Structural Calculations

Relating to:

Kitchen Internal Wall Removal at

[redacted]

Project Preface

Client name:	[redacted]
Client address:	[redacted]

Senior Partner:	David Allcott
Prepared at:	Allcott Associates LLP 1st Floor The Fosse Fosseway Radford Semele Warwickshire CV31 1XN
Document prepared by:	**James Bodicoat** MEng (Hons), CEng, MICE, MIStructE

Date of Inspection:	5th April 2022

Job reference:	138041

1 Notes Specific to the design

1. The Building Contractors will need to and must check all dimensions of openings on site prior to ordering steel, as we will not be held responsible for any incorrect lengths that are ordered.

2. Beams are designed to be the most economical size for the loading imposed in most cases, not for the thickness of wall above. It is therefore the contractor's responsibility to ensure that the load is correctly supported above the beam with a plate or other method.

3. The design is for the support Beam only and we are not responsible for ensuring the adequacy of any foundations beneath the supporting wall. This will generally the responsibility of the Building Contractor to open up areas for the Building Inspector to verify. If we have to confirm foundation adequacy which is over and above the design an extra charge will be levied.

4. Should the length of the beams be revised by the client or the Building Contractor after we have completed our design which results in a redesign we reserve the right to charge again for all redesign works.

5. All dimensions used for design are clear openings only. Add a minimum 150mm bearing length to each end of beam unless otherwise stated for actual beam length when ordering beams

6. The designs are based on domestic loads only unless otherwise stated.

7. Changes to all drawings are at client's instructions. All drawings should be checked for accuracy and should not be scaled from. Any discrepancy should be immediately informed to Allcott Associates.

8. The design is for the steel beams only, not the foundation or additional width support on the beam for the wall or other above the beam.

9. This design does not mean that any other part of the building or than the beam itself complies with current building regulations and this should be checked with the Local Authority prior to commencement of the works.

10. We are not obligated to check any other area within the Building and advise at to whether other areas fall under the Building Regulations. Our design will specifically pertain to the support beam required only

11. We take no responsibility for any design if the works are started before the necessary Building Regulation permission approval has been obtained from the local authority. If any works are started before the Local Authority Approval has been obtained, then then these works will be specifically at the risk of the owner.

12. Unless otherwise stated pad stones should be proprietary precast C35 concrete 450mm long by 225 deep and 100mm wide.

13. Designs are based on client's instructions. If these are given incorrectly by the client and the design beam is not correct for the opening, this will not the responsibility of this company. We reserve the right to charge again for any re-inspection and subsequent re-design.

14. The design will be based on the information including any drawings provided. Any opening up of areas will be the responsibility of the client. Any areas that are not opened up and are subsequently found not be as informed to us by the Client and requires either a re-visit or re-calculation will be charged again.

15. The scope and any limitations to miscellaneous services will be agreed with you before commencing.

16. Should the configuration of the building change after the design of the beams which subsequently affect Part A of the Building regulations, which requires re-calculation and a revisit then this will be charged again.

17. It is the responsibility of the Building Contractors to ensure that all walls for the support of the beams are adequate for the correct support of the beams.

18. These calculations are for the sole use of the person instructing the design and cannot be passed to a third party without the consent of Allcott Associates as the content will not be guaranteed to be correct as to when the report was transferred.

19. These calculations are only valid for 6 months from the date of the survey as codes of practice change. If the practical works are commenced within that period, you should check that the calculations are still valid.

20. All beams to be finished with red oxide paint and correctly fire protected as required under the current Building Regulations.

