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APPENDIX D

GSE – DESIGN CALCULATIONS

J002378 – 16 Pilgrim's Lane BIA



16 PILGRIM'S LANE NW3 1SN

Structural Design Package Proposed Lower Ground floor

December 2022

J002378



16 PILGRIM'S LANE STRUCTURAL DESIGN REPORT for Mr Andrew Lavery

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Revision	Date of issue	Notes	Compiled By	Checked By
А	17.02.23	Initial Issue – For BIA purpose only	NW	AA
А	21.02.23	Initial Issue – For BIA purpose only	NW	AA

	Project		Job Ref	
	16 PILGRIM'S LA	J002378		
	Drawing Ref	Calculations by	Checked by	Sheet
ENGINEERING	NW			
	Part of Structure	•	Date	
	STRUCTURAL DI	ESIGN	December 2022	

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2.0 LOADINGS

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GREEN GREEN Drawing Ref		Calculations by	Checked by	Sheet
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1.0 Design Philosophy

The design of the structural elements will be carried out in such a way to limit the impact of the structural works on the existing building construction and that of the neighbouring properties.

New Lower Ground Floor Structure

The existing load bearing structure will be underpinned in a traditional '1 to 5' sequence to form the new lower ground floor. The underpins will comprise of a vertical stem which will be immediately beneath the existing wall and will be at least the same thickness as the existing wall. In the case of a party wall, the rear face of the stem will be in line with the face of the wall above so as not to encroach into the adjacent property's space, should they wish to construct a similar basement/lower ground floor in the future. The reinforcement in the stems will be designed for bending about the top of the base in the permanent case.

The vertical loads applied to the underpin stems from the existing structure will be calculated according to the thickness and height of the existing structure above.

The underpins will be designed for the temporary and permanent cases, as follows:

- In the temporary case, the underpins will be designed for soil pressures and a surcharge. The factor of safety against overturning and sliding will be taken as 1.5.
- In the permanent case, the underpins will be designed for soil pressures, a surcharge and water pressures calculated at 1 m below the retained height. The new lower ground floor slab will be structurally connected to the underpinning bases using dowel bars, therefore it will be assumed that the new lower ground floor slab will restrain the underpins against sliding.

Surcharge on the underpins will be taken as follows:

Internal live load (e.g. floors) = 5.0 kN/m2 External: gardens, footpaths, driveways = 10 kN/m2

The lower ground floor slab will be designed for uplift due to water pressure, spanning between the bases of opposite underpins. The net uplift pressure is taken as the head of water minus the dead load of the lower ground floor slab and any permanent finishes, e.g. screed.

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Geotechnical Design

The ground conditions at the proposed site are comprised of nominal layer of made ground over the London Clay as shown in geotechnical survey report from borehole record at the proposed site location.

Layer Description	Depth mBGL
Made Ground	0-1.39
London Clay Formation	>10

The lower ground floor retaining walls, underpins and foundations have been designed with the following geotechnical design parameters:

Soil	Unit Weight	Shear angle
Made Ground	17	27
Clay	20	23

For the temporary case, the retaining walls will be designed using 'active' pressures (where movement of the retaining wall is likely and acceptable), as opposed to 'at rest' pressures (where movement of the retaining wall is unlikely or unacceptable). The underpinning process, where soil is excavated underneath an existing load bearing wall and a vertical shear face of soil is exposed, allows the excavated face of soil to move, thus mobilizing the 'active' pressures. For the permanent case, the walls will be designed using 'at rest' pressures, the wall is likely to have stopped moving and, over time, at rest pressures will be generated. These movements will be very slight and will most likely have a negligible effect on the vertical settlement of the retained soil behind the underpinning / retaining walls. These movement are considered acceptable.

Ground bearing pressures below the underpinning bases will be calculated for both the temporary and permanent conditions.

Water Table

During geotechnical investigations, ground water was not encountered, therefore it is considered that the ground water is below proposed lower ground floor formation level.

An accidental case will be assumed of 1.0 m below ground level for design of uplift on the slab and lateral forces on the retaining walls.

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Bearing Pressures

From the BGS information the local geology is confirmed as being medium dense sand and gravel. A borehole log at the proposed site (at no. 16 Pilgrim's Lane) indicates nominal layer of made ground underlain by London Clay - as shown in Figure 1 below.

S	G	ΕA							nical & nental Asso	ociates
Project							L.1111	Unin	BOREHOL	
16 P Job No	'ilgrims I	Date ac 11 D		-	ndla	vel (m OD)	Co-Ordinates ()		BH1	L
J223	352	16-11-2 16-11-2	2			2.65	co-ordinates ()			
Client		10111	-			gineer			Sheet	
Mr Andre	w Laver	v				GSE			1 of	1
SAM	MPLES 8	k TESTS					STRATA			fill
Depth	Type No	Test Result		Level	egeno	Depth (Thick- ness)	DESCRIPTION			Instrument / Backfill
0.25 0.40 0.50 1.00 1.20-1.65 1.85 2.00-2.45 2.75 3.00-3.45 4.00-4.45 4.75 5.00-5.45	D D D D D D D D D D D D D D D D D D D	1,1/1,2,1,2 N60 = 8 1,2/2,3,3,3 N60 = 15 2,3/4,4,4,4 N60 = 22		82 05 00000 81 91 91 91 91 91 91 91 91 91 91 91 91 91		0.15 0.60 (0.70) 1.30 (5.20)	Paving slab over concrete MADE GROUND (Loose brick rubble clavey brick, mortar and concrete gr MADE GROUND (Brown sandy silty fine to coarse fragments of brick, m charcoal) Soft becoming firm then stiff with d grey very sandy silty CLAV with pock orange-brown silt and fine sand	ravel) clay w ortar epth l	vith frequent and rare brown mottled	
6.50-6.95 7.50 8.00-8.45 9.00 9.50-9.95 10.00	U100 D D U100 D	2,3/4,5,5,6 N60 = 27		72.65		(3.50)	Very stiff fissured dark grey silty CL4 pockets and partings of grey silt and	AY wit	h occasional sand	
Borine	z Progre	ss and Water O	bserv	ations		t	GENERAL			I
	Date	Time Casi Depth 1	ng Dia. m	Wa	ter		REMARKS			
		- spati				Groundwa Borehole d	it excavated to depth of 1.20 m ter not encountered complete at 10.0 m installed to depth of 6.0 m on comp	letion		
All dimension	ons in me 1:65.625	tres Method/ Plant Used ro	otary	percus	sive	sampler		L	.ogged By AG	

Figure 1 – no. 16 Pilgrim's Lane - Borehole log

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Based on existing geology and geotechnical survey report at the proposed site, available bearing capacities within stiff clay may be designed for a bearing pressure of 125kN/m².

Temporary Works

The underpins/retaining walls will be designed where possible to be self-supporting under surcharge and soil loading in the construction stage of the project. The underpins will need to be propped during construction to avoid any sliding failure at the base in the granular materials.

Existing Masonry

Existing masonry is to be assessed in accordance with guidance given in CIRIA Report 111 i.e., for UNFACTORED LOADS

- i) Basic brick compressive strength = 0.42 N/mm2
- ii) Enhancement under bearings = 1.5
- iii) Therefore, padstones to be sized on the basis of a bearing stress of (0.42 x 1.5 =) 0.63 N/mm2

New Masonry

All new masonry will be designed using FACTORED LOADS in accordance with BS5628 – Code of Practice for the use of masonry.

Design Codes

This calculation package was carried out in accordance with the relevant *British Standards and Eurocodes*.

Materials

Reinforced Concrete	
Horizontal elements:	Grade C28/35
Vertical elements:	Grade C28/35
Reinforcement:	500 N/mm²

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2.0 Loadings

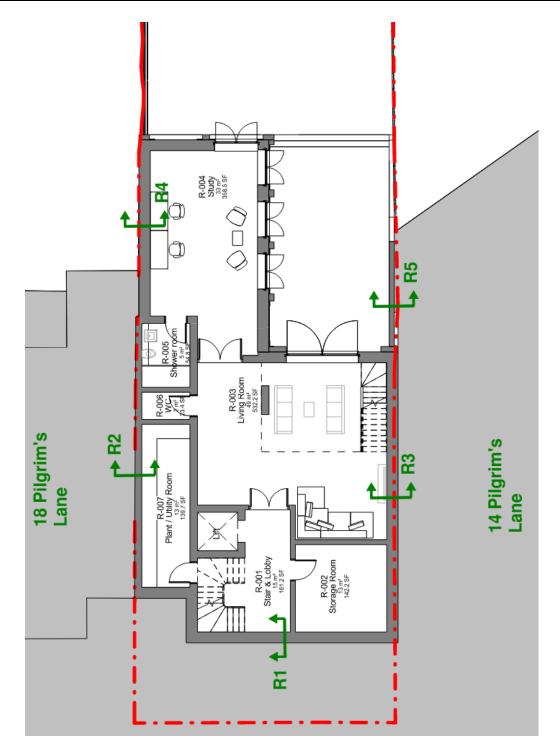
<u>Timber Flat Roof</u> Dead Loads Felt and chippings	0.45 kN/m²
Boards and joists	0.20 kN/m ²
Ceiling	0.20 kN/m ²
Services	0.15 kN/m ²
Total Dead Load	1.00 kN/m ²
Imposed Load	0.75 kN/m ²
Timber Pitched Roof	
Dead Loads	
Slate and felt	0.30 kN/m ²
Boards and joists	0.25 kN/m ²
Ceiling	0.25 kN/m ²
Services	0.15 kN/m ²
Total Dead Load	1.00 kN/m ²
Total Imposed Loading	1.00 kN/m ²
<u>Timber Floors</u>	
Dead Loads	
Boards and joists	0.35 kN/m ²
Ceiling	0.25 kN/m ²
Services	0.20 kN/m ²
Total Dead Load	0.80 kN/m ²
Imposed Load	1.50 kN/m²
Partitions (on plan)	0.60 kN/m ²
Comflor	
Dead Loads	
Screed	1.80 kN/m ²
Floor swt	2.38 kN/m ²
Ceiling, Services, FInishes	0.55 kN/m ²
Total Dead Load	4.73 kN/m ²
Imposed Load	1.50 kN/m²
Walls Loads (on elevation)	
Stud Partitions	0.60 kN/m ²
215 Brickwork + Render	5.30 kN/m ²
	5.50 Kity III

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	STRUCTURAL DESIGN		December 2022	

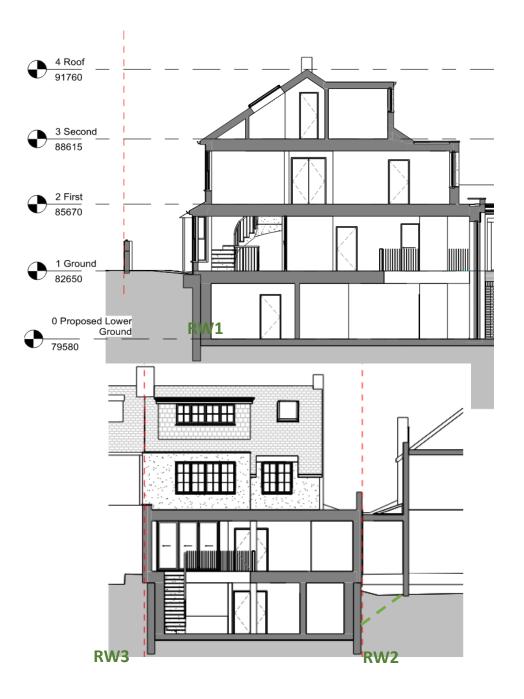
3.0LOWER GROUND FLOOR CALCULATIONS•Retaining walls R1, R2, R3, R4, R5

- Lower Ground floor slab
- Buoyancy check

	Project 16 Pilgrim's Lane		Job Ref. J002378	
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	Part of Structure Wall section IDs		Date Dec-22	



Project 16 Pilgrim's Lane		Job Ref. J002378	
Drawing Ref.	Calculations by NW	Checked by	Sheet
Part of Structure Retaining wall sections		^{Date} Dec-22	



	Project 16 Pilgrim's Lane		Job Ref. J002378	
GREEN STRUCTURAL ENGINEERING	Drawing Ref.	Calculations by NW	Checked by ME	Sheet
	Part of Structure Underpinning R-1 (Front elevation)		·	Date Dec-22
	-		h	= 3.35 m

The retaining walls will be designed for two load cases:

• Case 1 – Maximum vertical forces and minimum horizontal forces: This is the most onerous case for bearing pressures on the heel;

• Case 2 – Minimum vertical forces and maximum horizontal forces: This is the most onerous case for bearing pressures on the toe and overturning. For these the live loads will be removed.

