



**STRUCTURAL ENGINEERING REPORT
METHOD STATEMENT
FOR SUBTERANIAN DEVELOPMENT**

**36 Reddington Road
London N4 2ED**

May 2015

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Construction Method Statement for Proposed Subterranean Development Planning Report

ZUSSMAN BEAR PARTNERSHIP
APRIL 2015

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1.00 Introduction & Location

- 1.1 At Present 36 Reddington Road is a two storey self-contained semi-detached house with a single storey extension and garage to the side. A planning application is being lodged to demolish the existing building and construct a larger house with a single storey basement. The building is surrounded on all three sides by other properties with number 38 Reddington Road on the left, which already has been redeveloped including a double basement construction.



2.0 Structural Description

- 2.1 The existing building, photographed below is number 36 Reddington Road which is a traditional loadbearing brickwork and timber floor construction. This building will be demolished to allow for the construction of the new house.





2.2 The new house will be constructed as a steel frame with external brick cladding. The lower ground floor construction is as follows;

- Contiguous bored piles.
- Capping beam.
- RC retaining wall.
- Bearing piles supporting slab, lift shaft & steel columns.
- Suspended pile raft slab over compressible material.

2.3 The ground floor construction is as follows;

- Steel frame.
- Precast floor planks spanning between steel frame
- Internal non loadbearing walls.
- Framed lift shaft.

2.4 The first floor construction is as follows;

- Steel frame.
- Precast floor planks spanning between steel frame
- Internal non loadbearing walls.
- Framed lift shaft.

2.5 The loft floor construction is as follows;

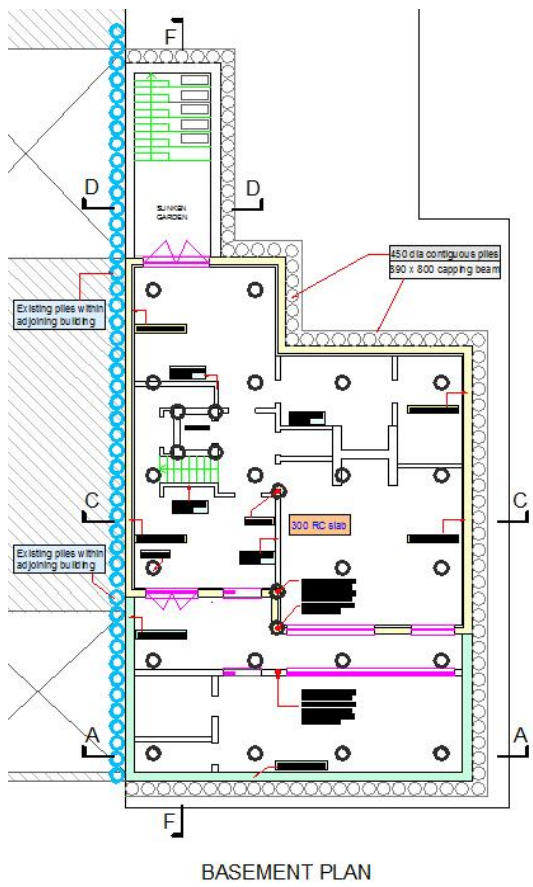
- Steel frame.
- Precast floor planks spanning between steel frame
- Internal loadbearing stud walls.
- Framed lift shaft.

2.6 The roof construction is as follows;

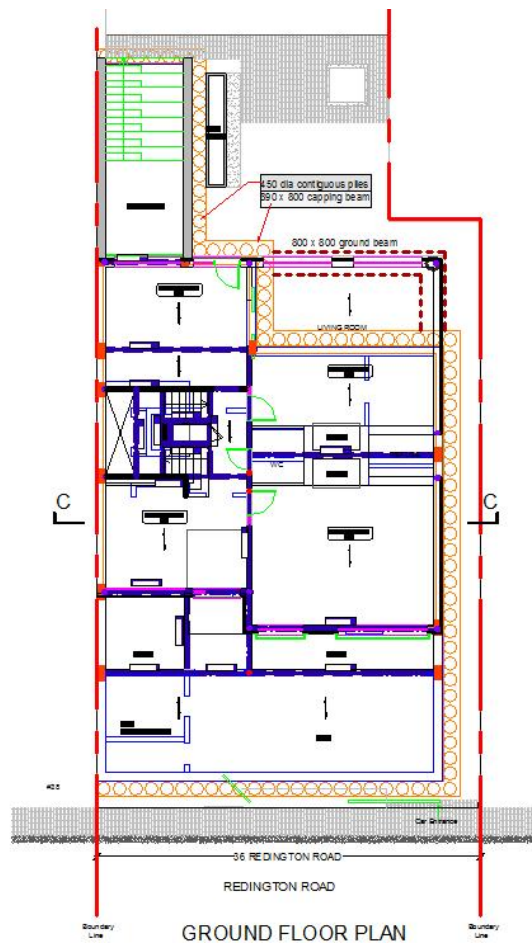
- Timber rafters.
- Loadbearing stud walls supporting rafters and purlins.
- Bracing and ply for stiffness

