Structural notes - formation of new opening through internal wall

82A New North Road, Huddersfield, HD1 5NE

The following notes must be read in conjunction with sketch sheet 'SK1' and the structural calculations.

All dimensions, materials and constructional information are from site inspection undertaken by Mr Nick Brooke on 28th February 2024.

Description of property

The property is a two-storey early Victorian, ashlar fronted semi-detached house with a large feature front pediment with deep entablature over four giant pilasters across the shared central two bays. The roof over the main body has a traditional duo-pitched profile clad with grey slates. The two outer bays have a feature eaves cornice and parapets. The property has a later two-storey coursed stone extension on the side and set back from the front with parapet detail and a flat roof.

There is a lower ground floor beneath the full footprint of the original dwelling i.e. three-storeys at the rear, with direct access from the lower ground floor to the rear gardens. There is also a single garage/workshop beneath the footprint of the side extension.

The property has a Grade II English Heritage listing status dated September 1978.

General constructional information & proposed work

The ground floor comprises of a large through hallway with access to the kitchen extension and the two (front and rear) reception rooms positioned against the party wall.

The hallway and rear reception room floors are suspended timber construction with joists spanning 'side to side' i.e. from the party wall to a wide supporting wall between the hallway and the reception rooms. The first floor construction and joist span direction is similar.

The ground floor in the front reception room is solid construction and there is an exposed shallow stone vaulted ceiling in the lower ground floor room directly below.

The ground floor joists in the hallway are overlaid with stone slabs and the original floor boards in both reception rooms have been overlaid with longstanding feature hardwood flooring, oak parquet and similar.

The dividing wall between the front and rear reception rooms is solid construction extending from lower ground floor level up to the underside of the main house roof. The wall is loadbearing and supports the roof purlins which span front to back with intermediate support provided by timber roof trusses.

The proposed work is to form two new openings:-

1. A standard width doorway, approx. 900mm wide, between the rear reception room and the hallway located close to the rear corner of the room.

2. A 3.00 metre wide opening in the dividing wall between the front and rear reception rooms.

The doorway is to be formed through a stone wall that extends the full height of the house and supports the first floor and some roof load. The wall is approximately 450mm thick.

The proposal is to use 3No. Naylor R9 prestressed concrete lintels to span the clear opening placed side by side over the thickness of the wall. The lintels are to have a minimum bearing onto solid masonry of 150mm at each end. See attached sketch for proposed position of opening and the associated calculation/Naylor lintels R9 load table which demonstrate the adequacy of the lintels specified.

The 3.00 metre wide opening will be approximately central to the width of the dividing wall and therefore no ‘Party Wall’ notification will be necessary. A nib measuring a minimum of 700mm must be retained adjacent to the party wall .

The wall is approximately 180mm thick when measured over the plaster finishes. The wall is constructed in stone and the steelwork has been designed to support the self-weight of the masonry above the opening and the associated roof loads which disperse down the wall as uniformly distributed loads (UDLs). See attached sketch for proposed position of opening and associated calculations which demonstrate the adequacy of the steel beam size specified.

Size of opening & protection of existing finishes

The clients preference is to create an opening that is 3.00 metres wide. The height to the underside of the finished opening should be 200mm above the height of the existing picture rail, approximately 2.65 metres above floor level.

The floor to ceiling height measured in the rear reception room is approximately 3.62 metres.

The builder is responsible for all necessary enabling works in order to prepare and adequately protect the existing finishes and the immediate surrounding environment throughout the duration of the work. The builder is to liaise with the property owner in relation to the careful removal and storage for re-use of the affected skirting boards etc. Additionally, the full scope of any reinstatement/making good of finishes on completion of the builders work should be agreed prior to commencement.

Temporary propping and high level access

The total factored load required to be supported is approximately 5.25 tons/linear metre.

The builder is responsible for all necessary temporary propping works in order to safely support the applied loads and to maintain the ongoing structural stability of the property throughout the work.

All props placed on the ground floor in the rear reception room should be onto scaffold spreader boards, positioned over a joist line and require ‘back propping’ down to lower ground floor level. The builder is responsible for selecting and using props of adequate strength and size.

Due to the height of the opening it is envisaged that the builder will also require temporary working platforms and/or tower scaffolds in order to both carefully remove the existing masonry and facilitate safe placement of the steel beam. The builder will be responsible for the type and adequacy of the working platforms.

