Structural Proposals

to

Replace the Brick Boundary Wall at Chamberlain Street London NW1 8BX with a new brick faced Reinforced Concrete Retaining Wall

for

Mr Jonny Bucknell of 8 Chamberlain Street
London, NW1 8XB

Frampton-Martin Sage Design Ltd

Reference: J102/1649

The Garden Studio
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Document History

Produced by:	Date:	Issue Status:	Issued to:
L Goodman	18th April 2019	For Information	Mr J Bucknell Simon Levy Associates

1.0 Introduction and Brief

1.0 Introduction and Brief

At the request of Mr Simon Levy of Simon Levy Associates on behalf of our client, Mr John Bucknell, Owner of number 8 Chamberlain Street, we visited the site on 22nd October 2018 to undertake our preliminary structural condition review of the existing brick wall shown in the photographs on Appendix A.

Following our initial structural review of the wall which forms the end of road/back of pavement and all or part of the rear gardens of 15, 16 and 17 Ainger Road, we have been commissioned to provide structural details for a replacement reinforced concrete wall with masonry facing.

No assessment of the adjacent or adjoining building structures has been carried out as part of this review

This report is for the personal use of the fee-paying Client only and is not assignable. As such Frampton-Martin Sage Ltd., offer no liability to any third parties for any opinions or facts stated within this report.

Our inspections and appraisal are based on a visual inspection and plumb line survey only. No physical probes, removal of finishes or foundation excavations have been carried out as part of this initial review.

We have not inspected woodwork or other parts of structures, which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect.

References to right and left hand are made when viewing the property from the front elevation.

Appendix A contains photographs of the existing wall

Appendix B contains structural details of the replacement reinforced concrete wall and bar bending schedules together with our site notes from the initial review.

Appendix C contains the pile specification

Review undertaken by

Laurence Goodman

Laurence Goodman
Chartered Structural Engineer.

2.0 Existing Structure and Demolition	**2.0 Existing Structure and Demolition** The existing 215 brick wall is approximately 12m long and varies from 2400 to 2000 high above pavement level. The wall retains soil to the gardens of numbers 15, 16 and 17 Ainger Road. Soil pressure, direct tree pressure and indirect tree root activity have in combination resulted in wall being up to 380mm out of plumb. We have included our initial reporting plumb line survey notes in Appendix B (Site Notes sheet 03 and 04) of this report, such the contractor can understand the instability of the existing wall, which has of course been propped over part of its length.. No investigation of the foundations have been made at this stage, however foundations typical to this age and construction of wall are likely to be traditional shallow brick step, possibly on clinker concrete foundation. Foundation bearing soils typical to this location, would be a mix if clays/gravels and fill material. **The contractor is to take extreme caution in the staged removal of propping/ demolition of the wall and will provide a detailed method statement and risk assessment of how the wall is to be demolished safely bearing in mind the close proximity of residents and public etc.**
3.0 Wall Condition	**3.0 Wall Condition** With reference to the site notes sheet 03 and 04, our plumb line survey showed that adjacent to the existing Hawthorn tree, the wall is between 300 and 380mm out of plumb. In reality a 215mm thick wall would be unstable with this degree of lean. It is likely therefore that the Hawthorn tree is both pushing the wall over and holding the wall from collapse. **3.1 Walls reference A and B** Reference to site notes, Walls A and B do not appear to be leaning and shall remain as existing. **3.2 Wall reference C** The wall is approx 2600 high and has a top section lean towards the garden behind for the first 1500mm length from number 8 Chamberlain. The lean of the wall then becomes progressively worse in the other direction closer to the Hawthorn tree as noted on the site notes. This wall has a straight joint with wall B at the left side and returns to form the garden boundary between 15 and 16 Ainger Road, where again it has a straight joint with Wall D **3.3 Wall reference D** Again this wall varies in lean of between 220 and 300mm, also theoretically beyond its point of stability. At the location of the shed, the wall has a vertical fracture, indicating that the shed is in fact providing some buttrace effect to the wall

4.0 Proposed Works

4.1 General

Clearly wall sections C and D are in a dangerous state and the current propping is providing support. In reality a 215mm thick wall would be unstable with this degree of lean, and it is likely that the Hawthorn tree is directly affecting the wall in as much as it is both pushing the wall over and holding the wall from collapse.

In the rear garden of number 15 Ainger is a mature Sycamore tree located some 1400mm away from the wall.

A Sycamore tree, although of moderate water demand, in such close proximity to a soil mass, retained by a fragile structure, is likely to have a negative effect, either by direct pressure from the roots, or indirectly from fluctuating moisture content of the retained, typically clay content soils.

In addition, the soil levels of the gardens to the properties on Ainger road are some 1200 to 1400 mm above the pavement level of Chamberlain street. We noted no drainage within the retaining wall.

Without question, the lean and movement of the wall towards Chamberlain Road is as a direct result of the pressure from the un-drained soil to the gardens of 15 and 16 Ainger road. This movement has been enhanced by the Hawthorn tree, and possibly to a lesser effect by the Sycamore tree.

Careful removal and replacement of both wall sections C and D will be required as set out within Appendix B.

The Hawthorn Tree will have to be completely removed as it has grown into the existing brick wall. The Sycamore should also be removed, if it is not to be the case, the tree canopy must be reduced significantly, the roots trimmed back where the new retaining wall is to be installed and a suitable root barrier installed to protect the new wall and back of wall drainage.

We believe the shed to number 9 Chamberlain will have to be removed/reconstructed as it appears to be providing a buttrace to Wall D. Wall D has a vertical fracture at the shed location

Again extreme caution must be employed in demolishing the shed to ensure a wall collapse does not occur.

4.2 Replacement structure

We recommend that both walls C and D are replaced with a reinforced concrete structure faced with brickwork.

The base of the retaining wall would be set into the existing soil and supported onto small diameter concrete cast insutu piles to provide the necessary resistance to overturning and sliding.

5.0 Ground Conditions, Piling, Services Investigation etc

5.1 Ground Conditions

No site investigation has been carried out as part of this design. The contractor shall undertake all necessary bore hole and geotechnical site investigation to enable the design of the piles to be undertaken in accordance with the piling specification set out within Appendix C.

Should moisture sensitive clays be encountered below or to the rear of the new wall, the contractor will allow for providing suitable anti-heave measures as agreed with FMS Design and SLA.

5.2 Piling

The piling will be designed and installed by the specialist subcontractor in accordance with the requirements set out in Appendix C

5.3 Services Investigation

Prior to undertaking any bore hole investigation or pile installation, a statutory services search shall be undertaken by the contractor to establish the presence and depth of any services below the proposed retaining wall base.