3.0 Proposed drawings

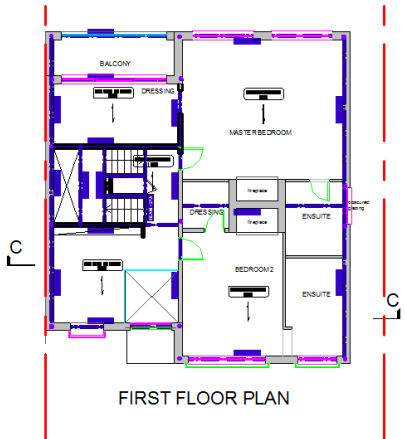
Proposed Floor Plans



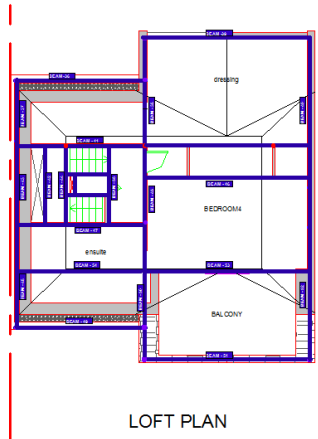
BASEMENT PLAN



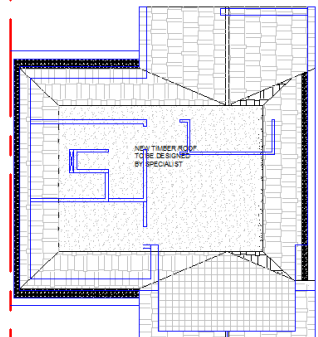
GROUND FLOOR PLAN



FIRST FLOOR PLAN



LOFT PLAN

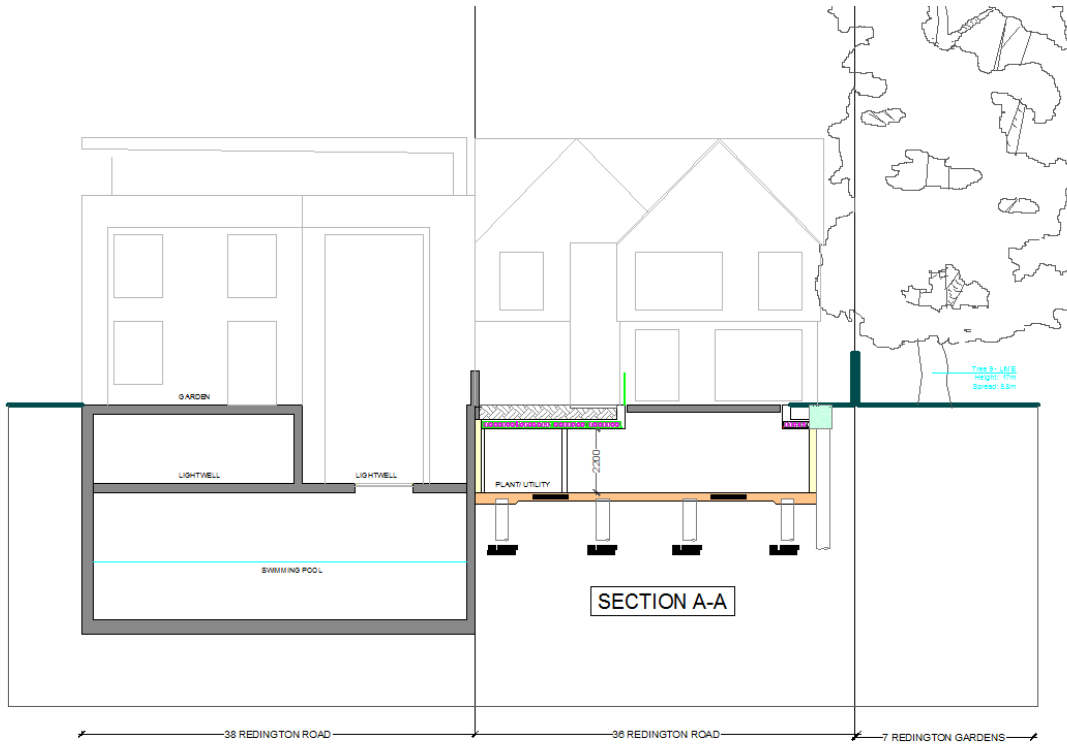


ROOF PLAN

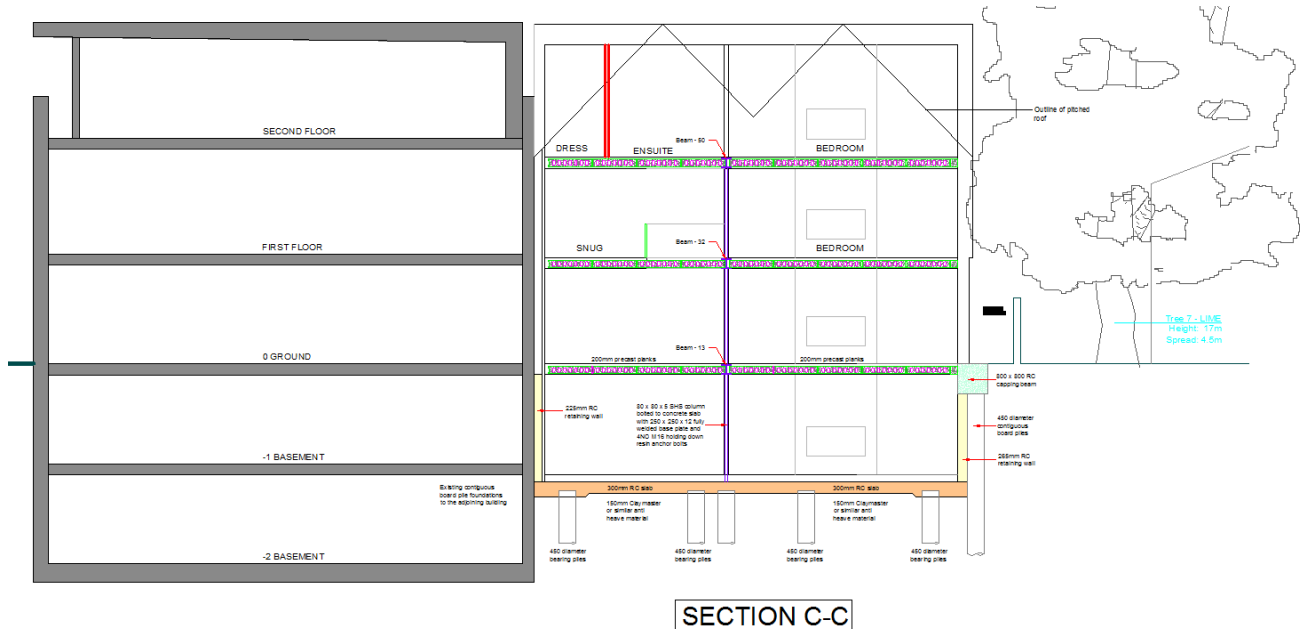


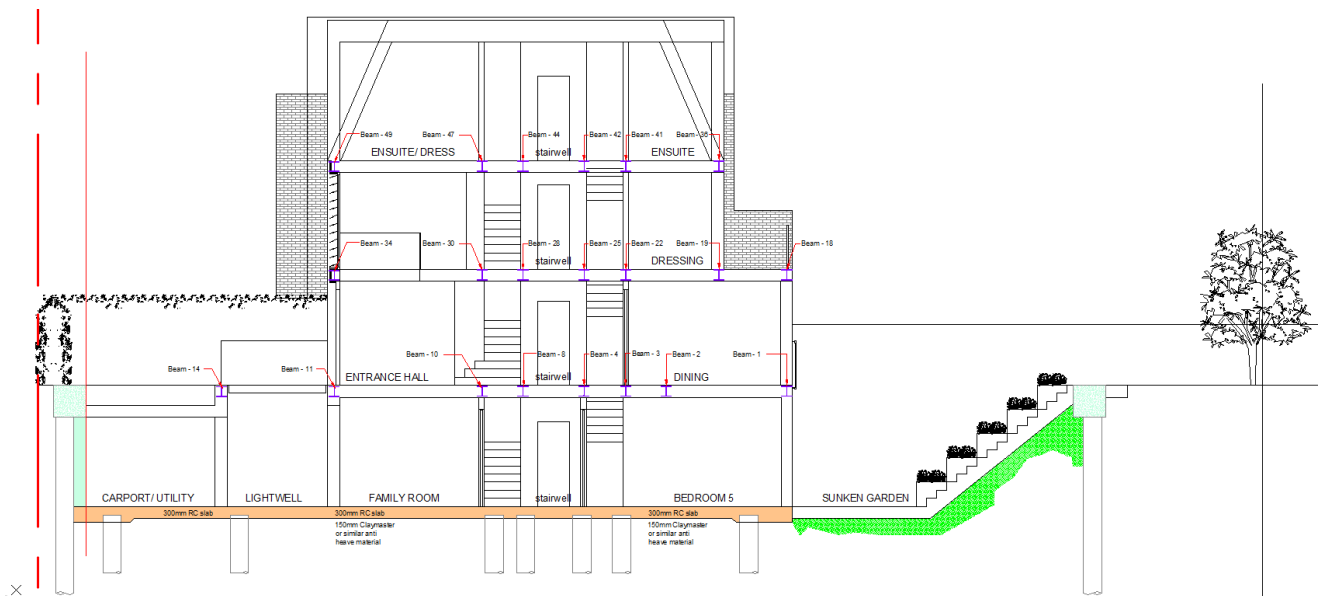
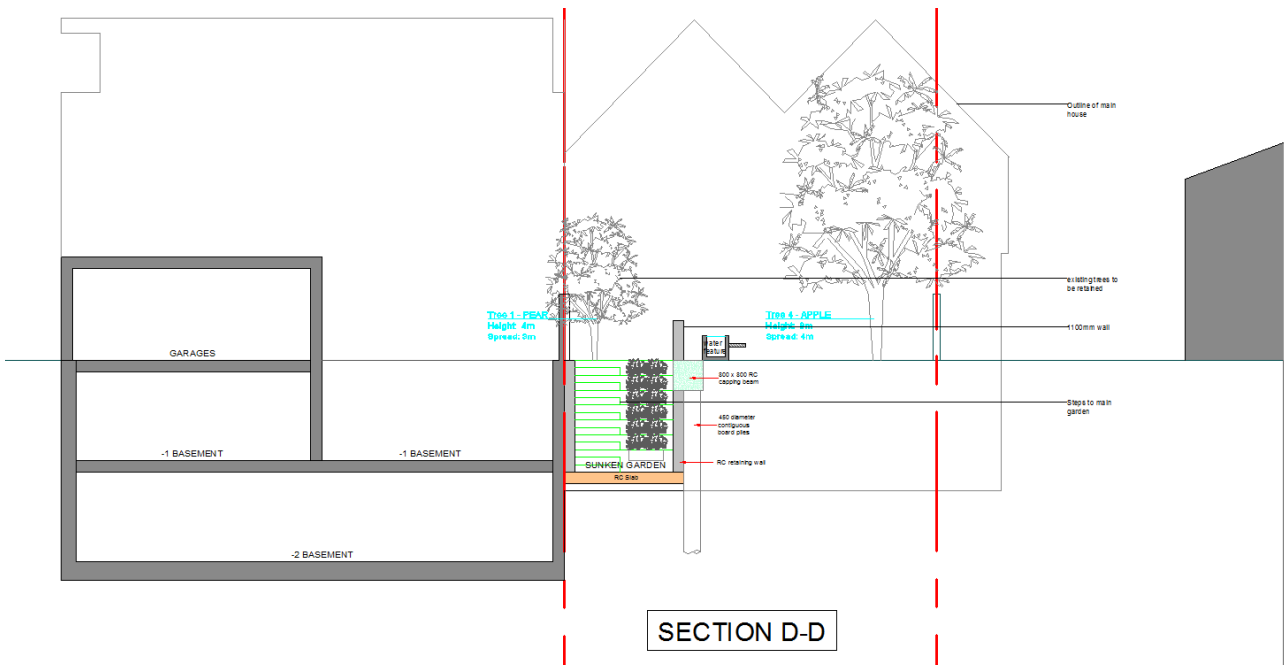
4.0 Proposed drawings

Proposed Sections



X







5.0 Ground Conditions

- 5.1 In order to determine and evaluate the design of this construction ground investigation was carried out by Southern Testing Environmental & Geotechnical investigations and the details of this report are attached. The works were carried out between 15 – 23 2014 and the weather conditions during this period was reasonably dry.
- 5.2 The scope of the investigations comprised excavation of trial pits to examine the presence of tree roots as it was requested by the arboriculturalist and sinking of two 20m deep boreholes using a light percussion 150mm diameter shell and auger boring rig. The ground conditions according to the geology of the area mainly consist of Claygate overlaying London Clay as indeed much of West London.
- 5.3 Depth of excavation for the basement slab, underpinning and foundation will be around 4.0 m and at these depths the material encountered will consist mainly of silty and sandy clays and ground water will be present as this was struck at around 1.1 m. The results of the Atterberg Limit determination of the spoils confirm high shrink ability factor and there will be swelling of the soil after under the excavation as the overburden weight of the material has been excavated added by the close presence of mature high water demand trees.

Table from Southern testing – Page 6 (Site Investigation report)

13 Soils as Found

The soils encountered are described in detail in the attached exploratory hole logs (Appendix A), but in general comprised a thin covering of made ground over sandy clays (assumed to represent the Claygate Member) over London Clay. A summary is given below.

Depth	Thickness	Soil Type	Description
GL to 0.7m	0.7m	Made Ground	Dark brown to brown silty sandy CLAY with occasional to frequent brick, ash and concrete fragments.
0.7 to 5.1/5.2m	4.5/4.6m	Claygate Member	Variable firm pale brown to brown and bluish grey silty sometimes slightly sandy CLAY. Some more gravelly or sandy clays present.
5.1/5.2 to 20m+	Thickness unproven	London Clay	Firm to stiff /high strength dark brown to grey silty CLAY.

13.1 Visual and Olfactory Evidence of Contamination

No obvious evidence of possible contamination was recorded during the fieldwork other than the presence of superficial made ground; which can contain elevated levels of some contaminants.

14 Groundwater Strikes

Water was struck in the exploratory holes as follows:

BH	Water Strikes
BH1	Groundwater strike at 2.7m depth.
BH2	No groundwater strikes were made.

The shallow trenches were dry.



6.0 Substructure design

- 6.1 The ground condition seen here generally consists of London Clay with high shrink ability factor and this requires for the substructure to transfer the loads to deeper mediums and for this piling solution will be adopted. The results of the ground investigation has confirmed swelling potential of the London Clay and for this reason the foundations of this building will be designed as a pile raft that will transfer all the vertical loads to a suitable depth beyond the shrinkable zone.
- 6.2 The Loading from the external elevation cladding and the frame is transferred onto the capping beam which is supported by the contiguous board piles and the retaining walls. The vertical loading is shared by the two elements with the contiguous pile transferring a portion of the load to the ground with the aid of side friction plus end bearing and the retaining wall transfers the other portion of the vertical load directly to the bearing piles placed below the pile raft.
- 6.3 The Loading from the internal frame system is transferred onto the pile raft. Within the areas of concentrated load individual piles are positioned to minimise eccentric load transfer.
- 6.4 The reinforced pile raft is designed as a stiff plate sufficiently reinforced to transfer any eccentricity and midspan load directly onto the bearing piles. The underside of the raft has no contact with the ground and compressible material is placed below the raft to allow for any heave and hydraulic pressure build up.