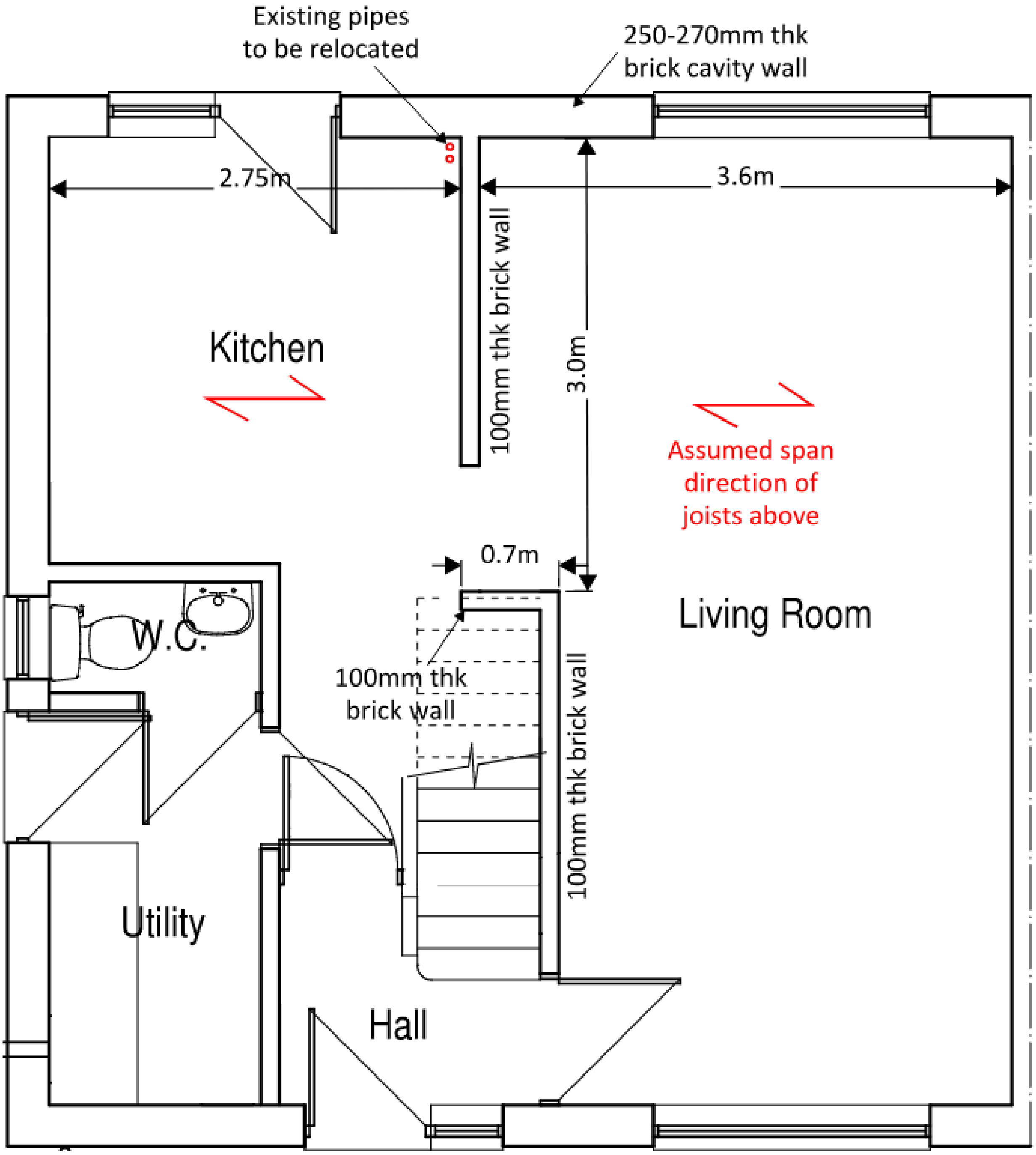
21. We are not responsible for advising on any fire precautions within other areas of the Building as a result of any wall removal. This should be addressed to either the Local Authority Fire Officer or Local Authority Building Inspector prior to commencement of works.

2 Calculations Sheet:- Specific to Scheme

Job title		Job no.		
[redacted]		138041		ALLCOTT ASSOCIATES
Made by JCB	Date 07/04/2022	Sheet no. 1	Rev 00	
Details: New Beam above opening between kitchen and living room				

REF | OUTPUT

Plan of existing ground floor layout (not to scale):



Please refer to the notes section regarding measurements.

