ABBEY PYNFORD

DESIGN CALCULATION SHEET

Project	Designed	JO	Date	Dec 2014	Project No:	GA19787
69 REDINGTON ROAD, LONDON, NW3 7RP	Checked	MJ	Date	Dec 2014	Sheet No.	CALC/01

STRUCTURAL ENGINEERING CALCULATIONS

OF

A RETROFIT BASEMET.

69 REDINGTON RD,

LONDON

NW3 7RP

ISSUE 1. 9th DEC 2014

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69 REDINGTON ROAD, LONDON, NW3 7RP	Checked	MJ	Date	Dec 2014	Sheet No.	CALC/02

CONTENTS

1. INTRODUCTION

Abbey Pynford has been commissioned to Design and Construct a new retrofit basement structure beneath the existing detached property at 69 Redington Road, NW3 7RP.

Drawings of the retrofit basement project by SHAKIB, revision dated on 4/11/2014, are showed in appendix A.

Abbey Pynford proposes a "Top-down" method of construction, generally as identified on General Arrangement drawings contained within Appendix B and explained in section 7.

I this report it is considered and studied the complete structural box in two construction stages; Temporary and Permanent scenarios. So this document covers the Abbey Pynford load take down, details of the anticipated ground conditions, ground design profile, and design and calculation of structural elements procedures.

Other reports by Abbey Pynford regarding Structural Calculations are:
- Line of Underpinning for the new basement at the back of the property. 26th Dec 2014
- Contiguous Bored Pile Wall and Bearing Piles. 21st Oct 2014
- Line of Underpinning for the new space at Existing Lower Ground Floor Level. In due course.

The loading assumption considered for the calculations in this report responds the unit loadings and load take down showing in section 3.

2. CODES AND STANDARDS

The standards listed below give the indications to follow in order to treat and cover all the scenarios that affect the structure, its behaviour and safety in use; All the issues are related to loading, combinations of loading, statics, overall and local equilibrium, and the basis of technical design supported in the general theory of elasticity and resistance of materials.

* BS 8002 "Earth retaining structures"
* BS 8004 "Foundations"
* BS 8110 - 1:1997 "Structural use of concrete"
* BS 8500 - 1:2006 "Concrete - complementary BS to BS EN 206-1"
* BS 4449:2005 + A2:2009 "Steel for the reinforcement of concrete"
* BS 5950 - 1:2000 "Structural use of steelwork in building"
* BS9399 "Loading for buildings"
* BS 648 "Schedule of Weights of building materials"

3. MATERIAL SPECIFICATIONS

Foundation and Transfer Slabs : RC35
Columns and Liner Walls : RC35
Underpins : RC35
Reinforcement Steel : f_y = 500MPa

4. UNIT LOADINGS AND LOAD TAKE DOWN (γ_f = 1.0)

Abbey Pynford has considered the superstructure loadings in order to undertake our own load take down, which is shown as a summary (Total Loads) on Calculation Sheet CALC/06 (in the FE model, DL and LL are separated loads as can be seen in appendices D and E). Some modification in internal bearing walls for the permanent conditions will take place, so at that stage in the model, the loading from the FAIRHURST Consulting Engineers are also considered, refer to Calculation Sheet CALC/07.

These loadings have then been applied at the top of the underpin line. All loads given are non-factored.

SUPERSTRUCTURE

Roof Loading (45° Pitch)

a) Dead Load (LC 4)

Tiles	=	0.75 kN/m²	
Felt / Insulation / Battens	=	0.10 kN/m²	
Trussed Rafters	=	0.15 kN/m²	
	Total	1.00 kN/m²	
Allowing for 45° roof pitch = 1.00/cos45 =		1.41 kN/m2	
Insulation	=	0.04 kN/m2	
Ceiling Joists	=	0.10 kN/m2	
P.board & Skim	=	0.15 kN/m2	
			DL = 1.7 kN/m²

b) Live Load (LC 5)

Roof allowance	=	0.60 kN/m²	
Services Allowance	=	0.15 kN/m²	**LL = 0.75 kN/m²**

Note : assume the same for flat roof areas.

