

STRUCTURAL CALCULATIONS

Client: Ms Greenwood

Site Address: 255 Stand Lane
Radcliffe
Manchester
M26 1AJ

Project Number: 23248

Reference (Revision): 23248-DCE-XX-XX-T-S-001-C01

Date: 10/07/2023

Author: B. Wright. Date: Jul 2023

Checker: Paul Boulton Date: Jul 2023

Approved by;
Paul Boulton

Job No.	23248	Sheet No.	i
Calcs By:	BW	Date	Jul '23

CLIENT: Ms Greenwood

PROJECT TITLE: 255 Stand Lane

ARCHITECT: TBC

DESIGN PHILOSOPHY:

This calculation package includes the structural calculations for the proposed single storey extension to a two-storey terrace house at 255 Stand Lane, Radcliffe.

The proposed works include demolishing an existing extension and constructing a new larger extension to rear of the building with timber rafters, brick/block cavity walls, thickened edge raft slab tied into existing slab and a steel frame to form the opening on the rear wall.

The thickened edge raft slab is to be founded on minimum 200mm thick type 1 stone, assumed to be founded on natural strata (TBC) with minimum AGBP=50kN/m², to be agreed with the Building Control inspector.

Existing foundations to be confirmed by trial pits during site works. To avoid underpinning or strengthening works existing foundations below the new columns, the proposals is to install a pair steelwork *picture / letterbox frames* to transfer the concentrated load into steel beams below FFL which will spread the load across the existing foundations.

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CODES OF PRACTICE

Loading Codes:	Dead and Imposed Loads	BS 6399: Part 1
	Roof Loads	BS 6399: Part 3
	Wind Loads	BS 6399: Part 2
Building Regulations and Codes of Practice:	General	Current Building Regulations
	Steelwork	BS 5950
	Reinforced Concrete	BS 8110
	Masonry	BS 5628
	Timber	BS 5268
	Foundations	BS 8004
Materials:	Concrete	Grade
	Reinforcement	$f_y = 500 \text{ N/mm}^2$
	Structural Steel	S355
	Structural Steel Execution Class	EXC2
	Brickwork	20N/mm ² Clay; (iii) Mortar M4
	Blockwork	Min. 7N/mm ² ; (iii) Mortar M4
	Timber	Min. C16
Fire Resistance:	To architects' details	
Exposure Conditions:		
Subsoil Conditions, Bearing Pressure and Foundation Type:	To be confirmed following trial pits on site.	
Other relevant information, data given, etc:		

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LOADING:		Working Load (kN/m ²)	Safety Factor	Design Load (kN/m ²)
ROOF (Existing)	Dead Loads			
	Slates on Battens on Rafters	0.75		
	Self weight of timbers	0.25		
	Ceiling & Lighting	0.15		
	Plaster & Skim	0.10		
	Total Dead Loads (On Plan)	1.25	1.40	1.75
	Imposed Loads	0.75	1.60	1.20
	Total DL + IL	2.00	1.48	2.95
FLOOR (Existing)	Dead Loads			
	T&G Board on Timber Joists	0.35		
	Ceiling & Lighting	0.15		
	Total Dead Loads	0.50	1.40	0.70
	Imposed Loads	1.50	1.60	2.40
	Total DL + IL	2.00	1.55	3.10
Walls	102.5mm Brick Leaf	2.30	1.40	3.22
	100mm Block Leaf with Plaster finish	1.85	1.40	2.59
OTHER				

New Extension Details.

✓ Design new steel beam(s) to support rear external wall & remain exty. Central Pier.

