COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 2 New Steel beams

Beam B4 - Analysis

Span (m)	4.100

Choose steel section: 152x152x23 ▼ ○ UB ◉ UC ○ RSJ ○ PFC

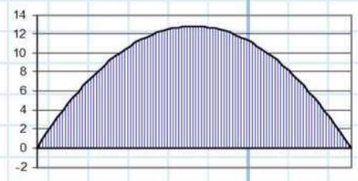
Load Factors	
Dead	1.4
Imposed	1.6

E (N/mm²)	205000
Ix (cm⁴)	1250

Simply supported beam

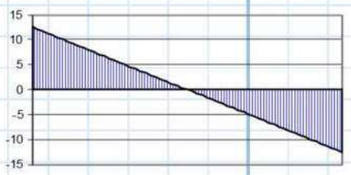
Design Status		capacity ratio
Vertical shear	PASS	0.07
Moment	PASS	0.22
Buckling	PASS	0.48
Deflection	PASS	0.52

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	2.41	1.5		-
Point load				
Point load				-
Point load				
Point load				-
Partial UDL				
Partial UDL				

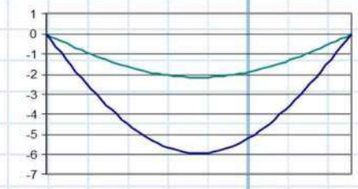


Bending Moment Diagram

RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm) Imposed only	Max. deflection (mm) Total load		Dead kN	Imposed kN
kNm	kN			LHS	5.40	3.08
12.80	12.48	-2.15	-5.94	RHS	-5.40	-3.08



Shear Force Diagram



Deflection Diagram

Design

Design Strength	
p_y N/mm²	355

Steel grade ○ grade S275 ◉ grade S355

Shear Capacity	
Area A_v mm²	capacity P_v kN
883.9	188.27

cl. 4.2.3

section classification
Semi-Compact

Moment Capacity	Position m	Moment kNm	Fv kN	M_{cx} kNm	Unity Factor
Maximum Moment	2.050	12.80	0.00	58.22	0.22
Critical section	2.050	12.80	0.00	58.22	0.22

* low shear

Lateral torsional buckling

Equivalent Uniform Moment		kNm
Maximum moment	M_A	12.80
Uniform factor	m	1.00
Buckling moment	M_{bar}	12.80

cl. 4.3.7.2

Z_x (cm³)	164
S_x (cm³)	182

Slenderness Ratio				
Effective length L m	factor	L_E m	radius of gyration r_y (cm)	slenderness λ
4.100	1.4L+2D	6.045	3.7	163.37

cl. 4.3.7.5

Deflection

Deflection Limits span/deflection ratios		Allowable mm	Actual mm
Imposed Loads	360	11.4	2.2
Total Loads	360	11.4	5.9

cl. B.2.4	limiting slenderness	λ_{LO}	30.20
cl. 4.3.7.6	correction factor	n	**1.00**
	buckling parameter	u	0.84
	torsional index	x	20.7
cl. B.2.5(d)	slenderness factor	v	0.702
cl. B.2.5	equivalent slenderness	λ_{LT}	96.36
cl. B.2.3	Perry coefficient	η_{LT}	0.463
	Plastic moment capacity	M_p	64.61
cl. B.2.2	Elastic critical moment	M_E	39.66
	Buckling index	ϕ_B	61.32
cl. B.2.1	**Buckling capacity**	M_b	26.71

Section used:	UC	152x152x23

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 2 New Steel beams

Beam B5 - Analysis

Span (m)	4.100

Choose steel section: 152x152x23 ▼ ○ UB ◉ UC ○ RSJ ○ PFC

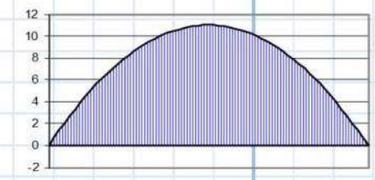
Load Factors	
Dead	1.4
Imposed	1.6

E (N/mm²)	205000
Ix (cm⁴)	1250

Simply supported beam

Design Status		capacity ratio
Vertical shear	PASS	0.06
Moment	PASS	0.19
Buckling	PASS	0.41
Deflection	PASS	0.44

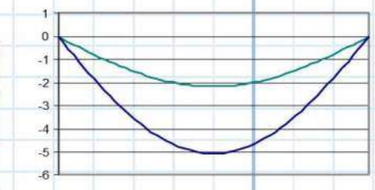
LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	1.8	1.5		-
Point load				
Point load				-
Point load				
Point load				-
Partial UDL				
Partial UDL				