Assumptions:

- Total retained height 3350mm
- Accidental water level assumed at 1mBGL

- Surcharge of 10kN/m2 has been taken as minimum required (BS8002)

- 150Pa safe bearing pressure
- it is assumed that the floor joists span front to back of the property

Ltoe =	2.1 m
Lheel =	0.2 m

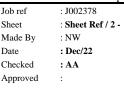
Loading (w)

Dead Load (G_k) :		kN/m ²	m	kN/m
Masonry 215mm (assumed) - reduced load by 30% due to window openings		3.7	6	22.26
Comflor (GF)		4.7	1.65	15.61
Timber floor (1st, 2nd)	2	0.8	1.65	2.64
Pitched roof		1.0	1	1.00
TOTAL LC1				41.51
TOTAL LC2				37.36
Live Load (Q_k) :		kN/m ²	m	kN/m
surcharge considered		10.00		
Comflor (GF)	2	1.5	1.65	4.95
Timber floor (1st, 2nd)	1	2.1	1.65	3.47
		1.00	1	1.00
Pitched roof				
Pitched roof				
Pitched roof				9.415



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MASTERKEY: RETAINING WALL DESIGN TO BS 8002: 1994 AND BS 8110: 1997

R1 - Front retaining wall - LC1 **Reinforced Concrete Retaining Wall with Reinforced Base** 9.5 kN @ -165 mm 0.01 kN/m² 0.00 kN.m 3350 Wall 47.3 @1847 89.18 kN.m 0.05 kN/m² 48.48 kN/m² 49.65 kN/m 35.34 kN/m² Passive Pressure Diagram At Rest Pressure Diagram Bending Moment Diagram per m run Summary of Design Data All dimensions are in mm and all forces are per metre run Notes Material Densities (kN/m³) Back Soil - Dry 20.00, Saturated 22.00, Submerged 12.00 Front Soil - Dry 18.00, Saturated 20.80, Submerged 10.80, Concrete 24.00 Concrete grade fcu 35 N/mm², Permissible tensile stress 0.250 N/mm² Wall inner cover 50 mm, Wall outer cover 35 mm, Base cover 50 mm

fy 500 N/mm² designed to BS 8110: 1997 Surcharge 0.00 kN/m², Water table level 0 mm

Therefore no sliding check is required

 $\phi = Atn(Tan(20)/1.2) = 16.87^{\circ}$

 $\phi = Atn(Tan(30)/1.2) = 25.69^{\circ}$

Front of wall 368 mm

Concrete covers (mm) Reinforcement design Surcharge and Water Table Unplanned excavation depth ⁺ The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice

Additional Loads

Wall Propped at Base Level Vertical Line Loads

† Dimensions

Soil Properties

Bearing pressure

Back Soil Friction and Cohesion Base Friction and Cohesion Front Soil Friction and Cohesion

Loading Cases

G_{Soil}- Soil Self Weight, G_{Wall}- Wall & Base Self Weight, Fv_{Heel}- Vertical Loads over Heel, P_a- Active Earth Pressure Case 1: Geotechnical Design 1.00 G_{Soil}+1.00 G_{Wall}+1.00 Fv_{Heel}+1.00 P_a $1.40 \,\, G_{\text{Soil}}{+}1.40 \,\, G_{\text{Wall}}{+}1.40 \,\, \text{Fv}_{\text{Heel}}{+}1.00 \,\, \text{Pa}$ Case 2: Structural Ultimate Design

Geotechnical Design

41.5 kN/m @ X -165 mm and Y 0 mm - Load type Dead 9.5 kN/m @ X -165 mm and Y 0 mm - Load type Live

 $\delta = Atn(0.75xTan(Atn(Tan(20)/1.2))) = 12.82^{\circ}$

Ties, line loads and partial loads are measured from the inner top edge of the wall

Premissable service pressure @ front 125.00 kN/m², @ back 125.00 kN/m²

Wall Stability - Virtual	Back Pressure		
Case 1 Overturning/Stabilising	81.690/236.903	0.345	OK
Wall Sliding - Virtual B	ack Pressure		
Fx/(Rx _{Friction} + Rx _{Passive})	0.000/(25.424+0.000)	0.000	OK

: 0.397 0.350 1005 mm ² 565 mm ² m ² 258 mm 112.8 kN.m 0.790 0.52 565 mm ²	ок ОК 1.29 ОК ОК
0.350 1005 mm² 565 mm² 112.8 kN.m 0.790 0.52	ок 1.29 ОК ОК
0.350 1005 mm² 565 mm² 112.8 kN.m 0.790 0.52	ок 1.29 ОК ОК
565 mm² m² 258 mm 112.8 kN.m 0.790 0.52	ок
565 mm² m² 258 mm 112.8 kN.m 0.790 0.52	ок
565 mm² m² 258 mm 112.8 kN.m 0.790 0.52	OK
565 mm² m² 258 mm 112.8 kN.m 0.790 0.52	OK
565 mm² m² 258 mm 112.8 kN.m 0.790 0.52	OK
	OK
565 mm ²	
1005 mm ² 260 mm 64.0 kN.m 0.012 0.06	ОК ОК ОК
112.8 kN.m	ОК
0.65	OK
n;	0.06 1005 mm ² 565 mm ² 1 ² 258 mm 112.8 kN.m 0.882



1997

37.5 kN @ -165 mm

Wall 47.3 @1847

e 2.0 kN 80 mm 64 kN 80 mm

2350

Back Soil - Dry 20.00, Saturated 22.00, Submerged 12.00

fcu 35 N/mm², Permissible tensile stress 0.250 N/mm²

Surcharge 10.00 kN/m², Water table level 2350 mm

fy 500 N/mm² designed to BS 8110: 1997

Therefore no sliding check is required

Front Soil - Dry 18.00, Saturated 20.80, Submerged 10.80, Concrete 24.00

Wall inner cover 50 mm, Wall outer cover 35 mm, Base cover 50 mm

330

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3350

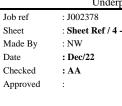
94.98 kN/m²

2032

Use $\delta = 0$ @ virtual back

Front of wall 368 mm

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MASTERKEY: RETAINING WALL DESIGN TO BS 8002: 1994 AND BS 8110: R1 - Front retaining wall - LC2 Reinforced Concrete Retaining Wall with Reinforced Base 6.67 kN/m² 0.00 kN.m

> 76.51 kN/m At Rest Pressure Diagram

138.52 kN.m Bending Moment Diagram per m run

0.05 kN/m² Passive Pressure Diagram

Summary	of Design Data
Notes	All dimensions are in mm and all forces are per metre run

Notes Material Densities (kN/m³)

Special Assumptions (virtual back) Concrete grade Concrete covers (mm) Reinforcement design Surcharge and Water Table Unplanned excavation depth + The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice

Additional Loads

Wall Propped at Base Level Vertical Line Load † Dimensions

37.5 kN/m @ X -165 mm and Y 0 mm - Load type Dead Ties, line loads and partial loads are measured from the inner top edge of the wall

Soil Properties

Bearing pressure Back Soil Friction and Cohesion Base Friction and Cohesion Front Soil Friction and Cohesion Premissable service pressure @ front 125.00 kN/m², @ back 125.00 kN/m² $\phi = Atn(Tan(23)/1.2) = 19.48^{\circ}$ $\delta = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86^{\circ}$ $\phi = Atn(Tan(30)/1.2) = 25.69^{\circ}$

Loading Cases

Gsoil- Soil Self Weight, Gwall- Wall & Base Self Weight, FvHeel- Vertical Loads over Heel, $\mathsf{P}_{\mathsf{a}}\text{-}$ Active Earth Pressure, $\mathsf{P}_{\mathsf{surcharge}}\text{-}$ Earth pressure from surcharge Case 1: Geotechnical Design 1.00 G_{Soil}+1.00 G_{Wall}+1.00 Fv_{Heel}+1.00 P_a+1.00 P_{surcharge} Case 2: Structural Ultimate Design 1.40 G_{Soil}+1.40 G_{Wall}+1.40 Fv_{Heel}+1.00 P_a+1.00 P_{surcharge}

Geotechnical Design

Wall Stability - Virtua	l Back Pressure		
Case 1 Overturning/Stabilising	136.508/201.873	0.676	OK
Wall Sliding - Virtual I	Back Pressure		
Fx/(Rx _{Friction} + Rx _{Passive})	0.000/(25.602+0.000)	0.000	OK
Prop Reaction Case 2 (Service)	107.6 kN @ Base		

		ctural Engineering Ltd	Job ref Sheet	: J002378 : Sheet Ref / 5 -	
	Unit 5, Quayside Lodge William Morris Way, Fu Tel: (0203) 4053120	ham, SW6 2UZ	Made By Date Checked	: NW : Dec/22 : AA	
	Email: info@gseltd.co.ul www.gseltd.co.uk	Web:	Approved	:	
Soil Press	ure				
Virtual Back Wall Back		94.980/125 kN/m ² , Length under pres 94.726/125 kN/m ² , Length under pres		0.760 0.758	OK OK
VVdII DdCK				0.756	UK
		Structural Des	sign		
t Rest Ea	rth Pressure				
•	essures magnification	$(1+Sin(\phi)) \times \sqrt{OCR} = (1+Sin(19.48)x_V)$	√1		1.33
rop Reac					
•	Reaction (Ultimate)	143.3 kN @ Base			
Critical Section	gn (Inner Stee	Critical @ 0 mm from base, Case 2			
Steel Provided ((Cover)	Main B20@200 (50 mm) Dist. B12@2		1571 mm²	Ok
	eel Provided (Cover)	Main B12@200 (35 mm) Dist. B12@2		565 mm²	
Leverarm z=fn(270 mm, 1000 mm, 1571 mm ² , 500 N	I/mm², 35.0 N/mm		
Mr=fn(above,As		565 mm ² , 41 mm, 49 mm, 0.18		169.5 kN.m	0
Shear Capacity	ty Check (M/Mr) Check	M 138.5 kN.m, Mr 169.5 kN.m F 119.2 kN, vc 0.651 N/mm ² , Fvr 175.	.8 kN	0.817 0.68	Ok
. ,	Steel Design	- , , , -			
Steel Provided (Main B12@200 (50 mm) Dist. B12@2	200 (62 mm)	565 mm ²	OK
	eel Provided (Cover)	- () -	200 (70 mm)	1571 mm ²	
Leverarm z=fn(274 mm, 1000 mm, 565 mm ² , 500 N/	mm ² , 35 N/mm ²	260 mm	
Mr=fn(above,As		1571 mm ² , 60 mm, 18 mm, 0.06		64.0 kN.m	
	ty Check (M/Mr)	M 1.8 kN.m, Mr 64.0 kN.m		0.029	Ok
Shear Capacity		F 18.5 kN, vc 0.459 N/mm ² , Fvr 125.8	3 KIN	0.15	Ok
Steel Provided (om Steel Desi		200 (70 mm)	1571 mm²	Ok
	eel Provided (Cover)	Main B12@200 (50 mm) Dist. B12@2		565 mm ²	UN
	()	270 mm, 1000 mm, 1571 mm ² , 500 N		248 mm	
		565 mm ² , 56 mm, 49 mm, 0.18	, , ,,	169.5 kN.m	
Leverarm z=fn(Mr=fn(above,As	<i>, u , n , n , u)</i>			0.935	OK
Leverarm z=fn(Mr=fn(above,As	ty Check (M/Mr)	M 158.4 kN.m, Mr 169.5 kN.m F 111.4 kN, vc 0.651 N/mm ² , Fvr 175.		0.935	UN