This report is to be provided to FMS/SLA. If any concern is raised as to the possible presence of services, hand excavations shall be undertaken as appropriate to locate such services.

Should any deviation from the proposed structural arrangement be required, this is to be agreed with FMS

5.4 Demolition and Temporary Support

As noted above, the contractor is to take extreme caution in the staged removal of propping/demolition of the wall and will provide a detailed method statement and risk assessment of how the wall is to be demolished safely bearing in mind the close proximity of residents and public etc. The method statement and risk assessment shall be agreed in principle with the principle designer.

The contractor shall provide all necessary temporary propping for the staged demolition works and retention of existing garden soil to the houses on Ainger Road

End of report

L P Goodman

L P Goodman
Chartered Structural Engineer
For and on behalf of Frampton-Martin Sage Ltd

Appendix A
Photographs of the existing wall

Photograph 01

Photograph 02

Photograph 03

Photograph 04

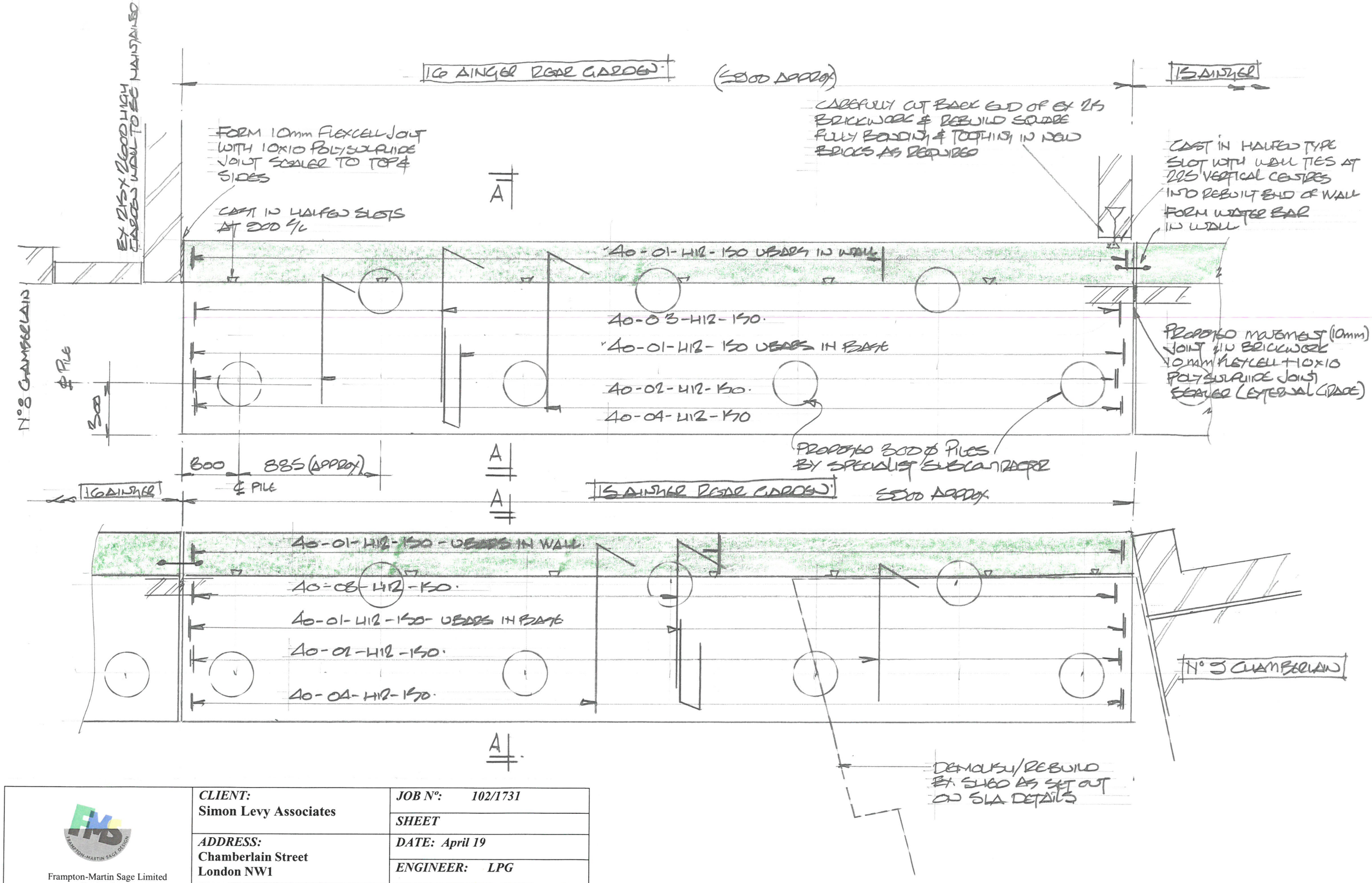
	
Photograph 05	*Photograph 06*
	
Photograph 07	*Photograph 08*

