

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				1	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	P.L	18.06.21	M.Bradbury	18.06.21		

1 – INTRODUCTION

The following document is associated with the construction work to take place at the above mentioned address and contains design calculations for structural elements, as well as approximate schematic arrangements of those elements.

2 - DEFINITIONS

The "Engineer" is HEALEY CONSULTING

The "Client" is the individual or organisation that has instructed the engineer to carry out structural engineering consultancy work.

The "Architect" is the individual or organisation that has provided the information upon which these calculations are based.

The "Builder" is the contractor who has been engaged to undertake the construction work to which this document relates.

3 - IMPORTANT GUIDANCE ON THE USE OF THIS DOCUMENT **(TO BE READ BY ALL PARTIES)**

This document is intended to be accompanied by all relevant architects' and engineer's drawings, and all relevant documentation should be considered prior to commencement of the work.

Engineer's drawings relating to this document will be explicitly outlined herein.

This document should be reviewed in its entirety (along with any other relevant documentation) by the builder, architect (if applicable) and client, prior to commencement of the work.

Any layouts, instructions or recommendations should be considered. Any deviations from the proposals outlined herein are to be approved by the Engineer prior to the work being undertaken. Any deviations from the proposals made

without the Engineer's consent are beyond the scope of this document and the Engineer cannot be held liable for any adverse consequences of such deviations.

The calculations within this document have been carried out in good faith based on the data provided by the client and/or builder/architect.

Where applicable extracts of the information provided will be included within this document for reference.

It is the responsibility of the architect (where applicable) or client to notify the engineer when changes are made to the information. This will enable the design to be reviewed and, where necessary, changes made.

Approval of these calculations and drawings by the Local Authority Building Control or similar approved body should be obtained prior to any ordering of material or fabrication. No liability is accepted for any changes that may be required as a result of work having commenced prior to such an approval.

Where information about the existing arrangements of buildings is not available (e.g. floor / roof span orientations or load-bearing wall arrangements) the Engineer will use their judgement to make assumptions. These (generally conservative) assumptions will be clearly outlined within the document, and should be confirmed by a suitably qualified individual on site. The engineer is then to be notified of any discrepancies prior to commencement of the work as design changes may be necessary.

IF IN DOUBT: ASK!!

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				2	
Calc. by	Date	Chk'd by	Date	App'd by	Date	
P.L	18.06.21	M.Bradbury	18.06.21			

It should be noted that until the existing structure has been exposed it is not always possible to foresee what the existing structural arrangement will be. This may include floor and roof span directions, construction materials and existing beam locations among other aspects. It is therefore advised to remove finishes from areas being modified as early as possible to avoid any delays on site that the untimely discovery of such (previously unknown) information can lead to.

In addition, it is advised to carry out some form of ground investigation as early as possible to avoid any unexpected below ground construction requirements which may cause delays on site e.g. piled foundations, raft foundations etc.

Wherever there is any uncertainty we will make every effort to highlight where this lies, however suitable project planning / management by the contractor / client are essential to the smooth execution of any construction project.

4 - HEALTH & SAFETY

It should be noted that structural work, particularly where this involves the transit and installation of large, heavy structural elements, has the potential to be hazardous. Where possible any specific risks are identified either within these calculations or drawings related to this document.

IF IN DOUBT: ASK!!

5 - PARTY WALL AGREEMENTS

If the building work involves:

- work on an existing wall which is shared with another property, or
- building on the boundary with a neighbouring property, or
- excavating near a neighbouring building,

then the client must find out whether the work falls under the Party Wall Act. If it does, the Act requires the client to notify all affected neighbours of proposed works. Refer to your architect for guidance, or see this website for guidance:- <https://www.gov.uk/guidance/partywall-etc-act-1996-guidance>.

6 - CONSTRUCTION NOTES

GENERAL NOTES

- Any SPAN / HEIGHT DIMENSIONS shown in this document are for CALCULATION PURPOSES ONLY and are not to be used as a final dimension for the fabrication / machining of structural elements.
- All dimensions are to be checked on site by the builder / contractor / fabricator prior to commencement of fabrication / machining / construction.

Any discrepancies between the information outlined herein and the dimensions on site are to be reported to the engineer.

- Temporary works are the sole responsibility of the builder / contractor. Temporary works method statements are to be provided to the Engineer by the builder / contractor prior to commencement of the work.
- All parties are assumed to be aware of their responsibilities under the Construction Design and Management (CDM) Regulations 2015.

If you are unsure of this please contact the Engineer.

- HEALEY CONSULTING take no responsibility for any elements outside of the scope of these calculations. For structural elements not covered by this document it is assumed that a design is being prepared / provided by others, if additional calculations / drawings / specifications are required then please contact HEALEY CONSULTING and we can provide a fee for their design.