7.0 Superstructure design

- 7.1 The superstructure of the building will be a steel frame construction that will be designed to support precast floor planks and the external cladding.
- 7.2 Steel columns externally will be supported directly over the capping beam and the internal steel columns will be supported directly over the pile raft.
- 7.3 Steel beams will connect the columns to form a suitable frame and a grillage for each floor. The external beams will support the cavity wall cladding and the internal beams will support the floor structure.
- 7.4 The advantage of a steel frame design is that the skeleton and the support of the building is constructed with speed and is not reliant upon different trades such as brick and block subcontractors or precast floor manufacturers.

8.0 Construction sequence

The construction sequence has been illustrated in the following drawings.

8.01 Demolition of the existing building

Number 38 Reddington Road was constructed recently as a totally independent structure and does not rely on number 36 for any lateral stability. Therefore with the removal of number 36 there will be no issues with having to prop or restrain number 38. However a comprehensive schedule of conditions will be prepared by the Party wall surveyors.

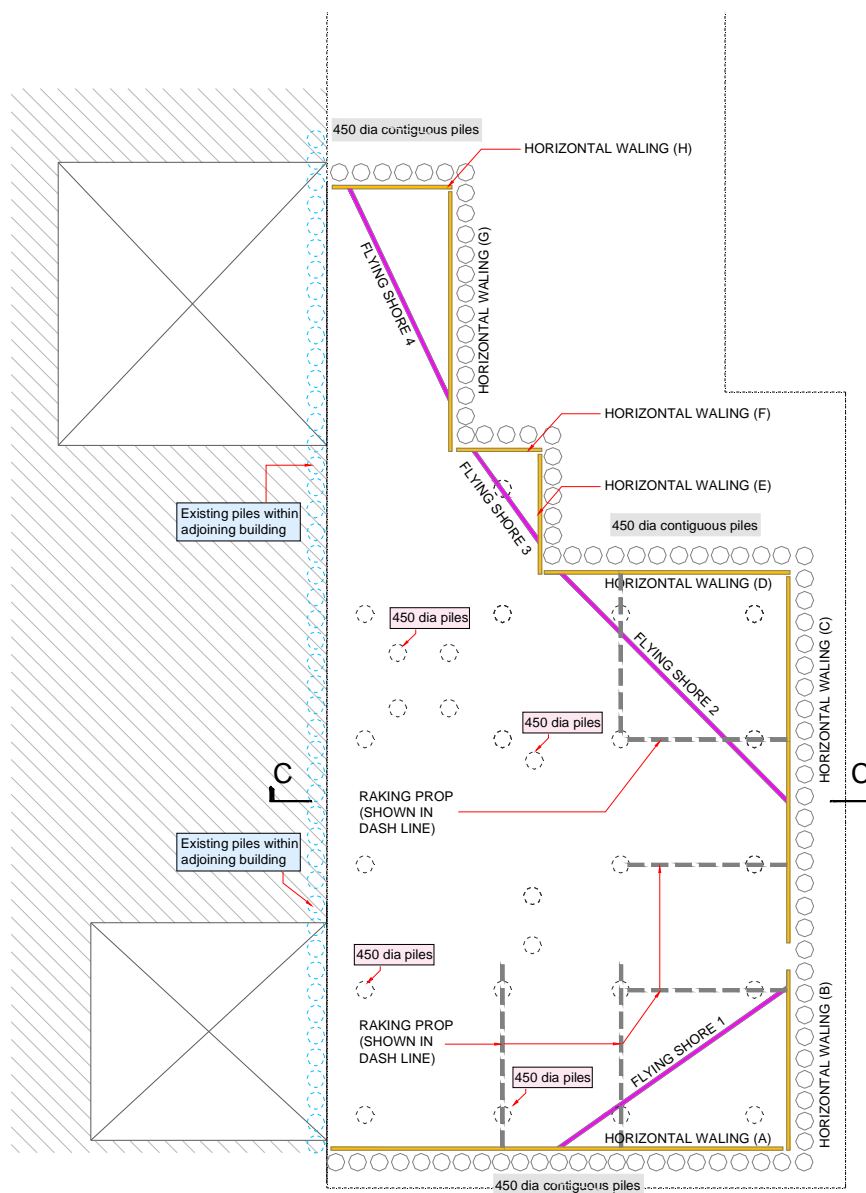
The demolition of number 36 will commence with careful stripping out of the roof and removal of all the fixture and fittings and any elements attached to number 38 will be removed carefully to ensure no damage is caused to any of the finishes.

After the removal of the roof, the floors will be gradually taken out followed by the internal and external walls. The contractor will ensure that the stability of the building is maintained at all times and the removal of debris is carried out in a orderly and sequential manner to minimise any noise and disturbance to the adjoining owners.



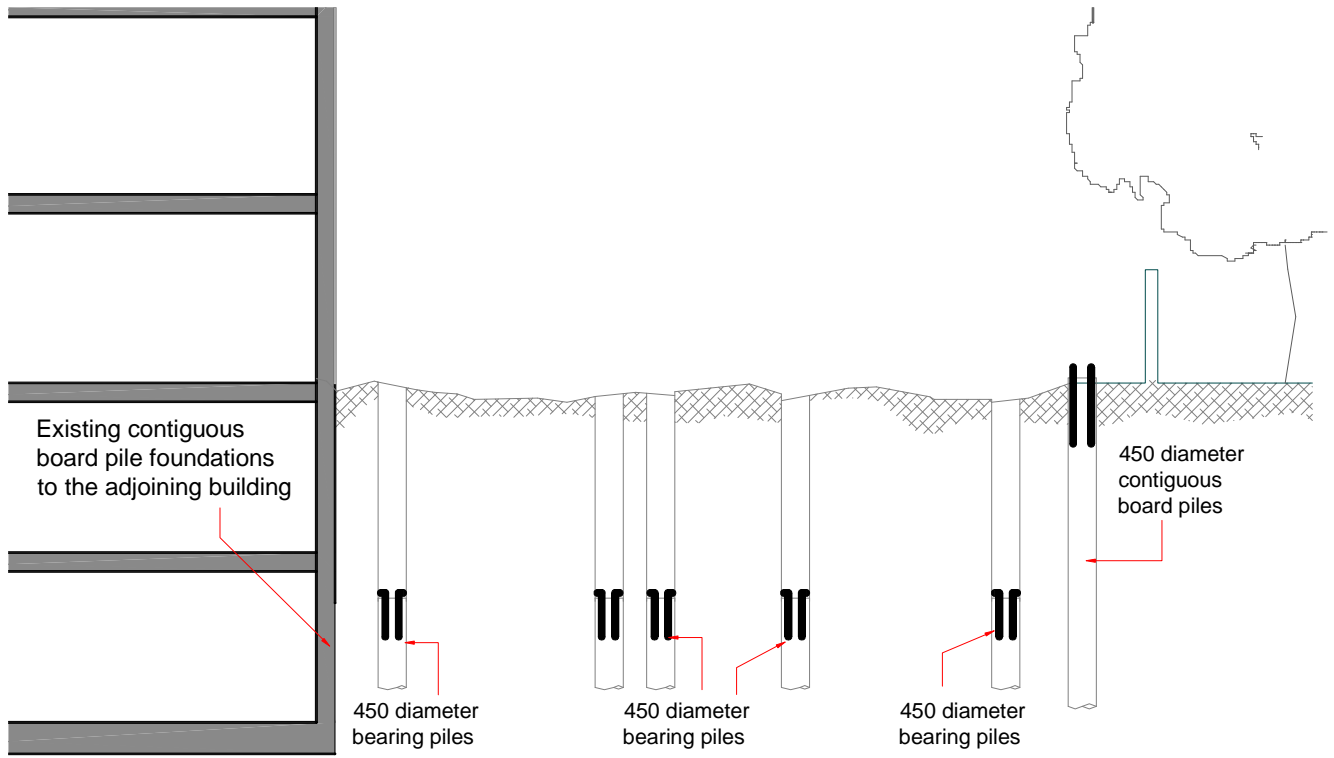
8.20 STAGE -1 PILING

After demolition of the existing building and construction of all the necessary protective elements around the perimeter of the site the piling mat will be provided and the piling contractor will commence installation of both the bearing and contiguous piles. The bearing piles will be poured down to their required cut off level which will be approximately 2.5m below the ground level. In order to reduce deflection in temporary condition at the head of the piles, temporary propping will be introduced and designed by specialist contractor as shown using either raking props or flying shores.