Ground Floor, 1st and 2nd Floor Loadings (Domestic)

c) Dead Load (LC4)

Floor Boards	=	0.15 kN/m²	
Floor Joists	=	0.50 kN/m²	
P.board & Skim	=	0.15 kN/m²	
Partition Allowance	=	1.2 kN/m²	**DL = 2.0 kN/m²**

d) Live Load (LC 5)

Domestic Allowance	=	1.50 kN/m²	**LL = 1.5 kN/m²**

Note : assume the same total loads for roof terrace at 1st floor.

SUBSTRUCTURE

Lower Ground Floor Loading (Residential)

Note : existing LGF floor is to be demolish prior to installation of underpins. Self-weight of new structural elements are considered in Load Case 1 of the FE Analysis.

e) Dead Load (Load Case 8)

75mm Screed	=	1.80 kN/m²	
Finishes	=	0.50 kN/m²	
			DL = 2.3 kN/m²

f) Live Load (LC 6)

Domestic allowance	=	2.50 kN/m²	**LL = 2.5 kN/m²**

Lower Ground Floor Loading (Exterior)

g) Dead Load (LC 8)

75mm Screed	=	1.80 kN/m²	
Finishes	=	1.20 kN/m²	
			DL = 3 kN/m²

h) Live Load (LC 7)

Terrace allowance	=	2.50 kN/m²	**LL = 2.5 kN/m²**

Basement levels

i) Dead Load (LC 8)

100mm Screed/Sacrificial concrete	=	2.30 kN/m²	
Finishes	=	1.00 kN/m²	
			DL = 3.3 kN/m²
Allowance for walkway/slab around the pool			**DL = 2.5 kN/m²**

j) Live Load

Imposed (LC 9)	=	2.5 kN/m²	**LL = 2.5 kN/m²**
Plant room (LC 10)	=	7.0 kN/m²	**LL = 7.0 kN/m²**

k) Uplift force / Water pressure (LC 11) = 40 kN/m² (max) **LL = 40.0 kN/m²**

l) Weight of Water (swimming pool) (LC 2) = 22 kN/m² **LL = 22.0 kN/m²**

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Project	Designed	Date	Project No:
69 REDINGTON ROAD, LONDON, NW3 7RP	**JO**	**Dec 2014**	**GA19787**
	Checked **MJ**	Date **Dec 2014**	Sheet No. **CALC/06**

EXISTING BRICKKORK WALLS

m) Solid external walls (LC 3)

440 mm	**DL = 9.2 kN/m²**
343 mm	**DL = 7.2 kN/m²**

n) Solid Internal bearing walls (LC3)