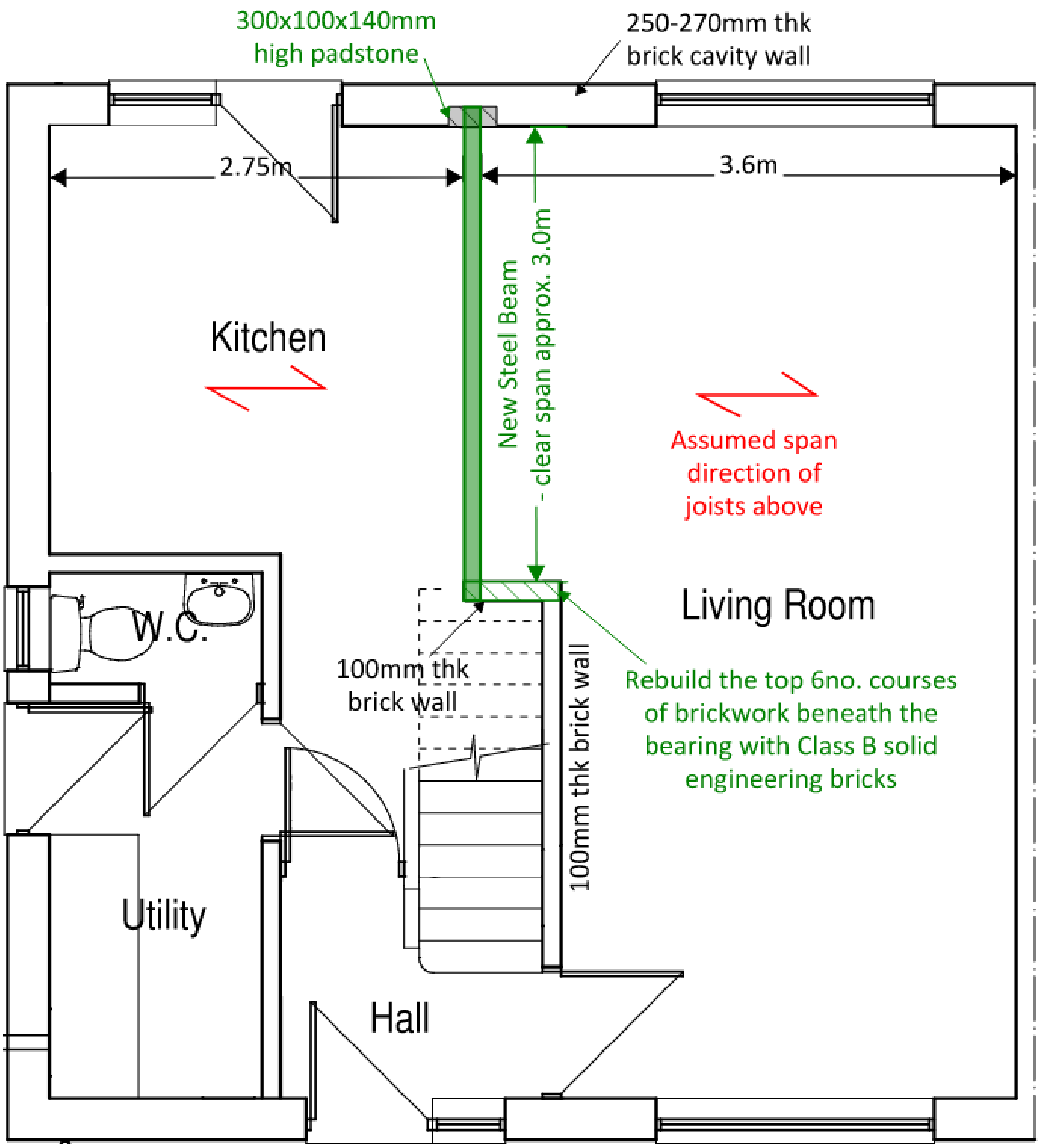
Job title	Job no.	
[redacted]	138041	

Made by	Date	Sheet no.	Rev
JCB	07/04/2022	2	00

Details

New Beam above opening between kitchen and living room

Plan of proposed ground floor layout (not to scale):



Important note: All beams are designed for clear openings. The bearing length is to be added to each end to establish the actual beam length. All measurements to be confirmed prior to ordering.

Job title		Job no.		
[redacted]		138041		ALLCOTT ASSOCIATES
Made by JCB	Date 07/04/2022	Sheet no. 3	Rev 00	
Details New Beam above opening between kitchen and living room				

Loads and Load Combinations:

All dead and imposed loads are determined in accordance with BS EN 1991 Part 1-4. Refer to Appendix A for a breakdown of typical dead and imposed load build ups.

Design criteria:

- FoS for steelwork design (to BS5950) = 1.4 Dead Load + 1.6 Imposed Load
- Allowable Deflection δ= Span / 360 for brittle finishes (e.g. plaster)

1. Consider New Steel Beam

- Clear Span = 3.0m
- Supports first floor and 80mm thick lightweight blockwork partition walls above only.
- We have reviewed drawings for the recent loft conversion as supplied by the client. These show that the new floor and roof to the loft is supported on 305x165x54 UB steel beams spanning from the gable wall to the party wall.
- Given the size of these beams, we are satisfied that they are designed to span the full width of the house and do not impose any load on the internal walls at first floor Furthermore, the internal walls at first floor are of narrow lightweight block construction which is non-structural, and these are not aligned with the ground floor wall. Therefore we are satisfied that the loft conversion does not impose any load on the kitchen wall to be removed.

