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

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

cl. 4.3.7.5

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

Section used:	UC	152x152x37

CONSTRUCTION

Project No:		Calc By:
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Project:				
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
Date:	torsional index	x	13.3
cl. B.2.5 (b)	slenderness factor	v	0.596
cl. B.2.5	equivalent slenderness	λ_{LT}	79.15
	Perry coefficient	η_{LT}	0.314
cl. B.2.2	Plastic moment capacity	M_b	84.98
	Elastic critical moment	M_E	99.79
	Buckling index	ϕ_B	108.04
cl. B.2.1	**Buckling capacity**	M_b	51.53

Z_x (cm³)	273
S_x (cm³)	309

Title: Structural Calculations for Proposed Refurbishment of 161 Arlin

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Project No:		Calc By:
S-2930		BC

| Project:	
161 ARLINGTON ROAD, LONDON NW1 7ET	

Date:		Rev:
1 Nov 24		Rev 01

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

Basement

The proposed basement works has two distinct parts, the construction of the new basement to the rear extension and the underpinning of the main walls in the main house, The wall to the church does not require underpinning as it was previously underpinned for the construction of the church c1927as shown in the following plan:

Rear Basement

The existing basement appears to have been constructed within the original rear lightwell, with the original wall retained (a wall in this position was observed during the trial pit investigation but could not be investigated further.

The basement has two distinct parts.

At the rear, adjacent the house, there are existing walls present on all sides:
- The rear wall of No161
- The retaining wall between the lightwell to the rear of No159 and No161. This wall founds at a similar level to existing formation level and has been confirmed by trial pit.
- The flank wall to the church link building. This wall founds at a similar level to existing Formation level and has been confirmed by trial pit.

In this zone the lateral loading is minimal due to the existing walls. There may be a requirement for underpinning.

At the front, further from the house, the basement retains the soil to the gardens (L Clay). This is the worst design case.

To enhance safety during construction it has been assumed that the garden walls adjacent the front basement section will be demolished for the duration of construction and rebuilt to match the existing once the basement has been constructed. This also deals with the matter of the No159 garden wall showing lateral movement beyond the limits normally taken for stability.

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Section 3	Ground Conditions and Design Parameters

Ground Conditions and Geotechnical Parameters

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:
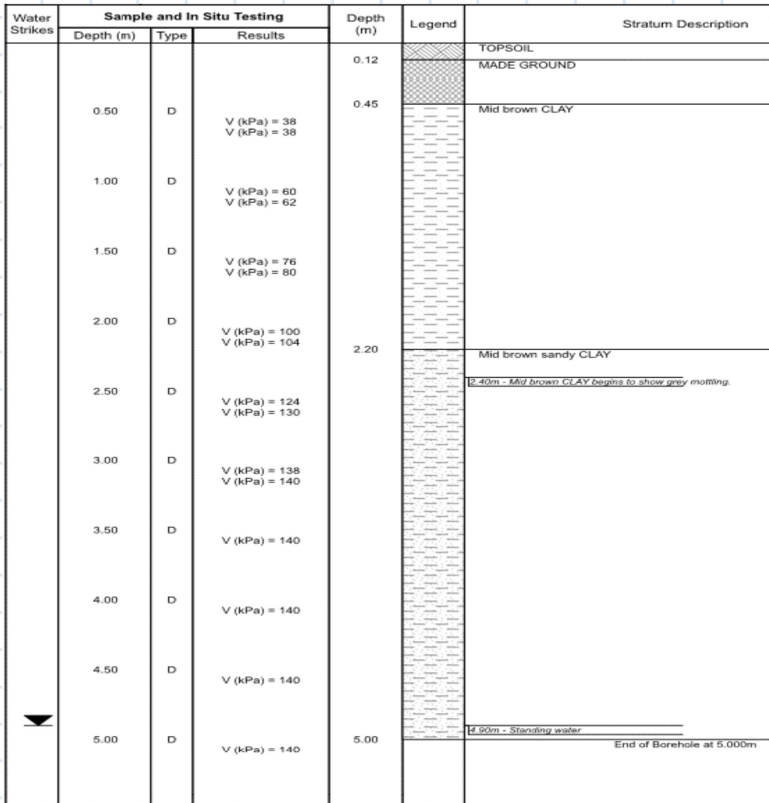
Geotechnical Design Parameters