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				3	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	P.L	18.06.21	M.Bradbury	18.06.21		

- All structural work has to be carried out by a competent builder in accordance with the requirements of The Building Regulations Part A and the recommendations set out in BS8103 Parts 1-3.
- This document is to be read in conjunction with the architectural drawings / details, and any discrepancies reported to the engineer immediately. Final steel levels and dimensions are to be confirmed by the architectural consultant.
- If HEALEY CONSULTING are not contracted to visit site we take no responsibility for the quality of construction nor its compliance with this document. It is the contractor's responsibility to ensure that all works comply with the drawings, notes and assumptions made within these calculations.
- The client / contractor should be aware of beam, frame and column deflections and their impact on existing or adjacent elements, for example beam deflection on bi-fold doors. Typical beam deflections will be span/200 total (Dead+Live) for beams and height/300 (Wind) for columns.

The following calculations provide anticipated deflections within the relevant sections.

- The client should be aware that where beams are installed within existing masonry structures it is likely that minor cracking will occur within the masonry above due to the load redistribution. It is recommended that the contractor allows to make suitable repairs within their contract.
- All proprietary (i.e. off-the-shelf) items specified within this document are to be installed in strict accordance with the manufacturer's recommendations. This includes, but is not limited to restraint straps, lintels, chemical / resin anchors and fixing brackets.
- For structural elements not considered within the scope of this document it is assumed that a suitable specification is to be made by others. If additional calculations, specifications or drawings are required then please contact HEALEY CONSULTING and we can provide a fee for their design.
- At locations where beam bearing information is provided on the layout this will be in a position where load-bearing masonry (with foundations / support) has been assumed. It should be confirmed by a suitably qualified individual that these walls are load-bearing, and the masonry is to be inspected for suitability prior to commencement of the work.

7. DESIGN PHILOSOPHY

All structural members are designed to be capable of withstanding applied loads during construction, operation and maintenance of the building without any distress, failure, loss of function, damage or durability problems. They are to support the most onerous combinations of dead, imposed and (where applicable) wind loads tending to produce either maximum ultimate stresses or deflection.

8. STABILITY STATEMENT

For this project the stability is to be provided by the following structural systems or a combination thereof:

Global Lateral Stability: moment-transmitting frames / masonry piers or shear walls with dead load restoring moment / floors or ceilings to provide diaphragm (boarded & strapped where critical)

Wall Panel Local Lateral Stability: steel or timber posts / masonry piers or walls / floors, ceilings or rafters (boarded & strapped where critical) / timber stud walls.

Vertical Loads: masonry walls, piers or columns with padstones for concentrated loads where necessary / steel posts / strip footings / pad foundations

Internal walls are to be removed. If required sway frames will be introduced

 HEALEY consulting structural engineering consultants	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				4	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	P.L	18.06.21	M.Bradbury	18.06.21		

DESIGN PHILOSOPHY

The calculations shall be read in conjunction with Healey Consulting drawing nos. **HC-21388-(60).01**.

STABILITY STATEMENT

Stability not affected

GROUND BEARING PRESSURES

Not applicable

Notes:

Timber designs carried out in accordance with BS 5268: Part 2:1996
Masonry designs carried out in accordance with BS 5628: Part 1:1992
Steel beams designed in accordance with BS 5950: Part 1 2000
All beam-ends are to be bolted down to concrete pad stones using
M12 – RAWL R-HPT THROUGH BOLTS 100mm Long

LOADING

LOADINGS

	kn/m ²	kn/m ²
<u>ROOF</u>		
Dead + Services + Pbrd Ceiling	0.93	
Live		0.75

FLOORS

Dead	
Finishes + Boards	0.15
Insulation	0.05
Timber Joists	0.20
Single boarded ceiling + Plaster	0.15
	<u>0.55</u>

Live

Domestic	1.50
Partitions	0.25
	<u>1.75</u>

WALL

100 wide blockwork	2.00
Plaster each face	0.20

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				5	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	P.L	18.06.21	M.Bradbury	18.06.21		