Unit 5, Quayside Lodge SWC OUT

0.000

OK

William Morris Way, Tel: (0203) 4053120	-	Date Checked	: Dec/22 : AA	
Email: info@gseltd.co www.gseltd.co.uk	D.uk Web:	Approved	:	
R2	INING WALL DESIGN TO BS 1997 - Party wall with no 18 oncrete Retaining Wall	- LC2 1	ГЕМР	
0.05 kN/m² Passive Pressure Diagram	31.5 KN @ -165 mm		urge 21 kN 40.77 kN/m ² 101.79 k	0.00 kN.m (N.m ing Moment Diagram per m run
Summary of Design Da	ata			
Notes Material Densities (kN/m ³) Special Assumptions (virtual back) Concrete grade Concrete covers (mm) Reinforcement design Surcharge and Water Table Unplanned excavation depth	All dimensions are in mm and all forces are Back Soil - Dry 20.00, Saturated 22.00, Su Front Soil - Dry 18.00, Saturated 20.80, Su Use $\delta = 0$ @ virtual back fcu 35 N/mm ² , Permissible tensile stress 0 Wall inner cover 50 mm, Wall outer cover fy 500 N/mm ² designed to BS 8110: 1997 Surcharge 5.00 kN/m ² , Water table level 0 Front of wall 368 mm rself to the reinforcement detailing requiremen	bmerged 12.0 ubmerged 10.8 0.250 N/mm ² 35 mm, Base (0 mm	0 30, Concrete 24.00 cover 50 mm	
Wall Propped at Base Level Horizontal Surge Vertical Line Load † Dimensions	Therefore no sliding check is required 21 kN acting @ -2500 mm above the top e 31.5 kN/m @ X -165 mm and Y 0 mm - Lo Ties, line loads and partial loads are meas	ad type Dead		e wall
Soil Properties Bearing pressure Back Soil Friction and Cohesion Base Friction and Cohesion Front Soil Friction and Cohesion	Premissable service pressure @ front 125. $\phi = Atn(Tan(23)/1.2) = 19.48^{\circ}$ $\delta = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 16^{\circ}$ $\phi = Atn(Tan(30)/1.2) = 25.69^{\circ}$		back 125.00 kN/m ²	
Loading Cases G _{Soi} - Soil Self Weight, G _{Wall} - Wall & B P _a - Active Earth Pressure, P _{surcharge} - E Case 1: Geotechnical Design Case 2: Structural Ultimate Design	$\begin{array}{c} 1.00 \ G_{\text{Soil}}{+}1.00 \ G_{\text{Wall}}{+}1.00 \ \text{Fv}_{\text{Heel}}{+}1.00 \ \text{P}_{\text{a}}{+} \\ 1.40 \ G_{\text{Soil}}{+}1.40 \ \text{G}_{\text{Wall}}{+}1.40 \ \text{Fv}_{\text{Heel}}{+}1.00 \ \text{P}_{\text{a}}{+} \end{array}$	1.00 P _{surcharge} 1.00 P _{surcharge}		
	Geotechnical Des	ign		
Wall Stability - Virtual Case 1 Overturning/Stabilising Wall Sliding - Virtual F	100.263/142.863		0.702	ОК

Wall Sliding - Virtual Back Pressure Fx/(Rx_{Friction}+ Rx_{Passive}) 0.000/(24.112+0.000)

Green Stru Unit 5, Quayside Lodg William Morris Way, Tel: (0203) 4053120		Job ref Sheet Made By Date Checked	: J002378 : Sheet Ref / 7 - : NW : Dec/22 : AA	
Email: info@gseltd.co www.gseltd.co.uk	uk Web:	Approved	:	
Prop Reaction Case 2 (Service)	98.2 kN @ Base			
Soil Pressure				
Virtual Back Wall Back Note:	129.267/125 kN/m ² , Length under pressum 128.840/125 kN/m ² , Length under pressum Length under pressure Is less than 75% of	e 1.411 m	1.034 1.031 Jth	Warning Warning Warning
	Structural Desig	n		
Prop Reaction				
Maximum Prop Reaction (Ultimate)	106.5 kN @ Base			
Wall Design (Inner Ste	el)			
Critical Section Steel Provided (Cover) Compression Steel Provided (Cover) Leverarm z=fn(d,b,As,fy,Fcu) Mr=fn(above,As',d',x,x/d) Moment Capacity Check (M/Mr) Shear Capacity Check	Critical @ 0 mm from base, Case 2 Main B20@150 (50 mm) Dist. B12@200 (Main B12@200 (35 mm) Dist. B12@200 (270 mm, 1000 mm, 2094 mm ² , 500 N/mm 565 mm ² , 41 mm, 65 mm, 0.24 M 101.8 kN.m, Mr 219.4 kN.m F 93.8 kN, vc 0.717 N/mm ² , Fvr 193.5 kN	(47 mm)	2094 mm² 565 mm² n² 241 mm 219.4 kN.m 0.464 0.48	OK OK OK
Base Top Steel Design				
Steel Provided (Cover) Compression Steel Provided (Cover) Leverarm z=fn(d,b,As,fy,Fcu) Mr=fn(above,As',d',x,x/d) Moment Capacity Check (M/Mr) Shear Capacity Check	Main B12@200 (50 mm) Dist. B12@200 (Main B20@150 (50 mm) Dist. B12@200 (274 mm, 1000 mm, 565 mm ² , 500 N/mm ² 2094 mm ² , 60 mm, 18 mm, 0.06 M 2.2 kN.m, Mr 64.0 kN.m F 21.2 kN, vc 0.459 N/mm ² , Fvr 125.8 kN	70 mm)	565 mm² 2094 mm² 260 mm 64.0 kN.m 0.034 0.17	ОК ОК ОК
Base Bottom Steel Des			0.17	UK
Steel Provided (Cover) Compression Steel Provided (Cover) Leverarm z=fn(d,b,As,fy,Fcu) Mr=fn(above,As',d',x,x/d) Moment Capacity Check (M/Mr)	Main B20@150 (50 mm) Dist. B12@200 (Main B12@200 (50 mm) Dist. B12@200 (270 mm, 1000 mm, 2094 mm ² , 500 N/mm 565 mm ² , 56 mm, 65 mm, 0.24 M 112.5 kN.m, Mr 219.4 kN.m	62 mm)	2094 mm ² 565 mm ² 241 mm 219.4 kN.m 0.513	ОК
Shear Capacity Check	F 100.2 kN, vc 0.717 N/mm ² , Fvr 193.5 kN	l	0.52	OK

	Project 16 Pilgrim's Lane		Job Ref. J002378	
GREEN STRUCTURAL FINGINEERING	Drawing Ref.	Calculations by NW	Checked by	Sheet
	Part of Structure Underpinning R-2	2 (party wall with no. 18	Pilgrim's Lane)	Date Dec-22
			h	= 3.35 m

The retaining walls will be designed for two load cases:

• Case 1 – Maximum vertical forces and minimum horizontal forces: This is the most onerous case for bearing pressures on the heel;

• Case 2 – Minimum vertical forces and maximum horizontal forces: This is the most onerous case for bearing pressures on the toe and overturning. For these the live loads will be removed.

Assumptions:

- Total retained height 3350mm

- Accidental water level assumed at 1mBGL

- Surcharge of 5kN/m2 has been considered for the area underneath existing floor

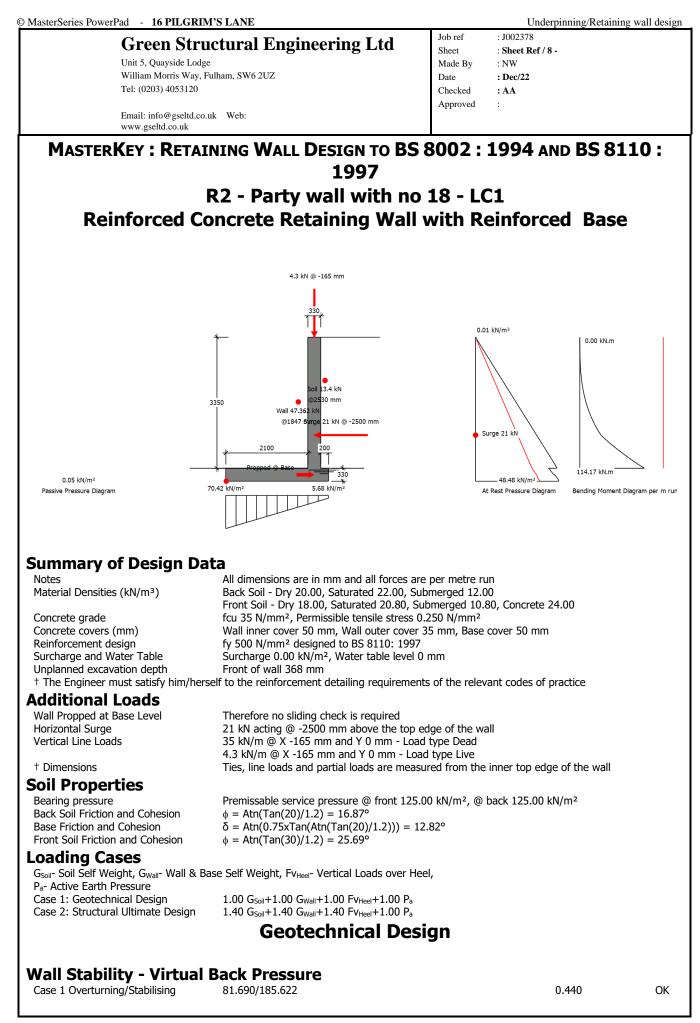
- 150Pa safe bearing pressure

- it is assumed that the floor joists of the side extension span side to side with similar arrangement considered at no.18)

Ltoe =	2.1 m
Lheel =	0.2 m

Loading (w)

Dead Load (G_k) :		kN/m ²	m	kN/m
Party wall - masonry 215mm (assumed)		5.3	4.5	23.85
Comflor (GF)		4.7	1.9	8.99
Flat roof		1.0	1.9	1.90
Surge force due to no18 flank wall (multiplied by K0)	19.55	5.3	7	37.10
		1.0	2	2.00
TOTAL LC1				34.74
TOTAL LC2				31.26
Live Load (Q_k) :		kN/m ²	m	kN/m
surcharge considered		5.00		
Suichaige considered		5.00		
Sui charge considered		5.00		
Ground floor - timber		1.5	1.9	2.85
			1.9 1.9	2.85 1.43
Ground floor - timber Flat roof	1	1.5 0.75	1.9	1.43
Ground floor - timber	1	1.5	-	
Ground floor - timber Flat roof	1	1.5 0.75	1.9	1.43



Croop Street	otural Engineering I td	ref : J002378	
Unit 5, Quayside Lodge	ctural Engineering Ltd		
William Morris Way, Fu		de By : NW e :Dec/22	
Tel: (0203) 4053120		ecked : AA	
	App	proved :	
Email: info@gseltd.co.u www.gseltd.co.uk	k Web:		
Vall Sliding - Virtual Ba	ick Pressure		
Fx/(Rx _{Friction} + Rx _{Passive})	0.000/(22.762+0.000)	0.000	O
Prop Reaction Case 2 (Service)	87.7 kN @ Base		
Soil Pressure			
Virtual Back (No uplift)	Max(62.030/125, 14.063/125) kN/m ²	0.496	0
Wall Back (No uplift)	Max(70.416/125, 5.677/125) kN/m ²	0.563	0
	Structural Design		
At Rest Earth Pressure			
At rest earth pressures magnification	$(1+Sin(\phi)) \times \sqrt{OCR} = (1+Sin(16.87)) \times \sqrt{1}$		1.2
Prop Reaction			
Maximum Prop Reaction (Ultimate)	124.0 kN @ Base		
Vall Design (Inner Stee	el)		
Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main B16@150 (50 mm) Dist. B12@200 (66 mi		0
Compression Steel Provided (Cover)	Main B12@200 (35 mm) Dist. B12@200 (47 mi	m) 565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	272 mm, 1000 mm, 1340 mm ² , 500 N/mm ² , 35.		
Mr=fn(above,As',d',x,x/d)	565 mm ² , 41 mm, 42 mm, 0.15	147.7 kN.m	
Moment Capacity Check (M/Mr)	M 114.2 kN.m, Mr 147.7 kN.m	0.773	0
Shear Capacity Check	F 109.0 kN, vc 0.615 N/mm², Fvr 167.3 kN	0.65	0
Base Top Steel Design			-
Steel Provided (Cover)	Main B12@200 (50 mm) Dist. B12@200 (62 mm		0
Compression Steel Provided (Cover)	Main B16@150 (50 mm) Dist. B12@200 (66 mi		
Leverarm z=fn(d,b,As,fy,Fcu) Mr=fn(above,As',d',x,x/d)	274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 35 N 1340 mm ² , 58 mm, 18 mm, 0.06	64.0 kN.m	
Moment Capacity Check (M/Mr)	M 1.7 kN.m, Mr 64.0 kN.m	0.027	0
Shear Capacity Check	F 17.1 kN, vc 0.459 N/mm ² , Fvr 125.8 kN	0.14	0
Base Bottom Steel Desi		0.2.1	0
Steel Provided (Cover)	Main B16@150 (50 mm) Dist. B12@200 (66 mi	n) 1340 mm ²	0
Compression Steel Provided (Cover)	Main B12@200 (50 mm) Dist. B12@200 (62 mi		0
Leverarm z=fn(d,b,As,fy,Fcu)	272 mm, 1000 mm, 1340 mm ² , 500 N/mm ² , 35		
Mr=fn(above,As',d',x,x/d)	565 mm ² , 56 mm, 42 mm, 0.15	147.7 kN.m	
Moment Capacity Check (M/Mr)	M 130.8 kN.m, Mr 147.7 kN.m	0.885	0
Shear Capacity Check	F 104.1 kN, vc 0.615 N/mm ² , Fvr 167.3 kN	0.62	0