Dead Loads:

- Due to first floor construction = $0.705 \times \frac{(3.6 + 2.75)}{2}$ = 2.24 kN/m
- Due to lightweight block wall above = 1.5 x 2.5 = 3.75 kN/m

Total Dead Load UDL = 6.0 kN/m

Imposed Loads:

- Imposed load on first floor = $1.5 \times \frac{(3.6 + 2.75)}{2}$ = 4.8 kN/m

Total Imposed Load UDL = 4.8 kN/m

Refer to the beam analysis output in Appendix B, pages B1 to B3.

Adopt a 178x102x19UB steel section, grade S275

- Utilisation in bending = 0.68, therefore acceptable (conservatively assumes no lateral restraint)
- Maximum deflection = 4.2mm = span / 714, therefore acceptable

Beam to be installed tight to underside of existing timber joists.

Consider Beam End Bearings onto Internal Brickwork Wall:

From Beam Analysis, maximum unfactored reactions at the ends of the beam are as follows:

R_{DL} = 9.3 kN
R_{IL} = 7.2 kN

From observations on site assume 102.5mm clay bricks with a compressive strength of 10N/mm^2, mortar designation (iii) and a bearing length of 100mm.

Brickwork is not adequate, even with a padstone. **Therefore rebuild the top 6no. courses of brickwork beneath the bearing with Class B engineering bricks, 700mm wide. Provide 100mm bearing to the end of the beam directly onto the engineering brick.**

Refer to calculations in Appendix B, pages B4 to B7.

Consider Beam End Bearings onto Rear Cavity Wall:

From Beam Analysis, maximum unfactored reactions at the ends of the beam are as follows:

R_{DL} = 9.3 kN
R_{IL} = 7.2 kN

From observations on site assume the inner leaf comprises 102.5mm clay bricks with a compressive strength of 10N/mm^2, mortar designation (iii) and a bearing length of 100mm.

Brickwork is not adequate without a padstone. **Therefore provide a 300x100x140mm high precast concrete padstone. Bear to have 100mm bearing to the end of the beam onto the padstone.**

Refer to calculations in Appendix B, pages B8 to B9.

3 Rights of Originator

We reserve the right to refuse copies of the report to any third party (other than those named above). We also reserve the right to amend our opinions in the event of additional information being made available at some future date. The Contracts (Rights of Third Parties) Act 1999 shall not apply to this agreement.

END OF REPORT

James Bodicoat MEng (Hons), CEng, MICE, MIStructE
Partner
For and on behalf of **Allcott Associates LLP**

Appendix A:- Common Loadings from EN 1991 1 - 4

Dead Loads

225mm Solid Wall	9"Brickwork	4.73 KN/m²
	Plaster	0.20 KN/m²
		4.93 KN/m²
250mm Cavity Wall	102 Brick	2.10 KN/m²
	100 Block	1.35 KN/m²
	Plaster	0.20 KN/m²
		3.65 KN/m²
100mm Solid Wall	4"Brick	2.10 KN/m²
	Plaster	0.20 KN/m²
		2.30 KN/m²
Tiled Roof	Tiling/Battens/Felt	0.67 KN/m²
	Timber	0.30 KN/m²
	Ceiling/Insulation	0.20 KN/m²
		1.17 KN/m²
1st Floor	Floor joists, boarding	0.305 KN/m²
	Finishes	0.050 KN/m²
	Ceiling	0.20 KN/m²
	Miscellaneous	0.15 KN/m²
		0.705 KN/m²
Flat roof	Timbers / Felt Etc	0.42 KN/m²
Ceiling	Plasterboard / Plaster	0.21 KN/m²
		0.63 KN/m²
Slate Roof	Slates/ Bath/ felt	0.28 KN/m²
	Timber	0.30 KN/m²
	Ceiling / Insulation	0.20 KN/m²
		0.78 KN/m²