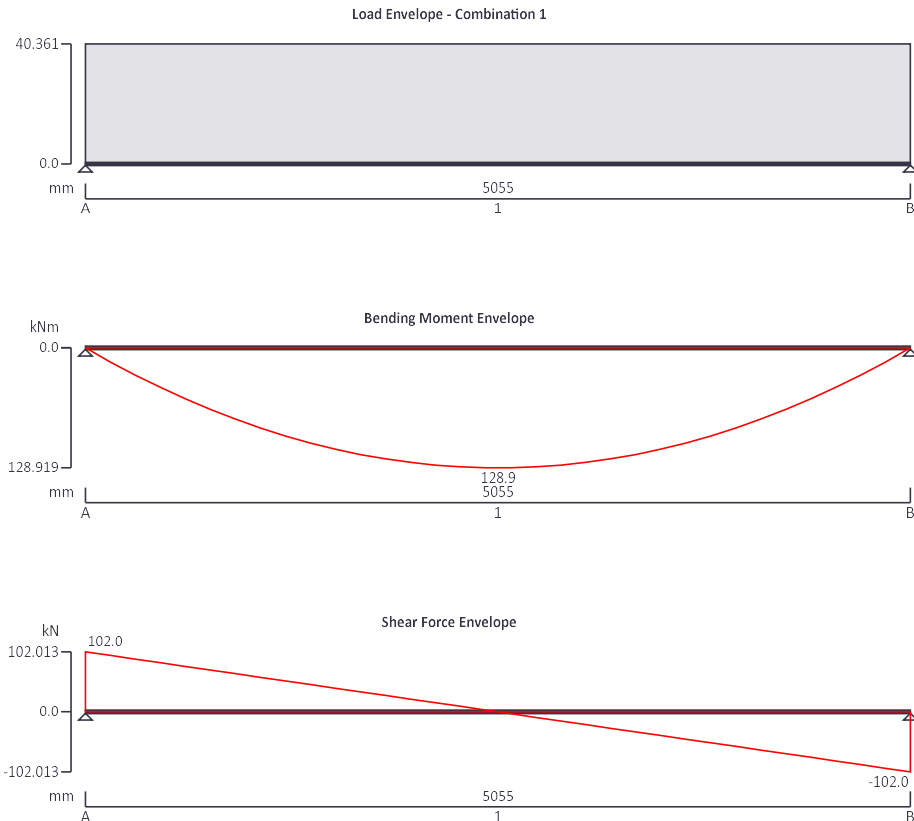
BEAM OVER NEW OPENING SUPPORTING EXTG FLOOR & ROOF

STEEL BEAM ANALYSIS & DESIGN (BS5950)

STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.07



Support conditions

Support A

Vertically restrained

Rotationally free

Support B

Vertically restrained

Rotationally free

Applied loading

Beam loads

Dead self weight of beam $\times 1$

Floor - Dead full UDL 1.14 kN/m

Floor - Imposed full UDL 3.325 kN/m

Wall - Dead full UDL 10.575 kN/m

Roof - Dead full UDL 5.022 kN/m

Roof - Imposed full UDL 4.05 kN/m

Lean to roof - Dead full UDL 1.53 kN/m

Lean to roof - Imposed full UDL 1.24 kN/m

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				6	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	P.L	18.06.21	M.Bradbury	18.06.21		

Load combinations

Load combination 1

Support A

Dead $\times 1.40$

Imposed $\times 1.60$

Dead $\times 1.40$

Imposed $\times 1.60$

Support B

Dead $\times 1.40$

Imposed $\times 1.60$

Analysis results

Maximum moment

$M_{\max} = 128.9 \text{ kNm}$

$M_{\min} = 0 \text{ kNm}$

Maximum shear

$V_{\max} = 102 \text{ kN}$

$V_{\min} = -102 \text{ kN}$

Deflection

$\delta_{\max} = 10 \text{ mm}$

$\delta_{\min} = 0 \text{ mm}$

Maximum reaction at support A

$R_{A_{\max}} = 102 \text{ kN}$

$R_{A_{\min}} = 102 \text{ kN}$

Unfactored dead load reaction at support A

$R_{A_{\text{Dead}}} = 48 \text{ kN}$

Unfactored imposed load reaction at support A

$R_{A_{\text{Imposed}}} = 21.8 \text{ kN}$

Maximum reaction at support B

$R_{B_{\max}} = 102 \text{ kN}$

$R_{B_{\min}} = 102 \text{ kN}$

Unfactored dead load reaction at support B

$R_{B_{\text{Dead}}} = 48 \text{ kN}$

Unfactored imposed load reaction at support B

$R_{B_{\text{Imposed}}} = 21.8 \text{ kN}$

Section details

Section type

UC 254x254x73 (BS4-1)

Steel grade

S275

From table 9: Design strength p_y

Thickness of element

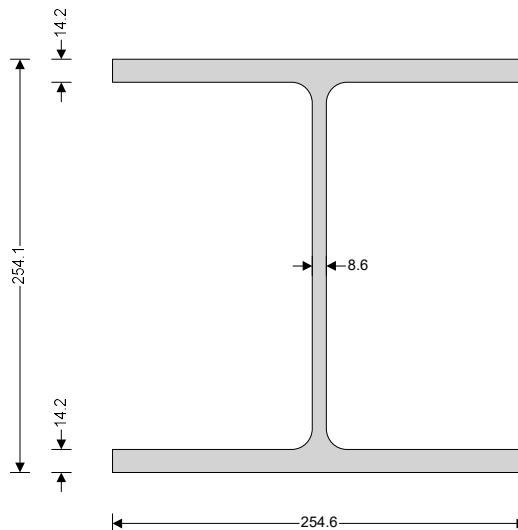
$\max(T, t) = 14.2 \text{ mm}$

Design strength

$p_y = 275 \text{ N/mm}^2$

Modulus of elasticity

$E = 205000 \text{ N/mm}^2$



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

$K_{LT,A} = 1.20 + 2 \times D$

$K_{LT,B} = 1.00 + 2 \times D$

 HEALEY consulting structural engineering consultants	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				7	
Calc. by	Date	Chk'd by	Date	App'd by	Date	
P.L	18.06.21	M.Bradbury	18.06.21			