Photograph 09

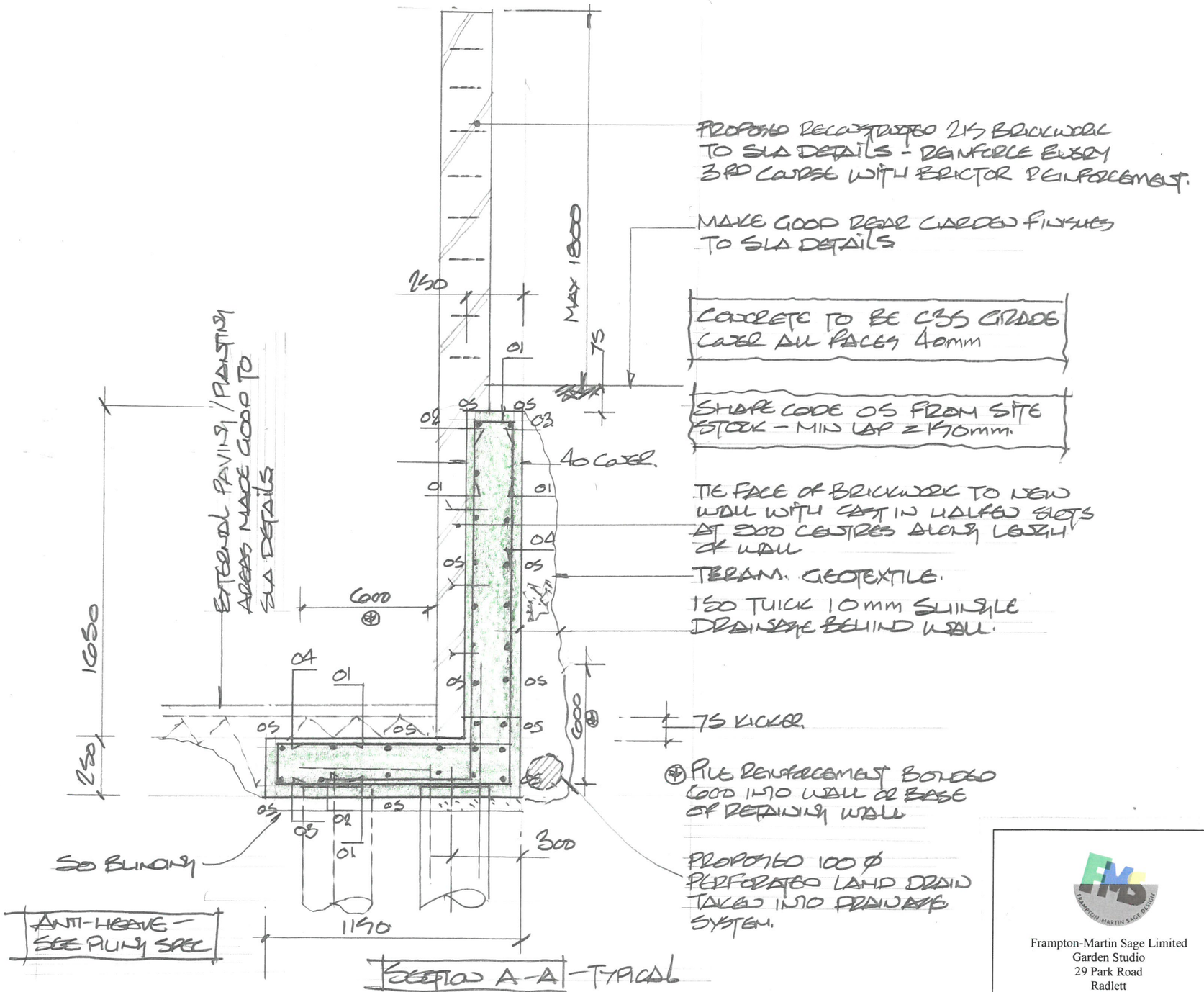
Photograph 09

Appendix B

Structural details of the replacement reinforced concrete wall, bar bending schedules and structural calculations



Frampton-Martin Sage Limited Garden Studio 29 Park Road Radlett Herts WD7 8EG	***CLIENT:*** **Simon Levy Associates**	***JOB N°:*** ***102/1731***
		SHEET
	ADDRESS: **Chamberlain Street** **London NW1**	***DATE:*** ***April 19***
		ENGINEER: ***LPG***
	SUBJECT: **Retaining Wall**	***APPROVED:***
		CLIENT REF:



Frampton-Martin Sage Limited Garden Studio 29 Park Road Radlett Herts WD7 8EG *T. 01923 289 777 M. 07956 476 179*	***CLIENT:*** **Simon Levy Associates**	***JOB N°:*** ***102/1731*** ***SHEET***
	ADDRESS: **Chamberlain Street** **London NW1**	***DATE:*** ***April 19*** ***ENGINEER:*** ***LPG***
	SUBJECT: **Retaining Wall**	***APPROVED:*** ***CLIENT REF:***

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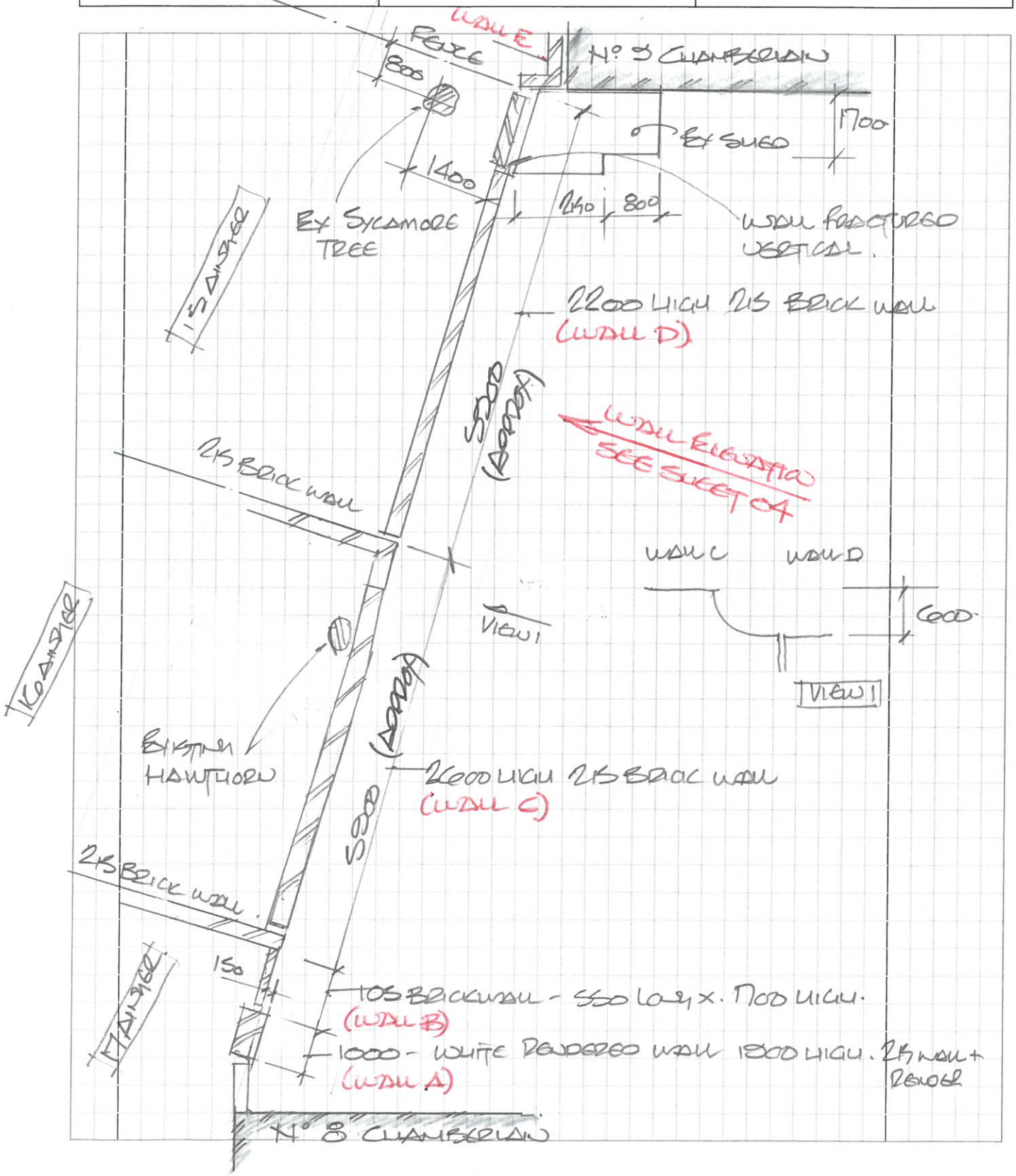
CLIENT: **Simon Levy Associates**	***JOB N°:*** *102/1731*
	SHEET ***OF:*** SITE NOTES
ADDRESS: **Chamberlain Street – London NW3**	***DATE:*** *Oct 18*
	ENGINEER: *LPG*
SUBJECT: **Retaining Wall Site Notes**	***APPROVED:***
	CLIENT REF:



