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BASEMENT CALCULATION
(RC Retaining wall)

FOR

Basement Design
(Planning Application)

at

70 Gascony Avenue
London
NW6 4NE

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Date June 22	Sheet No.
Eng. SG	1
Job No. 21.535	

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NW6 4NG

General Loading

Loading		DL	IL
Pitched Roof			
Dead Load -	Tiles / Roof Finishes	0.80	
	Battens + felt	0.10	
	Rafters + Insulation	0.20	
	Ceiling + Services	0.15	
Imposed Load -	Snow		0.60
		1.25 kN/m²	0.60 kN/m²
Flat Roof			
Dead Load -	Waterproofing + Roof Finishes	0.60	
	Boards + Joists + fixing	0.25	
	Ceiling + Services	0.15	
Imposed Load -	Snow + Access	1.10 kN/m²	0.75 kN/m²
" -	Balcony Terrace		1.50 kN/m²
Suspended Timber Floor			
Dead Load -	Finishes	0.05	
	Timber board / Plyboard	0.15	
	Timber Joists + Insulation	0.25	
	Ceiling + Services	0.15	
Imposed Load -	Residential		1.50
		0.60 kN/m²	1.50 kN/m²
Existing Masonry (225mm Brickwall)			
Dead Load -	215mm Brickwall	4.30	
	Plaster	0.44	
		4.75 kN/m²	
Existing Masonry (325mm Brickwall)			
Dead Load -	325 mm Brickwall	6.50	
	Plaster	0.44	
		6.95 kN/m²	
Cavity Wall			
Dead Load -	100 Brick	2.00	
	Insulation	0.05	
	100 Block	1.50	
	Plaster + Render	0.44	
		4.00 kN/m²	

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Date June 22	Sheet No. 2
Eng. SG	
Job No. 21.535	

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	DL	IL
Masonry Inlall (110mm Brickwall)		
Dead Load - 100mm Brickwall	2.00	
Plaster 2 faces	0.44	
	2.45 kN/m²	
Internal Timber Stud Inlall		
Dead Load - Plywood / Plasterboard	0.15	
stud	0.10	
Plywood / Plasterboard	0.15	
	0.40 kN/m²	

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Date June 22	Sheet No.
Eng. SG	3
Job No. 21-535	

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Basement Design

Design Consideration
Surcharge Earth and Water

Loading

Surcharge

From BS 8002
Surcharge q = 10.00 kN/m²
5.00 kN/m² for Build up Earth
2.00 kN/m² for Inside House - Imposed

Earth Pressure

From Site Analytical Service Ltd
Basement Impact Assesment
* Site Investigation Data (Section 5)
* Foundation Design (Section 6)

Soil - Made ground over London Clay Formation
"silty sand clay. partings of silty fine sand and gypsum crystals
Bearing Pressure - 200 kN/m² @ 3.00m
Using ≏ 150 kN/m²

Water Pressure

From Site Analytical Service Ltd
Basement Impact Assesment
* Site Investigtion Data (Section 5)
* Foundation Design (Section 6)

Water was found at Borehole 1, 6.14m below ground
Design will be based on water pressure of two-third height of design retaining wall or borehole data or which is greater

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Date June 22	Sheet No. 4
Eng. SG	
Job No. 21.535	