Design inner leaf Beam:

Span = 3800mm

Loading:	load	cover	sls	γ_f	ucs
Ex. Roof DL	1.25	$\times 9.0/2m$	$= 5.7 \text{ kN/m}$	$\times 1.4$	$= 7.8 \text{ kN/m}$
IL	0.75	$\times "$	$= 3.4 "$	$\times 1.6$	$= 5.4 "$
Floor DL	0.55	$\times 3.6/2m$	$= 0.9 "$	$\times 1.4$	$= 1.3 "$
IL	1.50	$\times "$	$= 2.7 "$	$\times 1.6$	$= 4.3 "$
Wall	2.00	$\times 2.5m$	$= 5.0 "$	$\times 1.4$	$= 7.0 "$
SW		Allow	$= 0.3 "$	$\times 1.4$	$= 0.4 "$
total = $18.0 \text{ kN/m} (\times 1.46) = 26.2 \text{ kN/m}$					

$$V_{max} = 26.2 \times 3.8/2 = 50 \text{ kN}$$

$$M_{max} = 26.2 \times 3.8^2/8 = 47.5 \text{ kNm}$$

$$I_{req} = 1.52 \times 26.2 \times 3.8^3 = 2185 \text{ cm}^4$$

$$L_E = 1.0L + 2D = 5.0m$$

→ Provide 254 x 146 x 31 UB (S355)

$$M_b = 49.3 > 47.5$$

$$I_{pew} = 4413 > 2185 \therefore \text{ok}$$

Design outer leaf Beam:

Loading:	load	cover	sls	γ_f	ucs
New Roof DL	1.25	$\times 2.5/2m$	$= 1.6 \text{ kN/m}$	$\times 1.4$	$= 2.2 \text{ kN/m}$
IL	0.75	$\times "$	$= 1.0 "$	$\times 1.6$	$= 1.6 "$
Wall	2.3	$\times 2.5m$	$= 5.8 "$	$\times 1.4$	$= 8.0 "$
SW		Allow	$= 0.3 "$	$\times 1.4$	$= 0.4 "$
total = $8.7 \text{ kN/m} (\times 1.4) = 12.2 \text{ kN/m}$					

$$V_{max} = 12.2 \times 3.8/2 = 23.2 \text{ kN}$$

$$M_{max} = 12.2 \times 3.8^2/8 = 22 \text{ kNm}$$

$$I_{req} = 1.52 \times 12.2 \times 3.8^3 = 1017 \text{ cm}^4$$

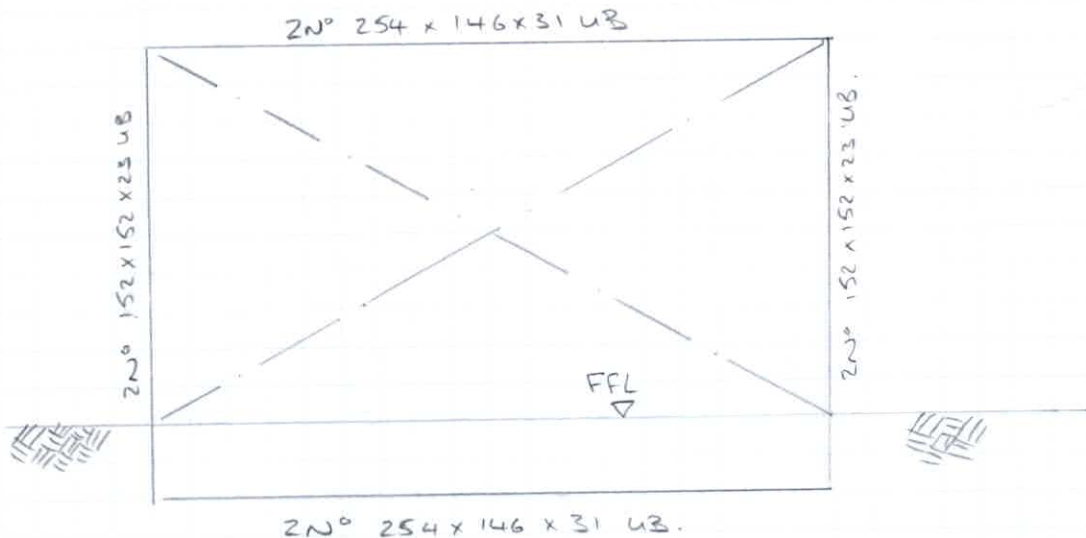
$$L_E = 1.0L + 2D = 5.0m$$

→ Provide minimum 202 x 133 x 25 UB. However for ease of construction suggest use same beam as the inner leaf.