Bending Moment Diagram

RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm) Imposed only	Max. deflection (mm) Total load		Dead kN	Imposed kN
kNm	kN			LHS	4.15	3.08
11.00	10.73	-2.15	-5.06	RHS	-4.15	-3.08

Shear Force Diagram



Deflection Diagram

Design

Design Strength	
p_y N/mm²	355

Steel grade ○ grade S275 ◉ grade S355

Shear Capacity	
Area A_v mm²	capacity P_v kN
883.9	188.27

cl. 4.2.3

section classification
Semi-Compact

Moment Capacity	Position m	Moment kNm	Fv kN	M_{cx} kNm	Unity Factor
Maximum Moment	2.050	11.00	0.00	58.22	0.19
Critical section	2.050	11.00	0.00	58.22	0.19

* low shear

Lateral torsional buckling

Equivalent Uniform Moment		kNm
Maximum moment	M_A	11.00
Uniform factor	m	1.00
Buckling moment	M_{bar}	11.00

cl. 4.3.7.2

Z_x (cm³)	164
S_x (cm³)	182

Slenderness Ratio				
Effective length L m	factor	L_E m	radius of gyration r_y (cm)	slenderness λ
4.100	1.4L+2D	6.045	3.7	163.37

cl. 4.3.7.5

Deflection

Deflection Limits span/deflection ratios		Allowable mm	Actual mm
Imposed Loads	360	11.4	2.2
Total Loads	360	11.4	5.1

cl. B.2.4	limiting slenderness	λ_{LO}	30.20
cl. 4.3.7.6	correction factor	n	**1.00**
	buckling parameter	u	0.84
	torsional index	x	20.7
cl. B.2.5(d)	slenderness factor	v	0.702
cl. B.2.5	equivalent slenderness	λ_{LT}	96.36
cl. B.2.3	Perry coefficient	η_{LT}	0.463
	Plastic moment capacity	M_p	64.61
cl. B.2.2	Elastic critical moment	M_E	39.66
	Buckling index	ϕ_B	61.32
cl. B.2.1	**Buckling capacity**	M_b	26.71

Section used:	UC	152x152x23

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 2 New Steel beams

Beam B6 - Analysis

Span (m) 4.500

Choose steel section: 152x152x37 (UB / UC / RSJ / PFC)

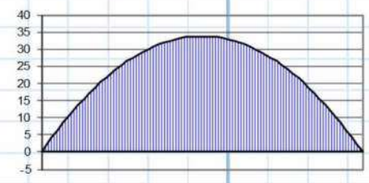
Simply supported beam

Load Factors	
Dead	1.4
Imposed	1.6

E (N/mm²)	205000
Ix (cm⁴)	2210

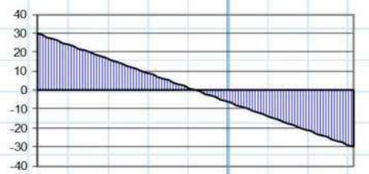
Design Status		capacity ratio
Vertical shear	PASS	0.14
Moment	PASS	0.40
Buckling	PASS	0.66
Deflection	PASS	0.83

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	3.51	4.95		-
Point load				
Point load				-
Point load				
Point load				-
Partial UDL				
Partial UDL				

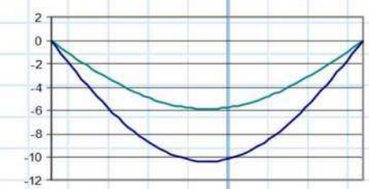


Bending Moment Diagram

RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm)			Dead	Imposed
		Imposed only	Total load		kN	kN
kNm	kN			LHS	8.71	11.14
33.77	-30.02	-5.83	-10.40	RHS	-8.71	-11.14



Shear Force Diagram



Deflection Diagram

Design

Design Strength	
p_y N/mm²	275

Steel grade: grade S275 / grade S355

section classification
Plastic

Shear Capacity		
	Area A_v	capacity P_v
	mm²	kN
	1294.4	213.58

cl. 4.2.3

Moment Capacity	Position m	Moment kNm	Fv kN	M_{cx} kNm	Unity Factor
Maximum Moment	2.250	33.77	0.00	84.98	0.40
Critical section	2.250	33.77	0.00	84.98	0.40