STAGE -1 PILING & PROPPING

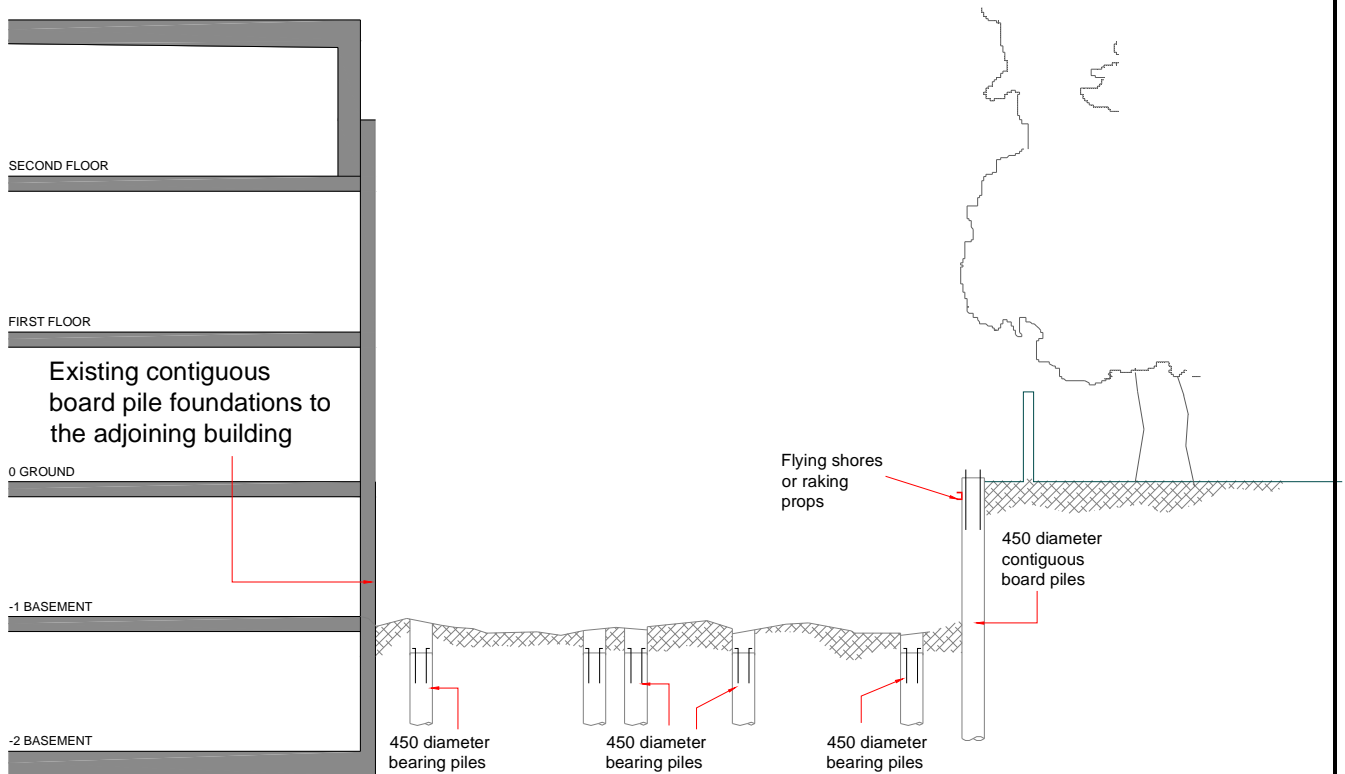
8.10 STAGE-1 Piling



STAGE 1- Piling Section C-C

8.20 STAGE -2 Excavations & Propping

After the installation of the piles has been completed, excavation of the ground can commence. The contractor will ensure all the necessary provisions for dewatering have been made and as it has been recommended in the site investigations report any ingress of water can be pumped from a pre-constructed sump. The site investigation also confirms that the presence of ground water will not be very significant. Raking props or flying shores will be installed in accordance with recommendations made on floor plan. (Page 12)



STAGE 2 - Excavation & PROPPING



8.20 STAGE -2 Excavation initial stages.

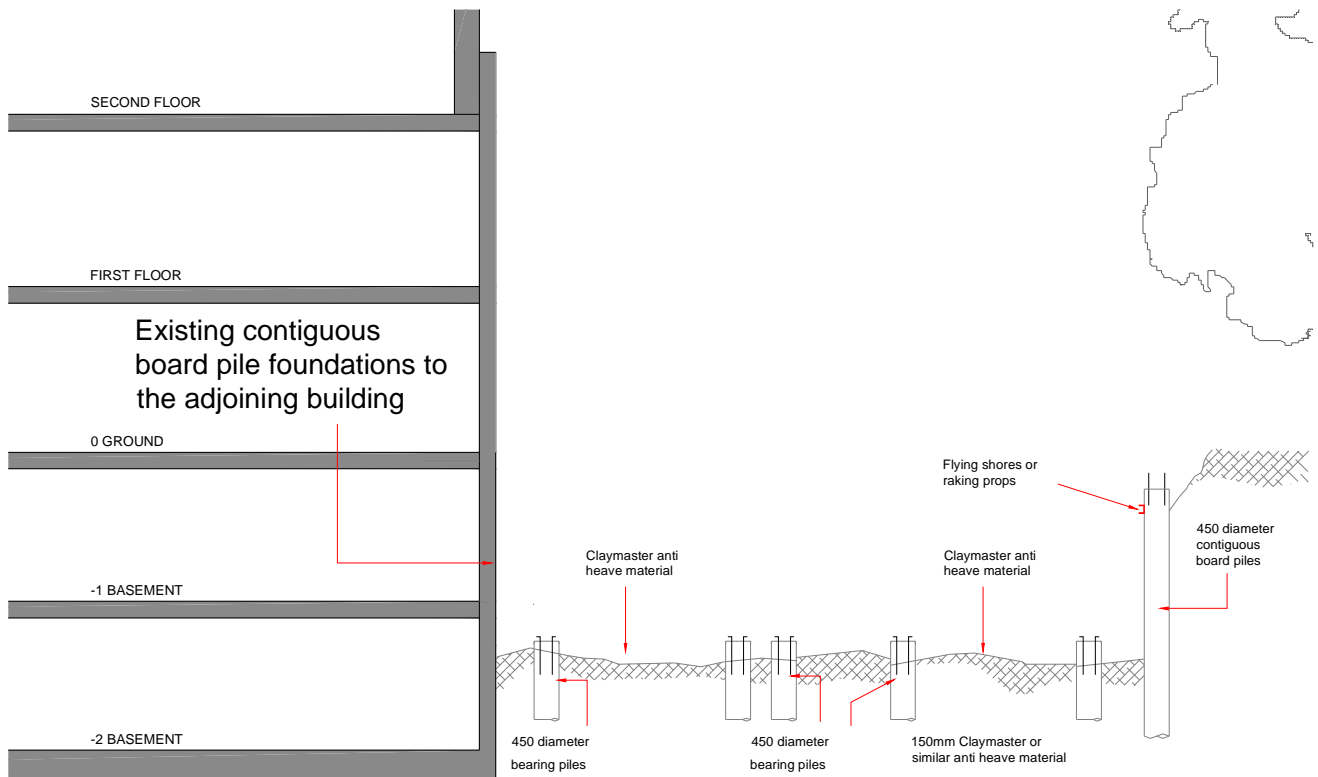


STAGE -2a Installation of props



8.30 STAGE -3 Excavation

The Excavation of the ground will continue down to the required formation level of the basement pile raft. The ground will be levelled and the starter bars from the bearing piles will be prepared to be linked to the basement pile raft. The clay master compressible material will be laid and ground will be ready to receive concrete for the pile raft.



STAGE 3 - Excavation

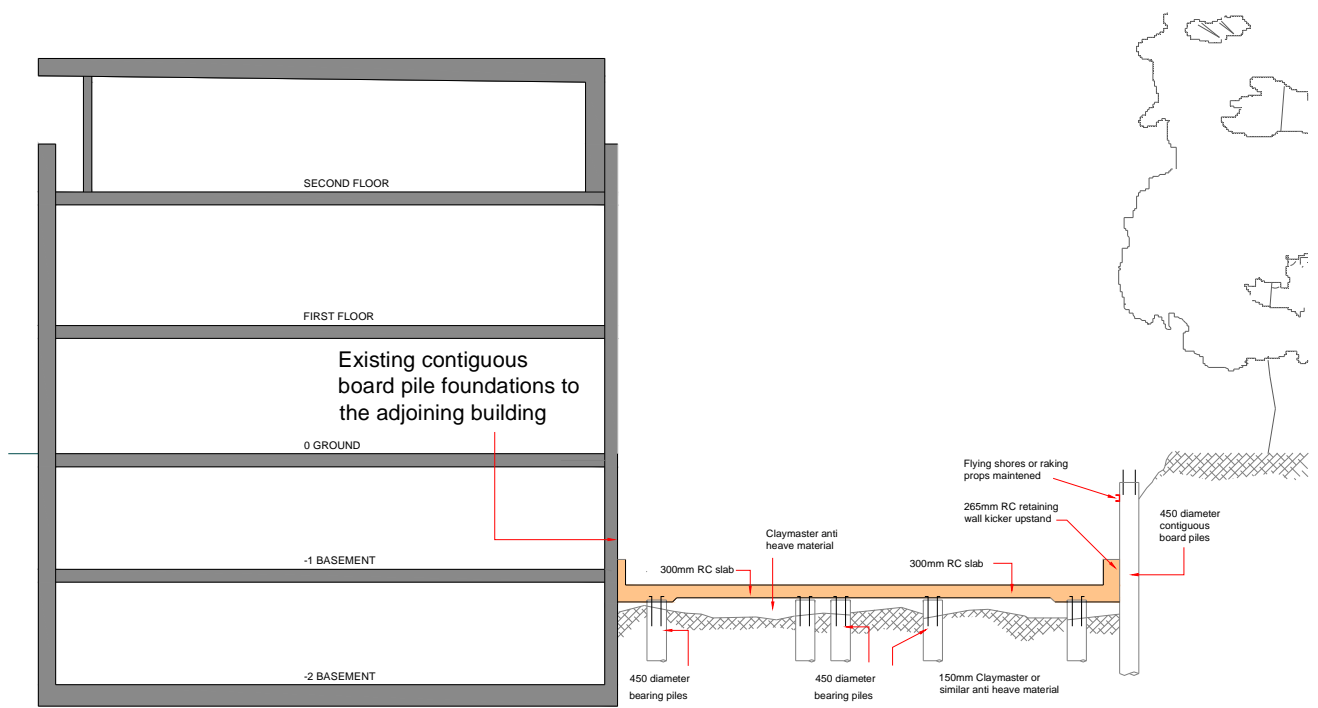


STAGE-3 Excavation exposing bearing piles



8.40 STAGE -4 Slab Construction

All necessary formwork will be cut and prepared and the reinforcing bars will be laid and tied to the bearing pile starter bars. A kicker will be formed around the perimeter of the slab for the attachment of formwork for the retaining walls. Sufficient preparations and excavations will be made at ground level for the casting of the capping beam that will be constructed over the contiguous piles.