298 mm	**DL = 6.2 kN/m²**
228 mm	**DL = 4.8 kN/m²**
150 mm	**DL = 3.2 kN/m²**

ABBEY PYNFORD

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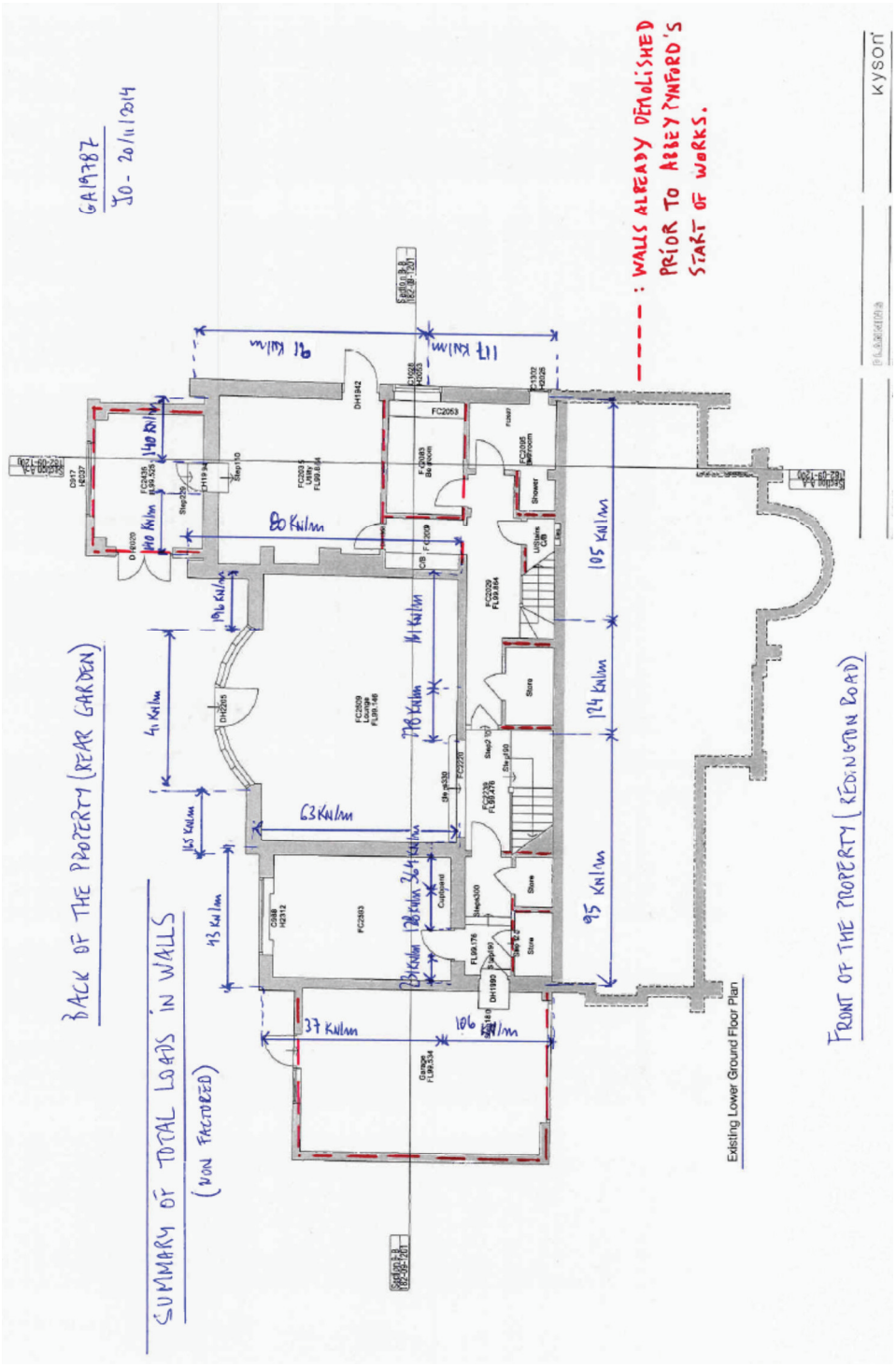
Project	Designed	JO	Date	Dec 2014	Project No:	GA19787
69 REDINGTON ROAD, LONDON, NW3 7RP	Checked	MJ	Date	Dec 2014	Sheet No.	CALC/07

Abbey Pynford's Load Take Down summary Sketch.

