Design.
3. Heave Design.
4. Independent Dynamic Load testing to verify the design.

Factor of Safety

In accordance with BS 8004 we propose a design factor of safety (fos) of 2.0 with dynamic load testing as an optional extra.

Higher factors are applicable for bored piles as there are more things that can go wrong and the design cannot be verified by re-strike testing.

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Soils

Summary of the Soil Conditions

GI ref 2230462

Depth m	Soil Type	Cohesion kN/m2	N value	Equivalent Skin Friction kN/m2	Equivalent Bearing kN/m2
0-1	fill				
1-2	fill				
2-3	fill			0	
3-4	clay		3	10.5	
4-5	clay		17	59.5	1190
5-6					
6-7					
7-8					
8-9					
9-10					
10-11					
Note:					

The boreholes are not deep enough to predict the pile lenghts.

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Geotechnical Design

SWL	150 kN
Ref drawings	

$$Q = Q_s + Q_b$$

$$Q_s = q_s \times A_s \times$$

$$Q_b = q_b \times A_b$$

Q = ultimate bearing capacity of a single pile kN

Qs = ultimate skin friction kN

Qb = ultimate end bearing kN

qs = skin friction kN/m²

qb = end bearing kN/m²

As = surface area of shaft m²

0.53 m²/m

D = depth of shaft m

Ab = area of base m²

0.022 m²

Depth m	qs	qb	Qs	Qb	Q
0-1					
1-2					
2-3	0		0		
3-4	10.5		7		7
4-5	59.5	1190	41	26	75
5-6					
6-7					
7-8					
8-9					
9-10					
10-11					

Design Factor of Safety	2	
Group Effect Reduction	1	
Maximum design load	300	kN
Design Depth	?	m

The boreholes are not deep enough to predict the pile lengths.
Safer to design to a set on re-strike.

Pile Set Calculation		
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Design for a pile installed by freefall drop weight hammer

The pile design and set is based on the following Formula, where:



$$\begin{aligned}
 Q \cdot (s+t/2) &= W \cdot h \cdot e \\
 s+t/2 &= (W \cdot h \cdot e) / Q \\
 s &= (W \cdot h \cdot e) / Q - t/2
 \end{aligned}$$

Ultimate load	:	Q (kN)	
Hammer drop	:	h (mm)	2000
Hammer weight	:	W (kN)	5.00
Efficiency	:	e (%)	0.5
Temporary set	:	t (mm)	10
Factor of safety	:	F.O.S.	2
Set in mm per blow	:	s	

S.W.L (kN)	Q	h	s (mm/blow)	Blows/100mm
150	300	2000	11.67	9
250	500	2000	5.00	20
275	550	2000	4.09	24
300	600	2000	3.33	30
325	650	2000	2.69	37
350	700	2000	2.14	47
375	750	2000	1.67	60
400	800	2000	1.25	80

The final driven depth of pile is dependant on the density of the underlying ground conditions combined with the set required.

Sets above 50 blows per 100mm are classified as refusal.

Pile Set Calculation					
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Lead has a mass of 11340kg/m ³					
Hammer weights:					
Kilogrammes	W (kN)	Kilogrammes	W (kN)	Kilogrammes	W (kN)
100	1.00	520	5.20	960	9.60
120	1.20	540	5.40	980	9.80
140	1.40	560	5.60	1000	10.00
160	1.60	580	5.80	1020	10.20
180	1.80	600	6.00	1040	10.40
200	2.00	620	6.20	1060	10.60
220	2.20	640	6.40	1080	10.80
240	2.40	660	6.60	1100	11.00
250	2.50	680	6.80	1120	11.20
280	2.80	700	7.00	1140	11.40
300	3.00	720	7.20	1160	11.60
320	3.20	740	7.40	1180	11.80
340	3.40	750	7.50	1200	12.00
360	3.60	780	7.80	1220	12.20
380	3.80	800	8.00	1240	12.40
400	4.00	820	8.20	1260	12.60
420	4.20	840	8.40	1280	12.80
440	4.40	860	8.60	1300	13.00
460	4.60	880	8.80	1320	13.20
480	4.80	900	9.00	1340	13.40
500	5.00	920	9.20	1360	13.60
520	5.20	940	9.40	1380	13.80

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Heave Design

$Q = Q_{sh} - Q_s$

Q = ultimate net heave kN
 Q_s = ultimate skin friction kN
 Q_{sh} = ultimate heave kN
 q_s = skin friction kN/m²
 A_s = surface area of shaft m²
 D = depth of shaft m

0.8 m²/m

Depth m	q_s	Q_s	Q_{sh}	Q
0-1				
1-2				
2-3				
3-4				
4-5				
5-6				

No evidence of rootlets and sandy fill therefore not designed for heave.

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Testing and Conclusion

Design Depths

Piles expected to reach a set at 5-8m. No heave.

Test Results

Not requested.