Design Calculations			
Title:	Loadbearing Pile Design		
Job:	HOXTON HOTEL SITE AT 203 HIGH HOLBORN LONDON WC1V 7BD		
Client:	Garenne Interiors		
Date:	27/04/18	Revision:	005
Calc's By	SCU , LP		

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HOXTON HOTEL EXTENSION 203 HIGH HOLBORN PILE LOADS AND LENGTHS

Introduction

The development at this site will be supported by a piled foundation made up by 64 CFA piles of various lengths and diameter of 300mm and 450mm
This report gives the calculations for these piles.

Ground conditions

Campbell Reith Consulting Engineers appointed Dunelm Geotechnical and Environmental to put down one shell and auger borehole to depth of 40m.
The soil layers encountered in this borehole may be summarized as follows
GL-4.10m Made Ground
4.1-5.0m Dense to very dense GRAVEL
5.0-27m Stiff to very stiff/hard CLAY
No groundwater was encountered in this borehole.
Standard Penetration Tests (SPTs) were carried out at regular intervals which indicated that the CLAY increased in strength linearly with depth at a rate of 8kN/m^2 per m starting at 75kN/m2 at 5.0m. This increase can be expressed by the equation c=75+8z where z is measured downwards from a depth of 5.0m

Pile type

CFA bored piles 300mm and 450mm in diameter will be used.

Method of calculation

The calculations that follow are based on Eurocode 7. This method requires the unfactored dead and live loads acting on each pile to be factored upwards and the strength of the soil to be factored downwards . In both cases the partial factors f used are specified in the code and are as follows
Dead load on piles f=1
Live load on piles f=1.3
Skin friction on piles f=1.6
End bearing on piles f=2.0
Model factor for total of skin friction and end bearing f=1.4
The skin friction and end bearing is estimated using standard theory as laid down in textbooks and British codes of practice.

Proposed Construction procedure

All piles will be constructed from existing ground level. After completion of this stage the top 2.5m of soil will be excavated and each pile cut down to the desired level. This means that the top 2.5m of each pile from cut off level will be surrounded by either Made Ground or natural sand/gravel. The skin friction in this top 2.5m will be ignored so that all the skin friction on the piles is derived only by the underlying London Clay and the clays of the Lambeth group. The proposed pile length of each of the 64 piles are shown in the attached tables which will be used on site after a final check.

<u>Sample calculation</u>

Pile length 21m Pile diameter 450mm

Skin frictionGL-5.0m =0 (excavated soil made ground and sand/gravel)

Cohesion at 5.0m=75kN/m2

Cohesion at 21m=203 kN/m2

Average cohesion=139kN/m2

Skin friction 5.0-20m = (3.14 x 0.45 x 16) x (139) x O.5= 1571kN

End bearing = base area x factor x cohesion at base =0.159 x 9 x 203= 290kN

Factored skin friction=1571/1.6=982

Factored end bearing =290/2=145

Total resistance=982+145=1127kN

Factored resistance=966/1.4 =805kN

Tables for the required length of each pile (measured from existing ground level) is given below for guidance purposes only and subject to review and recheck before being presented to the operators on site.

Pile No	1	2	3	4	5	6	7	8
Gk kN	475	475	475	800	800	800	800	800
Qk kN	165	165	165	350	350	350	310	310
Design Load kN	689	689	689	1255	1255	1255	1203	1203
Pile dia mm (all 450mm)								
Pile length m	19.5	19.5	19.5	27	27	27	26.5	26.5

Pile No	16	17	18	19	20	21	22	23
Gk kN	375/-275	800	375/-275	100/-50	100/-50	1000	1000	1000
Qk kN	125	310	125	75	75	200	230	230
Design load kN	536	1203	537	197	197	1260	1299	1299
Pile dia mm (all 450mm)								
Pile length m	17	26.5	17	10	10	27	27.5	27.5

Pile No	24	25	26	27	28	29	30	31	32	33	34
Gk kN	1000	1000	1000	325	325	325	325	325	326	325	325
Qk kN	230	230	230	175	175	175	175	175	175	175	175
Design Load kN	1299	1299	1299	552	552	552	552	552	552	552	552
Pile dia mm (all 450mm)											
Pile length m	27.5	27.5	27.5	17	17	17	17	17	17	17	17

Pile No	35	36	37	38	39	40	41	42	43
Gk kN	325	325	425	425	425	675/-100	675/-100	675/-100	675/-100
Qk kN	175	175	130	130	130	140	140	140	140
Design Load kN	552	552	594	594	594	856	856	856	856
Pile dia mm	(all 450mm)								
Pile length m	17	17	18	18	18	22	22	22	22

Pile No	44	45	46	47	48	49	50	51	52	53
Gk kN	675/-100	675/-100	675/-100	275	275	275	200	200	150	150
Qk kN	140	140	140	115	115	115	90	90	65	65
Design Load kN	857	857	857	419	419	419	317	317	234	234
Pile dia mm	450	450	450	300	300	300	300	300	300	300
Pile length m	15,5	15.5	15.5	19	19	19	19	19	19	19

Pile No	5 4	55	56	57	58	59	60	61	62	63	64
Gk kN	125	125	125	125	150	150	225	225	300	300	350
Qk kN	65	65	65	65	65	65	90	90	115	115	115
Design Load kN	209	209	209	209	234	234	303	303	449	449	449
Pile dia mm	(all 300mm)										
Pile length m	13	13	13	13	14	14	17	17	21	21	21

Axial stress on piles

For 300mm dia piles the maximum applied load is 375kN and the cross sectional area is 0.07m^2 which results in a axial stress of 5357kN/m^2 or 5.3N/mm^2.
For 450mm dia piles the maximum applied load is 1200kN and the cross sectional area is 0.159 m^2 resulting in an axial stress of 7547kN/m^2 or 7.54N/mm^2

The concrete used in the piles will have a compressive strength of at least $32N/mm^2$

Horizontal stress on piles

Wind loads on some of the piles could be as much as 50kN

This load will induce a bending moment in the pile and the position and magnitude of this bending moment is difficult to quantify as most of the piles will be restrained at the top by RC slabs and beams and the coefficient of subgrade reaction in the soil near the top of the pile is unknown. It is proposed to reinforce the top of each pile by a 6m long steel reinforcement cage made up with 6H16 bars.

This reinforcement will be adequate to cater for a maximum bending moment of 50kNm in a 300mm dia pile and 75kNm in a 450mm dia pile.

Piles subject to tension

All piles subject to tension will have a single 1H32 bar in the top 11m as the skin friction in the top 11m of all piles will be greater than the tension load.

Piles in the semi contiguous piles

See separate design

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