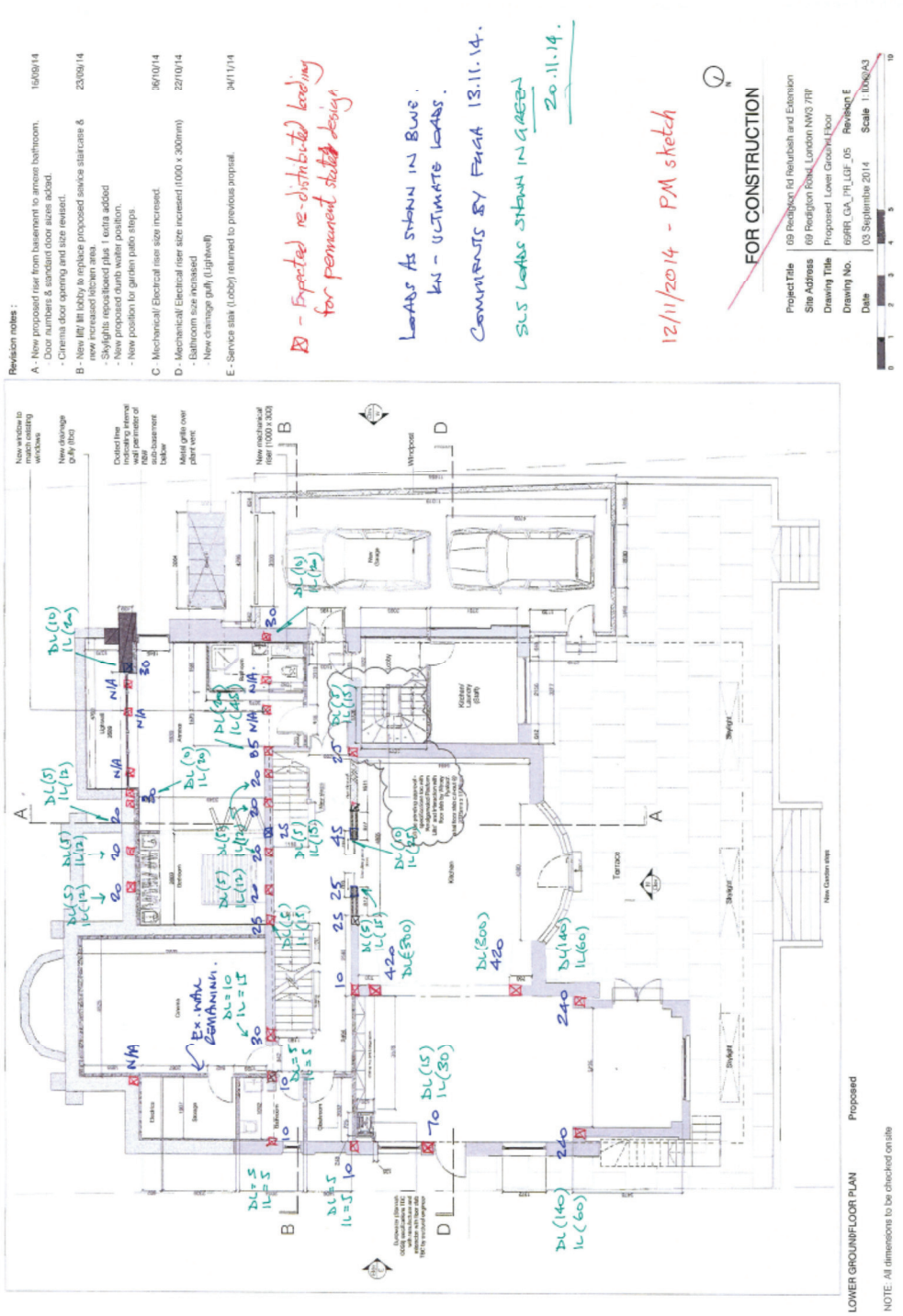


ABBEY PYNFORD

DESIGN CALCULATION SHEET

Project	Designed	JO	Date	Dec 2014	Project No:	GA19787
69 REDINGTON ROAD, LONDON, NW3 7RP	Checked	MJ	Date	Dec 2014	Sheet No.	CALC/08

Loads from FAIRHURST Consulting Engineers after alterations in original bearing Walls.



5. SOIL PROFILE AND CHARACTERISTICS

The ground investigation report that has been used was undertaken by "Chelmer site Investigations", ref FACT/4310, dated on March 2014.

The ground investigation comprised the drilling of three boreholes, two of them 8 m deep and the other one 15 m deep. In appendix C it is presented the whole SI report with results of tests and programmed laboratory analysis.

The stratigraphy is defined as follows :

Concrete paving slab or Top Soil with occasional gravel and brick fragments. Approx. 0.2 m deep.

Orange-brown, sandy, very silty CLAY becoming firm, stiff and very stiff in depth. To level 93m.

Very stiff, grey, silty, very sandy CLAY. To level 92 m.

Medium/dense, fine to medium SAND. To level 91 m.

Then, Stiff to very stiff, dark grey, silty, very sandy CLAY to depth.

Groundwater “standing” at 94m
Groundwater “strike” at 91.5 m

The results of the PH test and chemical analysis indicate that the underlying soils are alkaline and with very low sulphate content, corresponding to DS-1 (design Sulfate Class) for Clays.