Imposed Loads

	1st Floor	1.50 KN/m²
	Flat Roof (no access)	0.75 KN/m²
	Pitched Roof	0.75 KN/m²

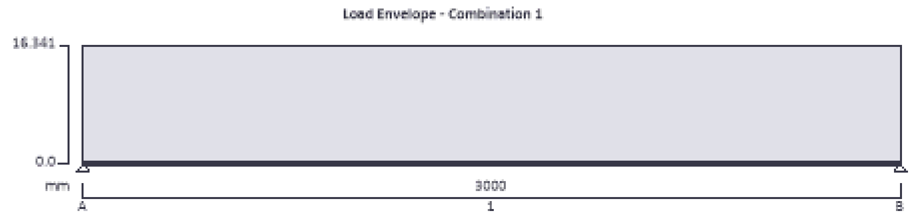
Appendix B:- Computer Analysis Results

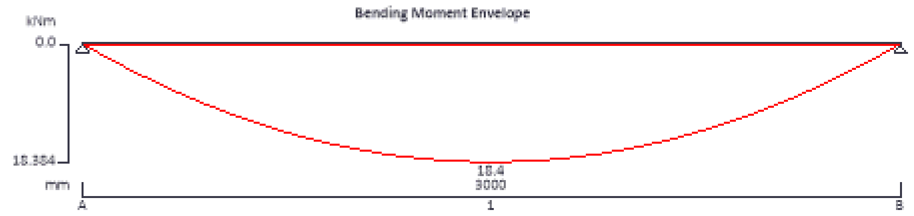
Allcott Associates LLP Fosse Way, Unit 3, First Floor The Fosse, Radford Semele Warwickshire, CV31 1XN	Project [redacted]				Job no. 138041	
	Calcs for Steel Beam				Start page no./Revision B 1	
	Calcs by JCB	Calcs date 07/04/2022	Checked by JCB	Checked date 07/04/2022	Approved by JCB	Approved date 07/04/2022

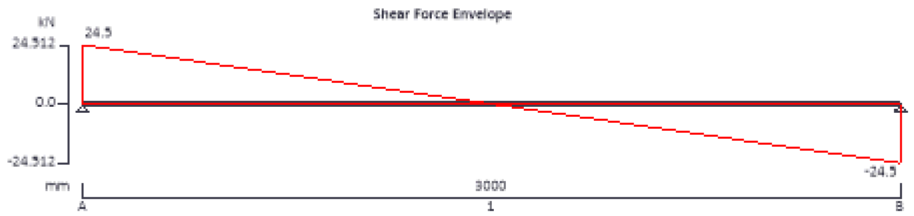
STEEL BEAM ANALYSIS & DESIGN (BS5950)

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 * 1
	Dead full UDL 6 kN/m
	Imposed full UDL 4.8 kN/m

Load combinations

Load combination 1	Support A	Dead * 1.40
		Imposed * 1.60
		Dead * 1.40
		Imposed * 1.60
	Support B	Dead * 1.40
		Imposed * 1.60

Analysis results

Maximum moment	M_{max} = **18.4** kNm	M_{min} = **0** kNm

Maximum shear V_{max} = **24.5** kN V_{min} = **-24.5** kN

Deflection δ_{max} = **4.2** mm δ_{min} = **0** mm

Maximum reaction at support A R_{A_max} = **24.5** kN R_{A_min} = **24.5** kN

Unfactored dead load reaction at support A R_{A_Dead} = **9.3** kN

Unfactored imposed load reaction at support A $R_{A\_Imposed}$ = **7.2** kN

Maximum reaction at support B R_{B_max} = **24.5** kN R_{B_min} = **24.5** kN

Unfactored dead load reaction at support B R_{B_Dead} = **9.3** kN

Unfactored imposed load reaction at support B $R_{B\_Imposed}$ = **7.2** kN

Section details

Section type **UKB 178x102x19 (Tata Steel Advance)**

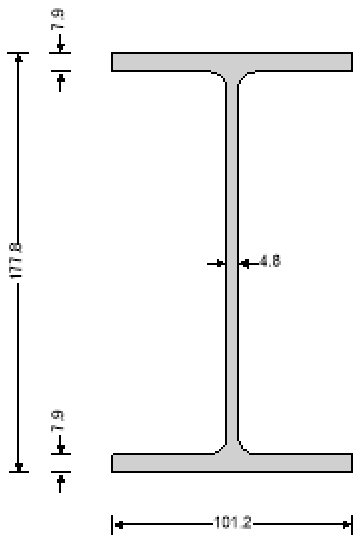
Steel grade **S275**

From table 9: Design strength p_y

Thickness of element max(T, t) = **7.9** 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 $K_{LT.A}$ = **1.00**

$K_{LT.B}$ = **1.00**

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 = **146.8** mm

$d / t = 30.6 * \varepsilon <= 80 * \varepsilon$ Class 1 plastic

Outstand flanges - Table 11

Width of section b = B / 2 = **50.6** mm

$b / T = 6.4 * \varepsilon <= 9 * \varepsilon$ Class 1 plastic

Section is class 1 plastic

Shear capacity - Section 4.2.3

Design shear force — $F_v = \max(\text{abs}(V_{max}), \text{abs}(V_{min}))$ = **24.5** kN