STAGE 4 - Slab construction



STAGE-4 Slab construction reinforcement fixed



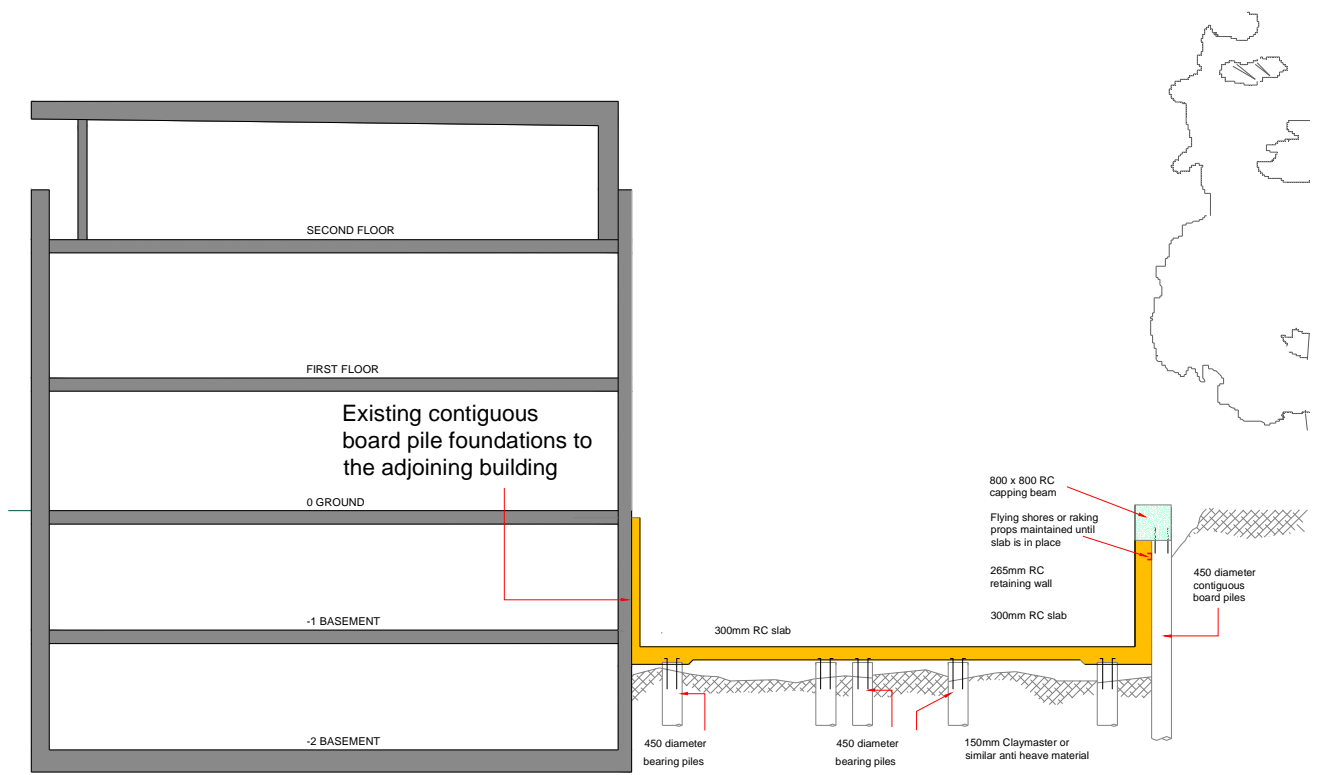


STAGE-4 Slab construction concrete poured



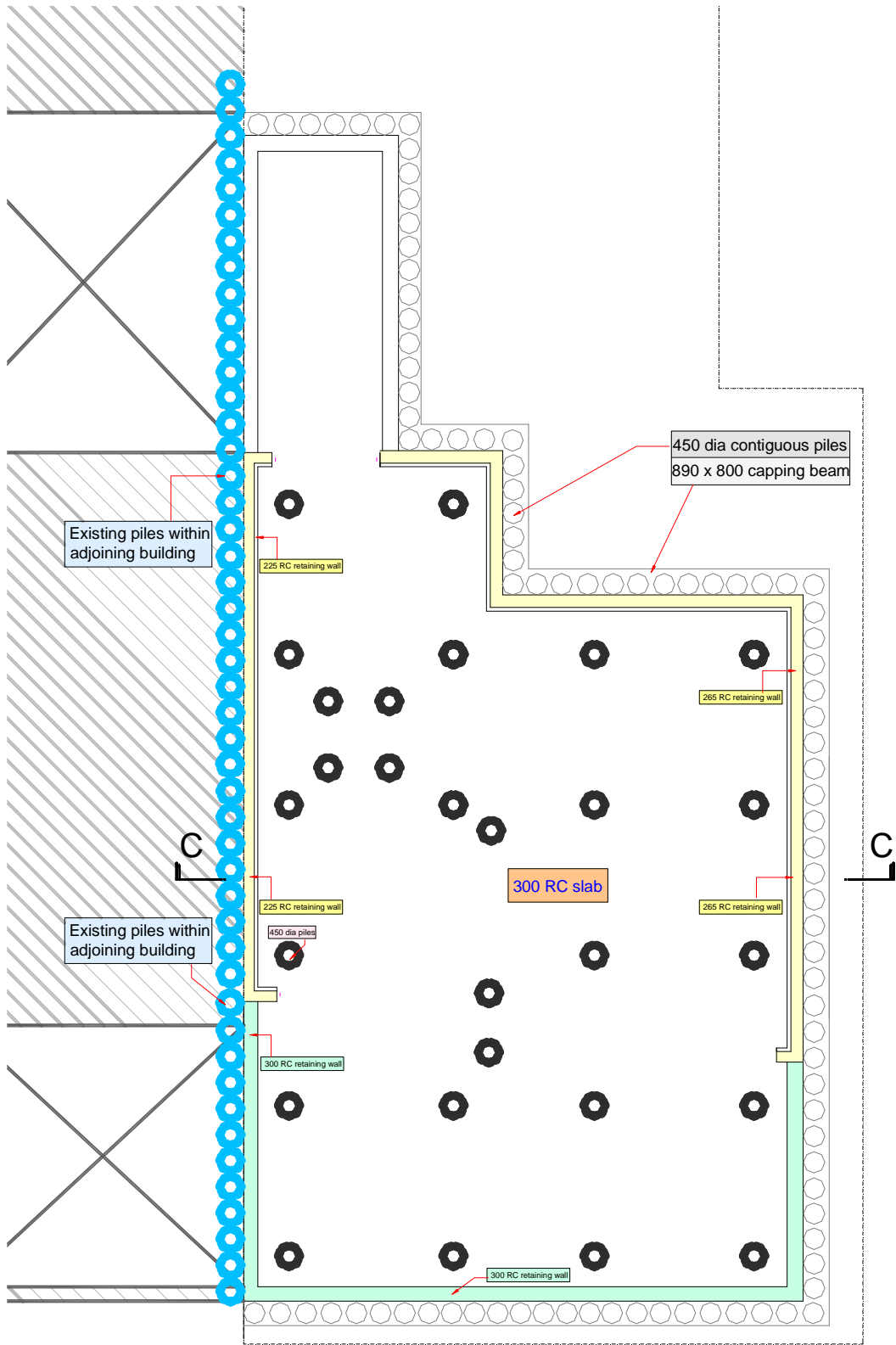
8.40 STAGE -5 Retaining wall and capping beam construction.

Reinforcement will be fixed for both the retaining wall and the capping beam and concrete will be poured to complete the substructure construction.



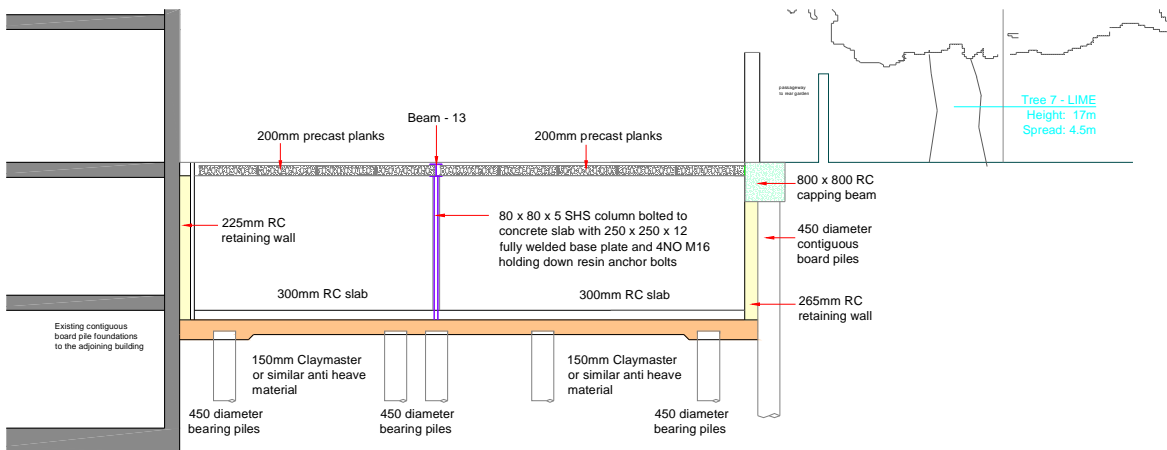
STAGE 5 - Retaining wall & capping beam

8.50 STAGE-5 Retaining wall and capping beam construction.

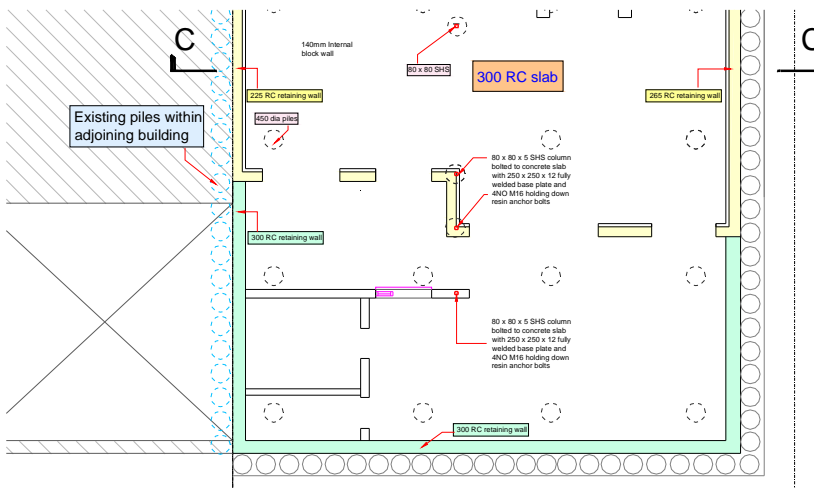


8.60 STAGE -6 Retaining wall and capping beam construction.

Reinforcement will be fixed for both the retaining wall and the aping beam and concrete will be poured to complete the substructure construction. Propping will be provided during temporary condition and maintained until the permanent structure has been completed.