The Soil Parameters taken into consideration are :

CLAY (UNDRAINED) :

BULK DENSITY	=	20 kN/m³
SOIL TYPE	=	Cohesive Undrained
UNDRAINED SHEAR STRENGTH (C_u)	=	65+6.7z

Medium/Dense SAND (layer 1 m thick) :

BULK DENSITY	=	20 kN/m³
SOIL TYPE	=	Granular
ANGLE OF FRICTION (φ')	=	30 °

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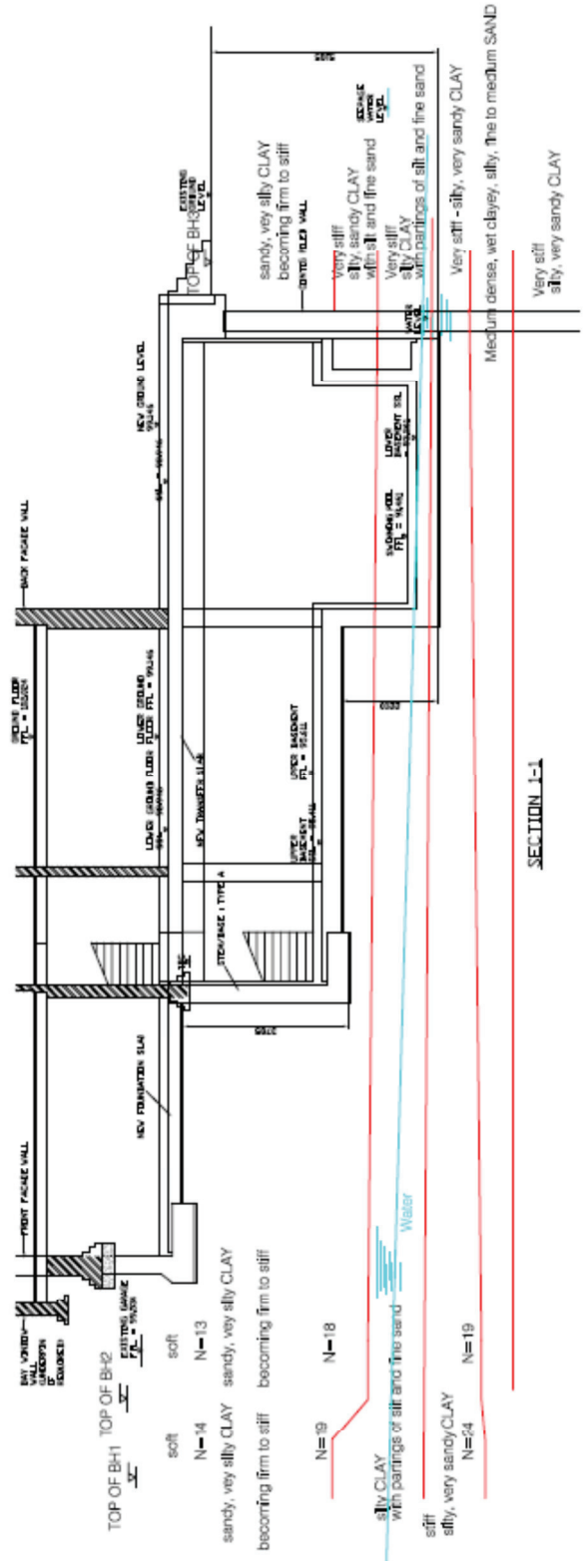
DESIGN CALCULATION SHEET

Project	Designed	JO	Date	Dec 2014	Project No:	GA19787
69 REDINGTON ROAD, LONDON, NW3 7RP	Checked	MJ	Date	Dec 2014	Sheet No.	CALC/10

The drawing below gives a reference of the levels in line with section 1-1 of GA's and site datum:

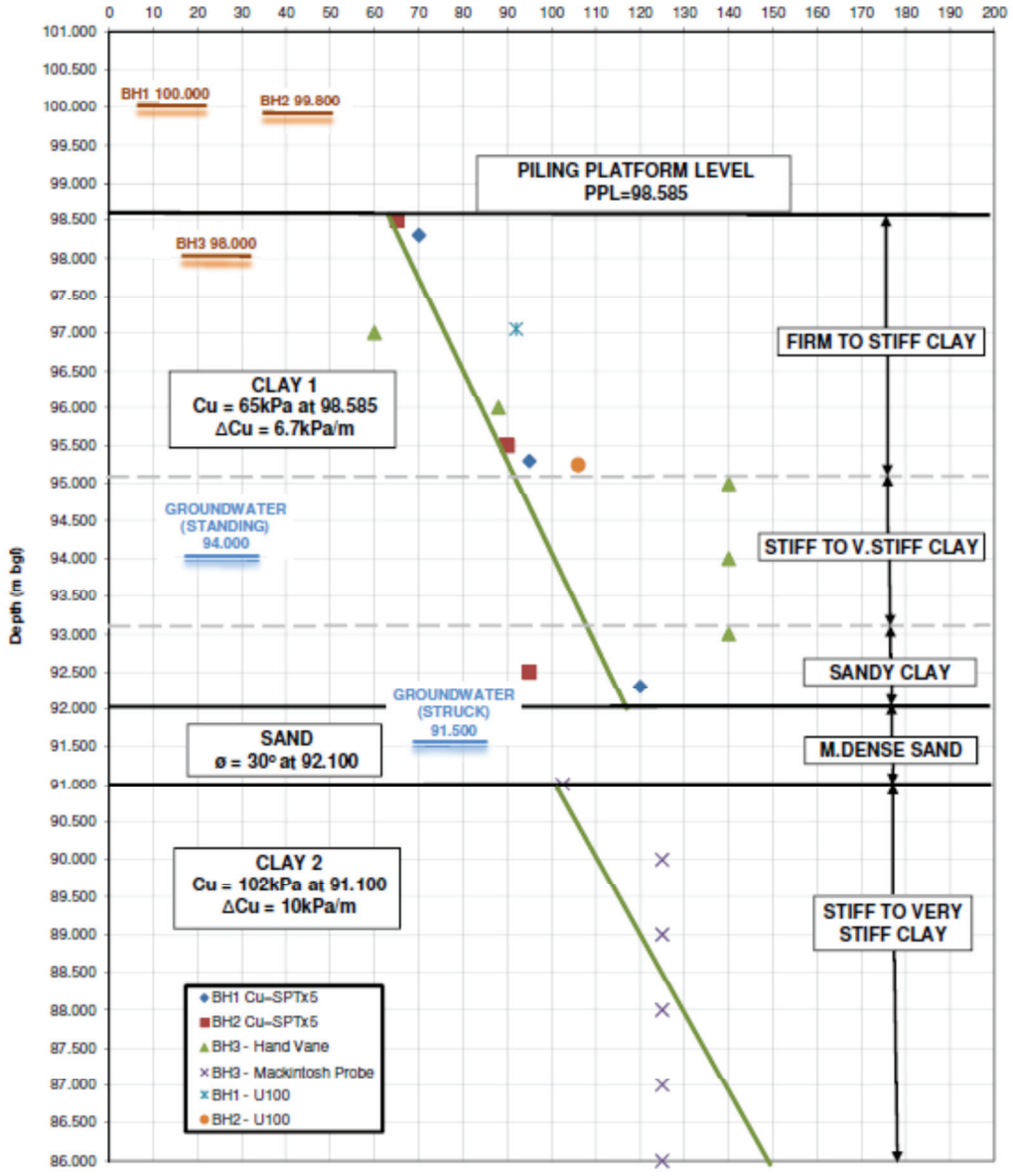


ABBEY PYNFORD

DESIGN CALCULATION SHEET

Project	Designed	JO	Date	Dec 2014	Project No:	GA19787
69 REDINGTON ROAD, LONDON, NW3 7RP	Checked	MJ	Date	Dec 2014	Sheet No.	CALC/11

Soil Profile:



6. SOFTWARE , SPREADSHEETS AND CALCULATIONS

To support calculations and approaches on designing and modelling structural elements, the following software have been used:

* Spreadsheets of "The Concrete Centre"

* DC-Bearing of "DC-software Doster&Christman GmbH, D-80997 Muenchen, Germany"

The software permits to assess the ultimate capacity of the soil at formation level taking into account the real geometry and dimensions of the footings (temporary and permanent).

* 3D Finite Element (FE) program by SOFiSTiK (further information can be found at www.sofistik.com).

