DEVISE.

42 SOUTHWOOD LANE, N6 5EB

LOWER GROUND FLOOR STRUCTURAL DESIGN PHILOSOPHY AND CALCULATIONS

INTRODUCTION

42 Southwood Lane is a mid-terrace property of late Victorian construction, with the external walls and the lower ground spine wall formed from solid masonry construction. The floors, roof and remaining internal walls and are formed from timber joist construction.

Strengthening works have taken place to the roof structure, while two openings were proposed within lower ground floor central spine wall as per demolitions plan adjacent.

DESIGN INTENT

The initial design intent was to create two small openings, highlighted in Figure 1 in yellow, and install prestressed concrete lintels spanning over the newly created openings, and onto masonry piers within the lower ground floor wall.

However, due to the condition of the existing lower ground floor masonry wall; its relative low assumed compressive strength; and the existing loading transferred from the floors and walls above, the proposed size of piers 225mm x 650mm and 225mm x 225mm were found to be inadequate for the proposed openings, see appendix B.

A significant level of historic settlement was also evident within the existing spine wall.

As such, in order to mitgate differential setlement to the return wall highlighted in blue on Figure 1 – and to negate underpinnning of the listed fabric to the spine wall, it was proposed to extend the steel beam (Beam B3) across the full width of the property (over the central spine wall at lower ground floor level).

The party walls were deemed sufficient to distribute the additional load from this steel beam with minimal impact to the exisitng building fabric.

The calculations for the loadings applied and the steel beam design and its respective bearings can be seen in appendix B which were shown to be satisfatory.

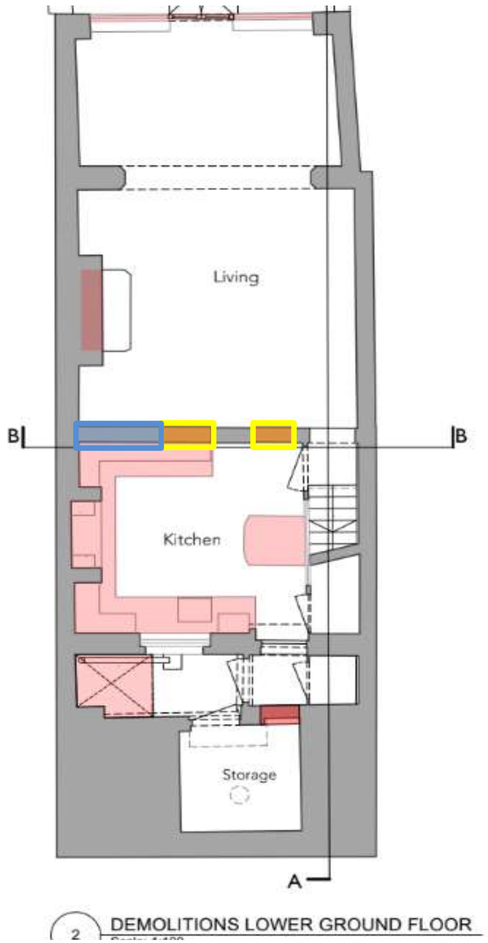

Figure 1 - Lower Ground Floor Plan with proposed demolitions in red.

APPENDIX A – LOADING SCHEDULE AND STRUCTURAL CALCAULATIONS FOR BEAM B3 INSTALLED OVER LOWER GROUND FLOOR WALL

						Permanent, Gk		**Variable, Qk**	
Existing Floors									
		thickness	width	centres	density				
Gk	Joists 175x50 @ 400	175	50	400	6	0.13			
	Floor boards	25	1	1	6	0.15			
	Ceiling and Services	15	1	1	10	0.15			
	Plywood 6mm	6	1	1	7	0.04			
	Insulation	100	1	1	1	0.10			
Gk, total						**0.57**	kN/m2		
Qk	Residential							1.5	
	Partitions								
Qk,total								**1.5**	kN/m2
Timber Wall									
		thickness	width	centres	density				
Gk									
	150mm Stud	150	50	400	6	0.11			
	Plywood	18	1	1	8	0.14			
	Plasterboard 2x12mm	24	1	1	9	0.22			
	Finishes	75	1	1	10	0.75			
	Insulation	100	1	1	1	0.10			
Gk, total						**1.32**	kN/m2		