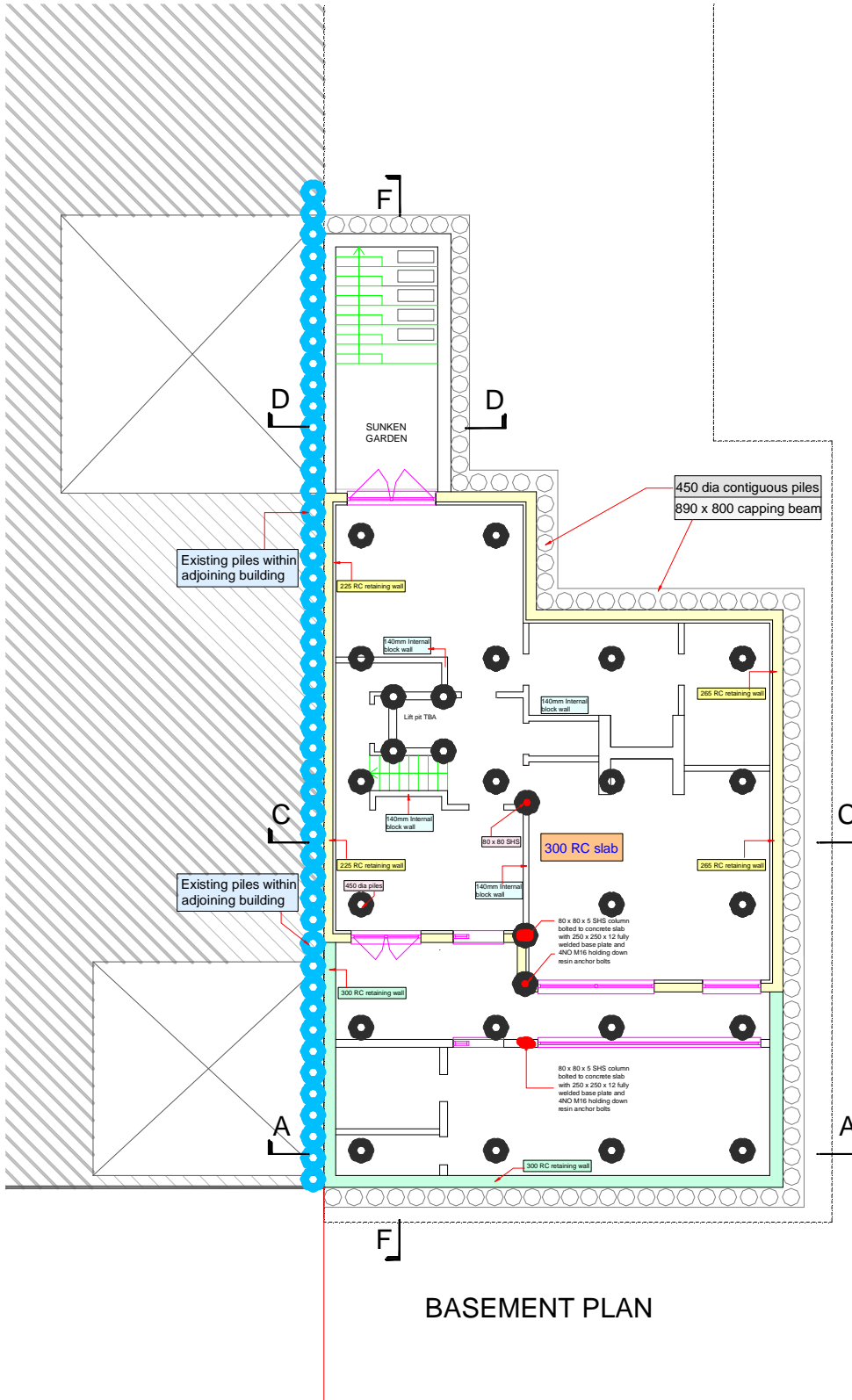


**STAGE 6 - Steel
Frame & construction**



**STAGE 6 - Steel
Frame & construction**

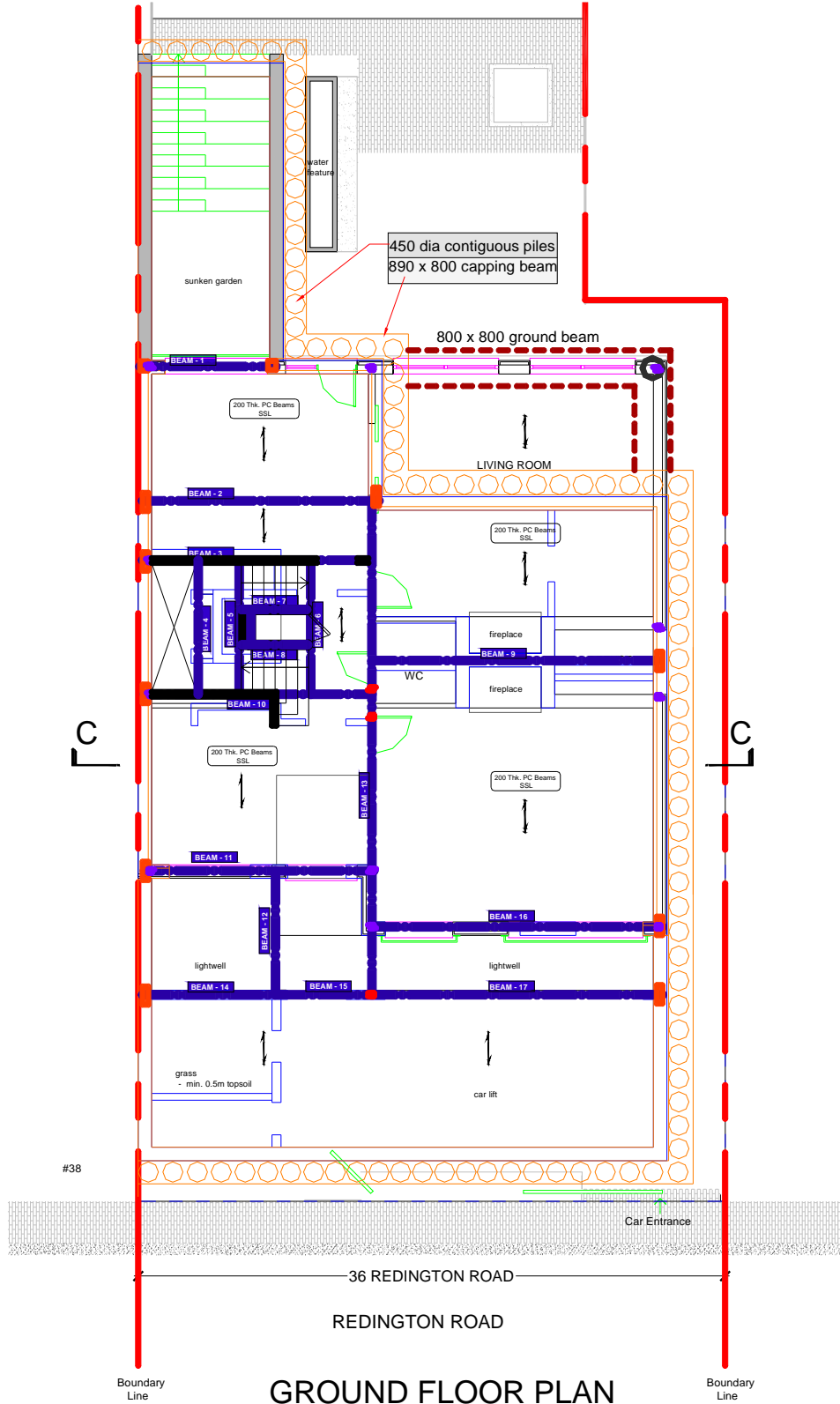
8.70 STAGE-7 Basement structure completed