* low shear

Lateral torsional buckling

Equivalent Uniform Moment		kNm
Maximum moment	M_A	33.77
Uniform factor	m	1.00
Buckling moment	M_{bar}	33.77

cl. 4.3.7.2

Z_x (cm³)	273
S_x (cm³)	309

Slenderness Ratio				
Effective length			radius of gyration	slenderness
L	factor	L_E		
m		m	r_y (cm)	λ
4.100	1.4L+2D	6.064	3.87	156.68

cl. 4.3.7.5

Deflection

Deflection Limits span/deflection ratios		Allowable mm	Actual mm
Imposed Loads	500	9.0	5.8
Total Loads	360	12.5	10.4

cl. B.2.4	limiting slenderness	λ_{LO}	34.31
cl. 4.3.7.6	correction factor	n	1.00
	buckling parameter	u	0.848
	torsional index	x	13.3
cl. B.2.5(d)	slenderness factor	v	0.596
cl. B.2.5	equivalent slenderness	λ_{LT}	79.15
cl. B.2.3	Perry coefficient	η_{LT}	0.314
	Plastic moment capacity	M_p	84.98
cl. B.2.2	Elastic critical moment	M_E	99.79
	Buckling index	ϕ_B	108.04
cl. B.2.1	**Buckling capacity**	M_b	51.53

Section used:	UC	152x152x37

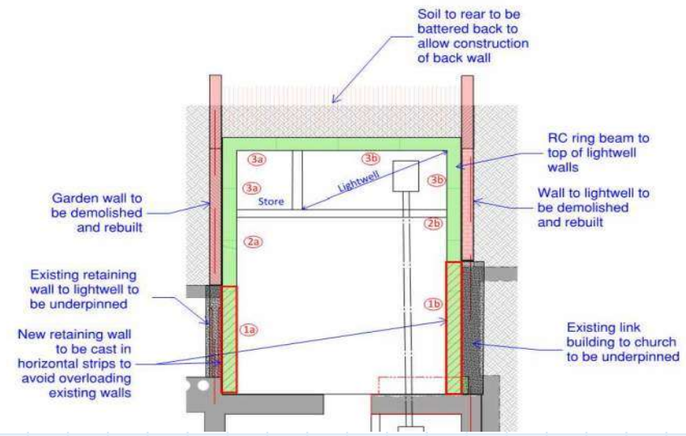
COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 3 Ground Conditions and Design Parameters

Basement

The proposed basement has three distinct parts as shown in the following plan:



Section 1
the sections closest to the main house will be built adjacent existing walls with the top of the new retaining walls is propped by the ground floor slab.
Section 1a (No159) wall will be cast adjacent the existing brick lightwell wall and will need to be cast in bands to avoid overloading the existing wall.
Section 1b (church) will be cast against the existing foundation wall and a similar approach to 1a will be adopted as the nature of the backfill behind the wall is not known.

Section 2
The middle sections will be built adjacent existing garden walls. It is currently proposed that the garden walls are demolished and rebuilt to ease construction. As with section 1 the top of the new retaining walls is propped by the ground floor slab.

Section 3
The rear section of the retaining walls consists of two distinct parts - the store area where the slab will prop the top of the new walls and the lightwell, where a ring beam will be cast at the top of the wall to provide support.
For construction it is proposed that the garden will be battered back (the extent of this will determine the extent of garden walls rebuilt) to allow construction of the retaining wall and backfilled.

<u>Ground Conditions and Geotechnical Parameters</u>

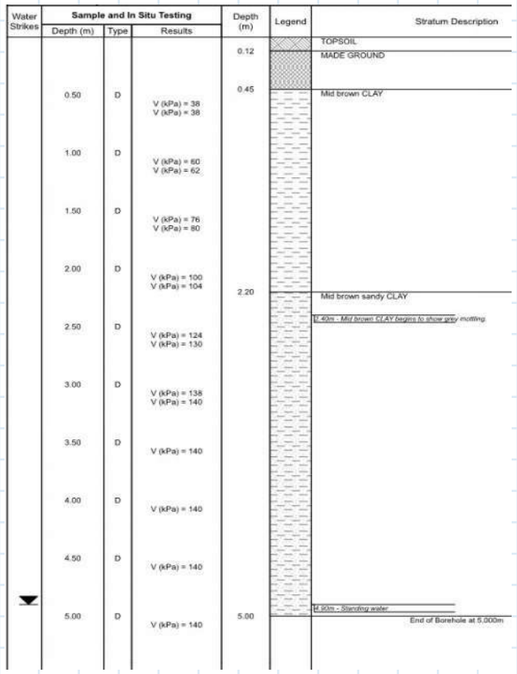
Fastrak Report 27798 included a borehole carried out at garden level which confirmed the soil strata on the site to be topsoil/made ground over brown London Clay. The borehole is included below:

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road

Section 3 Ground Conditions and Design Parameters



Geotechnical Design Parameters

For the design of the new retaining walls long term (>6m) / effectice stress parameters will be used:

Cohesion	c'	0	kN/m2
Angle of shearing resistance	ϕ'	23	degree
Density - London Clay	γ	20	kN/m3
Density - water	γ_w	10	kN/m3
Other Design parameters			
Surcharge	q	5	kN/m2
Density concrete	γ_c	24	kN/m3

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road

Section 4 New Extension - Assumed Basement Construction Sequence

Assumed Sequence of Construction

The sequence below has been assumed in the design of the new basement.

1. Demolish existing conservatory structure. Locate existing manhole
2. Demolish existing garden walls and ground floor slab to basement
3. Reduce dig across area of new basement
4. Install local propping to side faces
5. Demolish existing basement walls
6. Adjust propping to side walls
7. Batter back rear soil face
8. Demolish existing basement walls and floor slab
9. Site blind area of new basement
10. Install drainage and below ground services
11. Cast new basement slab with starter bars for walls
12. Cast new basement walls with starter bars to ground floro slab
13. Prop new basement walls as required
14. Cast new ground floor slab (RC on metal decking
15. Install waterproofing lining to basement
16. Complete fit out of new extension

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

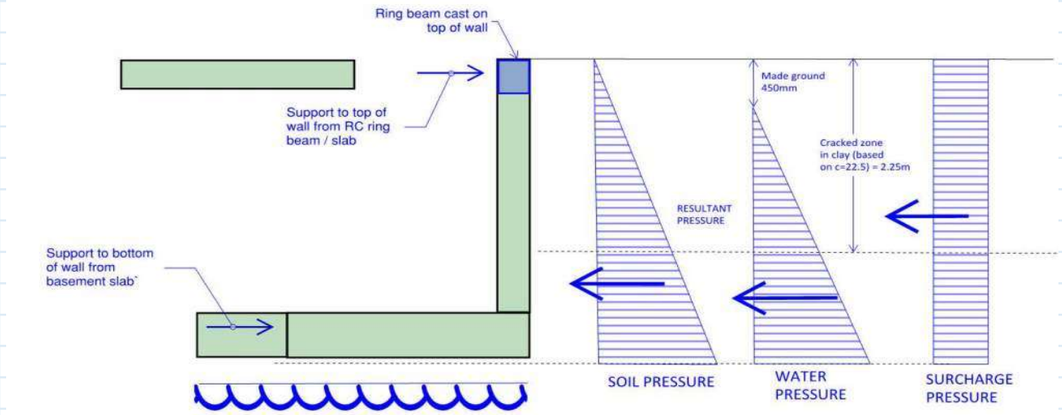
Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 5 New Extension - Basement

Rear Wall - Sections 3b (+3a)

Wall design:

Treat as propped cantilever
Use effective stress parameters
Design for full height water - cracked zone 2.35m from surface
Surcharge = 5kPa



Wall Parameters

Height to formation					
Floor to floor		2210	mm		
FFL dropped		350			
Finsihes, allow		250			
Slab		300			
Blinding		50			
		3160	Allow Ht =	3200	mm
Wall stem thickness		250	mm		
Base to wall		300	mm		
Base to wall width		1.7			
γ_{conc} =		24	kN/m3		

Soil Parametrs

Cohesion	c'	0	kPa	Ka =	1-sin ϕ' / 1+sin ϕ'
Angle of shearing resistance	ϕ'	23	degree	=	0.438

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 5 New Extension - Basement

Density London Clay	γ	20	kN/m3
Density water	γ_w	10	kN/m3

Surcharge 5 kPa

Applied Pressure/Forces

Soil	$p_s = K_a.\Upsilon'.H - 2c'\sqrt{K_a}$	Ps = 0.5 * ps * H	z = H/3
Water	$p_w = \Upsilon w * Hw$	Pw = 0.5*pw*Hw	z = Hw/3
Surcharge	p_q = Ka * q	Pq = p_q * H	z = H/2