Reaction loads (SLS):

$$\text{inner} = 34.2 \text{ kN}, \text{ outer} = 16.6 \text{ kN}$$

2/ Steel column / Frame.



Propose 'Letterbox' frame to form opening in rear elevation wall to allow concentrated loads to transfer from columns into ground beam which spread the load across the existing foundations as the beams are put into Bending.
 $\therefore$ No change to load on foundations except for minimal amount of additional roof load $< 5\%$ increase $\therefore$ ok

Check Columns in axial:

$$\text{Max axial} = 50 \text{ kN ucs}$$

$$\text{Capacity } 152 \times 152 \times 23 \text{ uc} = 770 \text{ kN} (L_e = L_m) \therefore \text{ok}$$

Check Stability of Frame:

Ensure Party walls & piers are fully tied/restrained to columns both sides.

From TEDD's Document overleaf, a basic frame analysis to assess the stability for maximum wind applied to the end of the terrace hauser

$$\text{Wind} = 0.7 \text{ kN/m} \times 5.5/2 = 3.0 \text{ kN/m}$$

Assessed as 1 frame, $\rightarrow$ Conservatve (2N° frames to be installed)

$$\text{Max Deflection on column} < 6 \text{ mm (SLS)} \approx 5 \text{ mm} / 420 \text{ total load} \therefore \text{ok}$$

3/ Bi-fold door Lintel

Span = 3.5m.

New roof = $(2.00 \times 2.5/2) = 2.5 \text{ kN/m SLS}$

→ Provide IG L1/S 100 Cavity lintel (or similar approved)

total UDL capacity = $26 \text{ kN (3:1)} > 8.75 \text{ kN} \therefore \text{ok}$

4/ timber rafter design

Span = 2.5m (on Plan) Pitch = 15°

From BS TRADA table 12: $0.75 > DL < 1.00$

→ Provide 38 x 150 C16 timber rafters @ 600mm c/c

$2.59 > 2.5 \therefore \text{ok}$

5/ New extension slab

- Propose thickened edge raft slab to extension minimum 175mm thick with 1 layer A252 mesh top + Btm. Thickening to be 450 x 600mm wide with supporting reinforcement. Minimum 300mm well compacted type 1 stone below raft.

Founding Strata TBC on site.

- Check for 3m soft spot: SLS

ULS

$$(wall) \quad W = 4.3 \text{ kN/m}^2 \times 2.5 \text{ m} = 10.8 \text{ kN/m (x 1.4)} = 15.1 \text{ kN/m}$$

$$M_{max} = 15.1 \times 3^2/8 = 17 \text{ kNm}$$

600 x 450 mm dp GB

$$d = 450 - 50 - 10 = 390 \text{ mm}$$

$$\frac{M}{bd^2 f_{cu}} = \frac{17 \times 10^6}{600 \times 390^2 \times 35} = 0.005$$

$$z = d \left\{ 0.5 + \sqrt{0.25 - \frac{0.005}{0.9}} \right\} = 990 > 0.95d \therefore \text{use } 0.95d$$