$d / t < 70 * \varepsilon$

Web does not need to be checked for shear buckling

Shear area — $A_v = t * D$ = **853** mm²

Design shear resistance — $P_v = 0.6 * p_y * A_v$ = **140.8** kN

PASS - Design shear resistance exceeds design shear force

Moment capacity - Section 4.2.5

Design bending moment — $M = \max(\text{abs}(M_{s1\_max}), \text{abs}(M_{s1\_min}))$ = **18.4** kNm

Moment capacity low shear - cl.4.2.5.2 — $M_c = \min(p_y * S_{xx}, 1.2 * p_y * Z_{xx})$ = **47.1** kNm

Effective length for lateral-torsional buckling - Section 4.3.5

Effective length for lateral torsional buckling — $L_E = 1.0 * L_{s1}$ = **3000** mm

Slenderness ratio — $\lambda = L_E / r_{yy}$ = **126.382**

Equivalent slenderness - Section 4.3.6.7

Buckling parameter — u = **0.888**

Torsional index — x = **22.560**

Slenderness factor — $v = 1 / [1 + 0.05 \times (\lambda / x)^2]^{0.25}$ = **0.790**

Ratio - cl.4.3.6.9 — β_W = **1.000**

Equivalent slenderness - cl.4.3.6.7 — $\lambda_{LT} = u \times v \times \lambda \times \sqrt{[\beta_W]}$ = **88.610**

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 — α_{LT} = **7.0**

Perry factor — $\eta_{LT} = \max(\alpha_{LT} \times (\lambda_{LT} - \lambda_{L0}) / 1000, 0)$ = **0.380**

Euler stress — $p_E = \pi^2 \times E / \lambda_{LT}^2$ = **257.7** N/mm²

$\phi_{LT} = (p_y + (\eta_{LT} + 1) \times p_E) / 2$ = **315.3** N/mm²

Bending strength - Annex B.2.1 — $p_b = p_E \times p_y / (\phi_{LT} + (\phi_{LT}^2 - p_E \times p_y)^{0.5})$ = **146.3** N/mm²

Equivalent uniform moment factor - Section 4.3.6.6

Moment at quarter point of segment — M_2 = **13.8** kNm

Moment at centre-line of segment — M_3 = **18.4** kNm

Moment at three quarter point of segment — M_4 = **13.8** kNm

Maximum moment in segment — M_{abs} = **18.4** kNm

Maximum moment governing buckling resistance — $M_{LT} = M_{abs}$ = **18.4** kNm

Equivalent uniform moment factor for lateral-torsional buckling

$m_{LT} = \max(0.2 + (0.15 \times M_2 + 0.5 \times M_3 + 0.15 \times M_4) / M_{abs}, 0.44)$ = **0.925**

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment — $M_b = p_b * S_{xx}$ = **25.1** kNm

M_b / m_{LT} = **27.1** 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 — $\delta_{lim} = L_{s1} / 360$ = **8.333** mm

Maximum deflection span 1 — $\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min}))$ = **4.169** mm

PASS - Maximum deflection does not exceed deflection limit

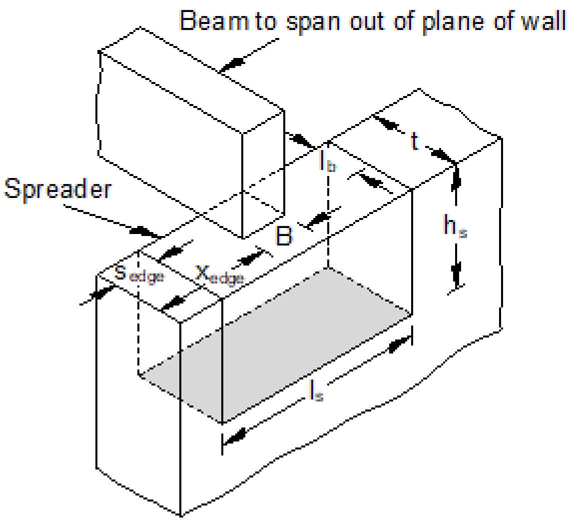
Allcott Associates LLP Fosse Way, Unit 3, First Floor The Fosse, Radford Semele Warwickshire, CV31 1XN	Project [redacted]				Job no. 138041	
	Calcs for Steel Beam Bearing Check on Internal Brick Wall				Start page no./Revision B 4	
	Calcs by JCB	Calcs date 07/04/2022	Checked by JCB	Checked date 07/04/2022	Approved by JCB	Approved date 07/04/2022