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	(Garden areas with no limited access)
Density concrete	γ_c	24	kN/m3
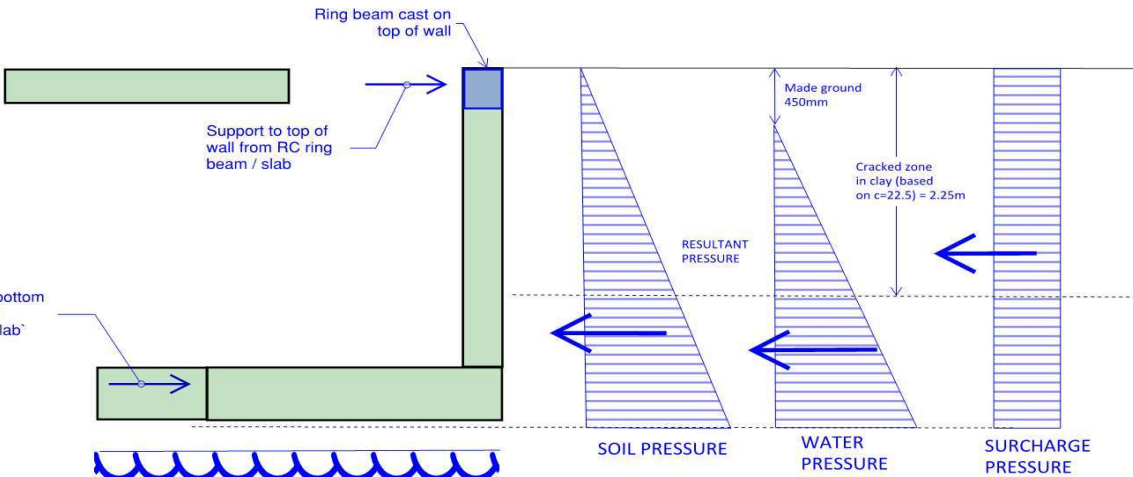
		Project No:		Calc By:	
CCC	**COCHRANE CONSTRUCTION CONSULTANTS**	S-2930		BC	
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Title:	Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Section 4	New Extension - Assumed Basement Construction Sequence

Assumed Sequence of Construction for Rear Basement
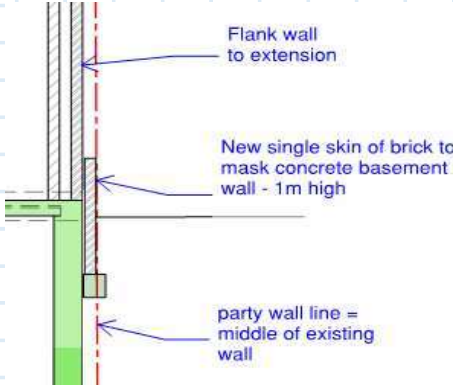
The sequence below has been assumed in the design of the new basement.

1. Isolate all services and ensure they are not live. Demolish existing conservatory structure.
2. Locally 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, demolishing original rear lightwell wall
6. Adjust propping to side walls as required
7. Batter back rear soil face to an slope of approx 60deg.
8. Demolish existing basement walls and floor slab
9. Install drainage and below ground services
10. Site blind area of new basement
11. Cast new basement slab with starter bars for walls
12. Cast new basement walls with starter bars to ground floor slab
13. Prop new basement walls off basement slab using push-pull props 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

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5Section 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	
	24	kN/m3

