COCHRANE CONSTRUCTION CONSULTANTS
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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

Document: Structural Calculations for Proposed Refurbishment of 161 Arlington Road
Contents & Introduction

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INTRODUCTION

The proposed works to 161 Arlington Road include the following structural works:
- Demolition and rebuilding the rear extension on a similar footprint, but with a larger basement
- Lowering the basement floor level by approximately 400mm

The new basement to the rear extension has a width similar to the existing but extends further into the garden with a footprint similar to the ground floor.

The basement design is considered in the sections 3, 4, 5 and 6.

161 Arlington Road was originally built in the 1830s as part of a terrace (running 155-169), with the northern part of the terrace demolished to allow construction of the adjacent church buildings.

Historically No161 was a shop with flat over until its conversion into a single residence c1982. The existing rear extension and mansard extension were added c1992.

From opening up investigation the 1982 refurbishment generally replaced the internal structure with new. No period features remain and internal walls generally timber stud with plasterboard.
The first floor floor structure was strengthened by adding additional joists between the original. The ground floor structure is not known, but is assumed to be similar to the first floor.
In summary:

Roof	-	New, added 1992
Third	-	New, added 1992
Second	-	New, added 1992
First	-	Strengthened 1992 by adding joists between existing
Ground	-	Not known, assumed as first floor
Basement	-	Modern concrete used, assumed 1992

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Section 1 Unit Loading

Dead Loads	kN/m2 **Dead**	kN/m2 **Live**
Floor - modern construction c1987	**0.67**	**1.50**
Finishes, allow 15mm engineered boards	0.12	
Decking - 19mm boards assumed	0.15	
Joists - 50x175@300c/cs	0.23	
Ceiling - 12mm plasterboard	0.12	
Insulation & services	0.05	
Domestic Loading		1.50
Existing partition Walls	0.44	
Plasterboard both faces - assumed 12mm plasterboard	0.24	
Timber stud - assume 50x100@400c/c	0.10	
Noggings and services	0.10	
Ground Floor - Rear Extension		

Use concrete slab on metal decking to provide restraint to basement walls, clear span 3700mm

ComFlor® 80 / Bar Fire Method / Unpropped

Single span deck, single span slab (m) - Normal weight concrete - Eurocode - Beam width 152mm
(Note: Single span deck with single span slab is only permitted using Bar Fire Method.)

Props	Fire period	Slab depth (mm)	Mesh 0.2% min. reqd.*	Total applied load (kN/m²) 5.00	7.50	10.00	5.00	7.50	10.00	5.00	7.50	10.00
				0.90mm			1.00mm			1.20mm		
None	60 minutes	140	A142	3.70 (10)	3.70 (12)	3.69 (16)	4.07 (10)	4.06 (12)	3.91 (16)	4.33 (12)	4.32 (16)	4.02 (16)
		150	A142	3.60 (10)	3.60 (10)	3.60 (12)	3.96 (10)	3.95 (12)	3.94 (16)	4.25 (12)	4.25 (12)	4.19 (16)
		160	A193	3.51 (10)	3.51 (10)	3.50 (12)	3.86 (10)	3.85 (12)	3.85 (12)	4.17 (10)	4.17 (12)	4.16 (16)
		170	A193	3.49 (10)	3.49 (10)	3.49 (12)	3.76 (10)	3.76 (10)	3.76 (12)	4.10 (10)	4.10 (12)	4.10 (16)
		180	A252	3.45 (8)	3.44 (10)	3.44 (12)	3.68 (10)	3.68 (10)	3.67 (12)	4.04 (10)	4.04 (12)	4.04 (12)
		190	A252	3.36 (8)	3.36 (10)	3.36 (10)	3.60 (10)	3.60 (10)	3.59 (12)	3.98 (10)	3.98 (12)	3.98 (12)
		200	A252	3.29 (8)	3.29 (10)	3.29 (10)	3.53 (8)	3.52 (10)	3.52 (12)	3.91 (10)	3.91 (10)	3.91 (12)

	3.95	**1.50**
Finishes - allow 50mm screed	0.95	
Deck - 150 comflor NWC slab. Man tables gives 2.63+0.15	2.78	
Ceiling - 12mm plasterboard	0.12	
Insulation & Services	0.10	
Domestic Loading		1.50
New Roof - Rear Extension	**0.90**	**1.50**
Finishes - allow asphalt	0.45	
Deck - 50x175 sw rafters @ 300c/cs	0.23	
Ceiling - 12mm plasterboard	0.12	
Insulation & Services	0.10	