Unit 5, Quayside Lodge William Morris Way, Fulham, SW6 2UZ

William Morris Way Tel: (0203) 4053120	, Fulham, SW6 2UZ	Date Checked	: Dec/22 : AA	
Email: info@gseltd.c www.gseltd.co.uk	o.uk Web:	Approved	:	
	INING WALL DESIGN 199 R2 - Party wall wi Concrete Retaining	7 ith no 18 - LC	2	
	31.5 kN @ -165 mm			
0.05 kN/m² Passive Pressure Diagram	330 Surcharge 1.0 kN (2230 mm Soil 9.64 kN (2230 mm Wall 47.362 kN (214N @ -2350 m 2129.02 kN/m ² 129.02 kN/m ²	nm • Su	rge 21 kN 	1.00 kN.m 2 kN.m Ing Moment Diagram per m run
	**			
Summary of Design D Notes Material Densities (kN/m ³)	ata All dimensions are in mm and a Back Soil - Dry 20.00, Saturated			
Special Assumptions (virtual back) Concrete grade Concrete covers (mm) Reinforcement design Surcharge and Water Table Unplanned excavation depth	Front Soil - Dry 18.00, Saturate Use $\delta = 0$ @ virtual back fcu 35 N/mm ² , Permissible tens Wall inner cover 50 mm, Wall of fy 500 N/mm ² designed to BS & Surcharge 5.00 kN/m ² , Water t Front of wall 368 mm erself to the reinforcement detailing to	sile stress 0.250 N/mm ² outer cover 35 mm, Base o 3110: 1997 cable level 2350 mm	cover 50 mm	
Additional Loads Wall Propped at Base Level Horizontal Surge Vertical Line Load † Dimensions	Therefore no sliding check is re 21 kN acting @ -2500 mm abov 31.5 kN/m @ X -165 mm and Y Ties, line loads and partial load	quired ve the top edge of the wa ′ 0 mm - Load type Dead		e wall
Soil Properties	Premissable service pressure @) front 125 00 kN/m2 @ k	back 125 00 kN/m2	
Bearing pressure Back Soil Friction and Cohesion Base Friction and Cohesion Front Soil Friction and Cohesion	$φ = Atn(Tan(23)/1.2) = 19.48^{\circ}$ δ = Atn(0.75xTan(Atn(Tan(23))) $φ = Atn(Tan(30)/1.2) = 25.69^{\circ}$	/1.2))) = 14.86°	Jack 125.00 kiv/iii-	
Loading Cases G _{Sol} - Soil Self Weight, G _{Wall} - Wall & P _a - Active Earth Pressure, P _{surcharge} - Case 1: Geotechnical Design Case 2: Structural Ultimate Design	$\begin{array}{c} 1.00 G_{Soil}{+}1.00 G_{Wall}{+}1.00 Fv_{Hee} \\ 1.40 G_{Soil}{+}1.40 G_{Wall}{+}1.40 Fv_{Hee} \end{array}$	a+1.00 Pa+1.00 Psurcharge a+1.00 Pa+1.00 Psurcharge		
Wall Stability - Virtua	Geotechnica I Back Pressure			
Case 1 Overturning/Stabilising	119.580/160.973		0.743	OK
Wall Sliding - Virtual I Fx/(Rx _{Friction} + Rx _{Passive})	Back Pressure 0.000/(23.744+0.000)		0.000	ОК

a a		Job ref : J002378	
Green Stru	ctural Knanggring I td	Sheet : Sheet Ref / 11 -	
Unit 5, Quayside Lodge		Made By : NW	
William Morris Way, F	ulham, SW6 2UZ	Date : Dec/22	
Tel: (0203) 4053120		Checked : AA	
		Approved :	
Email: info@gseltd.co. www.gseltd.co.uk	ık Web:		
Prop Reaction Case 2 (Service)	119.4 kN @ Base		
Soil Pressure			
Virtual Back	129.017/125 kN/m ² , Length under pressure 1	.387 m 1.032	Warning
Wall Back	128.484/125 kN/m ² , Length under pressure 1		Warning
Note:	Length under pressure Is less than 75% of th	e base width	Warning
	Structural Design		
At Rest Earth Pressure	2		
At rest earth pressures magnification	$(1+Sin(\phi)) \times \sqrt{OCR} = (1+Sin(19.48)) \times \sqrt{1}$		1.33
Prop Reaction			
Maximum Prop Reaction (Ultimate)	160.5 kN @ Base		
Wall Design (Inner Ste	el)		
Critical Section	Critical @ 0 mm from base, Case 2		
Steel Provided (Cover)	Main B20@150 (50 mm) Dist. B12@200 (70	mm) 2094 mm ²	OK
Compression Steel Provided (Cover)	Main B12@200 (35 mm) Dist. B12@200 (47		
Leverarm z=fn(d,b,As,fy,Fcu)	270 mm, 1000 mm, 2094 mm ² , 500 N/mm ² ,		
Mr = fn(above, As', d', x, x/d)	565 mm ² , 41 mm, 65 mm, 0.24	219.4 kN.m	
Moment Capacity Check (M/Mr)	M 144.8 kN.m, Mr 219.4 kN.m	0.660	OK
Shear Capacity Check	F 137.4 kN, vc 0.717 N/mm², Fvr 193.5 kN	0.71	OK
Base Top Steel Design			
Steel Provided (Cover)	Main B12@200 (50 mm) Dist. B12@200 (62		OK
Compression Steel Provided (Cover)	Main B20@150 (50 mm) Dist. B12@200 (70		
Leverarm z=fn(d,b,As,fy,Fcu)	274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 3		
Mr=fn(above,As',d',x,x/d)	2094 mm ² , 60 mm, 18 mm, 0.06	64.0 kN.m	0
Moment Capacity Check (M/Mr) Shear Capacity Check	M 1.7 kN.m, Mr 64.0 kN.m F 17.1 kN, vc 0.459 N/mm², Fvr 125.8 kN	0.027 0.14	OK
		0.14	UN
Base Bottom Steel Des Steel Provided (Cover)	Main B20@150 (50 mm) Dist. B12@200 (70	mm) 2094 mm ²	Ok
Compression Steel Provided (Cover)	Main B12@200 (50 mm) Dist. B12@200 (70		Ur Ur
Leverarm z=fn(d,b,As,fy,Fcu)	270 mm, 1000 mm, 2094 mm ² , 500 N/mm ² ,		
Mr = fn(above, As', d', x, x/d)	565 mm ² , 56 mm, 65 mm, 0.24	219.4 kN.m	
Moment Capacity Check (M/Mr)	M 172.5 kN.m, Mr 219.4 kN.m	0.786	OK
Shear Capacity Check	F 108.3 kN, vc 0.717 N/mm ² , Fvr 193.5 kN	0.56	OK

	Project 16 Pilgrim's Lane		Job Ref. J002378	
GREEN STRUCTURAL ENGINEERING	Drawing Ref.	Calculations by NW	Checked by	Sheet
	Part of Structure Underpinning R-3	3 (party wall with no. 14	Pilgrim's Lane)	Date Dec-22
	-		h	= 3.35 m

The retaining walls will be designed for two load cases:

• Case 1 – Maximum vertical forces and minimum horizontal forces: This is the most onerous case for bearing pressures on the heel;

• Case 2 – Minimum vertical forces and maximum horizontal forces: This is the most onerous case for bearing pressures on the toe and overturning. For these the live loads will be removed.

Assumptions:

- Total retained height 3350mm
- Accidental water level assumed at 1mBGL
- Surcharge of 5kN/m2 has been considered for the area underneath existing floor
- 150Pa safe bearing pressure
- it is assumed that the floor joists span front to back of the property, therefore not loading the party wall

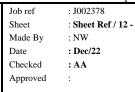
Ltoe =	1.7 m
Lheel =	0.2 m

Loading (w)

Dead Load (G_k) :			kN/m ²	m	kN/m
				-	
	Party wall - masonry 215mm (assumed)		5.3	8	42.40
	Comflor (GF)		4.7	2.1	19.87
	Timber floor (1st, 2nd)	2	0.8	2.1	3.36
	Pitched roof		1.0	1	1.00
	TOTAL LC1				66.63
	TOTAL LC2				59.96
Live Load (Q_k):			kN/m ²	m	kN/m
	surcharge considered		5.00		
	Timber floor (GF, 1st, 2nd)	3	1.5	2.1	9.45
	Timber floor (GF, 1st, 2nd) Pitched roof	3	1.5 1.00	2.1 1	9.45 1.00
		3			
	Pitched roof	3			1.00
		3			



Unit 5, Quayside Lodge



Unit 5, Quayside Lodge William Morris Way, Fu Tel: (0203) 4053120	lham, SW6 2UZ	Made By : NW Date : Dec/ Checked : AA	/22	
Email: info@gseltd.co.ul www.gseltd.co.uk	k Web:	Approved :		
F	NING WALL DESIGN TO 1997 R3 - Party wall wit ncrete Retaining N	h no 14 - LC1		
	10.5 kN @ -165 mm	0.01 kN/m²	0.00 kN.m	
0.05 kN/m² Passive Pressure Diagram	48.82 kN/m ² 71.89 kN/m ²	48.48 k At Rest Press	(N/m ²	Diagram per m run
Summary of Design Dat Notes Material Densities (kN/m ³) Concrete grade Concrete covers (mm) Reinforcement design Surcharge and Water Table Unplanned excavation depth	All dimensions are in mm and all f Back Soil - Dry 20.00, Saturated 2 Front Soil - Dry 18.00, Saturated 2 fcu 35 N/mm ² , Permissible tensile Wall inner cover 50 mm, Wall out fy 500 N/mm ² designed to BS 81 Surcharge 0.00 kN/m ² , Water tab Front of wall 368 mm	2.00, Submerged 12.00 20.80, Submerged 10.80, Cor e stress 0.250 N/mm ² er cover 35 mm, Base cover 5 10: 1997 le level 0 mm	50 mm	
[†] The Engineer must satisfy him/herse Additional Loads Wall Propped at Base Level	If to the reinforcement detailing rec Therefore no sliding check is requ		des of practice	
Vertical Line Loads † Dimensions	66.5 kN/m @ X -165 mm and Y 0 10.5 kN/m @ X -165 mm and Y 0 Ties, line loads and partial loads a	mm - Load type Dead mm - Load type Live	on edge of the well	
Soil Properties Bearing pressure Back Soil Friction and Cohesion Base Friction and Cohesion	Premissable service pressure @ fr ϕ = Atn(Tan(20)/1.2) = 16.87° δ = Atn(0.75xTan(Atn(Tan(20)/1.2))	ont 125.00 kN/m², @ back 1:		
Front Soil Friction and Cohesion Loading Cases G _{Soil} - Soil Self Weight, G _{Wall} - Wall & Bas	ϕ = Atn(Tan(30)/1.2) = 25.69° se Self Weight, Fv _{Heel} - Vertical Loads	over Heel,		
Pa- Active Earth Pressure Case 1: Geotechnical Design Case 2: Structural Ultimate Design	1.00 G _{Soli} +1.00 G _{Wall} +1.00 Fv _{Heel} + 1.40 G _{Soli} +1.40 G _{Wall} +1.40 Fv _{Heel} +	1.00 Pa		
Wall Stability - Virtual E		Design	0 220	OV
Case 1 Overturning/Stabilising Wall Sliding - Virtual Ba Fx/(RxFriction+ RxPassive)	81.690/241.322 ick Pressure 0.000/(30.618+0.000)		0.339 0.000	ОК