Classification of cross sections - Section 3.5

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

Internal compression parts - Table 11

Depth of section

$$d = 200.3 \text{ mm}$$

$$d / t = 23.3 \times \varepsilon \leq 80 \times \varepsilon \quad \text{Class 1 plastic}$$

Outstand flanges - Table 11

Width of section

$$b = B / 2 = 127.3 \text{ mm}$$

$$b / T = 9.0 \times \varepsilon \leq 9 \times \varepsilon \quad \text{Class 1 plastic}$$

Section is class 1 plastic

Shear capacity - Section 4.2.3

Design shear force

$$F_v = \max(\text{abs}(V_{\max}), \text{abs}(V_{\min})) = 102 \text{ kN}$$

$$d / t < 70 \times \varepsilon$$

Web does not need to be checked for shear buckling

Shear area

$$A_v = t \times D = 2185 \text{ mm}^2$$

Design shear resistance

$$P_v = 0.6 \times p_y \times A_v = 360.6 \text{ kN}$$

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment

$$M = \max(\text{abs}(M_{s1_max}), \text{abs}(M_{s1_min})) = 128.9 \text{ kNm}$$

Moment capacity low shear - cl.4.2.5.2

$$M_c = \min(p_y \times S_{xx}, 1.2 \times p_y \times Z_{xx}) = 272.8 \text{ kNm}$$

Effective length for lateral-torsional buckling - Section 4.3.5

Effective length for lateral torsional buckling

$$L_E = 1.2 \times L_{s1} + 2 \times D = 6574 \text{ mm}$$

Slenderness ratio

$$\lambda = L_E / r_{yy} = 101.474$$

Equivalent slenderness - Section 4.3.6.7

Buckling parameter

$$u = 0.849$$

Torsional index

$$x = 17.259$$

Slenderness factor

$$v = 1 / [1 + 0.05 \times (\lambda / x)^2]^{0.25} = 0.778$$

Ratio - cl.4.3.6.9

$$\beta_w = 1.000$$

Equivalent slenderness - cl.4.3.6.7

$$\lambda_{LT} = u \times v \times \lambda \times \sqrt{\beta_w} = 67.009$$

Limiting slenderness - Annex B.2.2

$$\lambda_{L0} = 0.4 \times (\pi^2 \times E / p_y)^{0.5} = 34.310$$

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

Bending strength - Section 4.3.6.5

Robertson constant

$$\alpha_{LT} = 7.0$$

Perry factor

$$\eta_{LT} = \max(\alpha_{LT} \times (\lambda_{LT} - \lambda_{L0}) / 1000, 0) = 0.229$$

Euler stress

$$p_E = \pi^2 \times E / \lambda_{LT}^2 = 450.6 \text{ N/mm}^2$$

$$\phi_{LT} = (p_y + (\eta_{LT} + 1) \times p_E) / 2 = 414.4 \text{ N/mm}^2$$

Bending strength - Annex B.2.1

$$p_b = p_E \times p_y / (\phi_{LT} + (\phi_{LT}^2 - p_E \times p_y)^{0.5}) = 195.8 \text{ N/mm}^2$$

Equivalent uniform moment factor - Section 4.3.6.6

Equivalent uniform moment factor for LTB

$$m_{LT} = 1.000$$

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment

$$M_b = p_b \times S_{xx} = 194.2 \text{ kNm}$$

$$M_b / m_{LT} = 194.2 \text{ kNm}$$

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to dead and imposed loads

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				8	
Calc. by	Date	Chk'd by	Date	App'd by	Date	
P.L	18.06.21	M.Bradbury	18.06.21			

Limiting deflection

$$\delta_{lim} = L_{s1} / 360 = \mathbf{14.042 \text{ mm}}$$

Maximum deflection span 1

$$\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min})) = \mathbf{10.034 \text{ mm}}$$

PASS - Maximum deflection does not exceed deflection limit

Use 254x254x73 U6 steel beam + 6Thk top plate

CONCRETE PADSTONE

MASONRY BEARING DESIGN (BS5628)