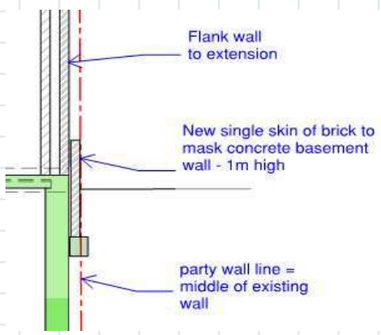
tbase 0.3 H = 3.2 m Hw = H-0.45 = 2.75 m
tstem 0.25

Taking metre width, moments about internal bottom corner of wall stem @ formation

Case	F / SLS	z	Mo	γ_f	F / ULS		
Soil	44.86	1.067	47.85	1.4	62.8		
Water	37.81	0.917	34.66	1.4	52.94	1.416	= ld factor
Surcharge	7.01	1.6	11.22	1.6	11.22		
	kN	m	kNm		kN		
Pa =	89.68	@	1.045	= Applied Resultant			
	kN		m above formation				

top reaction		bottom reaction		Moment base		Moment @ ld		
Rt = 12.79	kN	Rb = 76.9	kN	Mb = 52.81	kNm	Mp = 27.55	kNm	SLS
18.1	kN	108.9	kN	74.76	kNm	39.01	kNm	ULS

Side wall - Section 2



As Rear wall with additional loading :

i) new garden wall - line load parallel to wall
ii) flank wall over

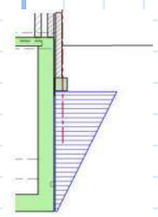
New garden wall

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 5 New Extension - Basement

Allow 1m single skin of brick on 300x300 mass concrete strip, founding 600mm below grd



Gives line load parallel to wall = 2.163 kN/m run

Pressure under footing = 7.21 kPa = pressure @ 600mm bgl
Pressure at formation (2.6m under) = 0.832 kPa (assume 45 deg spread)

Resultant Force 10.45 kN @ 1.733 m above formation

Case	F	z	Mo	γf		
Soil	44.86	1.067	47.85	1.4	62.8	
Water	37.81	0.917	34.66	1.4	52.94	
Surcharge	7.01	1.6	11.22	1.6	11.22	1.414 =ld factor
Wall line load	10.45	1.733	18.12	1.4	14.64	

Pa = 100.1 kN @ 1.117 m above formation = Applied Resultant

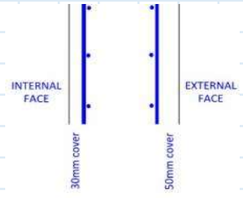
	top reaction	bottom reaction	Moment base	Moment @ ld	
Rt =	16.17 kN	Rb = 83.97 kN	Mb = 60.1 kNm	Mp = 33.69 kNm	SLS
	22.87 kN	118.7 kN	84.98 kNm	47.63 kNm	ULS

Design wall reinforcement for Section 2 ULS loading

External face

D = 250 mm gives d = 190
cover = 50 mm

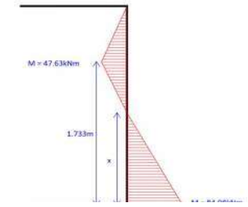
M = 84.98 kNm
fcu= 35 N/mm2 fy = 500
b = 1000 mm



K = 0.067 <0.156 no comp reinf reqd

z = 174.5 mm < 180.5

As = 1119 mm2 / m Use H20 @ 200 As prov = 1520 mm2 /m



x = (84.98/(47.63+84.98))*1.733
= 1.111 m from formation
= point of zero moment in wall

Use H20 L bars in bottom junction to give moment cap
Bars 1200x1400mm high

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 5 New Extension - Basement

Transverse reinf As =0.13% Ac = 325 mm2/m H12 @ 200 = 566 mm2

Internal Face

D = 250 mm gives d = 210
cover = 30 mm

M = 47.63 kNm
fcu= 35 N/mm2 fy = 500
b = 1000 mm

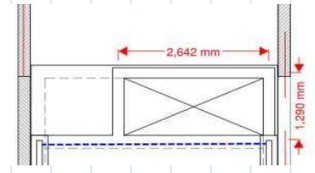
K = 0.031 <0.156 no comp reinf reqd

z = 202.5 mm > 199.5 Use z = 0.95d = 199.5 mm

As = 548.9 mm2 / m H12 @ 200 As prov = 566 mm2 /m

Transverse reinf As =0.13% Ac = 325 mm2/m H12 @ 200 = 566 mm2

Ring beam to lightwell



Load = 18.1 kN/m Span = 2.7 m

Moment = wl2/8 = 16.5 kNm
D= 250 mm
d = 250-30-10-10 = 200 mm b = 400 mm

fcu= 35 N/mm2 fy = 500

K = 0.029 <0.156 no comp reinf reqd

z = 193.2 mm > 190 Use z = 0.95d = 190 mm

As = 199.6 mm2 / m 3 H12 @ 200 As prov = 566 mm2 /m

Use 3H16 gives Asprov = 402 mm2

V = 24.44 kN v = 0.305 N/mm2 100As/bv.d = 0.503

Tb3.8 gives vc = 0.6 N/mm2 Therefore min links reqd
Asv = 0.4*bv*sv / 0.87fyv
fyv = 500 N/mm2
bv = 400 mm
sv max = 150 mm