AasterSeries PowerPad - 16 PILGRIM	'S LANE	-	Underpinning/Retain	ing wall desig
Green Stru Unit 5, Quayside Lodge William Morris Way, Fu Tel: (0203) 4053120	ctural Engineering Ltd Iham, SW6 2UZ	Job ref Sheet Made By Date Checked Approved	: J002378 : Sheet Ref / 13 - : NW : Dec/22 : AA :	
Email: info@gseltd.co.u www.gseltd.co.uk	k Web:			
Soil Pressure		•		
Virtual Back (No uplift) Wall Back (No uplift)	Max(48.821/125, 71.891/125) kN/m ² Max(60.486/125, 60.226/125) kN/m ²		0.575 0.484	OK OK
	Structural Desig	n		
At Rest Earth Pressure At rest earth pressures magnification	$(1+Sin(\phi)) \ge \sqrt{OCR} = (1+Sin(16.87)) \le \sqrt{1}$			1.29
Prop Reaction				
Maximum Prop Reaction (Ultimate)	94.6 kN @ Base			
Vall Design (Inner Stee Critical Section Steel Provided (Cover) Compression Steel Provided (Cover)	Čritical @ 0 mm from base, Case 2 Main B16@200 (50 mm) Dist. B12@200 (6 Main B12@200 (35 mm) Dist. B12@200 (4	17 mm)	1005 mm² 565 mm²	ОК
Leverarm z=fn(d,b,As,fy,Fcu) Mr=fn(above,As',d',x,x/d)	272 mm, 1000 mm, 1005 mm ² , 500 N/mm ² 565 mm ² , 41 mm, 31 mm, 0.12	, 35.0 N/mn	112.8 kN.m	
Moment Capacity Check (M/Mr) Wall Axial Design (N/Ncap)	M 89.2 kN.m, Mr 112.8 kN.m N 144.9 kN, Ncap 4620.0 kN		0.790 0.031	OK OK
Wall Slenderness λ Kmin = (Nuz-N)/(Nuz-Nbal) M _{add} = N.Kmin.h. $\lambda^2/2000$	Leff/tk =1.96x3350.0/330.0 Min(1.0, 5133.3 - 144.9)/(5133.3 - 1911.2) 144.9x1.0x330.0x19.9 ² /2000		19.9 1.0 9.5kN.m	OK
(M+Madd)/Mr _{Axial}	M+Madd 98.6 kN, Mr _{Axai} 132.1 kN.m		0.746	OK
Shear Capacity Check	F 79.6 kN, vc 0.559 N/mm ² , Fvr 152.0 kN		0.52	OK
Steel Provided (Cover) Compression Steel Provided (Cover) Leverarm z=fn(d,b,As,fy,Fcu)	Main B12@200 (50 mm) Dist. B12@200 (6 Main B16@200 (50 mm) Dist. B12@200 (6 274 mm, 1000 mm, 565 mm ² , 500 N/mm ² ,	6 mm)	565 mm ² 1005 mm ² 260 mm	OK
Mr=fn(above,As',d',x,x/d) Moment Capacity Check (M/Mr)	1005 mm², 58 mm, 18 mm, 0.06 M 0.2 kN.m, Mr 64.0 kN.m		64.0 kN.m 0.003	ОК
Shear Capacity Check	F 1.9 kN, vc 0.459 N/mm², Fvr 125.8 kN		0.02	OK
Base Bottom Steel Desi	gn			
Steel Provided (Cover) Compression Steel Provided (Cover) Leverarm z=fn(d,b,As,fy,Fcu) Mr=fn(above,As',d',x,x/d)	Main B16@200 (50 mm) Dist. B12@200 (6 Main B12@200 (50 mm) Dist. B12@200 (6 272 mm, 1000 mm, 1005 mm ² , 500 N/mm ² 565 mm ² , 56 mm, 31 mm, 0.12	52 mm)	1005 mm² 565 mm² 258 mm 112.8 kN.m	OK
Moment Capacity Check (M/Mr)	M 97.6 kN.m, Mr 112.8 kN.m		0.865	ОК
Shear Capacity Check	F 120.0 kN, vc 0.559 N/mm ² , Fvr 152.0 kN		0.79	UK



2199

Use $\delta = 0$ @ virtual back

Front of wall 368 mm

All dimensions are in mm and all forces are per metre run

Back Soil - Dry 20.00, Saturated 22.00, Submerged 12.00

fcu 35 N/mm², Permissible tensile stress 0.250 N/mm²

Surcharge 5.00 kN/m², Water table level 2350 mm

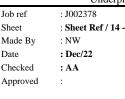
fy 500 N/mm² designed to BS 8110: 1997

Front Soil - Dry 18.00, Saturated 20.80, Submerged 10.80, Concrete 24.00

Wall inner cover 50 mm, Wall outer cover 350 mm, Base cover 50 mm

Unit 5, Quayside Lodge William Morris Way, Fulham, SW6 2UZ Tel: (0203) 4053120

Email: info@gseltd.co.uk Web: www.gseltd.co.uk



Underpinning/Retaining wall design

MAGTER VEV + DETAILING WALL DEGION TO BE 9002 + 1004 AND BE 911	-
MASTERKEY : RETAINING WALL DESIGN TO BS 8002 : 1994 AND BS 811 1997 R3 - Party wall with no 14 - LC2	0:
Reinforced Concrete Retaining Wall with Reinforced Base	
60 kN @ -165 mm	
0.05 kN/m ²	
0.05 kN/m ² Passive Pressure Diagram 104.46 kN/m ² At Rest Pressure Diagram Bending Moment Diagram	n per m run

0.05 kN/m² Passive Pressure Diagram

Summary	of	Design	Data
---------	----	--------	------

Notes Material Densities (kN/m³)

Special Assumptions (virtual back) Concrete grade Concrete covers (mm) Reinforcement design Surcharge and Water Table Unplanned excavation depth + The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice

Additional Loads

Wall Propped at Base Level Vertical Line Load † Dimensions

Therefore no sliding check is required 60 kN/m @ X -165 mm and Y 0 mm - Load type Dead Ties, line loads and partial loads are measured from the inner top edge of the wall

Soil Properties

Bearing pressure Back Soil Friction and Cohesion Base Friction and Cohesion Front Soil Friction and Cohesion Premissable service pressure @ front 125.00 kN/m², @ back 125.00 kN/m² $\phi = Atn(Tan(23)/1.2) = 19.48^{\circ}$ $\delta = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86^{\circ}$ $\phi = Atn(Tan(30)/1.2) = 25.69^{\circ}$

Loading Cases

Gsoil- Soil Self Weight, Gwall- Wall & Base Self Weight, FvHeel- Vertical Loads over Heel, Pa- Active Earth Pressure, Psurcharge- Earth pressure from surcharge Case 1: Geotechnical Design 1.00 G_{Soil}+1.00 G_{Wall}+1.00 Fv_{Heel}+1.00 P_a+1.00 P_{surcharge} Case 2: Structural Ultimate Design 1.40 G_{Soil}+1.40 G_{Wall}+1.40 Fv_{Heel}+1.00 P_a+1.00 P_{surcharge}

Geotechnical Design

Wall Stability - Virtual	Back Pressure		
Case 1 Overturning/Stabilising	119.580/203.738	0.587	OK
Wall Sliding - Virtual B	ack Pressure		
Fx/(Rx _{Friction} + Rx _{Passive})	0.000/(30.465+0.000)	0.000	OK
Prop Reaction Case 2 (Service)	98.4 kN @ Base		

MasterSeries PowerPad - 16 PILGRIM'S LANE		Underpinning/Retaining wall des		
Green Strue Unit 5, Quayside Lodge William Morris Way, Fu Tel: (0203) 4053120	ctural Engineering Ltd Iham, SW6 2UZ	Job ref Sheet Made By Date Checked	: J002378 : Sheet Ref / 15 - : NW : Dec/22 : AA	
Email: info@gseltd.co.ul www.gseltd.co.uk	K Web:	Approved	:	
Soil Pressure		-		
Virtual Back Wall Back	104.460/125 kN/m ² , Length under pressur 104.248/125 kN/m ² , Length under pressur	e 2.203 m	0.836 0.834	OK OK
	Structural Desig	n		
At Rest Earth Pressure At rest earth pressures magnification	$(1+Sin(\phi)) \times \sqrt{OCR} = (1+Sin(19.48)\times \sqrt{1})$			1.33
Prop Reaction				
Maximum Prop Reaction (Ultimate)	131.1 kN @ Base			
Wall Design (Inner Stee	el)			
Critical Section Steel Provided (Cover) Compression Steel Provided (Cover) Leverarm z=fn(d,b,As,fy,Fcu) Mr=fn(above,As',d',x,x/d)	Critical @ 0 mm from base, Case 2 Main B16@150 (50 mm) Dist. B12@200 (Main B12@200 (350 mm) Dist. B12@200 272 mm, 1000 mm, 1340 mm ² , 500 N/mm 565 mm ² , 356 mm, 42 mm, 0.15	(362 mm)	1340 mm² 565 mm² n² 253 mm 147.7 kN.m	OK
Moment Capacity Check (M/Mr)	M 119.8 kN.m, Mr 147.7 kN.m		0.811	OK
Wall Axial Design (N/Ncap)	N 121.1 kN, Ncap 4620.0 kN		0.026	OK
Wall Slenderness λ	Leff/tk = $2.00x3350.0/330.0$ Min(1.0, 5122.2, 121.1)/(5122.2, 1510.5)		20.3 1.0	OK
Kmin = (Nuz-N)/(Nuz-Nbal) M_{add} = N.Kmin.h. $\lambda^2/2000$	Min(1.0, 5133.3 - 121.1)/(5133.3 - 1519.5) 121.1x1.0x330.0x20.3 ² /2000		8.2kN.m	
(M+Madd)/Mr _{Axial}	M+Madd 127.2 kN, Mr _{Axail} 237.5 kN.m		0.535	OK
Shear Capacity Check	F 108.0 kN, vc 0.615 N/mm ² , Fvr 167.3 kN		0.65	OK
Base Top Steel Design				
Steel Provided (Cover) Compression Steel Provided (Cover) Leverarm z=fn(d,b,As,fy,Fcu) Mr=fn(above,As',d',x,x/d)	Main B12@200 (50 mm) Dist. B12@200 (Main B16@150 (50 mm) Dist. B12@200 (274 mm, 1000 mm, 565 mm ² , 500 N/mm ² 1340 mm ² , 58 mm, 18 mm, 0.06	66 mm)	565 mm² 1340 mm² 260 mm 64.0 kN.m	OK
Mi = m(above, As, a, x, x, a) Moment Capacity Check (M/Mr)	M 1.5 kN.m, Mr 64.0 kN.m		0.023	ОК
Shear Capacity Check	F 14.4 kN, vc 0.459 N/mm ² , Fvr 125.8 kN		0.11	OK
Base Bottom Steel Desi	gn			
Steel Provided (Cover) Compression Steel Provided (Cover) Leverarm z=fn(d,b,As,fy,Fcu) Mr=fn(above,As',d',x,x/d)	Main B16@150 (50 mm) Dist. B12@200 (Main B12@200 (50 mm) Dist. B12@200 (272 mm, 1000 mm, 1340 mm ² , 500 N/mm 565 mm ² , 56 mm, 42 mm, 0.15	62 mm)	1340 mm² 565 mm² 253 mm 147.7 kN.m	OK
Moment Capacity Check (M/Mr)	M 133.8 kN.m, Mr 147.7 kN.m		0.906	OK
Shear Capacity Check	F 129.7 kN, vc 0.615 N/mm ² , Fvr 167.3 kN		0.78	OK

	Project 16 Pilgrim's Lane		Job Ref. J002378	
GREEN STRUCTURAL ENGINEERING	Drawing Ref.	Calculations by NW	Checked by	Sheet
	Part of Structure Underpinning R-4	(party wall with no. 18	Pilgrim's Lane)	Date Dec-22
			h	= 0.6 m

The retaining walls will be designed for two load cases:

• Case 1 – Maximum vertical forces and minimum horizontal forces: This is the most onerous case for bearing pressures on the heel;

• Case 2 – Minimum vertical forces and maximum horizontal forces: This is the most onerous case for bearing pressures on the toe and overturning. For these the live loads will be removed.