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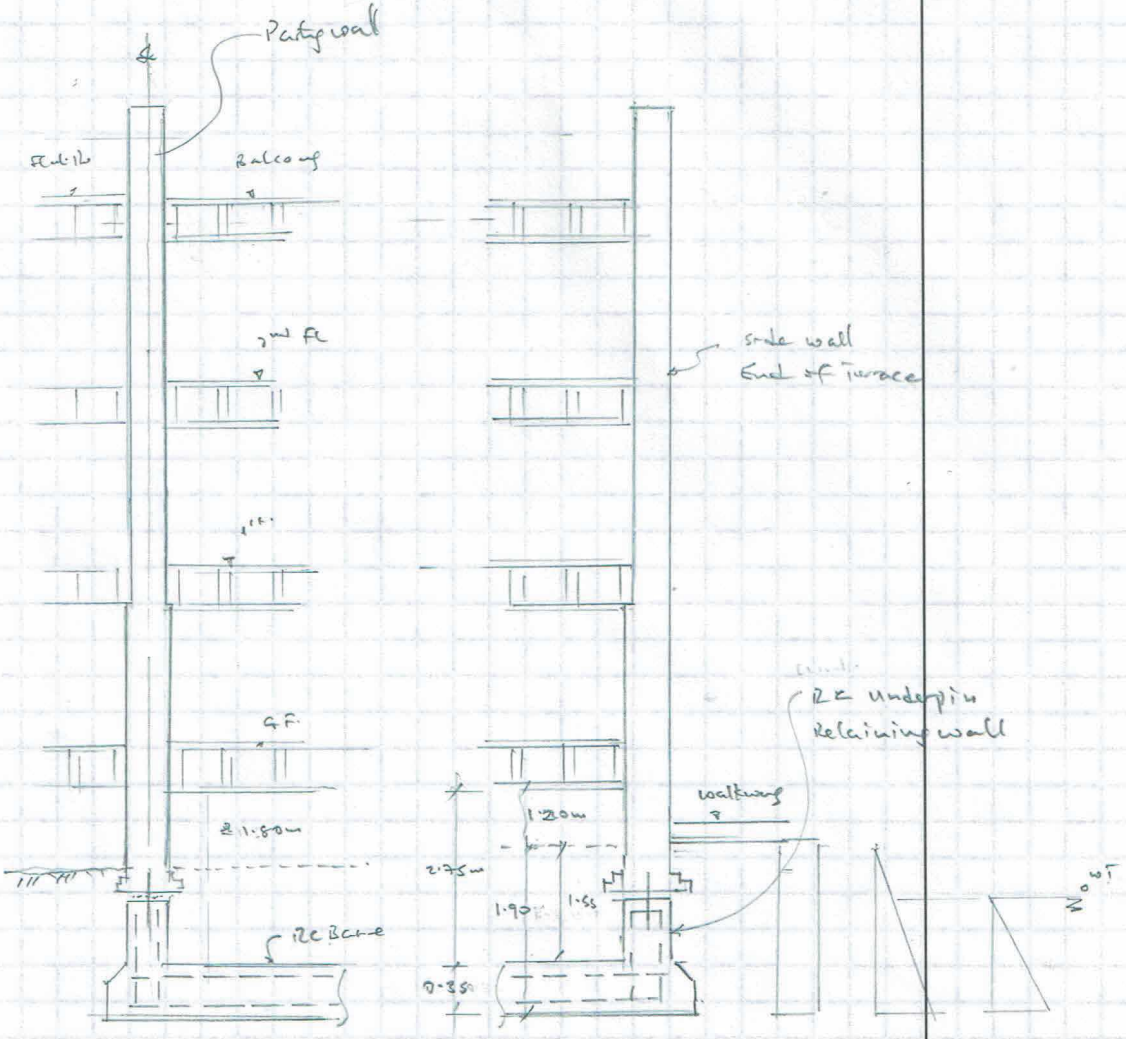
Load takedown to Masonry Party wall Foundation (Perimeter wall)



Load	Party wall worst case	DL	LL	DL + LL
Roof/Balcony	DL- 1.20kN/m² x say 0.5 x 2m	1.20		
	LL - 2.50kN/m² x 0.50m x 2m		2.50	
2nd + 1st + GR	DL - 0.70kN/m² x 0.50m x 3 Fl x 2	2.10		
	LL - 1.50kN/m² x 0.50m x 3 Fl x 2		4.50	
Masonry (225)	DL- 4.80kN/m² x say 7.50	36.00		
Masonry (220)	DL- 7.10kN/m² x say 5.00	35.50		
Beam A1	⇒ R1 = 16.40DL + 24.00LL } / 5.00m =	4.30	4.50	
Beam A2	⇒ R2 = 17.90DL + 14.4LL } / 5.00m =			
Total @ Top of RC wall		79.58kN/m	11.50kN/m	(SLS) 91.38kN/m