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road

Section 5 New Extension - Basement

Asv = 55.17 mm2 = 2 legs Use H10 links @ 1510 c/cs
Asv prov = 157 mm2

Basement slab

Flank wall load take down

			Dead	Live
Beams - spread over full length = 5 m				
B5	D	4.15		
	L	3.08		
B4	D	2.17		
	L	1.54		
B3				
B2				
B1	D	11.96		
	L	3.08		
	18.28	7.7	3.656	1.54
Masonry wall - brick /block cavity wall @ 3.75 kN/m2				
Ht 3 m			11.25	
Basement wall - 250 RC wall x 3.2m high			19.2	
Wall line loading			**34.11**	**1.54**
Basement slab 300mm thick + 100mm screed			7.2	
			1.6	
basement floor udl			**8.8**	**1.5**

Basement width 4.25 m

Total load / m width of basement slab

flank walls	68.21	3.08
UDL	37.4	6.375
SLS	**105.6**	**9.455**
ULS	147.9	15.13

Average load under slab 27.07 kN/m2 Less than allowable brearing pressure =138kN/m2 @ 3m bgl

Moment based on average load = wl2/8 = 61.13 kNm

D = 300 mm d = D -50 -10 = 240 mm b = 1000 mm
fcu = 35 N/mm2
fy = 500 MN/mm2

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road

Section 5 New Extension - Basement

K = 0.03
z = 0.97 d >0.95 d limit , gives z = 228 mm
As = 616.3 mm2/m
Use H16 @ 200, Asprov = 1010 mm2 / m

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

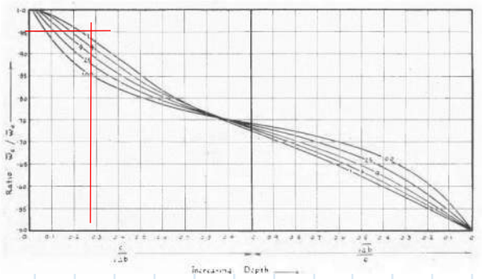
Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 6 Settlement of basement

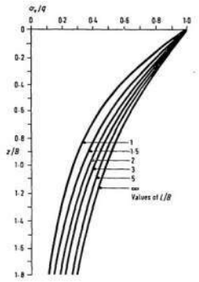
Total Long Term Settlement

Use Terzaghi 1D settelemnt method to calculate total long term settlement

Average loading, q =		27.07	kN/m2		
Length	L	5.00	m	L/B =	1.18
Width	B	4.25	m	B/L =	0.85
Depth	D	1.00	m		

Fox's correction factor (FCF)





Ciria SP27
Figure 60 Influence values for mean vertical stress ratio at dimensionless depth for a rectangle carrying uniform pressure

D/(BL)^0.5 = 0.217 Graph gives FCF = 0.95

CIRIA SP27 (fig 60) - and taking limit σv = 0.2q

σv/q = 0.2 give z/B = 1.3 Use layers = 0.2B = 0.85 m
to depth 1.3B = 5.53 m

Limiting σv/q to 0.2 gives z/B = 1.3

0.2B = 0.85 m 1m deep layers
1.3B= 5.53 m 6No layers

Layer	Thickness Δz	Depth of middle of layer z (middle of layer)	z/B	Stress Influence Factor Δσv/q (Fig 60)	Stress Increment Δσv	Existing Vertival Stress σv	mv at stress level mv	Change in Layer Thickness Δσv . Mv . Δz
1	1	0.5	0.118	0.85	23.01	10	0.05	1.15
2	1	1.5	0.353	0.61	16.52	30	0.05	0.83
3	1	2.5	0.588	0.46	12.45	50	0.05	0.62
4	1	3.5	0.824	0.34	9.21	70	0.05	0.46
5	1	4.5	1.059	0.30	8.12	90	0.05	0.41
6	1	5.5	1.294	0.20	5.41	110	0.05	0.27
							Σ Δ	3.74
							Σ Δ x FCF	**3.55**
								= Total long term