Soil Parametrs

Cohesion	c'	0	kPa	$Ka = 1-\sin\phi' / 1+\sin\phi'$
Angle of shearing resistance	ϕ'	23	degree	= 0.4381
Density London Clay	γ	20	kN/m3	
Density water		10	kN/m3	

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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	44.861	1.0667	47.851	1.4	62.805	
Water	37.813	0.9167	34.661	1.4	52.938	1.4156 = ld factor
Surcharge	7.01	1.6	11.215	1.6	11.215	
	kN	m	kNm		kN	
Pa =	89.683	@	1.0451	= Applied Resultant		
	kN		m above formation			

	top reaction	bottom reaction	Moment base	Moment @ ld	
Rt =	12.787 kN	Rb = 76.896 kN	Mb = 52.81 kNm	Mp = 27.554 kNm	SLS
	18.102 kN	108.86 kN	74.759 kNm	39.007 kNm	ULS

Side wall - Section 2

As Rear wall with additional loading :
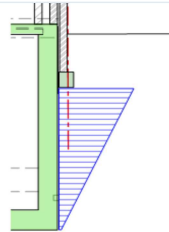
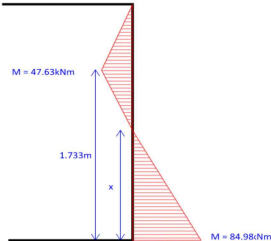i) new garden wall - line load parallel to wall

ii) flank wall over

New garden wall

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

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5Section 5   New Extension - Basement

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) =   0.8319 kPa   (assume 45 deg spread)

Resultant Force   10.455 kN @   1.7333 m above formation

Case	F	z	Mo	γf		
Soil	44.861	1.0667	47.851	1.4	62.805	
Water	37.813	0.9167	34.661	1.4	52.938	
Surcharge	7.01	1.6	11.215	1.6	11.215	1.414 =ld factor
Wall line load	10.455	1.7333	18.121	1.4	14.636	

Pa = 100.14   @   1.117   = Applied Resultant
     kN   m above formation

	top reaction		bottom reaction		Moment base		Moment @ ld	
Rt =	16.171 kN	Rb =	83.966 kN	Mb =	60.101 kNm	Mp =	33.685 kNm	SLS
	22.866 kN		118.73 kN		84.983 kNm		47.631 kNm	ULS

Design wall reinforcement for Section 2 ULS loading

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

  M = 84.983 kNm
  fcu= 35   N/mm2   fy = 500
  b = 1000 mm

  K = 0.0673   <0.156   no comp reinf reqd

  z = 174.54 mm <   180.5

  As = 1119.3 mm2 / m   Use H20 @ 200   As prov =   1520 mm2 /m

$x = (84.98/(47.63+84.98))*1.733$
    =   1.1106 m from formation
    = point of zero moment in wall

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

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 = 47.631 kNm
  fcu= 35   N/mm2   fy = 500
  b = 1000 mm

  K = 0.0309   <0.156   no comp reinf reqd

  z = 202.53 mm >   199.5   Use z = 0.95d = 199.5 mm

  As = 548.85 mm2 / m   H12 @ 200   As prov =   566   mm2 /m

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

Basement slab
New sun-room – spans onto columns either side – allow 2m either side

				Dead	Live
Roof	Dead	1.26	X 2	2.52	
	Live	1.5			3
Glazing, 2.5m high					
	Dead	1.36	/m run	1.36	
Ground floor slab					
	Dead	3.95	x2	7.9	
	Live	1.5			3
Basement wall - 250 RC wall x 3.2m high				19.2	
			Wall line loading	**30.98**	**6.00**
Basement slab 300mm thick + 100mm screed				7.2	
				1.6	
			basement floor udl	**8.8**	**1.5**

Basement width   3.6   m

Total load / m width of basement slab

		Dead	Live
	flank walls	61.962	12
	base slab	31.68	5.4
	SLS	**31.68**	**5.4**
	ULS	44.352	8.64

Average load under slab   10.3   kN/m2   Less than allowable bearing pressure