$$x = 0.95 \times 390 = 370.5 \text{ mm}$$

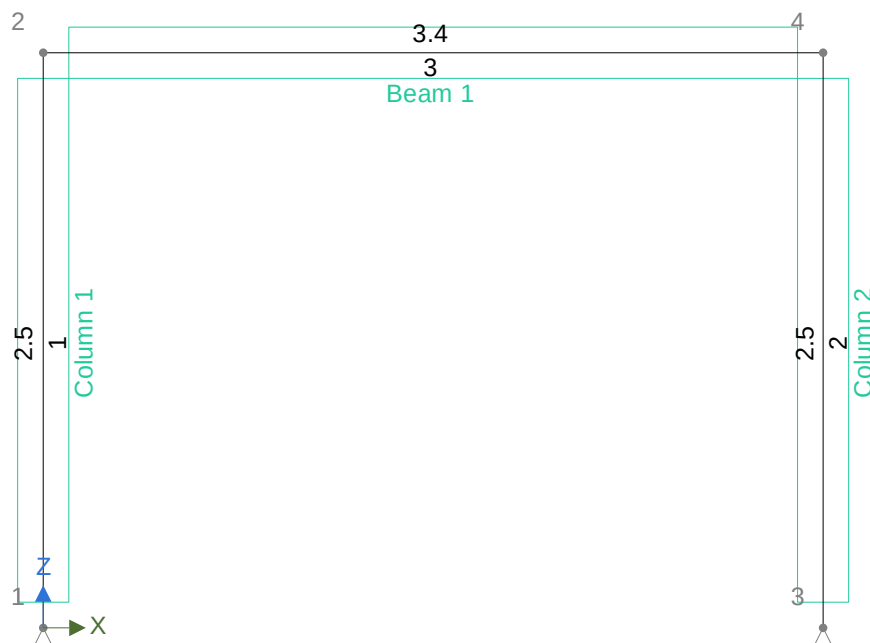
$$A_{s \text{ req}} = \frac{M}{0.87 \times f_y \times z} = \frac{17 \times 10^6}{0.87 \times 500 \times 370.5} = 105 \text{ mm}^2 \therefore \text{use A252 Mesh Btm}$$

ANALYSIS

Tedds calculation version 1.0.37

Geometry

Geometry (m) - Steel (BS5950)



Loading

Self weight included (Self weight x 1)

Load combination factors

Load combination	Self weight	Permanent	Imposed	Wind
1.4D (Strength)	1.40	1.40	1.20	1.20
1.4D + 1.6I + 1.6RI (Strength)	1.40	1.40	1.60	
1.0D + 1.0I + 1.0RI (Service)	1.00	1.00	1.00	
1.4D + 1.6I + 1.6S (Strength)	1.40	1.40	1.60	
1.0D + 1.0I + 1.0S (Service)	1.00	1.00	1.00	
1.2D + 1.2I + 1.2RI + 1.2W (Strength)	1.20	1.20	1.20	1.20
1.0D + 1.0I + 1.0RI + 1.0W (Service)	1.00	1.00	1.00	1.00
1.0D + 1.4W (Strength)	1.00	1.00		1.40

Member Loads

Member	Load case	Load Type	Orientation	Description
Beam 1	Permanent	UDL	GlobalZ	13.4 kN/m
Beam 1	Imposed	UDL	GlobalZ	6.1 kN/m
Column 1	Wind	UDL	GlobalX	3 kN/m



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Project

255 Stand Lane

Job no.