MASONRY BEARING DESIGN TO BS5628-1:2005

TEDDS calculation version 1.0.07

Masonry details

Masonry type	**Clay or calcium silicate bricks**
Compressive strength of unit	p_{unit} = **10.0** N/mm^2
Mortar designation	**iii**
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 = **103** mm
Effective thickness of masonry wall	t_{ef} = **103** mm
Height of masonry wall	h = **2400** mm
Effective height of masonry wall	h_{ef} = **2400** mm



Bearing details

Beam spanning out of plane of wall	
Width of bearing	B = **102** mm
Length of bearing	l_b = **100** mm
Edge distance	x_{edge} = **10** mm

Compressive strength from Table 2 BS5628:Part 1 - Clay or calcium silicate bricks

Mortar designation	Mortar = **"iii"**
Brick compressive strength	p_{unit} = **10.0** N/mm^2
Characteristic compressive strength	f_k = **3.40** N/mm^2

Loading details

Characteristic concentrated dead load	G_k = **9** kN
Characteristic concentrated imposed load	Q_k = **7** kN
Design concentrated load	F = (G_k × 1.4) + (Q_k × 1.6) = **24.5** kN
Characteristic distributed dead load	g_k = **1.0** kN/m

Characteristic distributed imposed load — q_k = **1.0** kN/m

Design distributed load — $f = (g_k \times 1.4) + (q_k \times 1.6)$ = **3.0** kN/m

Masonry bearing type

Bearing type — **Type 1**

Bearing safety factor — γ_{bear} = **1.25**

Check design bearing without a spreader

Design bearing stress — $f_{ca} = F / (B \times l_b) + f / t$ = **2.435** N/mm^2

Allowable bearing stress — $f_{cp} = \gamma_{bear} \times f_k / \gamma_m$ = **1.214** 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 = **140** mm

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

Rebuild top 6no. courses of wall beneath bearing with Class B Engineering Bricks - see following calculation

Spreader bearing type

Bearing type — **Type 3**

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

Check design bearing with a spreader

Loading acts eccentrically outside middle third – triangular stress distribution

Offset distance — $x_{off} = x_{edge} + (B / 2)$ = **61** mm

Maximum bearing stress — $f_{ca} = 2 \times F / (3 \times x_{off} \times t) + f / t$ = **2.646** N/mm^2

Allowable bearing stress — $f_{cp} = \gamma_{bear} \times f_k / \gamma_m$ = **1.943** N/mm^2

FAIL - Design bearing stress exceeds allowable bearing stress

Check design bearing at 0.4 × h below the bearing level

Slenderness ratio — h_{ef} / t_{ef} = **23.41**

Eccentricity at top of wall — e_x = **1.3** mm

From BS5628:1 Table 7

Capacity reduction factor — β = **0.61**

Length of bearing distributed at 0.4 × h — l_d = **1072** mm

Maximum bearing stress — $f_{ca} = F / (l_d \times t) + f / t$ = **0.253** N/mm^2

Allowable bearing stress — $f_{cp} = \beta \times f_k / \gamma_m$ = **0.597** N/mm^2

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

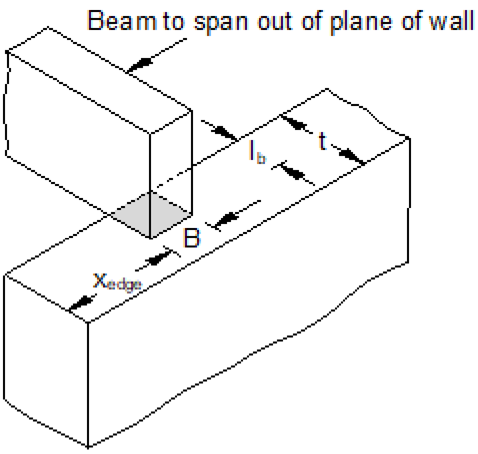
ALLCOTT ASSOCIATES Allcott Associates LLP Fosse Way, Unit 3, First Floor The Fosse, Radford Semele Warwickshire, CV31 1XN	Project [redacted]				Job no. 138041	
	Calcs for Beam Bearing on Internal Wall with Class B Engineering Brick				Start page no./Revision B 6	
	Calcs by JCB	Calcs date 07/04/2022	Checked by JCB	Checked date 07/04/2022	Approved by JCB	Approved date 07/04/2022

MASONRY BEARING DESIGN TO BS5628-1:2005

TEDDS calculation version 1.0.07

Masonry details

Masonry type	**Clay or calcium silicate bricks**
Compressive strength of unit	p_{unit} = **50.0** N/mm^2
Mortar designation	**iii**
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 = **103** mm
Effective thickness of masonry wall	t_{ef} = **103** mm
Height of masonry wall	h = **2400** mm
Effective height of masonry wall	h_{ef} = **2400** mm