Steel beam to new opening - 3000mm maximum clear span

The builder will be responsible for the safe delivery, handling, lifting and placement of the steel beam.

The steel beam required is a 254x146x43kg/m UB

The steel grade required is S275 steel.

The beam must be positioned under the centre line of the wall to be supported and requires a minimum bearing length of 250mm at each end. The beam is to be seated onto high strength precast concrete padstones that are a minimum of 300mm long x 150mm wide x 150mm deep.

General Notes:

All CDM requirements are the responsibility of the client and the principal contractor.

The attached calculations are issued for Building Control approval. Any structural construction works undertaken prior to approval being obtained are done so at risk by the client/building contractor.

All stated dimensions of clear spans are for calculation purposes only.

All statutory and necessary approvals where required should be in place prior to commencing with the work.

The setting out and positioning of steel beam is the full responsibility of the building contractor.

If any queries arise on site or if there are any queries in relation to the above requirements, then ask the structural engineer immediately for further guidance.

Contact:-
Nick Brooke
Structural Engineer
Redacted

N R B DESIGN

Structural Engineering Design & Advice

82A New North Road

Proposed new door opening – see sketch SK1 for position of opening

Dead loads		kN/m
wall	- 23.7 x 0.45 x 4.40 =	46.98
first floor	- 0.75 x 4.50/2 =	3.38
roof	- $\frac{1.10/\cos 30 \times ((3.21+2.95)/2) \times 4.5/2}{4.40}$ =	2.00
		52.36

Imposed loads		
first floor	- 2.00 x 4.50/2 =	4.50
roof (snow)	- $\frac{0.75/\cos 30 \times ((3.21+2.95)/2) \times 4.5/2}{4.40}$ =	1.36
		5.86

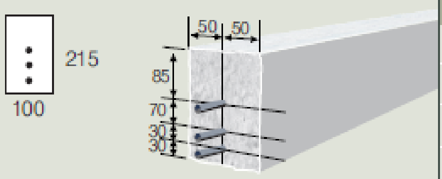
Total factored load w = (52.36 x 1.40) + (5.86x 1.6) = <u>82.68</u>

Moment $M = \frac{wL^2}{8} = \underline{10.34\ kNm}$ Shear $V = \frac{wL}{2} = \underline{41.34kN}$

From published Naylor lintel load tables, the moment of resistance and shear values for a single R9 prestressed concrete lintel with a clear span of 1000mm (maximum width of masons opening) are highlighted below. Therefore, and by inspection the use of 3No. R9 prestressed concrete lintels is structurally sufficient. R9 lintels are 215mm deep x 100mm wide and should be equally spaced to suit the overall width of the wall.

R9

Also
FacedR9
ChemR9
ColourR9
GroundR9



Section Properties

Height	215mm	Vco 100	47.22 kN
Width	100mm	Vco 100/1.5	31.48 kN
Ms	12.396 kNm	Vco 150	49.39 kN
Mu	23.867 kNm	Vco 150/1.5	32.93 kN
Mu/1.5	15.912 kNm	Effective Depth	141.67mm
Limiting MR	12.396 kNm	Self Weight	52 kg/m

Load Table

O/all Length	Clear Span	Eff. Span	Allowable Load - kN/m MR (A)	SR100 (B)	SR150 (B)	Limiting (C)
900	700	800	154.43	78.18		78.18
1100	900	1000	98.65	62.44		62.44
1200	1000	1100	81.44	56.72		56.72
1500	1200	1341.67	54.57		48.57	48.57
1800	1500	1641.67	36.27		39.60	36.27
2100	1800	1941.67	25.78			25.78
2400	2100	2241.67	19.21			19.21
2700	2400	2541.67	14.83			14.83
3000	2700	2841.67	11.76			11.76
3300	3000	3141.67	9.53			9.53
3600	3200	3341.67	8.36			8.36