The program has the following features which will be used within the Abbey Pynford designs :

· Selection of design code (BS 8110 on this project).
· Loadings drawn in the AutoCAD environment and read by the FE Software.
· Automatic meshing of the structure to form a finite element mesh with editing facility.
· Automatic pattern loading facility to ensure worst case forces are obtained.
· Calculation of moment and shear forces at corners of mesh elements.
· Calculation of principal forces (shear, moment, torsion) within beam elements.
· Derivation of principal forces within slab elements
· Resolution of principal slab forces into reinforcement directions.
· Calculation of contours of slab reinforcement required in each face in each direction (mm^2/m)
· Calculation of support forces and deflections.

7. STAGED CONSTRUCTION OF BASEMENT.

The proposed basement extension to the rear of the property shall be formed on three sides of reinforced concrete retaining walls spanning top to bottom and propped by the new lower ground floor level and basement reinforced concrete slabs. The fourth side is open and give access to the pool area, the existing rear façade is to be retained and shall be supported in the permanent condition upon the new ground floor transfer Slab structure on RC columns, walls and a contiguous pile wall (refer to Appendix B, Abbey Pynford General Arrangement Drawings). In temporary conditions the Transfer Slab will rest on Temporary Piles and Vertical Props.

In order to undertake the basement extension into the rear garden, retaining works are required in the form of a contiguous bored pile wall.

In order to minimise the risk to the adjoining structures as well as health and safety of those working on site associated with lateral propping techniques: the following top down methodology is intended to minimise the requirement for temporary propping works through installation of the permanent structures as early as possible for use in the temporary condition.

The sequence of works described below is also the base for the configuration of the staged construction modelling of the structure.

Stage 1: General excavation and underpinning works. Backfill holes of underpins type C (phase 1).

Stage 2: Installation of permanent retaining and temporary support piles at level 98.585. Both types of piles are to be installed in the rear garden within the footprint of the proposed basement. These piles shall be designed to support the existing rear façade structure during excavation of the basement until such time as the permanent supporting structure is installed. These piles shall be installed by way of a temporary case and auger open bore method. This methodology minimises vibration and allows piles to be formed through the London Clay substrata and the 1 meter thick layer of sands and gravels.

Stage 3: Construction of temporary pads digging holes to upper basement level. The pads will be connected with the foundation slab in stage 7. On these pads, columns C1, C2 and C3 will be constructed and vertical temporary props will be installed.

Stage 4: Installation of sacrificial stools on temporary pads and stems at lower ground floor level. These will permit to pick up the load of bearing internal and façade walls during the construction of the RC transfer structure.

Stage 5: Construction of the new lower ground floor transfer slab connected to stems, contiguous wall piles, permanent columns(1, 2 and 3) and temporary piles.

Stage 6: Excavation to 94.961. Except at the area of underpins type C, where a berm has to be allowed.

Stage 7: Construction of the foundation slab at upper basement level.

Stage 8: Install temporary horizontal props in underpins type C in a hit&miss approach.

Stage 9: Installation of new vertical props and relocation of existing ones in the line near the basement step. The aim is to spread the load from the façade as much as possible on the foundation slab prior the excavation to the lower basement level (pool area).

Stage 10: General excavation to 92.811 (lower basement level). Except at the area of underpins type C, where a hit&miss procedure will be undertaken to complete the retaining basement wall (phase 2).

> Note: Ground conditions and ground-water level will finally determine if a hit&miss procedure is required for the excavation and construction of the lower basement.

Stage 11: Construct foundation slab at lower basement level (pool area)

Stage 12: Construct step/wall between basement slabs.