Assumptions:

- Total retained height 600mm
- Accidental water level assumed at 1mBGL

- Surcharge of 10kN/m2 has been taken as minimum required (BS8002)

- 150Pa safe bearing pressure

Ltoe =	0.3 m
Lheel =	0.2 m

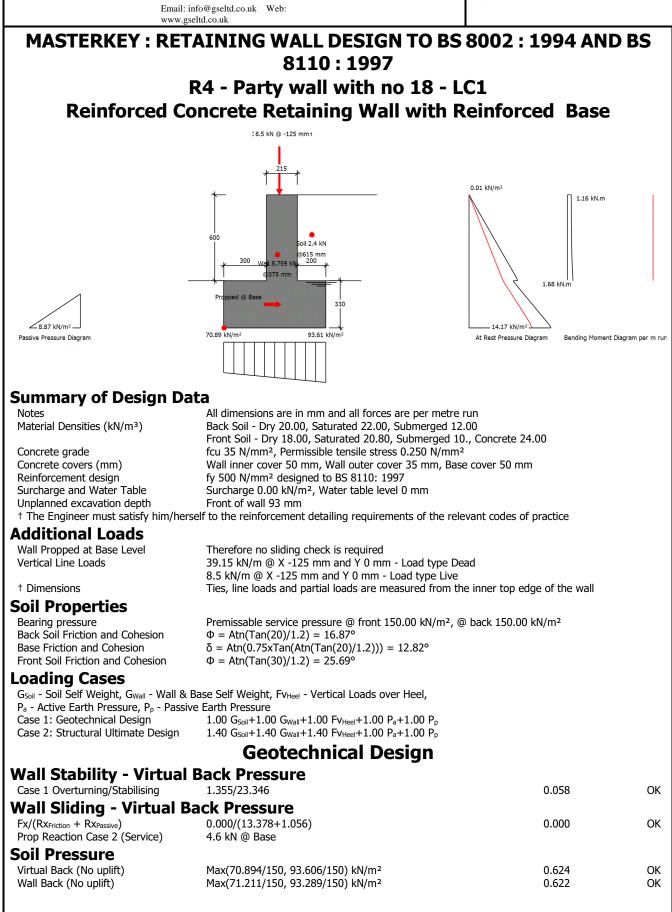
Loading (w)

Dead Load (G_k):			kN/m ²	m	kN/m
Party wall -	- masonry 215mm (assumed)		5.3	4.9	25.97
	Comflor (GF)		4.7	2.3	10.88
			1.0	2.3	2.20
	Flat Roof				2.30
	TOTAL LC1				39.15
	TOTAL LC2				35.23
$Line Load(O_{-})$					
Live Load (Q_k) :			kN/m ²	m	kN/m
Live Louid (\mathcal{Q}_k) :			kN/m²	m	kN/m
Live Loud (\mathcal{Q}_k) :	surcharge considered		kN/m² 5.00	m	kN/m
Live Loud (\mathcal{Q}_k) :	surcharge considered			m	kN/m
Live Loud (\mathcal{Q}_k) :	surcharge considered Timber floor (GF, 1st)	2		2.3	kN/m 6.90
Live Loud (\mathcal{Q}_k) :		2	5.00		
	Timber floor (GF, 1st)	2	5.00	2.3	6.90
	Timber floor (GF, 1st)	2	5.00	2.3	6.90
	Timber floor (GF, 1st)	2	5.00	2.3	6.90
	Timber floor (GF, 1st)	2	5.00	2.3	6.90



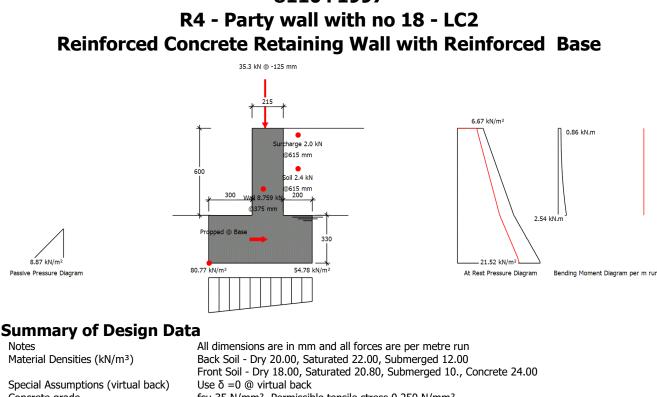
Unit 21 Berghem Mews Blythe Road, Hammersmith, W14 0HN Tel: (0203) 4053120

Job ref	: J002378
Sheet	: / 14 -
Made By	: NW
Date	: Dec/22
Checked	: AA
Approved	:



MasterSeries PowerPad -		X 1 C	10000070	Underpinn
Gree	en Structural Engineering Ltd	Job ref Sheet	: J002378	
			: / 15 - : NW	
			: Dec/22	
-	3) 4053120	Date Checked	: Dec/22 : AA	
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Email: inf www.gsel	îo@gseltd.co.uk Web: ltd.co.uk	rippioved	·	
	Structural Design			
At Rest Earth Pressure				
At rest earth pressures magnification	$(1+Sin(\Phi)) \times \sqrt{OCR} = (1+Sin(16.87)) \times \sqrt{1}$			1.2
Prop Reaction				
Maximum Prop Reaction (Ultimate)	6.1 kN @ Base			
Nall Design (Inner Stee	-			
Critical Section Steel Provided (Cover)	Critical @ 0 mm from base, Case 2 Main B10@200 (50 mm) Dist. B12@200 (60 mm)		393 mm²	C
Compression Steel Provided (Cover)	Main B12@200 (35 mm) Dist. B12@200 (60 mm)		565 mm ²	C
Leverarm z=fn(d,b,As,fy,Fcu)	160 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 35.0 N/mm	1 ²	152 mm	
Mr = fn(above, As', d', x, x/d)	565 mm ² , 41 mm, 12 mm, 0.08		26.0 kN.m	
Moment Capacity Check (M/Mr)	M 1.7 kN.m, Mr 26.0 kN.m		0.065	C
Shear Capacity Check	F 2.5 kN, vc 0.557 N/mm ² , Fvr 89.1 kN		0.03	C
Base Top Steel Design				
Steel Provided (Cover)	Main B12@200 (50 mm) Dist. B12@200 (62 mm)		565 mm²	C
Compression Steel Provided (Cover)	Main B12@200 (50 mm) Dist. B12@200 (62 mm)		565 mm²	
Leverarm z=fn(d,b,As,fy,Fcu)	274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 35 N/mm ²		260 mm	
Mr = fn(above, As', d', x, x/d)	565 mm ² , 56 mm, 18 mm, 0.06		64.0 kN.m	
Moment Capacity Check (M/Mr)	M 0.0 kN.m, Mr 64.0 kN.m		0.000	0
Shear Capacity Check	F 0.0 kN, vc 0.459 N/mm ² , Fvr 125.8 kN		0.00	C
Base Bottom Steel Desi				
Steel Provided (Cover)	Main B12@200 (50 mm) Dist. B12@200 (62 mm)		565 mm²	C
Compression Steel Provided (Cover)	Main B12@200 (50 mm) Dist. B12@200 (62 mm)		565 mm ²	
Leverarm $z=fn(d,b,As,fy,Fcu)$	274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 35 N/mm ²		260 mm 64.0 kN.m	
Mr=fn(above,As',d',x,x/d) Moment Capacity Check (M/Mr)	565 mm², 56 mm, 18 mm, 0.06 M 4.1 kN.m, Mr 64.0 kN.m		64.0 KN.M 0.065	C
Shear Capacity Check	F 28.3 kN, vc 0.459 N/mm², Fvr 125.8 kN		0.065	C

MASTERKEY: RETAINING WALL DESIGN TO BS 8002: 1994 AND BS 8110:1997



fcu 35 N/mm², Permissible tensile stress 0.250 N/mm²

Wall inner cover 50 mm, Wall outer cover 35 mm, Base cover 50 mm

fy 500 N/mm² designed to BS 8110: 1997 Surcharge 10.00 kN/m², Water table level 0 mm

Material Densities (kN/m³)

Special Assumptions (virtual back) Concrete grade Concrete covers (mm) Reinforcement design Surcharge and Water Table

en Structural Engineering Ltd erghem Mews ad, Hammersmith, W14 0HN) 4053120 o@gseltd.co.uk Web: td.co.uk Front of wall 93 mm If to the reinforcement detailing requirements of the relev	Job ref Sheet Made By Date Checked Approved	: J002378 : / 16 - : NW : Dec/22 : AA :	
erghem Mews ad, Hammersmith, W14 0HN) 4053120 o@gseltd.co.uk Web: td.co.uk Front of wall 93 mm	Made By Date Checked	: NW : Dec/22 : AA	
ad, Hammersmith, W14 0HN) 4053120 o@gseltd.co.uk Web: td.co.uk Front of wall 93 mm	Date Checked	: Dec/22 : AA	
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Front of wall 93 mm			
5 1	vant codes c	of practice	
		•	
-			
Therefore no sliding check is required	-		
35.3 kN/m @ X -125 mm and Y 0 mm - Load type Dead			
Ties, line loads and partial loads are measured from the	a inner top e	age of the wall	i.
Premissable service pressure @ front 150.00 kN/m ² , @	back 150.00	ጋ kN/m²	
$\delta = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86^{\circ}$			
$\Phi = Atn(Tan(30)/1.2) = 25.69^{\circ}$			
C-KW-t-kt. Ex			
ise Seir Weight, FV _{Heel} - Vertical Loads over Heel,			
1.40 G _{Soil} +1.40 G _{Wall} +1.40 F _{VHeel} +1.00 P _a +1.00 P _{surcharge} -	+1.00 Pp		
Geotechnical Design			
ack Pressure			
3.543/19.760		0.179	OK
ck Prossuro			
		0.000	
		0.000	OK
9.3 KN @ Base			
Max(80.766/150, 54.783/150) kN/m ²		0.538	OK
		0.531	OK
Sci decardi Design			
$(1+Sin(\Phi)) \times \sqrt{OCR} = (1+Sin(19.48)) \times \sqrt{1}$			1.33
12.2 kN @ Page			
-			
(<u> </u>			
Critical @ 0 mm from base, Case 2			
		393 mm²	OK
		565 mm ²	5
	12	152 mm	
	•	0.098	OK
F 6.4 kN, vc 0.557 N/mm ² , Fvr 89.1 kN		0.07	OK
,			51
- () - ()		565 mm²	OK
		565 mm ²	
565 mm ² , 56 mm, 18 mm, 0.06	(
M 0.0 kN.m, Mr 64.0 kN.m		0.000	OK
F 0.0 kN, vc 0.459 N/mm ² , Fvr 125.8 kN		0.00	OK
an			
		565 mm ²	OK
			UK
	6		~~~
			OK
F 27.6 kN, vc 0.459 N/mm², Fvr 125.8 kN		0.22	OK
	Premissable service pressure @ front 150.00 kN/m ² , @ $\Phi = Atn(Tan(23)/1.2) = 19.48^{\circ}$ $\delta = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86^{\circ}$ $\Phi = Atn(Tan(30)/1.2) = 25.69^{\circ}$ ase Self Weight, Fv _{Heel} - Vertical Loads over Heel, inth pressure from surcharge, P _p - Passive Earth Pressure 1.00 Goal+1.00 Gwal+1.00 FvHeel+1.00 Pa+1.00 Psurcharget 1.40 Goal+1.40 Gwal+1.40 FvHeel+1.00 Pa+1.00 Psurcharget Geotechnical Design Back Pressure 3.543/19.760 Ck Pressure 0.000/(12.856+1.056) 9.3 kN @ Base Max(80.766/150, 54.783/150) kN/m ² Max(79.631/150, 55.918/150) kN/m ² Max(79.631/150, 55.918/150) kN/m ² (1+Sin(Φ)) x $\sqrt{OCR} = (1+Sin(19.48)x/1$ 12.3 kN @ Base B) Critical @ 0 mm from base, Case 2 Main B10@200 (50 mm) Dist. B12@200 (60 mm) Main B12@200 (35 mm) Dist. B12@200 (60 mm) Main B12@200 (50 mm) Dist. B12@200 (62 mm) 255 mm ² , 41 mm, 12 mm, 0.08 M 2.5 kN.m, Mr 26.0 kN.m F 6.4 kN, vc 0.557 N/mm ² , Fvr 89.1 kN Main B12@200 (50 mm) Dist. B12@200 (62 mm) 274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 35. N/mm ² 565 mm ² , 56 mm, 18 mm, 0.06 M 0.0 kN.m, Mr 64.0 kN.m F 0.0 kN, vc 0.459 N/mm ² , Fvr 125.8 kN Gn Main B12@200 (50 mm) Dist. B12@200 (62 mm) 274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 35 N/mm ² 565 mm ² , 56 mm, 18 mm, 0.06 M 0.0 kN.m, Mr 64.0 kN.m F 0.0 kN, vc 0.459 N/mm ² , Fvr 125.8 kN Gn Main B12@200 (50 mm) Dist. B12@200 (62 mm) 274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 35 N/mm ² 565 mm ² , 56 mm, 18 mm, 0.06 M 0.0 kN.m, Mr 64.0 kN.m F 0.0 kN, wc 0.459 N/mm ² , Fvr 125.8 kN Gn Main B12@200 (50 mm) Dist. B12@200 (62 mm) 274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 35 N/mm ² 565 mm ² , 56 mm, 18 mm, 0.06 M 4.2 kN.m, Mr 64.0 kN.m	Premissable service pressure @ front 150.00 kN/m ² , @ back 150.00 $\Phi = Atn(Tan(23)/1.2) = 19.48^{\circ}$ $\delta = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86^{\circ}$ $\Phi = Atn(Tan(30)/1.2) = 25.69^{\circ}$ ase Self Weight, Fv _{ited} - Vertical Loads over Heel, inth pressure from surcharge, P _p - Passive Earth Pressure 1.00 G _{sol} +1.00 G _{wall} +1.00 Fv _{ited} +1.00 P _a +1.00 P _{aurdarge} +1.00 P _p 1.40 G _{sol} +1.40 G _{wall} +1.40 Fv _{ited} +1.00 P _a +1.00 P _{aurdarge} +1.00 P _p 1.40 G _{sol} +1.40 G _{wall} +1.40 Fv _{ited} +1.00 P _a +1.00 P _{aurdarge} +1.00 P _p Geotechnical Design Back Pressure 3.543/19.760 ck Pressure 0.000/(12.856+1.056) 9.3 kN @ Base Max(80.766/150, 54.783/150) kN/m ² Max(79.631/150, 55.918/150) kN/m ² Max(79.631/150, 55.918/150) kN/m ² Structural Design (1+Sin(Φ)) x $\sqrt{OCR} = (1+Sin(19.48)x\sqrt{1}$ 12.3 kN @ Base 10 Critical @ 0 mm from base, Case 2 Main B10@200 (50 mm) Dist. B12@200 (60 mm) Main B12@200 (35 mm) Dist. B12@200 (47 mm) 160 mm, 1000 mm, 393 mm ² , 500 N/mm ² , 35.0 N/mm ² 565 mm ² , 41 mm, 12 mm, 0.08 M 2.5 KN.m, Mr 26.0 kN.m F 6.4 kN, vc 0.557 N/mm ² , Fvr 89.1 kN Main B12@200 (50 mm) Dist. B12@200 (62 mm) Main B12@200 (50 mm) Dist. B12@200 (62 mm) Main B12@200 (50 mm) Dist. B12@200 (62 mm) 274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 35 N/mm ² 565 mm ² , 56 mm, 18 mm, 0.06 M 0.0 kN.m, Mr 64.0 kN.m F 0.0 kN, vc 0.459 N/mm ² , Fvr 125.8 kN 9n Main B12@200 (50 mm) Dist. B12@200 (62 mm) Main B12@200 (50 mm) Dist. B12@200 (62 mm) Main B12@200 (50 mm) Dist. B12@200 (62 mm) 274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 35 N/mm ² 565 mm ² , 56 mm, 18 mm, 0.06 M 0.0 kN.m, Mr 64.0 kN.m F 0.0 kN, vc 0.459 N/mm ² , Fvr 125.8 kN 9n Main B12@200 (50 mm) Dist. B12@200 (62 mm) Main B12@200 (50 mm) Dist. B12@200 (62 mm) 274 mm, 1000 mm, 565 mm ² , 500 N/mm ² , 35 N/mm ² 565 mm ² , 56 mn, 18 mm, 0.06 M 0.2 kN.m, Mr 64.0 kN.m	δ = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86° Φ = Atn(Tan(30)/1.2) = 25.69° ase Self Weight, FVHeel - Vertical Loads over Heel, inth pressure from surcharge, Pp - Passive Earth Pressure 1.00 Gsout-1.00 Gwat+1.00 Pa+1.00 Part.00 Partbarge+1.00 Pp 1.40 Gsout-1.40 Gwat+1.40 FVHeel+1.00 Pa+1.00 Partbarge+1.00 Pp Geotechnical Design Sack Pressure 3.543/19.760 0.179 Ck Pressure 0.000/(12.856+1.056) 0.000 9.3 kN @ Base Max(80.766/150, 54.783/150) kN/m2 0.538 Max(79.631/150, 55.918/150) kN/m2 0.531 Structural Design (1+Sin(Φ)) x √OCR = (1+Sin(19.48)x√1 12.3 kN @ Base Si Critical @ 0 mm from base, Case 2 Main B10@200 (50 mm) Dist. B12@200 (60 mm) 393 mm2 Main B12@200 (35 mm) Dist. B12@200 (47 mm) 565 mm2 160 mm, 1000 mm, 393 mm3, 500 N/mm2, 35.0 N/mm2 152 mm 555 mm2, 41 mm, 12 mm, 0.08 26.0 kN.m M 2.5 kN.m, Mr 26.0 kN.m 0.098 F 6.4 kN, vc 0.557 N/mm2, Fvr 89.1 kN 0.07 Main B12@200 (50 mm) Dist. B12@200 (62 mm) 565 mm2 274 mm, 1000 mm, 555 mm3, 500 N/mm2, 35 N/mm2 260 mm 555 mm2, 56 mm, 18 mm, 0.06 64.0 kN.m M 0.0 kN.m, Mr 64.0 kN.m 0.000 F 0.0 kN, vc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, vc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, wc 0.459 N/mm2, Fvr 125.8 kN 0.000 F 0.0 kN, w