MASONRY BEARING DESIGN TO BS5628-1:2005

TEDDS calculation version 1.0.06

Masonry details

Masonry type

Compressive strength of unit

Mortar designation

Least horizontal dimension of masonry units

Height of masonry units

Category of masonry units

Category of construction control

Partial safety factor for material strength

Thickness of load bearing leaf

Effective thickness of masonry wall

Height of masonry wall

Effective height of masonry wall

Aggregate concrete blocks (25% or less formed voids)

$$p_{unit} = \mathbf{7.3 \text{ N/mm}^2}$$

iii

$$l_{unit} = \mathbf{100 \text{ mm}}$$

$$h_{unit} = \mathbf{215 \text{ mm}}$$

Category II

Normal

$$\gamma_m = \mathbf{3.5}$$

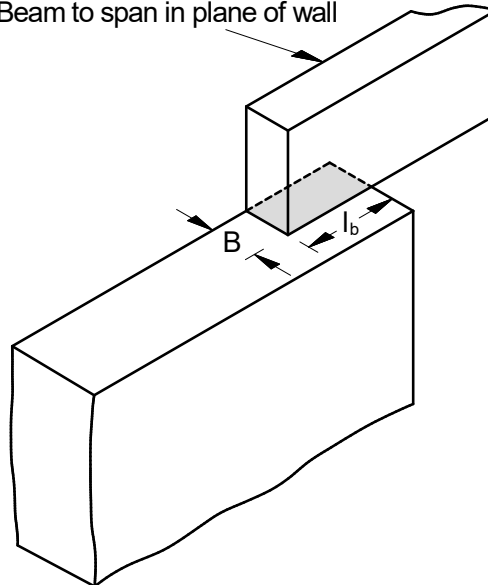
$$t = \mathbf{290 \text{ mm}}$$

$$t_{ef} = \mathbf{290 \text{ mm}}$$

$$h = \mathbf{2400 \text{ mm}}$$

$$h_{ef} = \mathbf{2400 \text{ mm}}$$

Beam to span in plane of wall



Bearing details

Beam spanning in plane of wall

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				9	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	P.L	18.06.21	M.Bradbury	18.06.21		

Width of bearing $B = 254$ mm

Length of bearing $l_b = 150$ mm

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

Mortar designation Mortar = "iii"

Block compressive strength $p_{unit} = 7.3$ N/mm²

Characteristic compressive strength (Table 2c) $f_{kc} = 3.20$ N/mm²

Characteristic compressive strength (Table 2d) $f_{kd} = 6.40$ N/mm²

Height of solid block $h_{unit} = 215.0$ mm

Least horizontal dimension $l_{unit} = 100.0$ mm

Block ratio $ratio = h_{unit} / l_{unit} = 2.2$

Ratio between 0.6 and 4.5 - OK

Characteristic compressive strength $f_k = 6.40$ N/mm²

Loading details

Characteristic concentrated dead load $G_k = 48$ kN

Characteristic concentrated imposed load $Q_k = 22$ kN

Design concentrated load $F = (G_k \times 1.4) + (Q_k \times 1.6) = 102.4$ kN

Characteristic distributed dead load $g_k = 0.0$ kN/m

Characteristic distributed imposed load $q_k = 0.0$ kN/m

Design distributed load $f = (g_k \times 1.4) + (q_k \times 1.6) = 0.0$ kN/m

Masonry bearing type

Bearing type **Type 2**

Bearing safety factor $\gamma_{bear} = 1.50$

Check design bearing without a spreader

Design bearing stress $f_{ca} = F / (B \times l_b) + f / t = 2.688$ N/mm²

Allowable bearing stress $f_{cp} = \gamma_{bear} \times f_k / \gamma_m = 2.743$ N/mm²

PASS - Allowable bearing stress exceeds design bearing stress

Check design bearing at $0.4 \times h$ below the bearing level

Slenderness ratio $h_{ef} / t_{ef} = 8.28$

Eccentricity at top of wall $e_x = 0.0$ mm

From BS5628:1 Table 7

Capacity reduction factor $\beta = 0.99$

Length of bearing distributed at $0.4 \times h$ $l_d = 1110$ mm

Maximum bearing stress $f_{ca} = F / (l_d \times t) + f / t = 0.318$ N/mm²

Allowable bearing stress $f_{cp} = \beta \times f_k / \gamma_m = 1.810$ N/mm²

PASS - Allowable bearing stress at $0.4 \times h$ below bearing level exceeds design bearing stress

Use 330Lg x extg wall width (300min) x 215Dp concrete padstone at left hand side

Use 215Lg x extg wall width (300min) x 215Dp concrete padstone at left hand side

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				10	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	P.L	18.06.21	M.Bradbury	18.06.21		