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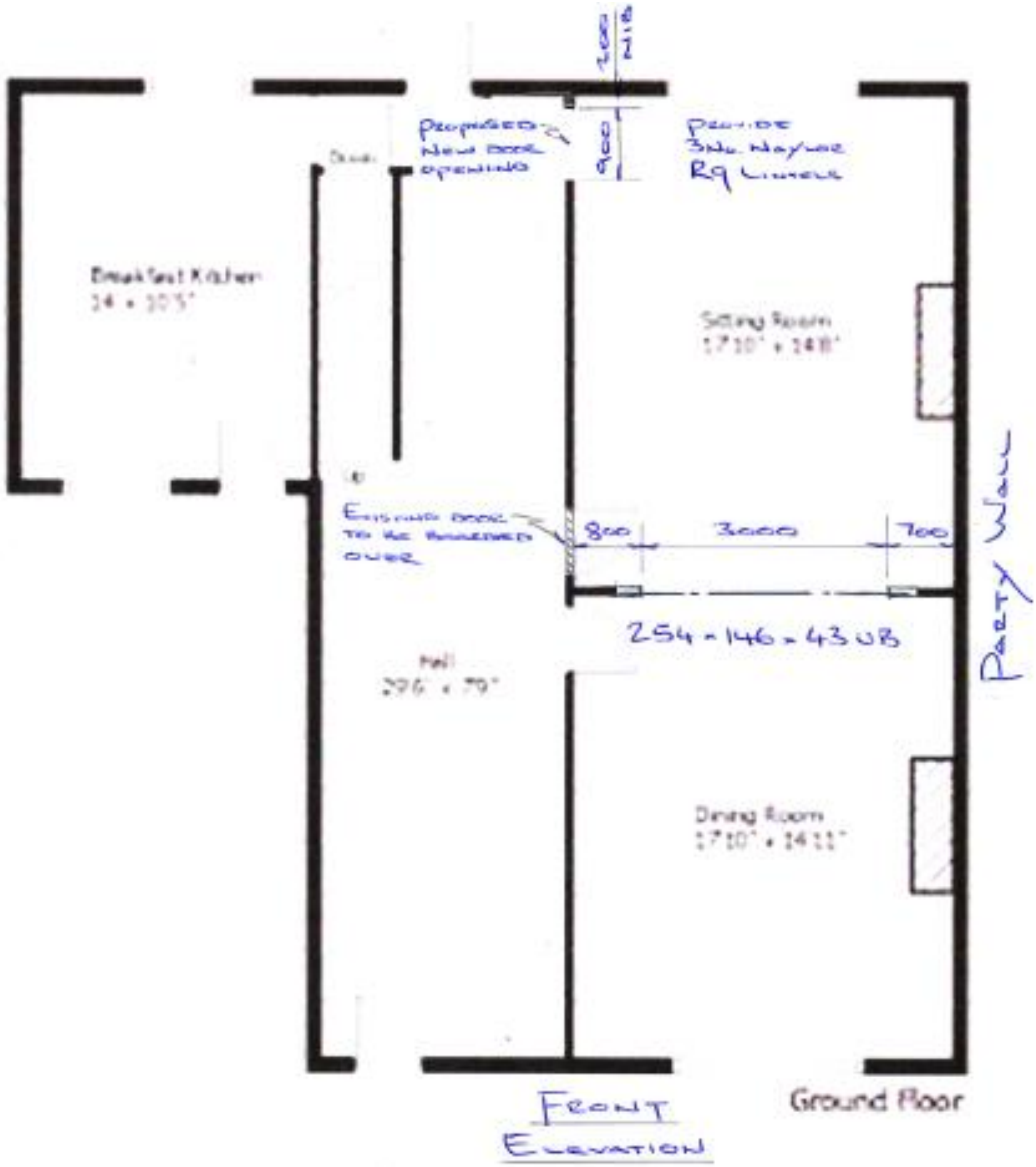
SK1 – sketch showing positions of the proposed door opening and the proposed 3.00 metre wide opening between the front and rear reception rooms

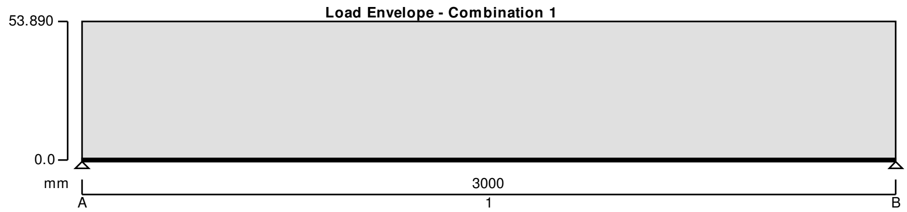


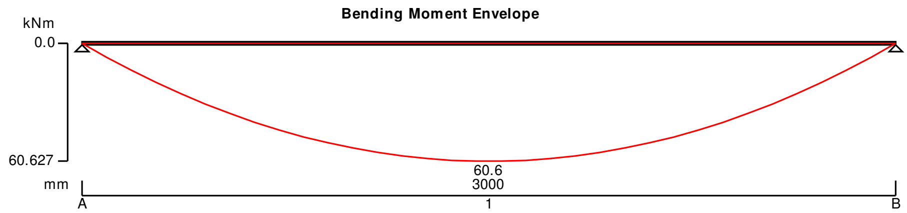
Read in conjunction with structural notes (pages 1 to 4) and steel beam design calculations
Not to scale - all figured dimensions are shown in millimetre