Typical Floor

	kN/m2
Dead	0.67
Live	1.50

Partition Wall

	kN/m2
Dead	0.44

Use Comflor 80 x 1.2 gauge x 150mm deep NWC slab with A193 mesh

Grd - Rear Ext

	kN/m2
Dead	3.95
Live	1.50

New Roof

	kN/m2
Dead	0.90
Live	1.50

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Section 1 Unit Loading

Imposed Loading - maintenance / snow (increased to allow for future solar panels)		1.50
New Terrace		
Floor Deck. Assume timber decking on joists	**0.40**	**1.50**
Deck - 19mm boarding	0.15	
Joists - 50x 75 @ 300 c/cs	0.10	
Insulation + services	0.05	
Soffit board - assume 12mm ply	0.10	
Imposed loading - residential		1.50
Façade - assume double glazing with metal framing	**0.68**	
glazing - 2 layers 4mm glass, 2.2m high	0.46	
metalwork - allow 0.1kN/m2	0.22	
Roof - assume roof as rear extension roof		
Rear Garden (over basement)		
As ground floor	3.95	1.50
External finishes – 50 mm stone paving	1.30	
Bedding mortar, 25mm thick	0.55	
Insulation + waterproofing	0.15	
Additional live load		1.00
	5.95	**2.50**

Terrace floor

	kN/m2
Dead	0.40
Love	1.50

Terrace façade

	kN/m
Dead	0.68

Terrace Roof

	kN/m2
Dead	0.90
Live	1.5

Rear_Gdn

Dead	5.95
Live	2.50

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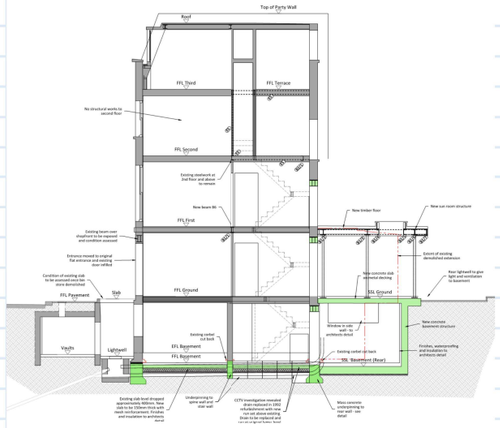
Section 2 New Steel beams

New Beams

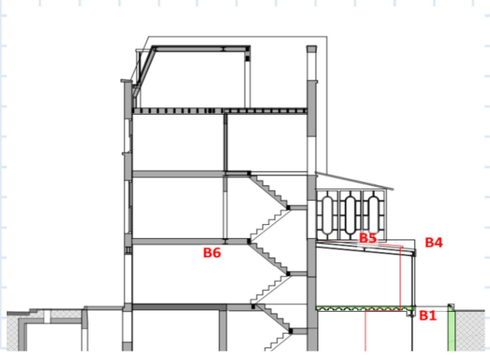


Structure at second floor and above is independent of structure below.
Existing spine beam at second floor supports second floor and part of third floor - post in spine wall carries rear channels.
Third floor spans between part walls
Mansard spans between party walls

Beam loading (Analysis below)

				Unit Ld	W / Ht	Dead	Live	Total
B1/1 - spine beam @ first	Span	4.4	m			**3.51**	**4.95**	
	Width act	3.3	m					
Floor - typ floor unit load				0.67	3.3	2.20		
				1.50	3.3		4.95	
Partition wall @ first (extg bm @ 2nd)				0.44	3	1.31		

Beam Summary



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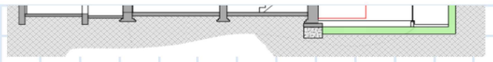


	Section	Reactions kN SLS	ULS
B1/1	152UC37	19.85	30.02

Choose steel section: 152x152x37 — ○ UB ◉ UC ○ RSJ ○ PFC

Simply supported beam

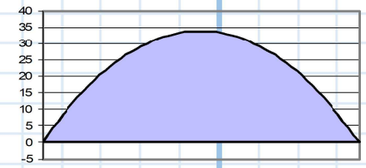
Span (m)	4.500

Load Factors	
Dead	1.4
Imposed	1.6

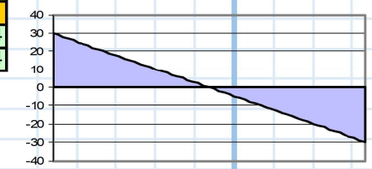
E (N/mm²)	205000
Ix (cm⁴)	2210

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				

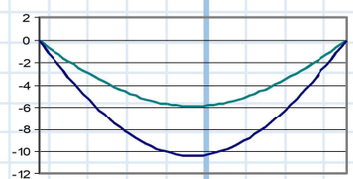
Design Status		capacity ratio
Vertical shear	PASS	0.14
Moment	PASS	0.40
Buckling	PASS	0.66
Deflection	PASS	0.83



Bending Moment Diagram



Shear Force Diagram



Deflection Diagram

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

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 L m	factor	L_E m	radius of gyration r_y (cm)	slenderness λ_v
4.100	1.4L+2D	5.064	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