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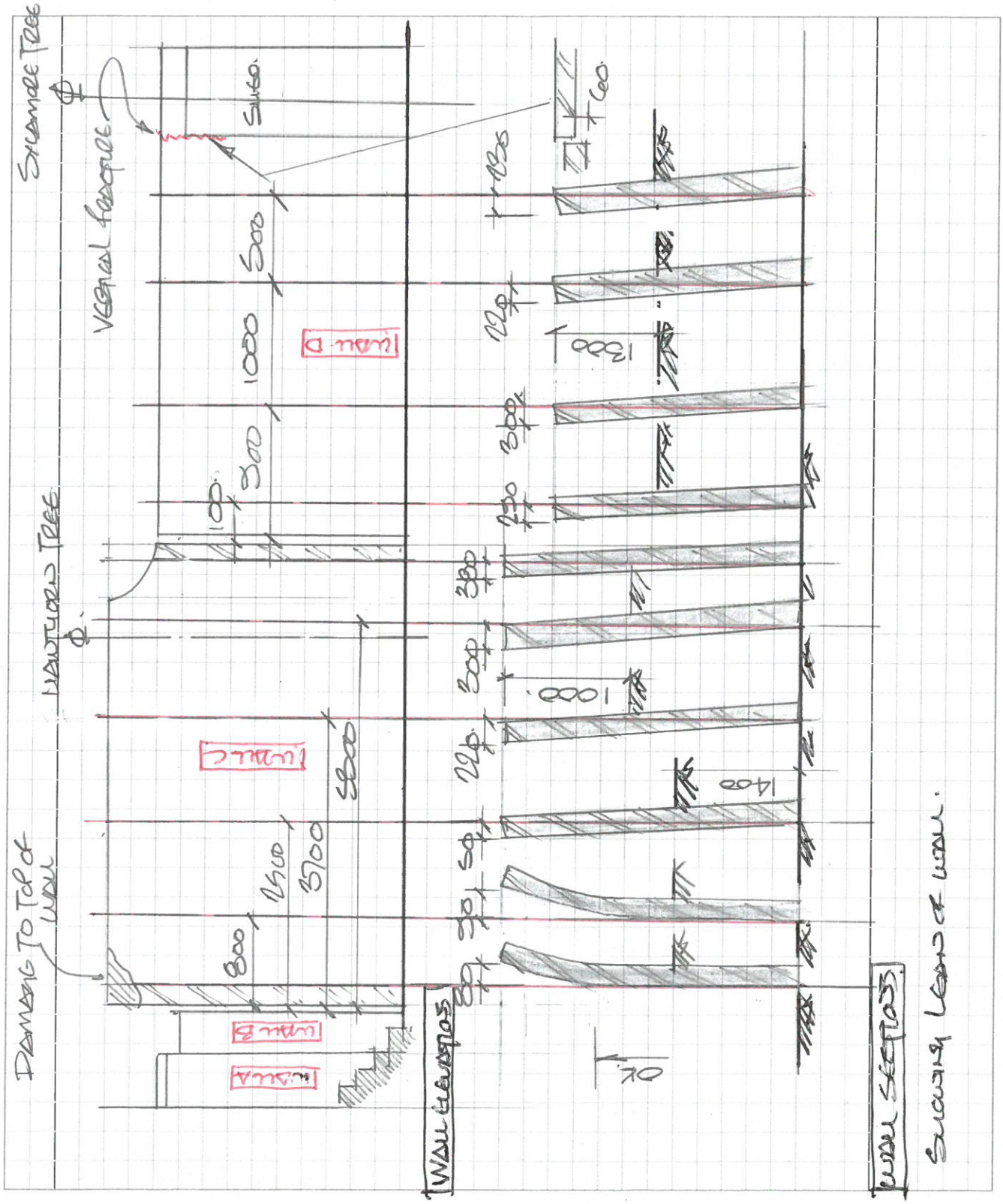
CLIENT: **Simon Levy Associates**	***JOB N°:*** *102/1731*
	SHEET ***OF:*** SITE NOTES C4
ADDRESS: **Chamberlain Street – London NW3**	***DATE:*** *Oct 18*
	ENGINEER: *LPG*
SUBJECT: **Retaining Wall Site Notes**	***APPROVED:***
	CLIENT REF:



Sage Design Limited

Site ref: CHAMBERLAIN ST.

SAGE design • safety • training

Bar schedule ref: 1 0 2 — 0 1   Rev letter:

Date prepared: LPG

Prepared by:

Date revised:

Checked by: \

Member	Bar mark	Type and size	No of mbrs	No of bars in each	Total No	Length of each bar +	Shape code	A* mm	B* mm	C* mm	D* mm	E/r* mm
RETAINING WALL - IN 2 SECTIONS												
	01	H12	2	80	160	775	13	300	170			
	02	H12	2	40	80	2350	11	1750				
	03	H12	2	40	80	2650	11	1750				
	04	H12	2	40	80	1800	11	900				
	05	H12	SITE STOCK TO BE CUT TO SUIT ON									
			SITE AS DISTRIBUTION REINFORCEMENT.									
			PROVIDE 380 m H12 IN STOCK LENGTHS.									