23248

Calcs for

Frame Stability Check

Start page no./Revision

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Calcs by

BW

Calcs date

11/07/2023

Checked by

PRB

Checked date

Approved by

Approved date

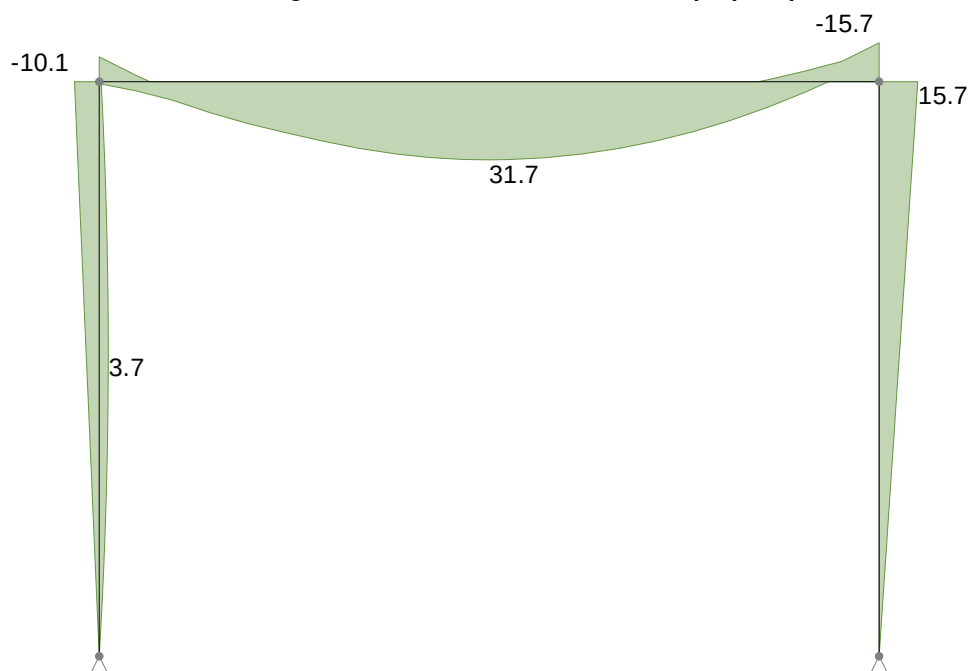
Results

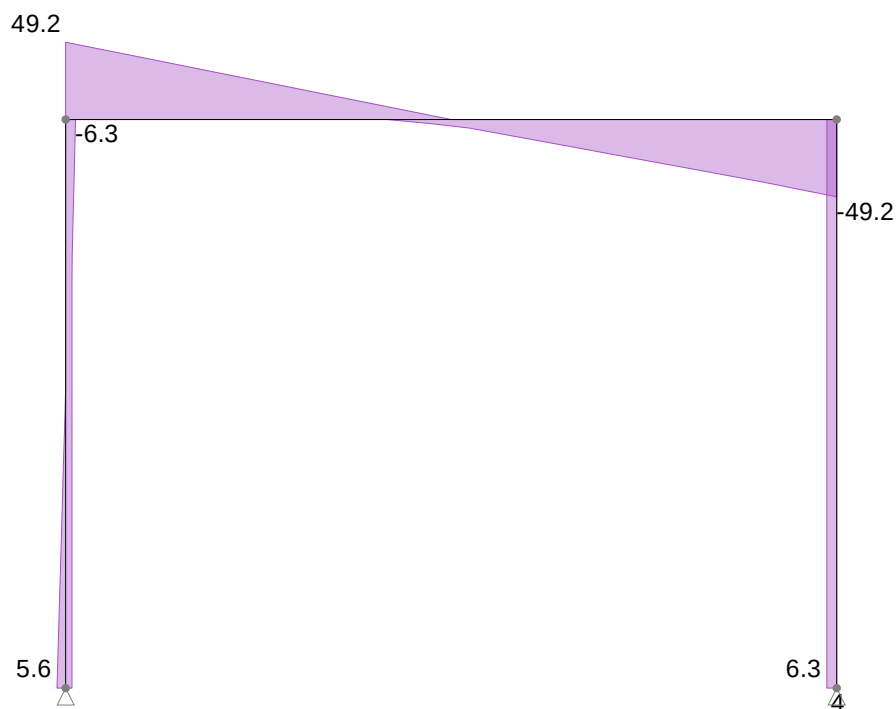
Total base reactions

Load case/combination	Force	
	FX (kN)	FZ (kN)
1.4D (Strength)	-9	91.7
1.4D + 1.6I + 1.6RI (Strength)	0	100
1.0D + 1.0I + 1.0RI (Service)	0	68.5
1.4D + 1.6I + 1.6S (Strength)	0	100
1.0D + 1.0I + 1.0S (Service)	0	68.5
1.2D + 1.2I + 1.2RI + 1.2W (Strength)	-9	82.2
1.0D + 1.0I + 1.0RI + 1.0W (Service)	-7.5	68.5
1.0D + 1.4W (Strength)	-10.5	47.7

Forces

Strength combinations - Moment envelope (kNm)



Strength combinations - Shear envelope (kN)**Service combinations - Deflection envelope (mm)**