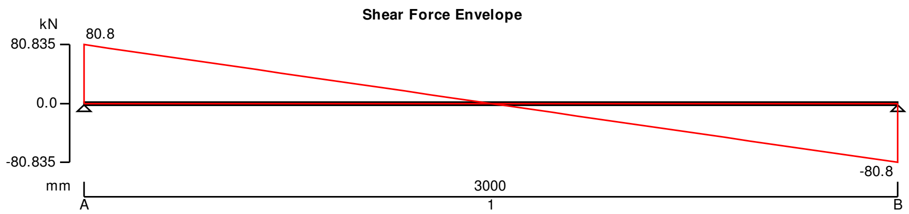
NRB DESIGN Structural Engineering Design & Advice	Project 82A New North Road, Huddersfield, HD1 5NE			Job Ref.	
	Section steel beam over proposed new opening - 3000mm clear span			Sheet no./rev. 1	
	Calc. by NB	Date March 2024	Chk'd by NB	Date March 2024	App'd by	Date

STEEL BEAM ANALYSIS & DESIGN (BS5950)

TEDDS calculation version 1.0.05







Support conditions

Support A	Vertically restrained
	Rotationally free
Support B	Vertically restrained
	Rotationally free

Applied loading

Beam loads

dimensions & materials from site inspection	Dead self weight of beam × 1
roof - 1.1/cos30 x (3.21+2.95)/2 =	Dead full UDL 3.91 kN/m
snow - 0.75/cos30 x (3.21+2.95)/2 =	Imposed full UDL 2.67 kN/m
attic floor - 0.70 x (3.21+2.95)/2 =	Dead full UDL 2.16 kN/m
domestic (no partitions) - 1.50 x (3.21+2.95)/2 =	Imposed full UDL 4.62 kN/m
wall (stone) - 23.7 x 0.18 (inc plaster) x 5.55 =	Dead full UDL 23.67 kN/m

Load combinations

Load combination 1	Support A	Dead × 1.40
		Imposed × 1.60

	Span 1	Dead × 1.40
		Imposed × 1.60
	Support B	Dead × 1.40
		Imposed × 1.60

Analysis results

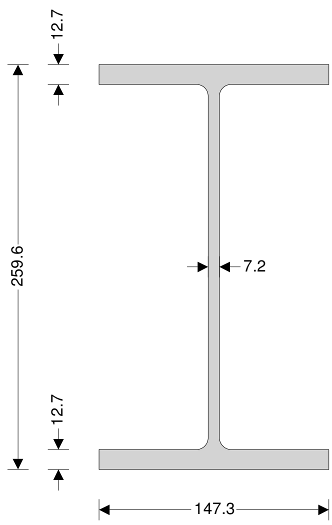
Maximum moment	M_{max} = **60.6** kNm	M_{min} = **0** kNm
Maximum moment span1	M_{s1_max} = **60.6** kNm	M_{s1_min} = **0** kNm
Maximum shear	V_{max} = **80.8** kN	V_{min} = **-80.8** kN
Maximum shear span1	V_{s1_max} = **80.8** kN	V_{s1_min} = **-80.8** kN
Deflection span1	δ_{s1_max} = **2.9** mm	δ_{s1_min} = **0** mm
Reactions at support A	R_{A_max} = **80.8** kN	R_{A_min} = **80.8** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **45.2** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **10.9** kN	
Reactions at support B	R_{B_max} = **80.8** kN	R_{B_min} = **80.8** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **45.2** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **10.9** kN	

Section details

Section type	**UB 254x146x43**
Steel grade	**S275**

From table 9: Design strength p_y

Thickness of element	max(T, t) = **12.7** mm
Design strength	p_y = **275** N/mm^2
Modulus of elasticity	E = **205000** N/mm^2



Lateral restraint

Span 1 has lateral restraint at supports only

Effective length factors

Effective length factor in major axis	K_x = **1.00**
Effective length factor in minor axis	K_y = **1.00**
Effective length factor for lateral-torsional buckling	$K_{LT.A}$ = **1.40** + 2 × D
	$K_{LT.B}$ = **1.40** + 2 × D