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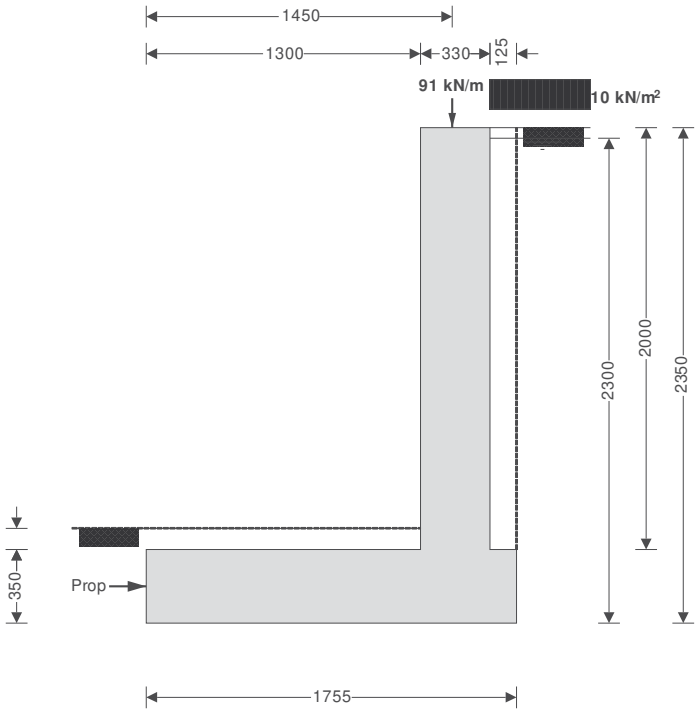
Project		Job no.			
70 Gascony Avenue		21.535			
Calcs for		Start page no./Revision			
Underpin RC Rataining Wall		5			
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
SG	June 2022				

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} = **2000** mm	Wall stem thickness	t_{wall} = **330** mm
Length of toe	l_{toe} = **1300** mm	Length of heel	l_{heel} = **125** mm
Overall length of base	l_{base} = **1755** mm	Base thickness	t_{base} = **350** mm
Height of retaining wall	h_{wall} = **2350** mm		
Depth of downstand	d_{ds} = **0** mm	Thickness of downstand	t_{ds} = **350** mm
Position of downstand	l_{ds} = **420** mm		
Depth of cover in front of wall	d_{cover} = **100** mm	Unplanned excavation depth	d_{exc} = **0** mm
Height of ground water	h_{water} = **2300** 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} = **2350** 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 = **0.0** 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	$P_{bearing}$ = **125** kN/m^2