BASEMENT PLAN



8.80 STAGE -8 Ground Floor Structure Completed

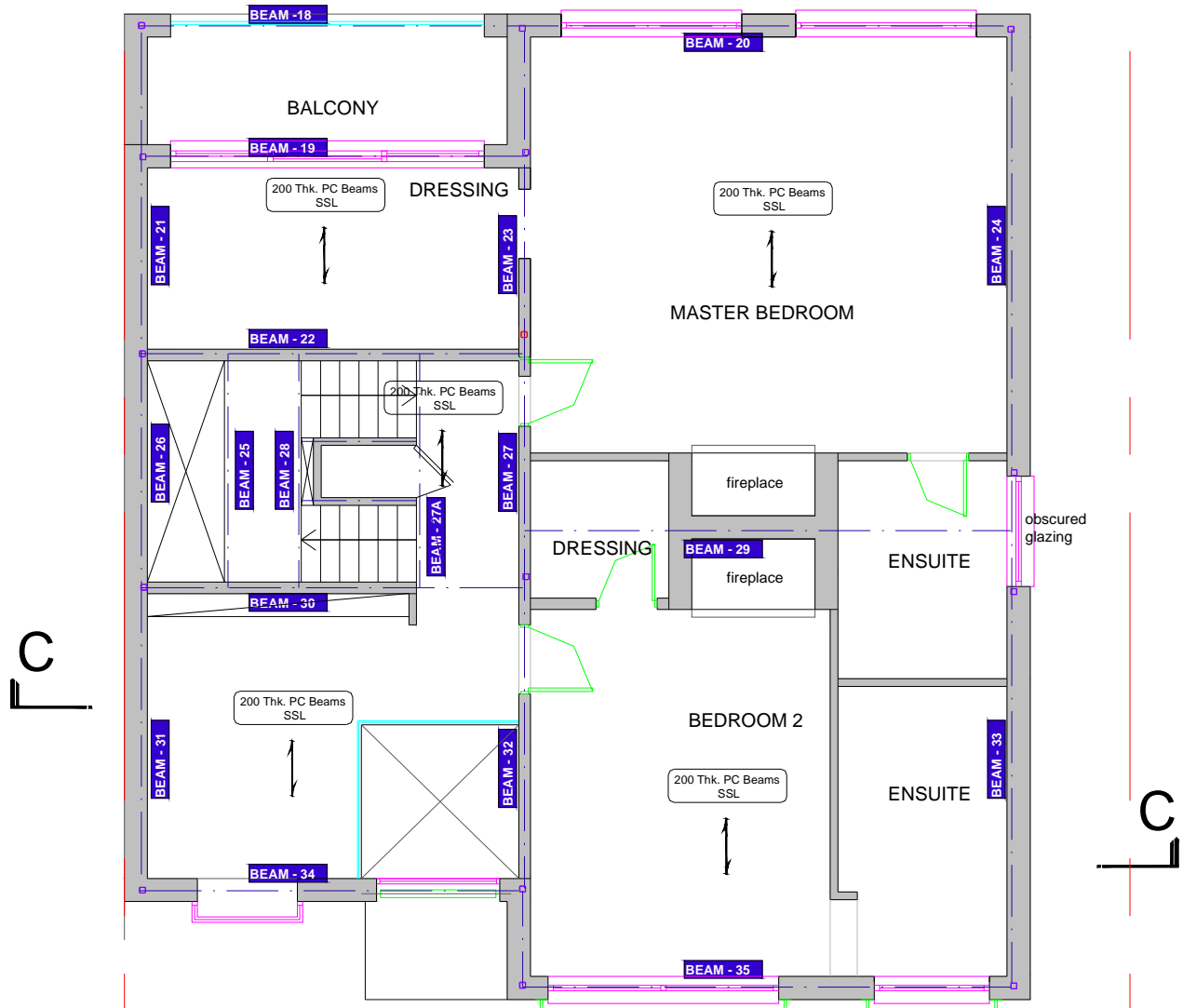


GROUND FLOOR PLAN

8.80 STAGE-8 Ground floor precast floor on capping beam



8.90 STAGE -9 First Floor Structure Completed



FIRST FLOOR PLAN

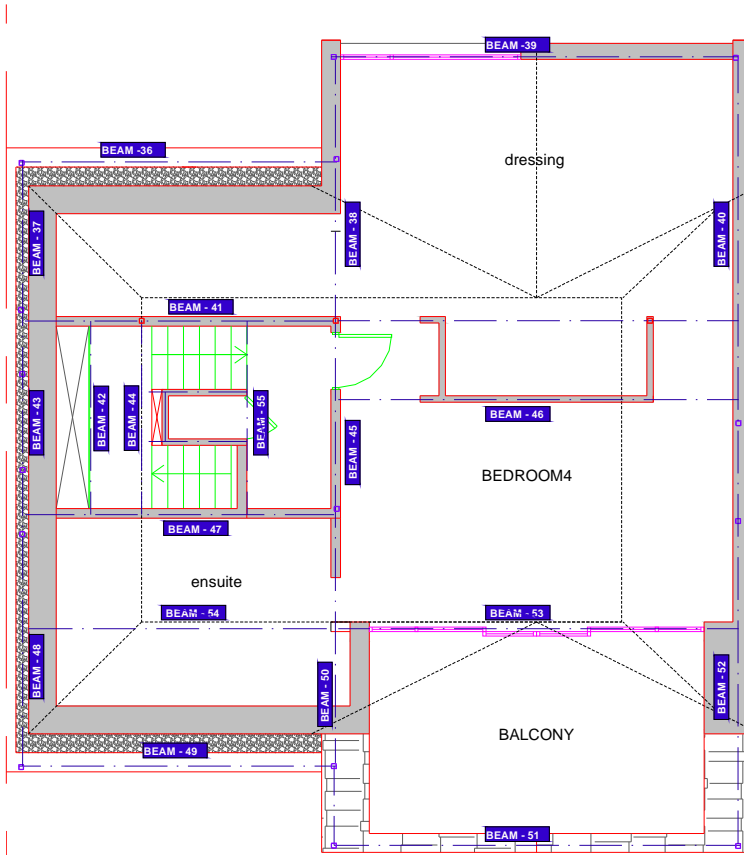


8.90 STAGE-9 First floor precast floor over steel frame





8.90 STAGE -9 Second Floor, Loft and Roof Completed



LOFT PLAN



9.00 Structural Calculations

The following design codes will be adopted for the structural design

BS8002	Earth Retaining Structures
BS8110	Structural Use of Concrete
BS648	Weight of Building Materials
BS6399	Loadings for Buildings
BS8004	Foundations

Underpinning party walls, worst case will be in temporary condition

Loading

Total area internally to be supported

$$12 \times 12 = 144\text{m}^2$$

$$\text{DL1} = 0.86 \times 144 = 120 \text{ kN}$$

$$\text{LL1} = 0.75 \times 144 = 108 \text{ kN}$$

$$\text{DL} = 0.25 \times 24 \times 144 \times 3 = 2592 \text{ kN}$$

$$\text{LL} = 1.5 \times 144 \times 3 = 684 \text{ kN}$$

$$\text{Total Load} = 120 + 108 + 2592 + 684 = 3600\text{kN}$$

$$\text{Number of internal piles} = 22$$

$$\text{Loading per pile} = 163 \text{ kN} + \text{basement slab} = 10 \times 9 = 90 \text{ kN}$$

$$\text{Total per bearing pile} = 253 \text{ kN}$$

External piles Loading :

$$\text{DL} = 0.86 + 0.75 + 18 + 4.5 = 25 \text{ kN per/m} \times 4 = 100 \text{ kN/m} + 4.8 \times 10 = 148 \text{ kN/m}$$

$$\text{Each pile supporting} = 148/3 = 50 \text{ kN}$$

$$\text{Contiguous piles each support} = 50 \text{ kN}$$

$$\text{Internal bearing piles} = 253 \text{ kN}$$



Design for internal bearing pile 8m deep

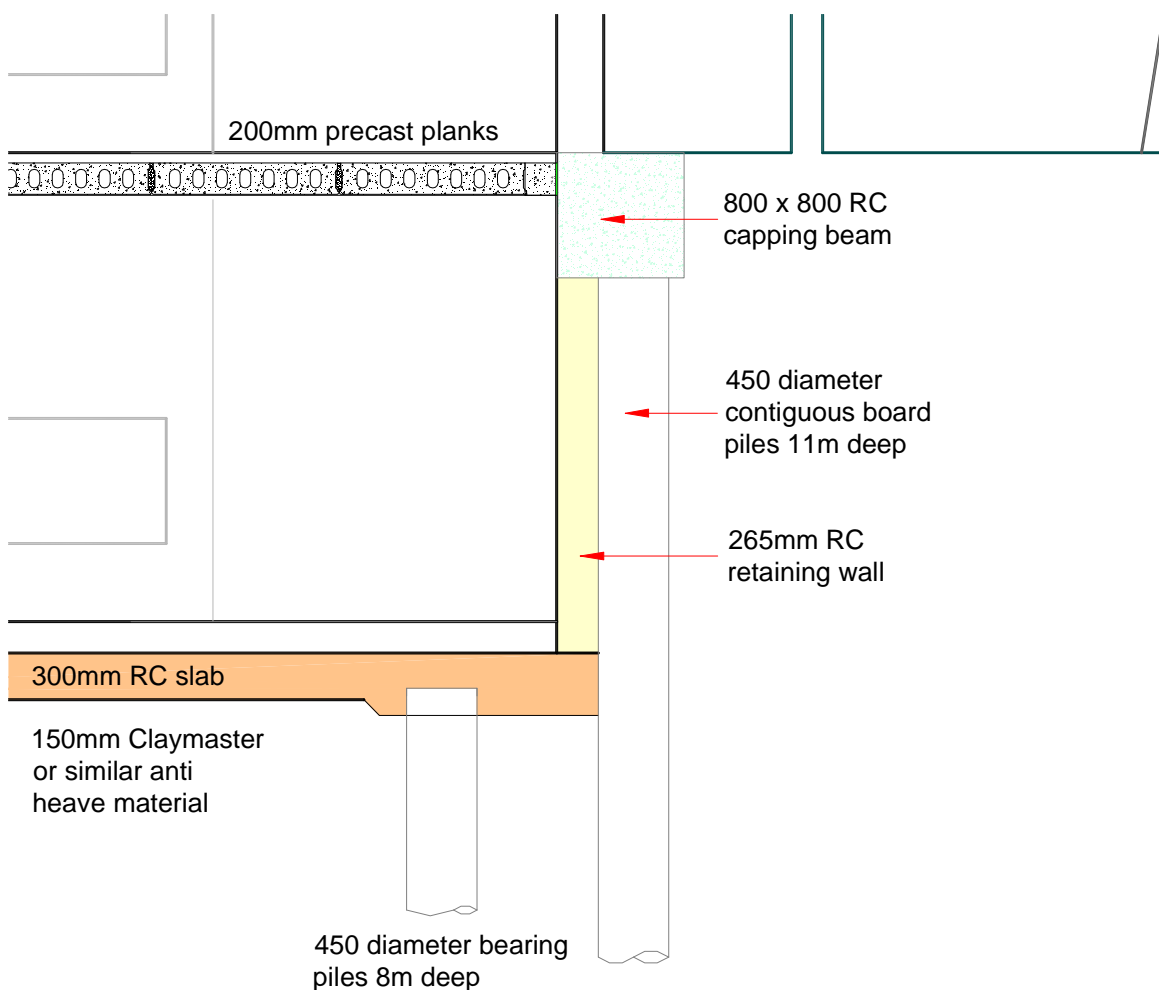
Pile capacity QS Friction = 0.45 x 80 x 11 = 396 kN
 Qb end bearing = 80 x 0.15 = 12 kN