This schedule complies with the requirements of BS 8666

* Specified in multiples of 5mm   + Specified in multiples of 25mm

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CLIENT: Simon Levy Associates	**JOB N°:** 102/1731
	SHEET **OF:** 01
ADDRESS: Chamberlain Street – London NW3	**DATE:** Oct 18
	ENGINEER: LPG
SUBJECT: Retaining Wall Site Notes	**APPROVED:**
	CLIENT REF:

1) GENERAL

IT IS PROPOSED TO REPLACE THE EXISTING BRICK BOUNDARY RETAINING WALL WHICH FORMS THE REAR CARDEN WALL TO N° 16 & 18 ALWYNE & PAVEMENT EDGE TO THE END OF CHAMBERLAIN ST AS SET OUT ON THIS SITE NOTES SHEETS 01 TO 04 IN APPENDIX A OF THESE CALCS.

BECAUSE OF ACCESS PROBLEMS TO THE REAR GARDENS OF 16 & 18 ALWYNE, THE WALL WILL HAVE TO BE CONSTRUCTED FROM CHAMBERLAIN STREET.

THE NEW WALL WILL PROVIDE RETENTION TO THE GARDENS OF 16 & 18. ALWYNE.

IT IS LIKELY THAT THE GROUND BELOW THE NEW RETAINING WALL IS FILL, i.e. TO PROVIDE ROTATION OF THE WALL, WE PROPOSE TO PROVIDE A PILED BASE.

2) PILING WORKS.

IT IS ANTICIPATED THAT 300 ϕ BORED CAST IN PLACE PILES WILL BE UTILISED.

PILES ARE TO BE DESIGNED BY A SPECIALIST SUB-CONTRACTOR

SITE INVESTIGATION & STATS SERVICES WILL BE UNDERTAKEN AS PART OF THE CONTRACT.

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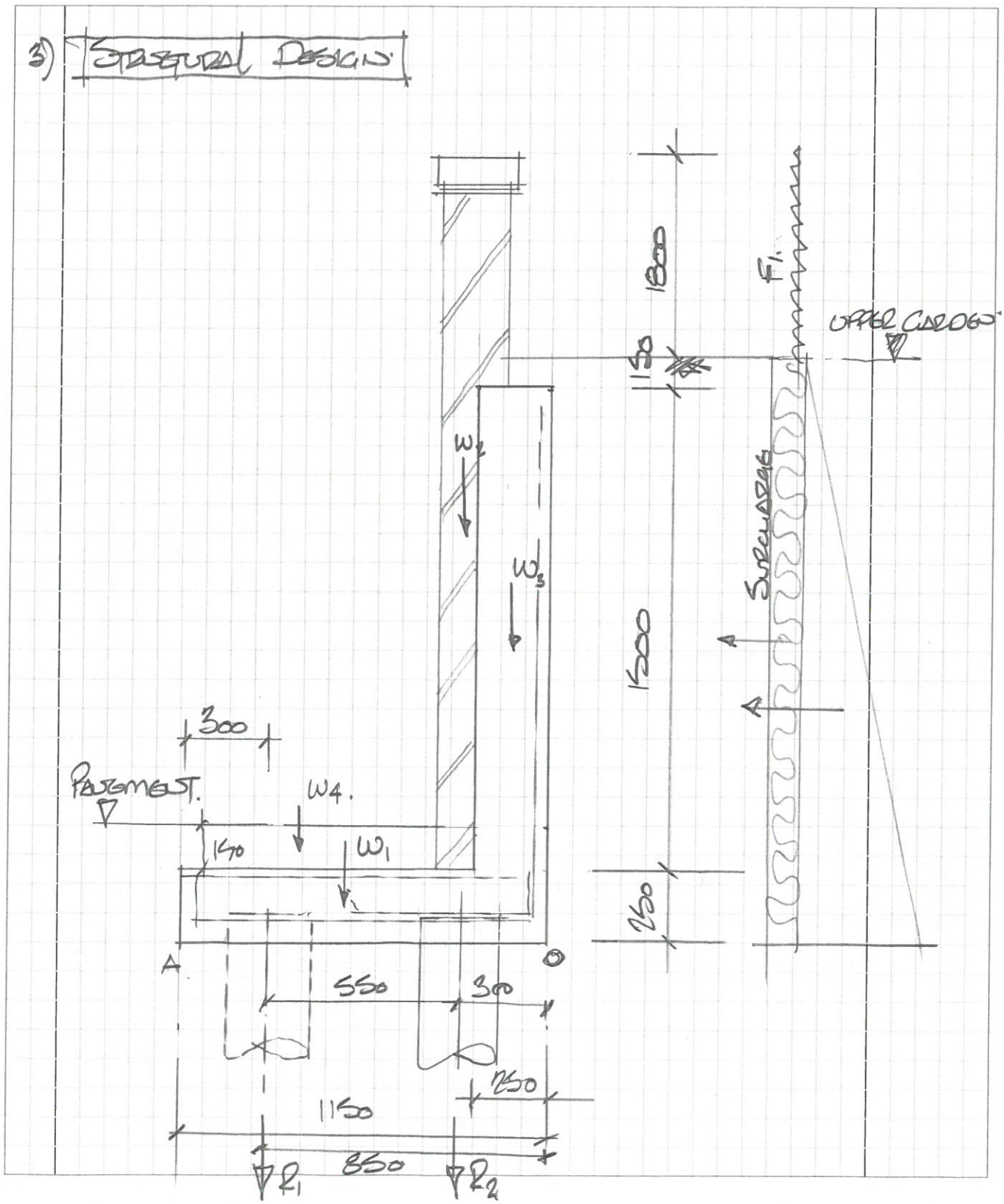
CLIENT: **Simon Levy Associates**	***JOB N°:*** *102/1731*
	SHEET ***OF:*** 02
ADDRESS: **Chamberlain Street – London NW3**	***DATE:*** *Oct 18*
	ENGINEER: *LPG*
SUBJECT: **Retaining Wall Remedial**	***APPROVED:***
	CLIENT REF:

3) STRUCTURAL DESIGN



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CLIENT: Simon Levy Associates	**JOB Nº:** 102/1731
	SHEET **OF:** 03
ADDRESS: Chamberlain Street – London NW3	**DATE:** Oct 18
	ENGINEER: LPG
SUBJECT: Retaining Wall Remedial	**APPROVED:**
	CLIENT REF:

Surcharge 10 kN/m² – Assume no water behind wall.

Active Pressure due to Soil = ⅓ × 19 × 1.75 = 11.1 kN/m.

Active Pressure Surcharge = 0.5 × 1.75 × 10 = 8.8 kN/m

Wind Load say 1.0 kN/m² × 1.8 = 1.8 kN/m.