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

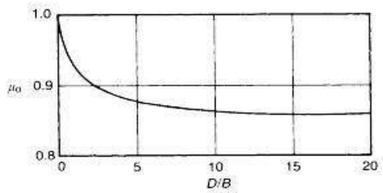
Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

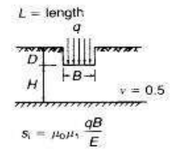
Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 6 Settlement of basement

Immediate settlement

Based on Giroud & Burland

$$s_i = \mu_0 \mu_1 \frac{qB}{E}$$



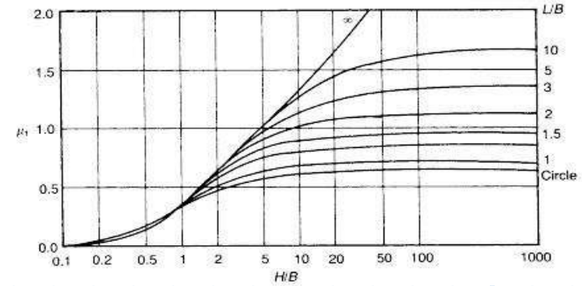


D/B 0.235 μ0 = 0.95

Based on 33m to base of London Clay (Camden Town borehole) and 3m difference in level

H = 33 m
H/B = 7.76 μ1 = 0.70

Eu = 50000 kN/m2



si = **1.53** mm = Immediate settlement

Summary construction settlements

Total long term settlement =	3.55	mm
Immediate settlement =	1.53	mm
Consolidation settlement =	2.02	mm

Check Heave at rear of basement

3m of soil removed	-60
Average load applied	27.07
Net pressure =	**-32.93**

	Δz	z	z/B	Δσv/q	Δσv	σv	mv	Δσv . Mv .
1	1	0.5	0.118	0.85	-27.99	10	0.05	-1.40
2	1	1.5	0.353	0.61	-20.08	30	0.05	-1.00
3	1	2.5	0.588	0.46	-15.15	50	0.05	-0.76
4	1	3.5	0.824	0.34	-11.19	70	0.05	-0.56
5	1	4.5	1.059	0.30	-9.88	90	0.05	-0.49
6	1	5.5	1.294	0.20	-6.59	110	0.05	-0.33
							Σ Δ	-4.54
							Σ Δ x FCF	**-4.32**

si = **-1.86** mm = Immediate settlement

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road

Section 6 Settlement of basement

Summary heave settlements

	Heave	Const	Net Settelement	
Total long term settlement =	-4.32	3.55	-0.77	mm
Immediate settlement =	-1.86	1.53	-0.33	mm
Consolidation settlement =	-2.46	2.02	-0.44	mm

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road

Section 7 Superstructure elements

Contents

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road

Section 7 Superstructure elements

New Extension - floor joist **To BS5268-2**

From Section 1 Dead = 0.67 kN/m2
Live = 1.5 kN/m2

timber grade = C24 basic σb= 7.5 Factors
Joist span = 2.1 m Duration K3 1.0
centers = 400 mm Depth K7 1.079
section width = 50 mm Load sharing K8 1.1
section depth = 150 mm
σb= 8.904
Z = bd2/6 = 187500 mm3 N/mm2
I =bd3/12 = 14062500 mm4
Emean = 10800
Bending due to UDL load on joist N/mm2

w = 0.866 kN/m
M = wl2/8 = 0.478 kNm

Gives Z reqd = 53634 mm Section OK (UF = 0.286) Use 50 x 150 @ 400 c/c for roof

Deflection limit = span / 360 = 5.8 mm

Deflection due to udl = 1.44 mm Section OK

Check shear at end notches

Beam 152UC23 D 152.2 B 152.4
T 6.8 t 6.1

Check concentrated point load pt ld applied over 300x300 area - lds one joist
ignore ld sharing

BS6399-1 gives concentrated load = 1.4 kN

apply at mid span giving M = WL/4 = 0.735 kNm

Gives Z reqd = 82551 mm Section OK (UF = 0.44)

Deflection limit = span / 360 = 5.8 mm

Deflection due to udl = 1.78 mm Section OK

150 dp joist to sit on bottom flange and be notched on top to suit flange

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road

Section 7 Superstructure elements

clear distance between flanges = 138.6 mm
depth of top notch - allow for 10mm tolerance = 21.4 say 25 mm
web to toe distance = 73.15
width of notch - allow 10mm tolerance = 83.15 say 85 mm

h 150
he 115
a 25

$$K_5 = \frac{h(h_e - a) + ah_e}{h_e^2} \text{ for } a \le h_e$$

K5 = 1.238 V = 0.7 kN σs= 0.71 N/mm2
x K5 = 0.879
Shear area = 5750 Shear cap = A *σs= 5.1 kN Section Ok