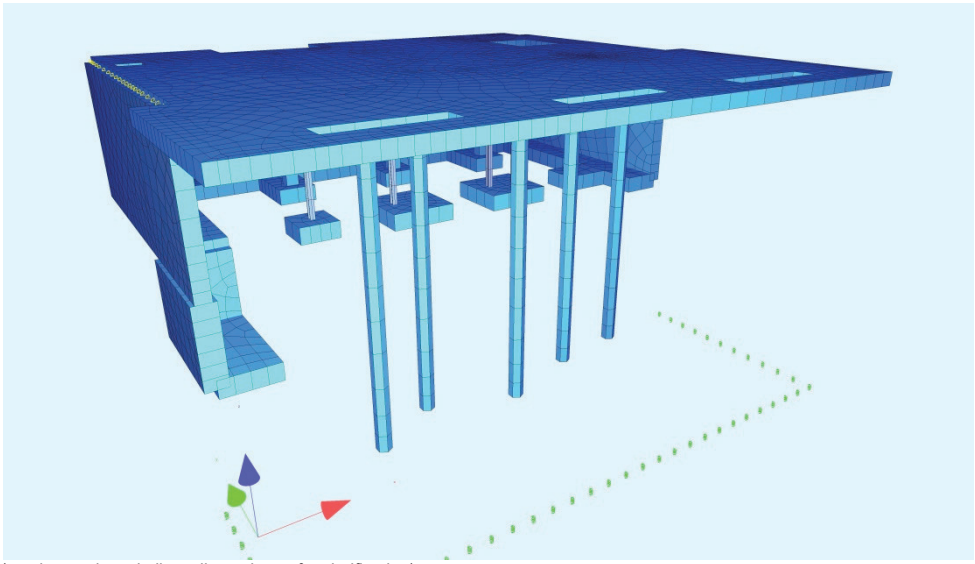
Stage 13: Construct Permanent Columns C4, C5 and C6.

Stage 14: Build up RC lining Walls.

Stage 15: Following sufficient curing of all permanent structural elements, the temporary support piles and props shall be removed and the structure made good as required.

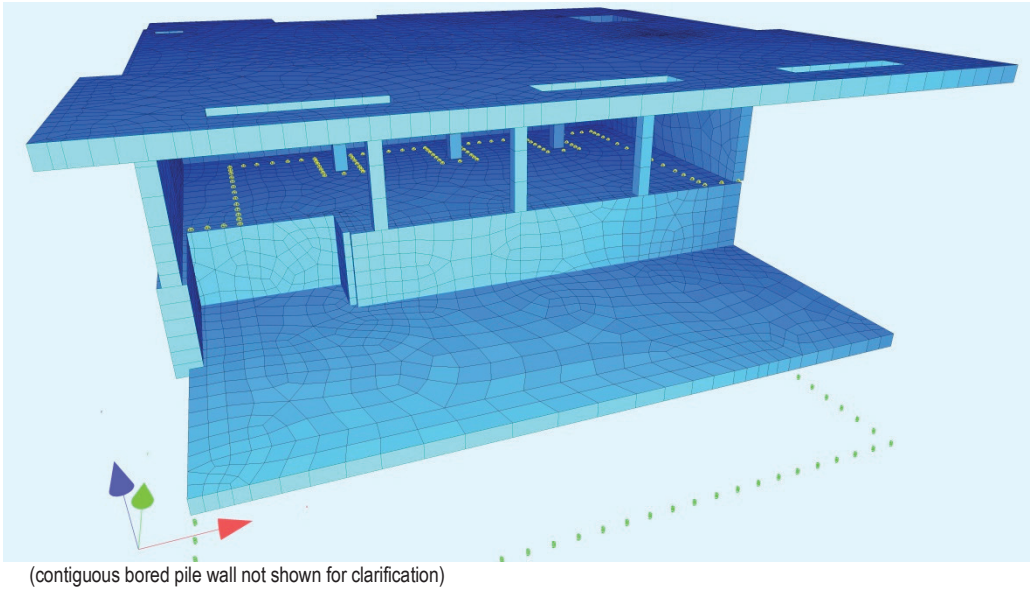
In the models presented in this report:

The Temporary Stage analyses the structural "box" when the new LGF transfer slab, underpins, columns C1, C2 and C3 on temporary pads, temporary props on pads and temporary piles are already built and the excavation reaches the formation level at upper basement. Up to Stage 6 of the previous description.



(contiguous bored pile wall not shown for clarification)

The Permanent Stage analyses the structure with all the elements, stage 15 of the previous description. Two types of loading have been assessed, one with the existing internal walls and one with the redistribution of load after alterations. The worst case has been taken into account for the arrangement of reinforcement and assessment of serviceability states.



(contiguous bored pile wall not shown for clarification)

APPENDIX A – *Drawings of the Retrofit Basement Project*