Σ 22 kN/m.

Cantilever overturning moments about 'O'

(1.8 × 2.8 [5.04]) + (8.8 × 0.875 [7.7]) + (11.1 × 0.58 [11.7]) = 24.5 kNm.

Max⁺ force in Pile Due To overturning: 24.5 × 2 / 0.85 = 58 kN

Cantilever Moments about 'R₁'

W_1 = Weight of Base = 0.25 × 1.15 × 24 = 6.9 kN/m.

W_2 = Weight of Brick = 0.105 × 2.84 [2.84] × 18 + 0.215 × 1.35 × 18 = 10.4 kN/m.

W_3 = Weight of wall = 0.25 × 1.5 × 24 = 9 kN/m.

W_4 = Passive = 0.15 × 0.9 × 18. = 2.43 kN/m.

W_5 = (Passive) Surcharge = 1.0 × 0.9 = 9 kN/m

$\left[(0.25 \times 0.85 \times 24)\frac{0.85}{2}\right] + [10.4 \times 0.6] + (9 \times 0.725) + \left(0.15 \times 18 \times \frac{0.45}{2}\right) + \left(9 \times \frac{0.45}{2}\right)$

(W_1, W_2, W_3, W_4, W_5)

= 2.17 + 6.24 + 6.53 + 0.61 + 2.05 = 17.6 kNm.

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	ADDRESS: **Chamberlain Street – London NW3**	***DATE:*** ***Oct 18*** ***ENGINEER:*** ***LPG***
	SUBJECT: **Retaining Wall Remedial**	***APPROVED:*** ***CLIENT REF:***

(MOMENTS ∂ O)

W1 0.5 W3 0.41 W4 1.5

$(0.25 \times 24 \times 0.3/2) + (0.15 \times 0.\frac{3}{2} \times 18) + (10 \times 0.3/2) + 24.5 = 27.3$ Knm.

$R_2 = (17.6 - 27.3)/0.55 = -18$ KN.

ASSUMING PILES AT 2m c/c MAX UPLIFT = **36 KN**

<u>MOMENTS ABOUT R_2</u>

2.55 W1 1.15 W3. 4.25 W4

$24.5 + (0.25 \times 24 \times .85/2) + (0.15 \times 0.85/2 \times 18) + (10 \times 0.85/2) = 32.5$ Knm.

W2 .523 W3 1.58

$(0.45 \times 0.05) + (9 \times 0.175) = 2.1$ Knm.

$R_1 = (32.5 - 2.1)/0.55 = +55.3$ KN.

ASSUMING PILES AT 2m c/c MAX COMPRESSIVE LOAD

= **111 KN**.

SCHEME PROVIDE 125KN CAPACITY PILES. FOS ON SAFE WORKING LOAD TO BE 2.5

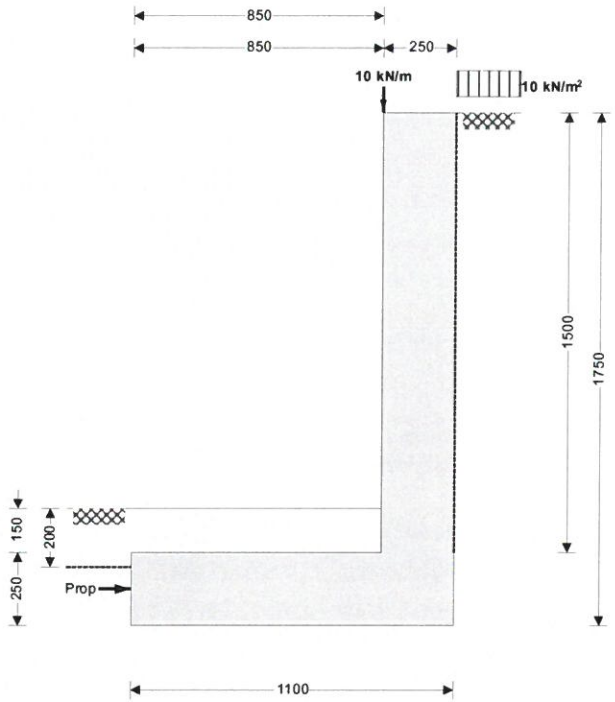
REFER TO FOLLOWING PAGES FOR WALL DESIGN.

SCHEME PROVIDE 250 RC WALL U12 @ 150 c/c REINFORCEMENT 40 COVER C35.

Sage Design Services Ltd 29 Park Road Radlett WD7 8EG	Project Chamberlain Street			Job no. 102/1497	
	Calcs for			Start page no./Revision 5	
	Calcs by LPG	Calcs date 21/04/2019	Checked by	Checked date	Approved by	Approved date

RETAINING WALL ANALYSIS (BS 8002:1994)

TEDDS calculation version 1.2.01.06



Wall details

Retaining wall type	**Cantilever**		
Height of wall stem	h_{stem} = **1500** mm	Wall stem thickness	t_{wall} = **250** mm
Length of toe	l_{toe} = **850** mm	Length of heel	l_{heel} = **0** mm
Overall length of base	l_{base} = **1100** mm	Base thickness	t_{base} = **250** mm
Height of retaining wall	h_{wall} = **1750** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **250** mm
Position of downstand	l_{ds} = **850** mm		
Depth of cover in front of wall	d_{cover} = **150** mm	Unplanned excavation depth	d_{exc} = **200** mm
Height of ground water	h_{water} = **0** mm	Density of water	γ_{water} = 9.81 kN/m^3
Density of wall construction	γ_{wall} = **23.6** kN/m^3	Density of base construction	γ_{base} = **23.6** kN/m^3
Angle of soil surface	β = **0.0** deg	Effective height at back of wall	h_{eff} = **1750** mm
Mobilisation factor	M = **1.5**		
Moist density	γ_m = **18.0** kN/m^3	Saturated density	γ_s = **21.0** kN/m^3
Design shear strength	ϕ' = **24.2** deg	Angle of wall friction	δ = **18.6** deg
Design shear strength	ϕ'_b = **24.2** deg	Design base friction	δ_b = **18.6** deg
Moist density	γ_{mb} = **18.0** kN/m^3	Allowable bearing	$P_{bearing}$ = **75** kN/m^2