New Extension - roof joist **To BS5268-2**

From Section 1 Dead = 0.90 kN/m2
Live = 1.5 kN/m2

timber grade = C24 basic σb= 7.5 Factors
Joist span = 2.1 m Duration K3 1.0
centers = 400 mm Depth K7 1.079
section width = 50 mm Load sharing K8 1.1
section depth = 150 mm
σb= 8.904
Z = bd2/6 = 187500 mm3 N/mm2
I =bd3/12 = 14062500 mm4
Emean = 10800
Bending due to UDL load on joist N/mm2

w = 0.959 kN/m
M = wl2/8 = 0.529 kNm

Gives Z reqd = 59374 mm Section OK (UF = 0.317)

Deflection limit = span / 360 = 5.8 mm

Deflection due to udl = 1.60 mm Section OK

Check shear at end notches

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road

Section 7 Superstructure elements

Beam 152UC23 D 152.2 B 152.4
T 6.8 t 6.1

Check concentrated point load pt ld applied over 300x300 area - lds one joist
ignore ld sharing

BS6399-1 gives concentrated load = 1.4 kN

apply at mid span giving M = WL/4 = 0.735 kNm

Gives Z reqd = 82551 mm Section OK (UF = 0.44)

Deflection limit = span / 360 = 5.8 mm

Deflection due to udl = 1.78 mm Section OK

150 dp joist to sit on bottom flange and be notched on top to suit flange

clear distance between flanges = 138.6 mm
depth of top notch - allow for 10mm tolerance = 21.4 say 25 mm
web to toe distance = 73.15
width of notch - allow 10mm tolerance = 83.15 say 85 mm

h 150
he 115
a 25

$$K_5 = \frac{h(h_e - a) + ah_e}{h_e^2} \text{ for } a \leq h_e$$

K5 = 1.238 V = 0.7 kN σs= 0.71 N/mm2
x K5 = 0.879

Shear area = 5750 Shear cap = A *σs= 5.1 kN Section Ok

COCHRANE CONSTRUCTION CONSULTANTS
Email: ccconsultw4@gmail.com
Tel: 07793200529

Project No:	Calc By:
S-2930	BC
Project:	
161 ARLINGTON ROAD,LONDON NW1 7ET	
Date:	**Rev:**
01 February 2024	0

Title: Structural Calculations for Proposed Refurbishment of 161 Arlington Road

Section 7 Superstructure elements

New extension - Wind Loading

New extension
New extension two storey above ground, height above ground = 2.8 m
Restraint provided by roof - max vertical span = 2.8 m

Wind load To BS6399-2

Maximum height 0f extension walls (above ground)	H =	2.85	m
Building type factor	Kb =	0.5	Tb1
Dynamic augmentation factor	Cr =	0.01	Fig3
Siza effect factor	Ca =	0.97	
Ground level is at approximately		29.4	mOD
Wind speed	Vb =	20.5	m/s
Altitude factor	Sa =	1.029	
Seasonal factor	Ss =	1	
Site is relatively level - topogrphy not significant			
Directional factor	Sd =	1	
Permanent condition	Sp =	1	
Site wind speed Vs = Vb. Sa . Sd . Ss . Sp =	Vs =	21.1	m/s
Maximum height of extension walls (above ground)	H =	6.2	m

Heights of surrounding buildings

161 AR	11
159 AR	9
OLoH	14
Ort House	15
128 Albert St	15

Dominant wind direction - use SW - Ort House

Maximum height of extension walls (above ground)	Hr =	2.85	m	
Height of building upwind	H0 =	15	m	
Distance to buildings upwind	X0 =	13.5	m	
Displacement Height	Hd =	12		
Effective Height = lesser of (Hr-Hd) or 0.4Hr				
Hr - Hd = -9.15 m				
0.4Hr = 1.14 m	He =	1.14	m	*(Cl1.7.3)*
Taking He <2 and site in town > 2km				
distance to sea = 55km	Sb =	1.1	Tb4	
Ve = Vs . Sb	Ve =	23.21	m/s	
Dynamic pressure qs = 0.613 Ve^2	qs =	0.33	kPa	