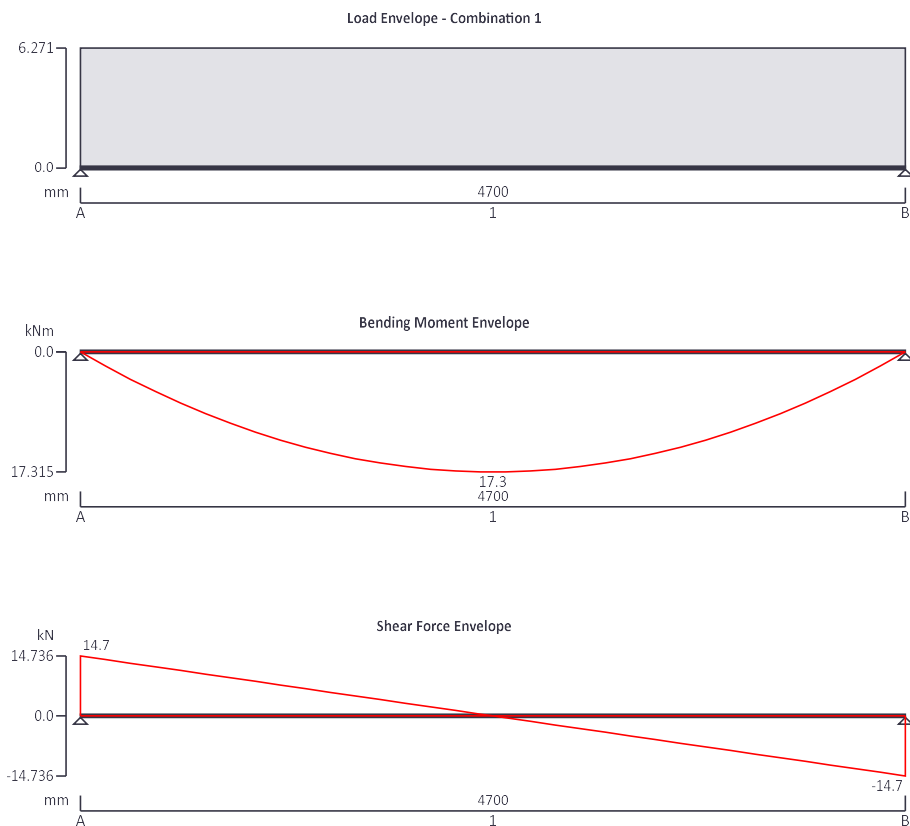
LINTEL BEAM

STEEL BEAM ANALYSIS & DESIGN (BS5950)

STEEL BEAM ANALYSIS & DESIGN (BS5950)

In accordance with BS5950-1:2000 incorporating Corrigendum No.1

TEDDS calculation version 3.0.07



Support conditions

Support A

Vertically restrained

Rotationally free

Support B

Vertically restrained

Rotationally free

Applied loading

Beam loads

Dead self weight of beam $\times 1$

Roof - Dead full UDL 1.7 kN/m

Roof - Imposed full UDL 1.35 kN/m

Wall - Dead full UDL 1.01 kN/m

Load combinations

Load combination 1

Support A

Dead $\times 1.40$

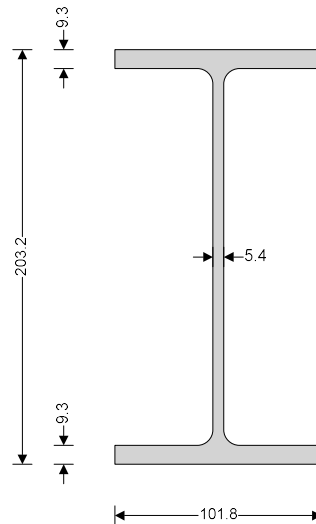
	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				11	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	P.L	18.06.21	M.Bradbury	18.06.21		

Analysis results

Maximum moment	$M_{max} = 17.3 \text{ kNm}$	$M_{min} = 0 \text{ kNm}$
Maximum shear	$V_{max} = 14.7 \text{ kN}$	$V_{min} = -14.7 \text{ kN}$
Deflection	$\delta_{max} = 2 \text{ mm}$	$\delta_{min} = 0 \text{ mm}$
Maximum reaction at support A	$R_{A_max} = 14.7 \text{ kN}$	$R_{A_min} = 14.7 \text{ kN}$
Unfactored dead load reaction at support A	$R_{A_Dead} = 6.9 \text{ kN}$	
Unfactored imposed load reaction at support A	$R_{A_Imposed} = 3.2 \text{ kN}$	
Maximum reaction at support B	$R_{B_max} = 14.7 \text{ kN}$	$R_{B_min} = 14.7 \text{ kN}$
Unfactored dead load reaction at support B	$R_{B_Dead} = 6.9 \text{ kN}$	
Unfactored imposed load reaction at support B	$R_{B_Imposed} = 3.2 \text{ kN}$	

Section details

Section type	UB 203x102x23 (BS4-1)
Steel grade	S275
From table 9: Design strength p_y	
Thickness of element	$\max(T, t) = 9.3 \text{ mm}$
Design strength	$p_y = 275 \text{ N/mm}^2$
Modulus of elasticity	$E = 205000 \text{ N/mm}^2$



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	$K_{LT,A} = 1.20 + 2 \times D$
	$K_{LT,B} = 1.20 + 2 \times D$