	Project 16 Pilgrim's Lane		Job Ref. J002378	
GREEN STRUCTURAL ENGINEERING	Drawing Ref.	Calculations by NW	Checked by	Sheet
	Part of Structure Underpinning R-5	; (party wall with no. 14	Pilgrim's Lane)	Date Dec-22
			h	= 3.35 m

The retaining walls will be designed for two load cases:

• Case 1 – Maximum vertical forces and minimum horizontal forces: No considered as no vertical forces are acting no this wall;

• Case 2 – Minimum vertical forces and maximum horizontal forces: This is the most onerous case for bearing pressures on the toe and overturning. For these the live loads will be removed.

Assumptions:

- Total retained height 3350mm
- Accidental water level assumed at 1mBGL
- Surcharge of 10kN/m2 has been taken as minimum required (BS8002)
- 150Pa safe bearing pressure

Ltoe = raft	m
Lheel =	0.2 m

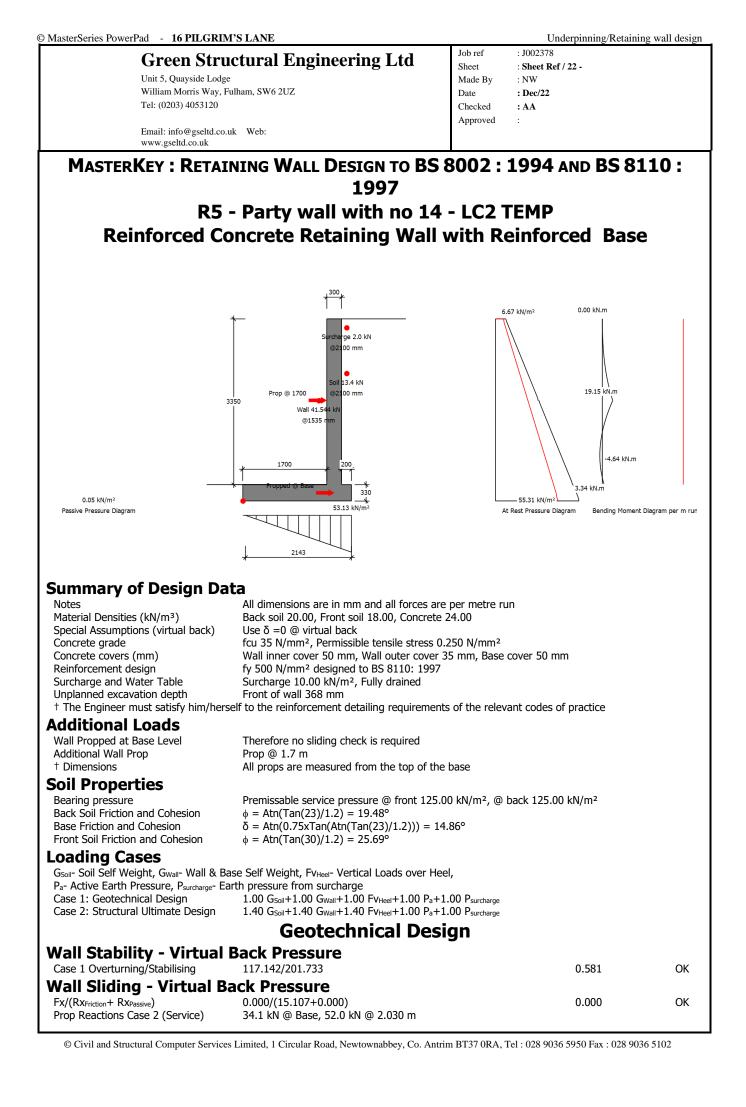
Loading (w)

		kN/m ²	m	kN/m
No vertical load	ing			
	No vertical load	No vertical loading		

	TOTAL LC2				0.00
Live Load (Q_k) :			kN/m ²	m	kN/m
	surcharge considered		10.00		
	No vertical loadir	ng			
					•

TOTAL LC2	
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0.00



	Green Struc Unit 5, Quayside Lodge William Morris Way, Ful Tel: (0203) 4053120	etural Engineering Ltd	Job ref Sheet Made By Date Checked Approved	: J002378 : Sheet Ref / 23 - : NW : Dec/22 : AA :	
	Email: info@gseltd.co.uk www.gseltd.co.uk	Web:			
Soil Press	ure		-		
Virtual Back Wall Back		53.133/125 kN/m ² , Length under pressure 53.139/125 kN/m ² , Length under pressure		0.425 0.425	OK OK
		Structural Desig			
At Rest Ea	rth Pressure				
	essures magnification	$(1+Sin(\phi)) \times \sqrt{OCR} = (1+Sin(19.48)) \times \sqrt{1}$			1.33
Prop Reac	tions Reactions (Ultimate)	45.3 kN @ Base, 69.2 kN @ 1.700 m			
•	in (Inner Stee				
Critical Section Steel Provided (Compression St Leverarm z=fn(Mr=fn(above,As	(Cover) eel Provided (Cover) d,b,As,fy,Fcu) 5',d',x,x/d) ty Check (M/Mr)	Critical @ 1700 mm from base, Case 2 Main B20@200 (50 mm) Dist. B12@200 (Main B12@200 (35 mm) Dist. B12@200 (240 mm, 1000 mm, 1571 mm ² , 500 N/mm 565 mm ² , 41 mm, 49 mm, 0.20 M 19.2 kN.m, Mr 149.0 kN.m F 40.1 kN, vc 0.697 N/mm ² , Fvr 167.4 kN	(47 mm)	1571 mm ² 565 mm ² 1 ² 218 mm 149.0 kN.m 0.128 0.24	ОК ОК ОК
	gn (Outer Stee			0.21	
Critical Section Steel Provided ((Cover) eel Provided (Cover) d,b,As,fy,Fcu)	Critical @ 590 mm from base, Case 2 Main B12@200 (35 mm) Dist. B12@200 (Main B20@200 (50 mm) Dist. B12@200 (259 mm, 1000 mm, 565 mm ² , 500 N/mm ² 1571 mm ² , 60 mm, 18 mm, 0.07	(70 mm)	565 mm² 1571 mm² 2 246 mm 60.5 kN.m	OK
Moment Capacit Shear Capacity	ty Check (M/Mr)	M 4.6 kN.m, Mr 60.5 kN.m F 0.0 kN, vc 0.475 N/mm², Fvr 122.9 kN		0.077 0.00	OK OK
	Steel Design	1 0.0 KN, VC 0.475 N/IIIIT , I VI 122.9 KN		0.00	
Steel Provided (Compression St Leverarm z=fn(Mr=fn(above,As	Cover) eel Provided (Cover) d,b,As,fy,Fcu) 5',d',x,x/d)	Main B12@200 (50 mm) Dist. B12@200 (Main B20@150 (50 mm) Dist. B12@200 (274 mm, 1000 mm, 565 mm ² , 500 N/mm ² 2094 mm ² , 60 mm, 18 mm, 0.06	(70 mm)	565 mm² 2094 mm² 260 mm 64.0 kN.m	ОК
Moment Capacil Shear Capacity	ty Check (M/Mr) Check	M 1.4 kN.m, Mr 64.0 kN.m F 9.4 kN, vc 0.459 N/mm², Fvr 125.8 kN		0.022 0.07	OK OK
	om Steel Desig				
Leverarm z=fn(Mr=fn(above,As	eel Provided (Cover) d,b,As,fy,Fcu) 5',d',x,x/d)	Main B20@150 (50 mm) Dist. B12@200 (Main B12@200 (50 mm) Dist. B12@200 (270 mm, 1000 mm, 2094 mm ² , 500 N/mm 565 mm ² , 56 mm, 65 mm, 0.24	(62 mm)	2094 mm² 565 mm² 241 mm 219.4 kN.m	Ok
	ty Check (M/Mr) Check	M 9.0 kN.m, Mr 219.4 kN.m F 27.6 kN, vc 0.717 N/mm ² , Fvr 193.5 kN		0.041 0.14	OK OK