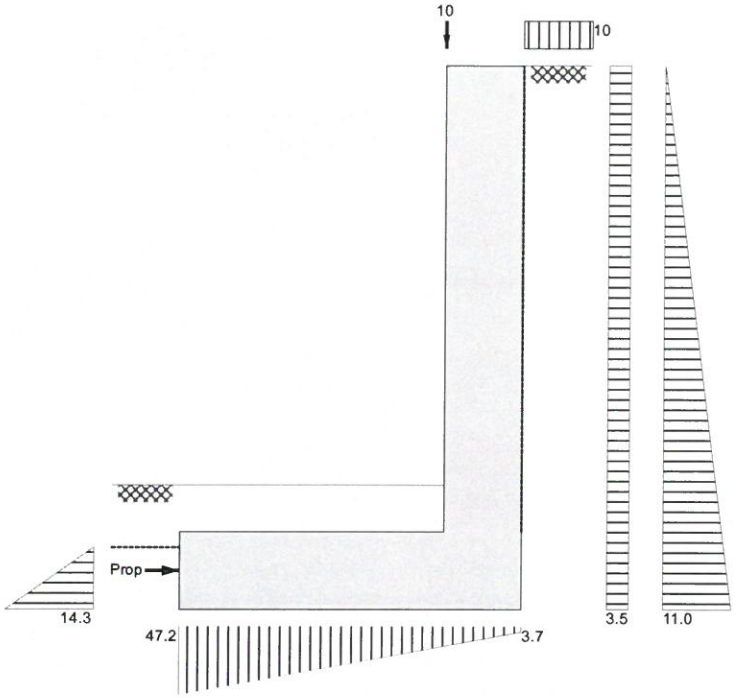
Using Coulomb theory

Active pressure	K_a =**0.369**	Passive pressure	K_p = **4.187**
At-rest pressure	K_0 = **0.590**		

Loading details

Surcharge load	Surcharge = **10.0** kN/m^2		
Vertical dead load	W_{dead} = **10.4** kN/m	Vertical live load	W_{live} = **0.0** kN/m
Horizontal dead load	F_{dead} = **0.0** kN/m	Horizontal live load	F_{live} = **0.0** kN/m

Position of vertical load l_{load} = **850** mm Height of horizontal load h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m²

Calculate propping force

Propping force F_{prop} = **5.7** kN/m

Check bearing pressure

Total vertical reaction R = **28.0** kN/m Distance to reaction x_{bar} = **393** mm

Eccentricity of reaction e = **157** mm

Reaction acts within middle third of base

Bearing pressure at toe p_{toe} = **47.2** kN/m² Bearing pressure at heel p_{heel} = **3.7** kN/m²

PASS - Maximum bearing pressure is less than allowable bearing pressure

RETAINING WALL DESIGN (BS 8002:1994)

TEDDS calculation version 1.2.01.06

Ultimate limit state load factors

Dead load factor γ_{f_d} = **1.4** Live load factor γ_{f_l} = **1.6**

Earth pressure factor γ_{f_e} = **1.4**

Calculate propping force

Propping force F_{prop} = **5.7** kN/m

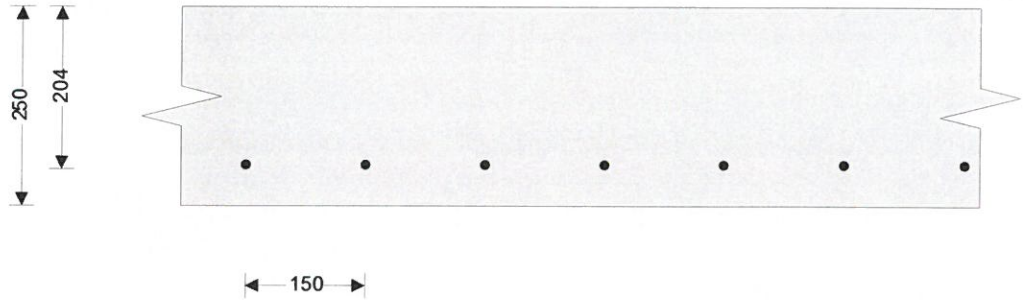
Design of reinforced concrete retaining wall toe (BS 8002:1994)

Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Base details

Minimum reinforcement k = **0.13** % Cover in toe c_{toe} = **40** mm



Design of retaining wall toe

Shear at heel V_{toe} = **32.2** kN/m Moment at heel M_{toe} = **31.3** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **12 mm dia.bars @ 150 mm centres**

Area required $A_{s\_toe\_req}$ = **370.8** mm^2/m Area provided $A_{s\_toe\_prov}$ = **754** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.158** N/mm^2 Allowable shear stress v_{adm} = **4.733** N/mm^2

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_toe} = **0.600** N/mm^2

v_{toe} < v_{c_toe} - No shear reinforcement required

Design of reinforced concrete retaining wall stem (BS 8002:1994)

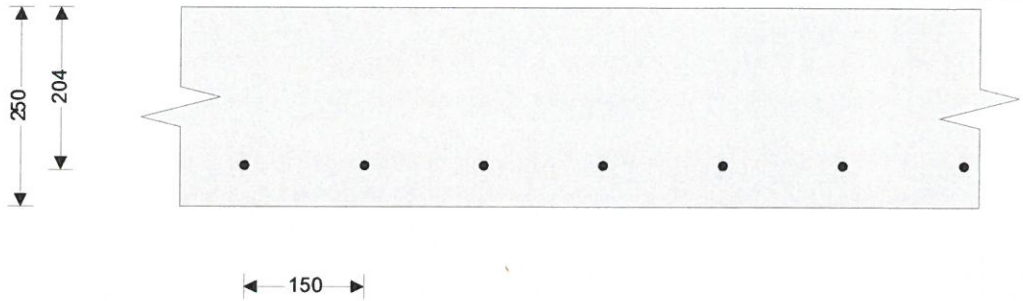
Material properties

Strength of concrete f_{cu} = **35** N/mm^2 Strength of reinforcement f_y = **500** N/mm^2

Wall details

Minimum reinforcement k = **0.13** %

Cover in stem c_{stem} = **40** mm Cover in wall c_{wall} = **40** mm



Design of retaining wall stem

Shear at base of stem V_{stem} = **5.7** kN/m Moment at base of stem M_{stem} = **22.8** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **12 mm dia.bars @ 150 mm centres**

Area required $A_{s\_stem\_req}$ = **325.0** mm²/m Area provided $A_{s\_stem\_prov}$ = **754** mm²/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.028** N/mm² Allowable shear stress v_{adm} = **4.733** N/mm²