Beam B3								
span, l =	4.5	m						
							kN/m	
Loadings							**Permane**	**Variable**
		Tributary		**Permar**	**Variable**			
Ground Floor		2.2	x	0.57			1.3	
		2.2	x		1.50			3.3
Ground Floor wall		2.6	x	1.32			3.4	
First floor		2.2	x	0.57			1.3	
		2.2	x		1.50			3.3
First floor wall		2.6	x	1.32			3.4	
Second floor		2.2	x	0.57			1.3	
		2.2	x		1.50			3.3
Second floor wall		2.6	x	1.32			3.44	
				gk + qk			14.1	9.9
				1.35gk + 1.5qk			19.0	14.9
				w_{Ek}			24.0	kN/m
				w_{Ed}			33.9	kN/m

Consider beam as simply supported:							
Flexure							
$M_{ed} = w_{Ed}l^2/8 + Pl/4=$		85.8	kNm				
Deflection							
limit δ_{qk} to l/360				12.5	So, $\delta_{qk\,=}$	12.5	mm
limit to l/250				18	So, $\delta_{gk+qk\,=}$	18	mm
$I_{req\ qk}$ =		2014	$x10^4mm^4$				
$I_{req\ gk+qk}$ =		3390	$x10^4mm^4$				
Provide	203x203x52						
$M_{b,Rd}$ =	182	kNm		c=1.0	Beam passes in bending		
Iprov =	5260	$x10^4mm^4$			Beam passes in deflection		
δ_{gk+qk} =		12	mm				
δ_{qk} =		5	mm				
203x203x52 Satisfies both in bending and deflection.							

Padstone					
$R_{Ek} = (w_{Ek} \times l)/2 =$			54.00	kN	
$A_{padstone,\ dims}$		w	100	mm	
		l	1300	mm	
$A_{padstone,\ area}$			130000	mm^2	
$\sigma = R_{Ek}/A_{padstone} =$			0.42	N/mm^2	1300mm LG 152x89x16 UB Padstone required

APPENDIX B – STRUCTURAL CALCULATIONS FOR MASONRY PIERS HIGHLIGHTED IN FIGURE 1

Pier Design - Lower Ground Floor				
Pier Properties (Pier 1)			Pier Properties (Pier 2)	
Wall type	Solid		Solid	
Height (mm)	2800		2800	
Width (mm)	225		225	
Length (mm)	650		225	
Height of wall above	5200		5200	
Design strength of Masonry (fd)	0.42		0.6	
Forces on Pier 1			Forces on Pier 2	
Self Weight of Pier (Np1)	7.78	kN	2.69	kN
Weight of masonry above (Np2)	14.45	kN	5.00	kN
Axial Force (Ned)	34.8	kN	34.8	kN
Total Axial force (N)	57.03	kN	42.50	kN
Med	0.00	kNm	0.00	kNm

Axial load check Pier 1			Axial load check Pier 2	
Height Effective (Heff)	2800		2800	
Thickness Effective (Teff)	225.0		215.0	
Slenderness ratio (Heff/Teff)	12.44	Therefore OK	13.02	Therefore OK
Area A	0.225	Therefore OK	0.215	Therefore OK
Reducation Factor, Gamma		No reduction factor		No reduction factor
Eccentricity ei	11.25		10.75	
Phi i	0.9		0.9	
em (Eccentricity at Mid height) em = max(M/N ± hef/450 ; 0.05t)	11.25		10.75	
u = ((hef/tef) – 2)/(23 – 37*(emk/t))	0.4938		0.5212	
A1 = 1 – (2*(emk/t))	0.9		0.9	
Reduction Factor at Mid height, ϕm ϕm = A1*e^(-u2/2)	0.80		0.79	
Critical reduction factor	0.80		0.79	
Nrd	49	kN	23	kN
Nrd > Ned		Fail		Fail
Foundation area	0.57	m^2	0.42	m^2

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