1997 R5 - Party wall with no 14 - LC2

> ge 2.0 kN 00 mm

.64 kN 00 mm

2350

330

Wall 55.008 kN @2652 mm

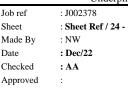
Unit 5, Quayside Lodge William Morris Way, Fulham, SW6 2UZ Tel: (0203) 4053120

Email: info@gseltd.co.uk Web: www.gseltd.co.uk

3350

55.27 kN/

2412



6.67 kN/m

76.51 kN/m

At Rest Pressure Diagra

Underpinning/Retaining wall design

MASTERKEY: RETAINING WALL DESIGN TO BS 8002: 1994 AND BS 8110: **Reinforced Concrete Retaining Wall with Reinforced Base** 0.00 kN.m 138.52 kN.m

Bending Moment Diagram per m ru

0.05 kN/m² Passive Pressure Diagram

Summary of Design Data

Notes All dimensions are in mm and all forces are per metre run Material Densities (kN/m³) Back Soil - Dry 20.00, Saturated 22.00, Submerged 12.00 Front Soil - Dry 18.00, Saturated 20.80, Submerged 10.80, Concrete 24.00 Special Assumptions (virtual back) Use $\delta = 0$ @ virtual back Concrete grade fcu 35 N/mm², Permissible tensile stress 0.250 N/mm² Concrete covers (mm) Wall inner cover 50 mm, Wall outer cover 35 mm, Base cover 50 mm fy 500 N/mm² designed to BS 8110: 1997 Reinforcement design Surcharge and Water Table Surcharge 10.00 kN/m², Water table level 2350 mm Unplanned excavation depth Front of wall 368 mm ⁺ The Engineer must satisfy him/herself to the reinforcement detailing requirements of the relevant codes of practice Additional Loads Wall Propped at Base Level Therefore no sliding check is required + Dimensions Soil Properties Bearing pressure Premissable service pressure @ front 125.00 kN/m², @ back 125.00 kN/m² Back Soil Friction and Cohesion $\phi = Atn(Tan(23)/1.2) = 19.48^{\circ}$ Base Friction and Cohesion $\delta = Atn(0.75xTan(Atn(Tan(23)/1.2))) = 14.86^{\circ}$ Front Soil Friction and Cohesion $\phi = Atn(Tan(30)/1.2) = 25.69^{\circ}$ Loading Cases Gsoil- Soil Self Weight, Gwall- Wall & Base Self Weight, FvHeel- Vertical Loads over Heel, Pa- Active Earth Pressure, Psurcharge- Earth pressure from surcharge Case 1: Geotechnical Design 1.00 G_{Soil}+1.00 G_{Wall}+1.00 Fv_{Heel}+1.00 P_a+1.00 P_{surcharge} Case 2: Structural Ultimate Design 1.40 G_{Soil}+1.40 G_{Wall}+1.40 Fv_{Heel}+1.00 P_a+1.00 P_{surcharge} **Geotechnical Design** Wall Stability - Virtual Back Pressure Case 1 Overturning/Stabilising 136.508/190.090 0.718 OK Wall Sliding - Virtual Back Pressure 0.000/(17.682+0.000)Fx/(RxFriction+ RxPassive) 0.000 OK Prop Reaction Case 2 (Service) 107.6 kN @ Base

Approved : /125 kN/m², Length under pressure 2.412 m 0.442 /125 kN/m², Length under pressure 2.42 m 0.441 under pressure Is less than 75% of the base width 0.441 Structural Design 0.441 (ϕ)) x $\sqrt{OCR} = (1+Sin(19.48)x\sqrt{1})$ 1 (ϕ) mm from base, Case 2 20@200 (50 mm) Dist. B12@200 (70 mm) 1571 mm² 565 mm² 12@200 (35 mm) Dist. B12@200 (47 mm) 565 mm² 1 n, 1000 mm, 1571 mm², 500 N/mm², 35.0 N/mm² 218 mm	Ok Ok Warning 1.33 Ok
(125 kN/m², Length under pressure 2.42 m 0.441 under pressure Is less than 75% of the base width Structural Design (ϕ)) x $\sqrt{OCR} = (1+Sin(19.48)x\sqrt{1})$ (ϕ) 0 mm from base, Case 2 20@200 (50 mm) Dist. B12@200 (70 mm) 1571 mm² 12@200 (35 mm) Dist. B12@200 (47 mm) 565 mm²	Ok Warning 1.33
(125 kN/m², Length under pressure 2.42 m 0.441 under pressure Is less than 75% of the base width Structural Design (ϕ)) x $\sqrt{OCR} = (1+Sin(19.48)x\sqrt{1})$ (ϕ) 0 mm from base, Case 2 20@200 (50 mm) Dist. B12@200 (70 mm) 1571 mm² 12@200 (35 mm) Dist. B12@200 (47 mm) 565 mm²	Ok Warning 1.33
(ϕ)) x √OCR = (1+Sin(19.48)x√1 N @ Base @ 0 mm from base, Case 2 20@200 (50 mm) Dist. B12@200 (70 mm) 1571 mm ² 12@200 (35 mm) Dist. B12@200 (47 mm) 565 mm ²	
© 0 mm from base, Case 2 20@200 (50 mm) Dist. B12@200 (70 mm) 1571 mm ² 12@200 (35 mm) Dist. B12@200 (47 mm) 565 mm ²	
© 0 mm from base, Case 2 20@200 (50 mm) Dist. B12@200 (70 mm) 1571 mm ² 12@200 (35 mm) Dist. B12@200 (47 mm) 565 mm ²	
@ 0 mm from base, Case 2 20@200 (50 mm) Dist. B12@200 (70 mm) 1571 mm ² 12@200 (35 mm) Dist. B12@200 (47 mm) 565 mm ²	ОК
@ 0 mm from base, Case 2 20@200 (50 mm) Dist. B12@200 (70 mm) 1571 mm ² 12@200 (35 mm) Dist. B12@200 (47 mm) 565 mm ²	Ok
20@200 (50 mm) Dist. B12@200 (70 mm) 1571 mm² 12@200 (35 mm) Dist. B12@200 (47 mm) 565 mm²	Ok
n², 41 mm, 49 mm, 0.20 149.0 kN.m	
5 kN.m, Mr 149.0 kN.m 0.929 2 kN, vc 0.697 N/mm², Fvr 167.4 kN 0.71	OK OK
12@200 (50 mm) Dist. B12@200 (62 mm) 565 mm² 20@150 (50 mm) Dist. B12@200 (70 mm) 2094 mm² n, 1000 mm, 565 mm², 500 N/mm², 35 N/mm² 260 mm m², 60 mm, 18 mm, 0.06 64.0 kN.m	Ok
,	OK
אויז, vc 0.459 iv/mm², fvf 125.8 kiv 0.15	Ok
12@200 (50 mm) Dist. B12@200 (62 mm) 565 mm ² n, 1000 mm, 2094 mm ² , 500 N/mm ² , 35 N/mm ² 241 mm	Ok
8 kN.m, Mr 219.4 kN.m 0.769	OK OK
	kN, vc 0.459 N/mm², Fvr 125.8 kN 0.15 20@150 (50 mm) Dist. B12@200 (70 mm) 2094 mm² 12@200 (50 mm) Dist. B12@200 (62 mm) 565 mm² n, 1000 mm, 2094 mm², 500 N/mm², 35 N/mm² 241 mm n², 56 mm, 65 mm, 0.24 219.4 kN.m

GREEN	Project	Project 16 Pilgrim's Lane		rim's Lane Project No. J00237		J002378
GDE STRUCTURAL ENGINEERING	Calculations by	NW	Checked by	AA	Sheet No.	1
	Element	Slab design			Date	December 2022

1) Slab design @ lower ground floor level

Slab at lower ground floor level, to be ground bearing and span between the toes of the existing underpins, is to be doweled into the R/C underpins, to tie the floor together. The slab will be designed for a condition for hydrostatic pressure, where water level is passed to in below ground level

Assumption	
Min slab span	4.00 m
Depth of the slab	0.3 m
Factored load for Water	1.00
Factored load for concrete	1.00
Loading to lower ground floor slab - design as	s a 1.00m strip - simply supported
Load due to hydrostatic pressure	
2.35 m x 10.00 kN/m ³ =	23.50 kN/m ²
Load due to heave	
3.35 m x $20 \text{ kN/m}^3 \text{ x50\%} =$	33.50 kN/m ² Clays only
Max Uplift	33.50 kN/m2
Self Weight of slab +Screed	
0.30 m x 24.00 kN/m ³ =	7.20 kN/m ²
0.08 m x 24.00 kN/m ³ =	1.80 kN/m ²
	9.00 kN/m2
Net Ultimate uplift	
(1.20 x 23.5) - (0.9 x 9) x 1.00 m =	24.50 kN/m
Slab design - design as a 1.00m strip - simply supp	ported
	A393 MESH $\phi =$ 10 mm
steel cover	50 mm
Effective depth d =	235 mm
Design Moment - $[w \cdot l^2]/8 =$	49.00 kNm (Hogging)
Shear Force - $[w \cdot I]/2 =$	49.00 kN
$K = M / (f_{cu} \cdot b \cdot d^2) =$	0.0254
z = d [0.5 + v(0.25-K/0.9)	228 mm ≤ 0.95d
z =	223.25 mm
$A_{s} = M / (0.87 \cdot F_{y} \cdot z)$	505 mm ² /m width of slab
Min area of reinforcement = 0.13 % b·d =	305.5 mm ² /m width of slab <u>Provide As</u>
∴ Use 2 x A393 mesh	786 mm ² /m width of slab
∴ Use H 0 Bars @ 200 crs T&B	0 mm ² /m width of slab
A_s provided =	786 mm ² /m width of slab <u>Verified</u>

^{Project} 16 Pilgrim's Lane		Job Ref. J002378	
Drawing Ref.	Calculations by NW	Checked by	Sheet 5
Part of Structure BOUYANCY CHECK		Date Jan-00	

BUOYANCY CHECK

TOTAL WEIGHT OF THE BUILDING

 $F_{weight total} = floor loading + underpin weight + party wall load =$

Loading (w)

Dead Load (G_k) :	kN/m ²	m	m ²	kN
		76.0		
		76.0		4000
External masonry walls - 215mm (3m H, 76m L) GF and				1208
1st	5.30			
External masonry walls - 215mm (av 1.5m H, 16m L)	5.30	16.0		127
RC Retaining walls (330mm thk, 3.35m H, 34m L)	8.09	34.0		921
RC Liftcore walls (150thkm, 8.5m H, 10m L)	3.68	10.0		312
Basement Slab 330mm thk	9.74		147.66	1437
Comflor (GF)	4.73		80	378
Timber floor - 1st	0.80		110	88
Timber floor - 2nd	0.80		70	56
Roof	1.00		100	100
		=	4629	kN

4629 kN

ON DEAD LOAD)

4165.9 x0.9 factor

TOTAL UPLIFT DUE TO HEAVE AND GROUNDWATER

$F_{uplift\ total} = w_{total\ upward\ force} *$	Aslab =	3470 kN	x1.0	factor
(where w_(total upward force) =	23.5 kN/ı	m2)		
(where Aslab =	147.66 m2)			
EQUILIERIEIRI ^{t total} facteriedighertotal	F aptifreti ota≥ 4166	F _{uplift to}	otal 3470	
EQUILIBRIUM SATISFIED		UR		1.20 (CONSIDERS 0.9 FACTOR

	Project 16 Pilgrim's Lane		Job Ref. J002378	
GREEN STRUCTURAL FINGINEERING	Drawing Ref.	Calculations by NW	Checked by	Sheet 5
	Part of Structure BOUYANCY CHECK - AF BOUYANCY	REA CONSIDERED FOR	^{Date} Jan-00	

LOWER GROUND FLOOR AREA CONSIDERED FOR BOUYANCY UNDER MAIN HOUSE. DUE TO CHANGE OF REAR, REAR IS CONSIDERED TO BE OPEN SPACE AND AT SIMILAR LEVEL TO EXTERNAL GROUND SO NO BOUYANCY APPLICABLE FOR REAR AREA.