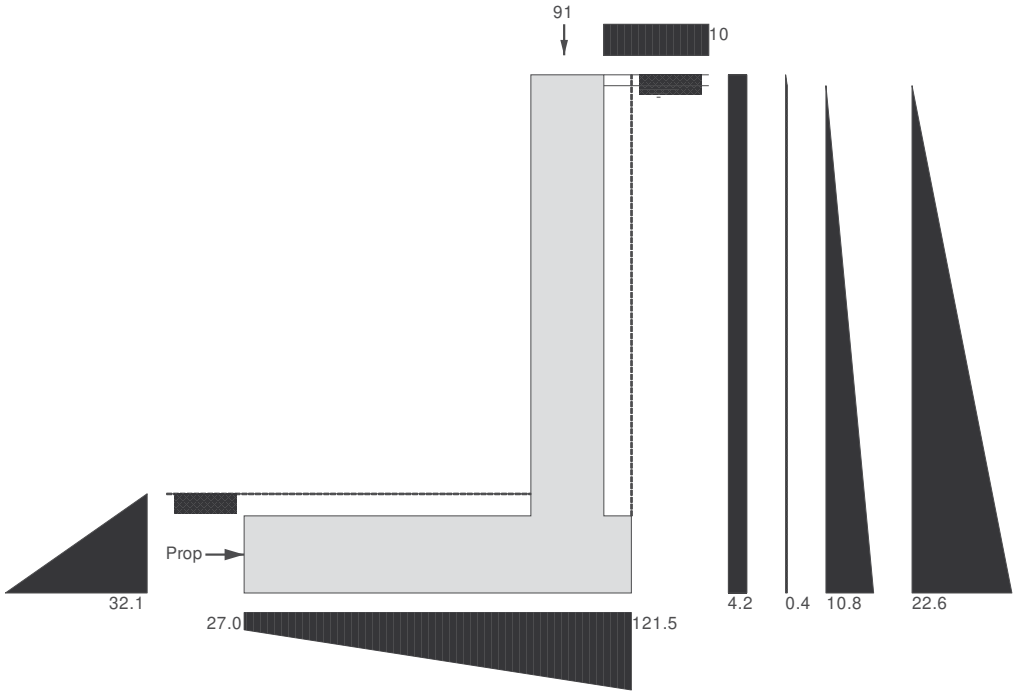
Using Coulomb theory

Active pressure	K_a =**0.419**	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} = **79.6** kN/m	Vertical live load	W_{live} = **11.8** 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} = **1450** mm	Height of horizontal load	h_{load} = **0** mm



Loads shown in kN/m, pressures shown in kN/m^2

Calculate propping force

Propping force F_{prop} = **3.1** kN/m

Check bearing pressure

Total vertical reaction	R = **130.3** kN/m	Distance to reaction	x_{bar} = **1064** mm
Eccentricity of reaction	e = **186** mm		

Reaction acts within middle third of base

Bearing pressure at toe	p_{toe} = **27.0** kN/m^2	Bearing pressure at heel	p_{heel} = **121.5** kN/m^2

PASS - Maximum bearing pressure is less than allowable bearing pressure

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Project				Job no.	
70 Gascony Avenue				21.535	
Calcs for				Start page no./Revision	
Underpin RC Rataining Wall				7	
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
SG	June 2022				

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} = **3.1** 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 = **0.25** % — Cover in toe c_{toe} = **40** mm

Design of retaining wall toe

Shear at heel V_{toe} = **105.9** kN/m — Moment at heel M_{toe} = **79.9** kNm/m

Compression reinforcement is not required

Check toe in bending

Reinforcement provided **16 mm dia.bars @ 200 mm centres**

Area required $A_{s\_toe\_req}$ = **875.0** mm^2/m — Area provided $A_{s\_toe\_prov}$ = **1005** mm^2/m

PASS - Reinforcement provided at the retaining wall toe is adequate

Check shear resistance at toe

Design shear stress v_{toe} = **0.351** 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} = **0.526** N/mm^2

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

Design of reinforced concrete retaining wall heel (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 = **0.25** % — Cover in heel c_{heel} = **40** mm

As the moment is negative the design of the retaining wall heel is beyond the scope of this calculation

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 = **0.25** %

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} = **43.6** kN/m — Moment at base of stem M_{stem} = **52.0** kNm/m

Compression reinforcement is not required

Check wall stem in bending

Reinforcement provided **16 mm dia.bars @ 200 mm centres**

Area required $A_{s\_stem\_req}$ = **825.0** mm^2/m — Area provided $A_{s\_stem\_prov}$ = **1005** mm^2/m

PASS - Reinforcement provided at the retaining wall stem is adequate

Check shear resistance at wall stem

Design shear stress v_{stem} = **0.155** 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_stem} = **0.547** N/mm^2