Pile resistance = 396 + 12 = 408 kN

Actual load = 140 kN

Factor of safety $408/140 = 3$

Bearing pile specification will be 8m deep 450mm diameter
Contiguous pile specification will be 11m deep 450mm diameter





Suspended slab design

DL = 0.35 x 24 = 8.4 kN/m²

LL = 1.50 1.5 kN/m²

Factored bending moment

8.4 x 1.4 + 1.5 x 1.6 = 21 x 3.5 x 3.5 / 8 = 32 kNm

300 slab

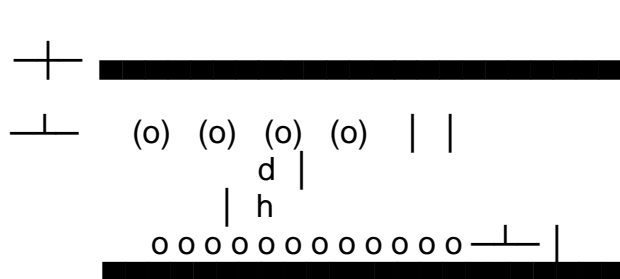
Location: Continuous slab

Bending in solid slabs (with comp.steel if reqd.), designed per metre

width, with checks on minimum steel and span/effective-depth ratio

Calculations are based on EN1992-1

2004 Eurocode 2: Design of concrete structures and assume the use of a simplified rectangular concrete stress-block, and that the depth to the neutral axis is restricted to 0.45d



Design moment - (i.e. factored moment)

Design BM before redistribution Mbef=32 kNm
Section being analysed is considered as continuous.
Section considered has a sagging moment

Materials

Char cylinder compress strength fck=35 N/mm⁻² (concrete)
Char yield strength of reinf fyk=460 N/mm⁻²
Max. aggregate size (for bar spc.) hagg=20 mm
Diameter of tension bars dia=12 mm

Diameter of distribution bars $diad=10\text{ mm}$

Durability and cover to reinforcement

Life of structure 50 years
 Exposure class $XC1$
 Designed concrete $C\ 35/45$
 Minimum cover $cover=50\text{ mm}$
 Fixing tolerance $tol=10\text{ mm}$
 Nominal cover (Cl. 4.4.1.1(2)) $cover=60\text{ mm}$

Section properties

Overall depth of section $h=300\text{ mm}$
 Effective depth of section $d=300\text{ mm}$
 Breadth of section $b=1000\text{ mm}$

Main reinforcement

Partial safety factor for steel $\gamma_{ms}=1.15$
 Char yield strength of reinf. $f_{yk}=f_y=460\text{ N/mm}^2$
 Partial safety factor for conc. $\gamma_{mc}=1.5$
 Char cylinder compress strength $f_{ck}=35\text{ N/mm}^2$ (concrete)
 Design yield strength of reinf. $f_{yd}=f_{yk}/\gamma_{ms}=460/1.15=400\text{ N/mm}^2$
 It is usual practice in the UK to restrict x/d to 0.45

Limit on factor $\delta=0.85$
 Factor $K'=0.597*\delta-0.18*\delta^2-0.209$
 $=0.597*0.85-0.18*0.85^2-0.209$
 $=0.1684$

Factor $K=M*1E6/(b*d^2*f_{ck})$
 $=32*1E6/(1000*300^2*35)$
 $=0.0102$

No compression reinforcement required.

Lever arm $z=d/2*(1+SQR(1-3.529*K))$
 $=300/2*(1+SQR(1-3.529*0.0102))$
 $=297.3\text{ mm}$

Reduce lever arm to $z=0.95*d=0.95*300=285\text{ mm}$
 Depth to neutral axis $x=2.5*(d-z)=2.5*(300-285)$
 $=37.5\text{ mm}$

Tension reinforcement required $A_s=M*1E6/(f_{yd}*z)=32*1E6/(400*285)$
 $=280.7\text{ mm}^2$

Mean width of the tension zone $b_t=b_w=1000\text{ mm}$
 Mean value axial tensile strength $f_{ctm}=0.3*f_{ck}^{(2/3)}=0.3*35^{(2/3)}$
 $=3.21\text{ N/mm}^2$

Minimum reinforcement required $A_{smin}=0.26*f_{ctm}*b_t*d/f_{yk}$
 $=0.26*3.21*1000*300/460$
 $=544.3\text{ mm}^2$

Area of tension reinforcement $A_s=A_{smin}=544.3\text{ mm}^2$
 Breadth of section $b_w=1000\text{ mm}$



Maximum reinforcement permitted $As_{max}=0.04*bw*h=0.04*1000*300$
 $=12000 \text{ mm}^2$

Percentage area steel required $\rho=100*As/(bw*d)$
 $=100*544.3/(1000*300)$
 $=0.1814 \%$

Distribution steel $As_{mpr}=As_{min}=544.3 \text{ mm}^2$

**DESIGN
SUMMARY
FLEXURE**

Overall depth	300 mm
Effective depth	300 mm
Parameter K	0.0102
Parameter K'	0.1684
Lever arm ratio z/d	0.95
Steel area (tension)	544.3 mm ² /m
Steel percentage req.	0.1814 %
Minimum area of steel	544.3 mm ² /m
Maximum area of steel	12000 mm ² /m
Distribution steel	544.3 mm ² /m

Use B1131 Mesh

British Standard reference	Longitudinal wires			Cross wires		
	size mm	pitch mm	area mm ² /m	size mm	pitch mm	area mm ² /m
Square Mesh Fabric						
A 393	10	200	393	10	200	393
A 252	8	200	252	8	200	252
A 193	7	200	193	7	200	193
A 142	6	200	142	6	200	142
A 98	5	200	98	5	200	98
Structural Fabric						
B1131	12	100	1131	8	200	252
B 785	10	100	785	8	200	252
B 503	8	100	503	8	200	252
B 385	7	100	385	7	200	193
B 283	6	100	283	7	200	193
B 196	5	100	196	7	200	193



Spacing of bars - Tension reinforcement

Minimum pitch (sagging moment) $p_{chmn}=50$ mm
 Maximum pitch of bars ($<3h$) $p_{chmx}=400$ mm
 Calculated pitch of bars $pitch=1000*PI*dia^2/(4*As)$
 $=1000*3.142*12^2/(4*544.3)$
 $=207.8$ mm

Round spacing (c.to c.of bars) to 200 mm (rounded).
 Chosen spacing of tension bars $pch=100$ mm
 Area of tension steel provided $Aspr=1000/pch*PI*dia^2/4$
 $=1000/100*3.142*12^2/4$
 $=1131$ mm²/m

TENSION (AND DISTRIBUTION) Diameter of bars 12 mm
 REINFORCEMENT Spacing of bars 100 mm
 Area of steel required 544.3 mm²/m
 Area of steel provided 1130 mm²/m

Deflection

Effective span of slab $L=3.5$ m
 Actual span to depth ratio $l'd=L*1000/d=3.5*1000/300$
 $=11.67$
 Reference reinforcement ratio $\rho_0=(f_{ck}^{0.5})/10=(35^{0.5})/10$
 $=0.5916$ %

Basic span effective depth ratio terms (Clause 7.4.2)
 $N1=1.5*(f_{ck}^{0.5})*\rho_0/\rho$
 $=1.5*(35^{0.5})*0.5916/0.1814$
 $=28.94$
 $N2=3.2*(f_{ck}^{0.5})*(\rho_0/\rho-1)^{1.5}$
 $=3.2*(35^{0.5})*(0.5916/0.1814-1)^{1.5}$
 $=64.35$
 $N=11+N1+N2=11+28.94+64.35$
 $=104.3$

Factor for simply supported spans $k=1.0$
 Flange beam factor $F1=1$
 Factor for long spans $F2=1.0$
 Tensile steel stress factor $F3=500/(f_{yk}*As/Aspr)$
 $=500/(460*544.3/1130)$
 $=2.257$ (conservative)
 Long spans factor $F2=1$
 Steel stress factor $F3=1.5$
 Allowable l/d ratio 40



10.00 Impact on Roadway and adjoining Buildings

- 10.10 The construction of this relatively small basement is confined within the boundaries of the main footprint of the house. The depth of excavation and the works is relatively low-level.
- 10.20 The works will have no effect to any roadway with the exception of skips and hoardings. The works will be carried out in accordance with an approved construction traffic management plan.
- 10.30 The surrounding buildings are classified as standard residential and there are no listed or historic buildings in the area that requires any special or particular attention. There will be minimal vibration as a result of installation of the piles and these are very unlikely to be felt within the surrounding area.
- 10.40 The new construction will not be deeper than the adjoining building at number 38 Reddington Road which has a double basement . The next neighbouring property at 7 Reddington Gardens will 5m away from the line of the excavation and with a single basement not being deeper than 3.8m the foundations of this building will not be undermined and no additional surcharge will be required to be taken for the design of the contiguous piles other than ground plus hydraulic pressure from standing water at a depth of 1m.
- 10.50 The ground which consists of London Clay will provide ample bearing and friction resistance to the piles and settlements expected from this relatively light weight construction will be minimal.



11.00 Conclusion

- 11.10 This construction is considered to be a simple and standard way of achieving a basement without affecting the surrounding areas.
- 11.20 A significant amount of data has been gathered including ground investigations borehole results and details of the adjoining building. Standard construction methods and techniques will be used together with traditional materials.
- 11.30 The construction techniques together with the presence of the contiguous board piles reduce the amount of temporary works and the nature of the underlying geology minimises the risk of ground slip and movement.
- 11.40 The new construction will be beneath the prevailing groundwater level and a suitable dewatering system will be designed involving sumps and pumps to discharge the water from the excavations. The construction method is controlled and will be undertaken in pre-determined sequences and without the need for large open excavations that could potentially be unstable.
- 12.50 On the basis of the above we can conclude that the construction of the proposed subterranean works will not affect the structural stability of the surrounding buildings and infrastructure.
- 12.60 There will be no disturbance to the geology and flow of natural water and there will be no disturbance to any critical utilities.
- 12.70 The works will not significantly increase the flow of storm water and the existing system will not be placed under any strain as a result of this work.

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