Classification of cross sections - Section 3.5

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

 HEALEY consulting structural engineering consultants	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				12	
Calc. by	Date	Chk'd by	Date	App'd by	Date	
P.L	18.06.21	M.Bradbury	18.06.21			

Internal compression parts - Table 11

Depth of section $d = 169.4 \text{ mm}$
 $d / t = 31.4 \times \varepsilon \leq 80 \times \varepsilon$ Class 1 plastic

Outstand flanges - Table 11

Width of section $b = B / 2 = 50.9 \text{ mm}$
 $b / T = 5.5 \times \varepsilon \leq 9 \times \varepsilon$ Class 1 plastic
Section is class 1 plastic

Shear capacity - Section 4.2.3

Design shear force $F_v = \max(\text{abs}(V_{\max}), \text{abs}(V_{\min})) = 14.7 \text{ kN}$
 $d / t < 70 \times \varepsilon$
Web does not need to be checked for shear buckling
Shear area $A_v = t \times D = 1097 \text{ mm}^2$
Design shear resistance $P_v = 0.6 \times p_y \times A_v = 181.1 \text{ kN}$
PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment $M = \max(\text{abs}(M_{s1_max}), \text{abs}(M_{s1_min})) = 17.3 \text{ kNm}$
Moment capacity low shear - cl.4.2.5.2 $M_c = \min(p_y \times S_{xx}, 1.2 \times p_y \times Z_{xx}) = 64.4 \text{ kNm}$

Effective length for lateral-torsional buckling - Section 4.3.5

Effective length for lateral torsional buckling $L_E = 1.2 \times L_{s1} + 2 \times D = 6046 \text{ mm}$
Slenderness ratio $\lambda = L_E / r_{yy} = 256.103$

Equivalent slenderness - Section 4.3.6.7

Buckling parameter $u = 0.888$
Torsional index $x = 22.460$
Slenderness factor $v = 1 / [1 + 0.05 \times (\lambda / x)^{2.25}] = 0.604$
Ratio - cl.4.3.6.9 $\beta_W = 1.000$
Equivalent slenderness - cl.4.3.6.7 $\lambda_{LT} = u \times v \times \lambda \times \sqrt{\beta_W} = 137.425$
Limiting slenderness - Annex B.2.2 $\lambda_{L0} = 0.4 \times (\pi^2 \times E / p_y)^{0.5} = 34.310$
 $\lambda_{LT} > \lambda_{L0}$ - Allowance should be made for lateral-torsional buckling

Bending strength - Section 4.3.6.5

Robertson constant $\alpha_{LT} = 7.0$
Perry factor $\eta_{LT} = \max(\alpha_{LT} \times (\lambda_{LT} - \lambda_{L0}) / 1000, 0) = 0.722$
Euler stress $p_E = \pi^2 \times E / \lambda_{LT}^2 = 107.1 \text{ N/mm}^2$
 $\phi_{LT} = (p_y + (\eta_{LT} + 1) \times p_E) / 2 = 229.7 \text{ N/mm}^2$
Bending strength - Annex B.2.1 $p_b = p_E \times p_y / (\phi_{LT} + (\phi_{LT}^2 - p_E \times p_y)^{0.5}) = 77 \text{ N/mm}^2$

Equivalent uniform moment factor - Section 4.3.6.6

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

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment $M_b = p_b \times S_{xx} = 18 \text{ kNm}$
 $M_b / m_{LT} = 18 \text{ kNm}$
PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to imposed loads
Limiting deflection $\delta_{lim} = L_{s1} / 360 = 13.056 \text{ mm}$
Maximum deflection span 1 $\delta = \max(\text{abs}(\delta_{\max}), \text{abs}(\delta_{\min})) = 1.988 \text{ mm}$

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				13	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	P.L	18.06.21	M.Bradbury	18.06.21		

PASS - Maximum deflection does not exceed deflection limit

CONCRETE PADSTONE

MASONRY BEARING DESIGN (BS5628)

MASONRY BEARING DESIGN TO BS5628-1:2005

TEDDS calculation version 1.0.06

Masonry details

Masonry type

Compressive strength of unit

Mortar designation

Least horizontal dimension of masonry units

Height of masonry units

Category of masonry units

Category of construction control

Partial safety factor for material strength

Thickness of load bearing leaf

Effective thickness of masonry wall

Height of masonry wall

Effective height of masonry wall

Aggregate concrete blocks (25% or less formed voids)