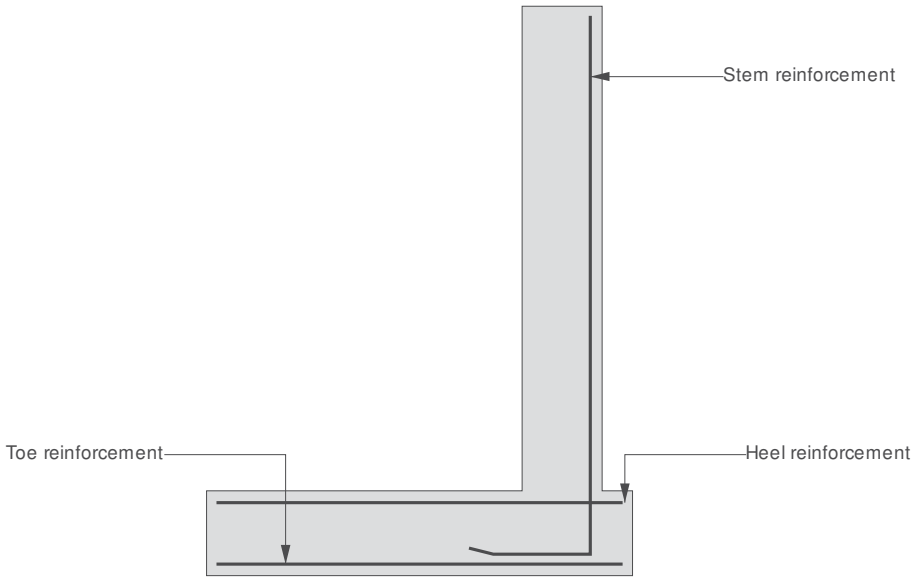
$v_{stem} < v_{c\_stem}$ - No shear reinforcement required

Check retaining wall deflection

Max span/depth ratio $ratio_{max}$ = **11.49** Actual span/depth ratio $ratio_{act}$ = **7.09**

PASS - Span to depth ratio is acceptable

Indicative retaining wall reinforcement diagram



Toe bars - 16 mm dia.@ 200 mm centres - (1005 mm^2/m)

The design of the retaining wall heel is beyond the scope of this calculation!

Stem bars - 16 mm dia.@ 200 mm centres - (1005 mm^2/m)

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Date	June 22	Sheet No.
Eng.	SG	10
Job No.	21.535	

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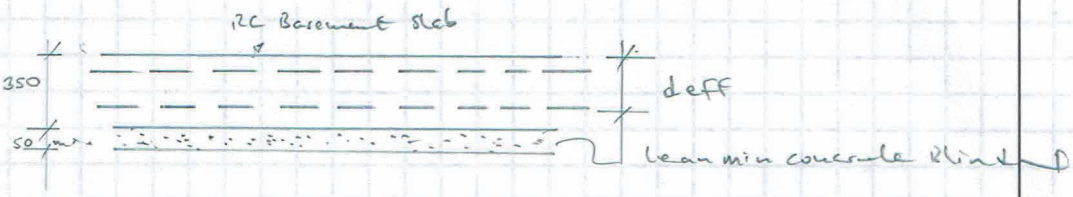
RC Basement Slab Design

Slab thickness = 350mm deep

Uplift force
Assume 2.30m below

$F = 2.30m \times 9.81 = 22.563 kN/m$ (SLS)
$\Rightarrow 22.563 \times 1.4 = 31.588 kN/m$ (ULS)

$$BM_{max} = \frac{31.60 \times 5.00^2}{8} = 98.75 kNm$$



$deff = 350 - 40 - 16/2 = 302 mm$

$$K = \frac{1000 \times 10^6}{1000 \times 302^2 \times 35} = 0.031$$

$$z = d\left\{0.5 + \left[\sqrt{\left(0.25 - \frac{0.031}{0.90}\right)}\right]\right\} = 0.96d$$

$$A_s = \frac{100 \times 10^6}{0.95 \times 460 \times 0.95 \times 302} = 800 mm^2/m$$

∴ PROVIDE H16 @ 200mm c/c ($1005 mm^2/m$)