Classification of cross sections - Section 3.5

$\varepsilon = \sqrt{[275 \text{ N/mm}^2 / p_y]} = \mathbf{1.00}$

Internal compression parts - Table 11

Depth of section — d = **219** mm

$d / t = 30.4 \times \varepsilon <= 80 \times \varepsilon$ — Class 1 plastic

Outstand flanges - Table 11

Width of section — b = B / 2 = **73.7** mm

$b / T = 5.8 \times \varepsilon <= 9 \times \varepsilon$ — Class 1 plastic

Section is class 1 plastic

Shear capacity - Section 4.2.3

Design shear force — $F_v = \max(\text{abs}(V_{max}), \text{abs}(V_{min})) = \mathbf{80.8}$ kN

$d / t < 70 \times \varepsilon$

Web does not need to be checked for shear buckling

Shear area — $A_v = t \times D = \mathbf{1869}$ mm^2

Design shear resistance — $P_v = 0.6 \times p_y \times A_v = \mathbf{308.4}$ kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment — $M = \max(\text{abs}(M_{s1\_max}), \text{abs}(M_{s1\_min})) = \mathbf{60.6}$ kNm

Moment capacity - Section 4.2.5

Moment capacity low shear - cl.4.2.5.2 — $M_c = \min(p_y \times S_{xx}, 1.2 \times p_y \times Z_{xx}) = \mathbf{155.7}$ kNm

Effective length for lateral-torsional buckling - Section 4.3.5

Effective length for lateral torsional buckling — $L_E = 1.4 \times L_{s1} + 2 \times D = \mathbf{4719}$ mm

Slenderness ratio — $\lambda = L_E / r_{yy} = \mathbf{134.195}$

Equivalent slenderness - Section 4.3.6.7

Buckling parameter — u = **0.891**

Torsional index — x = **21.162**

Slenderness factor — $v = 1 / [1 + 0.05 \times (\lambda / x)^2]^{0.25} = \mathbf{0.759}$

Ratio - cl.4.3.6.9 — $\beta_W = \mathbf{1.000}$

Equivalent slenderness - cl.4.3.6.7 — $\lambda_{LT} = u \times v \times \lambda \times \sqrt{[\beta_W]} = \mathbf{90.723}$

Limiting slenderness - Annex B.2.2 — $\lambda_{L0} = 0.4 \times (\pi^2 \times E / p_y)^{0.5} = \mathbf{34.310}$

$\lambda_{LT} > \lambda_{L0}$ - Allowance should be made for lateral-torsional buckling

Bending strength - Section 4.3.6.5

Robertson constant — $\alpha_{LT} = \mathbf{7.0}$

Perry factor — $\eta_{LT} = \max(\alpha_{LT} \times (\lambda_{LT} - \lambda_{L0}) / 1000, 0) = \mathbf{0.395}$

Euler stress — $p_E = \pi^2 \times E / \lambda_{LT}^2 = \mathbf{245.8}$ N/mm^2

$\phi_{LT} = (p_y + (\eta_{LT} + 1) \times p_E) / 2 = \mathbf{308.9}$ N/mm^2

Bending strength - Annex B.2.1 — $p_b = p_E \times p_y / (\phi_{LT} + (\phi_{LT}^2 - p_E \times p_y)^{0.5}) = \mathbf{142.1}$ N/mm^2

Equivalent uniform moment factor - Section 4.3.6.6

Equivalent uniform moment factor for LTB — $m_{LT} = \mathbf{1.000}$

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment — $M_b = p_b \times S_{xx} = \mathbf{80.5}$ kNm