$p_{unit} = 7.3 \text{ N/mm}^2$

iii

$l_{unit} = 100 \text{ mm}$

$h_{unit} = 215 \text{ mm}$

Category II

Normal

$\gamma_m = 3.5$

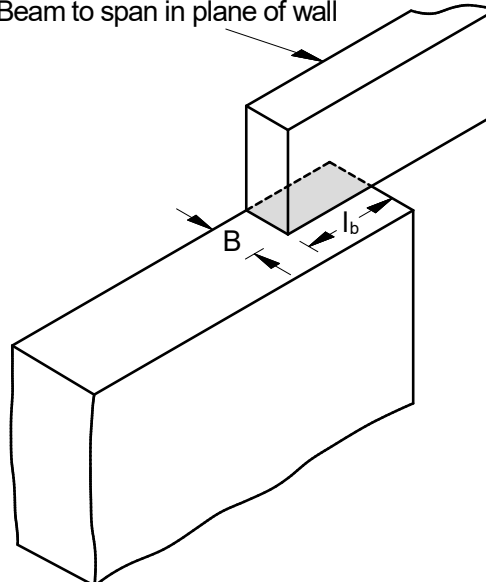
$t = 100 \text{ mm}$

$t_{ef} = 100 \text{ mm}$

$h = 2400 \text{ mm}$

$h_{ef} = 2400 \text{ mm}$

Beam to span in plane of wall



Bearing details

Beam spanning in plane of wall

Width of bearing

Length of bearing

$B = 100 \text{ mm}$

$l_b = 150 \text{ mm}$

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				14	
Calc. by	Date	Chk'd by	Date	App'd by	Date	
P.L	18.06.21	M.Bradbury	18.06.21			

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

Mortar designation	Mortar = "iii"
Block compressive strength	$p_{unit} = 7.3 \text{ N/mm}^2$
Characteristic compressive strength (Table 2c)	$f_{kc} = 3.20 \text{ N/mm}^2$
Characteristic compressive strength (Table 2d)	$f_{kd} = 6.40 \text{ N/mm}^2$
Height of solid block	$h_{unit} = 215.0 \text{ mm}$
Least horizontal dimension	$l_{unit} = 100.0 \text{ mm}$
Block ratio	$ratio = h_{unit} / l_{unit} = 2.2$

Ratio between 0.6 and 4.5 - OK

Characteristic compressive strength	$f_k = 6.40 \text{ N/mm}^2$
-------------------------------------	-----------------------------

Loading details

Characteristic concentrated dead load	$G_k = 7 \text{ kN}$
Characteristic concentrated imposed load	$Q_k = 4 \text{ kN}$
Design concentrated load	$F = (G_k \times 1.4) + (Q_k \times 1.6) = 16.2 \text{ kN}$
Characteristic distributed dead load	$g_k = 0.0 \text{ kN/m}$
Characteristic distributed imposed load	$q_k = 0.0 \text{ kN/m}$
Design distributed load	$f = (g_k \times 1.4) + (q_k \times 1.6) = 0.0 \text{ kN/m}$

Masonry bearing type

Bearing type	Type 2
Bearing safety factor	$\gamma_{bear} = 1.50$

Check design bearing without a spreader

Design bearing stress	$f_{ca} = F / (B \times l_b) + f / t = 1.080 \text{ N/mm}^2$
Allowable bearing stress	$f_{cp} = \gamma_{bear} \times f_k / \gamma_m = 2.743 \text{ N/mm}^2$

PASS - Allowable bearing stress exceeds design bearing stress

Check design bearing at $0.4 \times h$ below the bearing level

Slenderness ratio	$h_{ef} / t_{ef} = 24.00$
Eccentricity at top of wall	$e_x = 0.0 \text{ mm}$

From BS5628:1 Table 7

Capacity reduction factor	$\beta = 0.61$
Length of bearing distributed at $0.4 \times h$	$l_d = 1110 \text{ mm}$
Maximum bearing stress	$f_{ca} = F / (l_d \times t) + f / t = 0.146 \text{ N/mm}^2$
Allowable bearing stress	$f_{cp} = \beta \times f_k / \gamma_m = 1.106 \text{ N/mm}^2$

PASS - Allowable bearing stress at $0.4 \times h$ below bearing level exceeds design bearing stress

	Project				Job Ref.	
	12 Blackwin Street, Manchester				21388	
	Section				Sheet no./rev.	
	Steel beam & Padstones				15	
	Calc. by	Date	Chk'd by	Date	App'd by	Date
	P.L	18.06.21	M.Bradbury	18.06.21		

SUMMARY:

Use 254x254x73 UC for new knock thro' opening

Provide 215Lg x extg wall width (300min) x 215Dp concrete padstone at each end of the beam.

Steel beam to be site primed and with 2no. 12mm diameter holes at the bearings to receive M10 RAWL R-KEM+ 120mm overall. Steel beam to be bolted down on to concrete padstone.

For lintel over sliding door:

Use 203x102x23 UB for inner leaf lintel

Provide 330Lg x 100wide x 215Dp concrete padstone at each end of the beam.

Steel beam to be site primed and with 2no. 12mm diameter holes at the bearings to receive M10 RAWL R-KEM+ 120mm overall. Steel beam to be bolted down on to concrete padstone.