PASS - Design shear stress is less than maximum shear stress

Concrete shear stress v_{c_stem} = **0.600** N/mm²

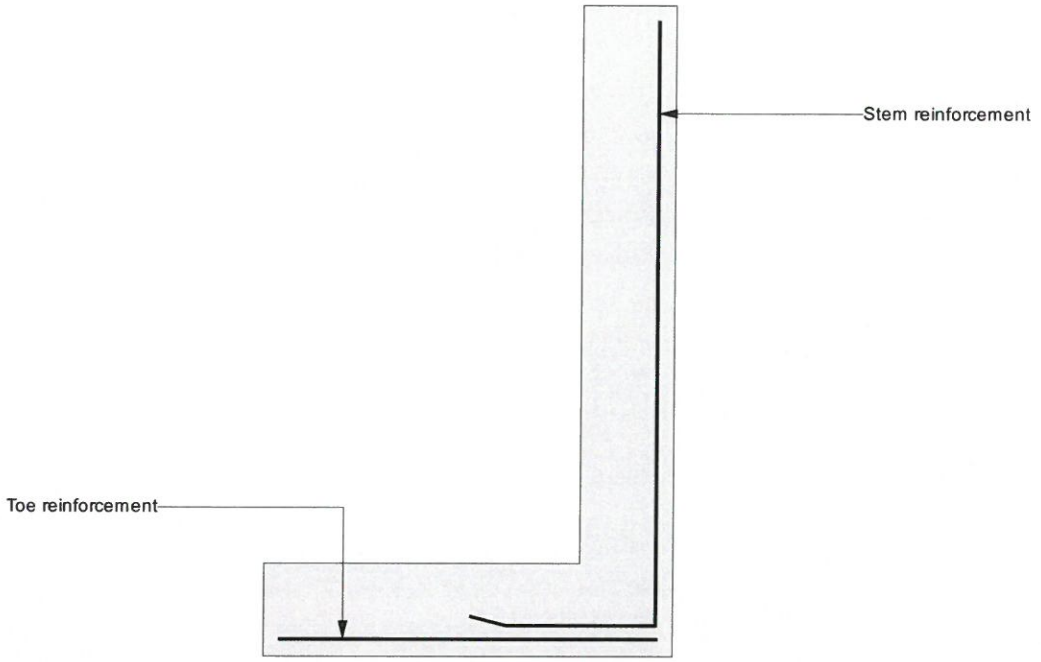
v_{stem} < v_{c_stem} - No shear reinforcement required

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **14.00** Actual span/depth ratio $ratio_{act}$ = **7.35**

PASS - Span to depth ratio is acceptable

Indicative retaining wall reinforcement diagram



Toe bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)
Stem bars - 12 mm dia.@ 150 mm centres - (754 mm^2/m)

Appendix C

Pile specification

Pile Specification

at

Chamberlain Street

for

SLA

Frampton-Martin Sage Design Ltd

FMS Job Reference: J102/1731

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Document History

Produced by:	Date:	Issue Status:	Issued to:
L Goodman	April 19	Tender	

Section **Contents**

1.0 Proposed Development and Contractor design requirement

The construction of a piled reinforcerd concrete retaining wall

The contractor will be required to design, supply and install the cast insitu reinforced concrete piles, including:

- All pile design and specification
- All site investigation deemed necessary by the contractor to establish the piled raft design

2.0 General

General requirements, materials, workmanship, tolerances, contract documentation and measurement etc. are to be in accordance with the Institute of Civil Engineers "Specification for Piling" published by Thomas Telford.

3.0 Bearing Piles

Bearing plies shall be installed at the positions shown on the Drawings. Piles will be of the following type:- **Bored cast insitu concrete.**

4.0 Superstructure Loading, Pile Diameters and Working Loads

Pile Diameters
Bearing plies shall have a cross-sectional area not less than that of a circle of 300mm diameter.

4.3 Working Loads
Bearing piles shall be designed and installed by the contractor to carry the working loads as follows

Max compressive load/pile – 125kN
Max uplift/pile – 40kN
Max shear/pile – 44kN

and to have an ultimate bearing capacity of at least three times the working load if no pile test is to be performed.

5.0 Contractor's Design Details

The Contractor shall submit for comment to the Engineer the following details:-

a) The size and type of pile

b) In case of driven piles, the definition "of final set" recorded as the penetration in mm per 10 blows

c) Reinforcement and concrete class where this is not specified

d) An undertaking that the piles will have an ultimate load carrying capacity of at least three times the working loads shown on the Drawings. The ultimate load is defined as that load applied to the head of the pile which causes the head of the pile to settle no greater than 10% of the pile diameter or 10% of the diameter of the circle of equivalent area to the gross area of non-circular pile.

6.0 Site Investigation and Existing Services

6.1 SI to be undertaken by the contractor

6.2 The Piling Contractor shall take all reasonable steps to locate and avoid existing underground services.

7.0 Records

7.1 The following records shall be kept of every pile:-

Pile identification number and location

Original ground level related to Ordnance

Nominal diameter

Date driven or bored

Date concreted

Depth from ground level to top of the concrete

Depth from ground level to bearing stratum

Final set for driven piles, weight and drops of hammer from commencement of the bearing stratum

Details of any obstruction observed

Details of offcuts and supplements.

7.2 All records shall be accurately kept in duplicate as the work proceeds and one copy shall be sent to the Engineer at the completion of the day's work.

8.0 Reinforcement

8.1 As a minimum, Piles to be continually reinforced through their length with 4 number H16 diameter longitudinal and H10 diameter helical link. Contractor to confirm details of proposals if otherwise.

8.2 Pile reinforcement to project a minimum of 600mm above the top of the pile, such that it may be bent into the line of raft reinforcement

9.0 Concrete

9.1 Concrete in piles and raft to be FND3 to BS5328 Sulphate Resisting.

10.0 Testing

10.1 Maintained Load Tests - **Not required.**

10.2 Indirect Methods for Testing Piles

Carry out continuity tests on all piles. All testing to be undertaken by specialist. Details of equipment to be used and of the method of analysis of test results shall be provided before the commencement of testing.

10.3 Soil Tests

Carry out sufficient sampling and testing required for pile design.

10.4 Probing

Carry out sufficient sampling and testing required for pile design.

11.0 Method and Sequence of Construction

11.1 To be such as not to damage piles already constructed or adjacent structures or such as to cause disturbance to neighbours through noise or vibration.

11.3 **Note - The piles are to be designed against heave for the type of subsoils and trees encountered within and surrounding the site**

11.4 **Tolerance -** Piles are to be cast to a tolerance of plus or minus 75mm from the grid line on plan. Costs arising from remedial design/work on site will be borne by the piling contractor.