$M_b / m_{LT} = \mathbf{80.5}$ kNm

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to dead and imposed loads

Limiting deflection δ_{lim} = min(14 mm, L_{s1} / 360) = **8.3** mm

Maximum deflection span 1 δ = max(abs(δ_{max}), abs(δ_{min})) = **2.945** mm

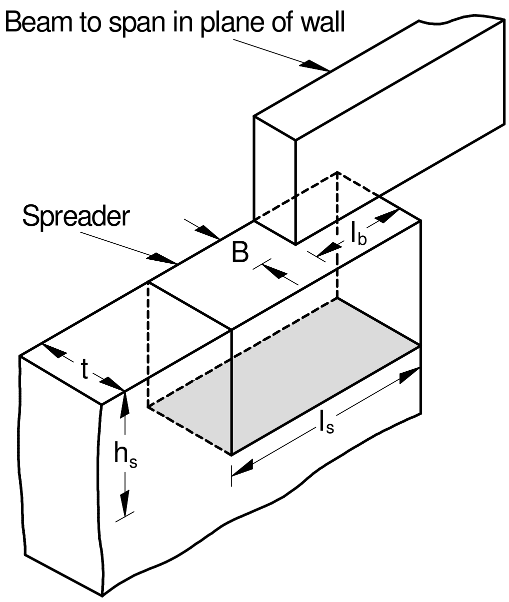
PASS - Maximum deflection does not exceed deflection limit

MASONRY BEARING DESIGN TO BS5628-1:2005

TEDDS calculation version 1.0.02

Masonry details

Masonry type	**Aggregate concrete blocks (25% or less formed voids)**
Compressive strength of unit	p_{unit} = **10.0** N/mm^2
Mortar designation	**iii**
Least horizontal dimension of masonry units	l_{unit} = **150** mm
Height of masonry units	h_{unit} = **140** mm
Category of masonry units	**Category II**
Category of construction control	**Normal**
Partial safety factor for material strength	γ_m = **3.5**
Thickness of load bearing leaf	t = **150** mm
Effective thickness of masonry wall	t_{ef} = **150** mm
Height of masonry wall	h = **2400** mm
Effective height of masonry wall	h_{ef} = **2400** mm



Bearing details

Beam spanning in plane of wall

Width of bearing	B = **150** mm
Length of bearing	l_b = **250** mm

Compressive strength from Table 2 BS5628:Part 1 - aggregate concrete blocks (25% or less formed voids)

Mortar designation	Mortar = **"iii"**
Block compressive strength	p_{unit} = **10.0** N/mm^2
Characteristic compressive strength (Table 2c)	f_{kc} = **3.98** N/mm^2
Characteristic compressive strength (Table 2d)	f_{kd} = **7.97** N/mm^2
Height of solid block	h_{unit} = **140.0** mm
Least horizontal dimension	l_{unit} = **150.0** mm

Block ratio ratio = h_{unit} / l_{unit} = **0.9**

Ratio between 0.6 and 4.5 - OK

Characteristic compressive strength f_k = **4.93** N/mm^2

Loading details

Characteristic dead load G_k = **46** kN

Characteristic imposed load Q_k = **11** kN

Design load on bearing F = ($G_k \times 1.4$) + ($Q_k \times 1.6$) = **82.0** kN

Masonry bearing type

Bearing type **Type 2**

Bearing safety factor γ_{bear} = **1.50**

Check design bearing without a spreader

Design bearing stress f_{ca} = F / (B × l_b) = **2.187** N/mm^2

Allowable bearing stress f_{cp} = $\gamma_{bear} \times f_k / \gamma_m$ = **2.114** N/mm^2

FAIL - Design bearing stress exceeds allowable bearing stress, use a spreader

Spreader details

Length of spreader l_s = **300** mm

Depth of spreader h_s = **150** mm

Edge distance s_{edge} = max(0 mm, x_{edge} – (l_s - B) / 2) = **0** mm

Spreader bearing type

Bearing type **Type 3**

Bearing safety factor γ_{bear} = **2.00**

Check design bearing with a spreader

Loading acts eccentrically within middle third – triangular stress distribution

Eccentricity of load e = (l_s – l_b) / 2 = **25** mm

Maximum bearing stress f_{ca} = F × (1 + (6 × e / l_s)) / (l_s × t)= **2.733** N/mm^2

Allowable bearing stress f_{cp} = $\gamma_{bear} \times f_k / \gamma_m$ = **2.819** N/mm^2

PASS - Allowable bearing stress exceeds design bearing stress

Check design bearing at 0.4 × h below the bearing level

Slenderness ratio h_{ef} / t_{ef} = **16.00**

Eccentricity at top of wall e_x = **0.0** mm

From BS5268:1 Table 7

Capacity reduction factor β = **0.90**

Length of bearing distributed at 0.4 × h l_d = **1210** mm

Maximum bearing stress f_{ca} = F / (l_d × t) = **0.452** N/mm^2

Allowable bearing stress f_{cp} = $\beta \times f_k / \gamma_m$ = **1.266** N/mm^2

PASS - Allowable bearing stress at 0.4 × h below bearing level exceeds design bearing stress