Bearing details

Beam spanning out of plane of wall

Width of bearing	B = **102** mm
Length of bearing	l_b = **100** mm
Edge distance	x_{edge} = **10** mm

Compressive strength from Table 2 BS5628:Part 1 - Clay or calcium silicate bricks

Mortar designation	Mortar = **"iii"**
Brick compressive strength	p_{unit} = **50.0** N/mm^2
Characteristic compressive strength	f_k = **8.40** N/mm^2

Loading details

Characteristic concentrated dead load	G_k = **9** kN
Characteristic concentrated imposed load	Q_k = **7** kN
Design concentrated load	F = (G_k × 1.4) + (Q_k × 1.6) = **24.5** kN
Characteristic distributed dead load	g_k = **1.0** kN/m

Characteristic distributed imposed load q_k = **1.0** kN/m

Design distributed load $f = (g_k \times 1.4) + (q_k \times 1.6)$ = **3.0** kN/m

Masonry bearing type

Bearing type **Type 1**

Bearing safety factor γ_{bear} = **1.25**

Check design bearing without a spreader

Design bearing stress $f_{ca} = F / (B \times l_b) + f / t$ = **2.435** N/mm^2

Allowable bearing stress $f_{cp} = \gamma_{bear} \times f_k / \gamma_m$ = **3.000** 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} = **23.41**

Eccentricity at top of wall e_x = **1.3** mm

From BS5628:1 Table 7

Capacity reduction factor β = **0.61**

Length of bearing distributed at 0.4 × h l_d = **1072** mm

Maximum bearing stress $f_{ca} = F / (l_d \times t) + f / t$ = **0.253** N/mm^2

Allowable bearing stress $f_{cp} = \beta \times f_k / \gamma_m$ = **1.474** N/mm^2

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

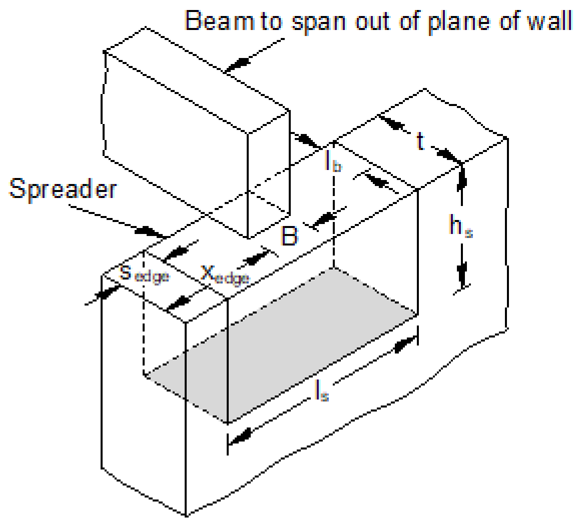
Allcott Associates LLP Fosse Way, Unit 3, First Floor The Fosse, Radford Semele Warwickshire, CV31 1XN	Project [redacted]				Job no. 138041	
	Calcs for Steel Beam Bearing Check on Rear Cavity Wall				Start page no./Revision B 8	
	Calcs by JCB	Calcs date 07/04/2022	Checked by JCB	Checked date 07/04/2022	Approved by JCB	Approved date 07/04/2022

MASONRY BEARING DESIGN TO BS5628-1:2005

TEDDS calculation version 1.0.07

Masonry details

Masonry type	**Clay or calcium silicate bricks**
Compressive strength of unit	p_{unit} = **10.0** N/mm^2
Mortar designation	**iii**
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 = **103** mm
Effective thickness of masonry wall	t_{ef} = **103** mm
Height of masonry wall	h = **2400** mm
Effective height of masonry wall	h_{ef} = **2400** mm



Bearing details

Beam spanning out of plane of wall

Width of bearing	B = **102** mm
Length of bearing	l_b = **100** mm
Edge distance	x_{edge} = **700** mm

Compressive strength from Table 2 BS5628:Part 1 - Clay or calcium silicate bricks

Mortar designation	Mortar = **"iii"**
Brick compressive strength	p_{unit} = **10.0** N/mm^2
Characteristic compressive strength	f_k = **3.40** N/mm^2

Loading details

Characteristic concentrated dead load	G_k = **9** kN
Characteristic concentrated imposed load	Q_k = **7** kN
Design concentrated load	F = (G_k × 1.4) + (Q_k × 1.6) = **24.5** kN
Characteristic distributed dead load	g_k = **8.0** kN/m

Characteristic distributed imposed load q_k = **1.0** kN/m

Design distributed load $f = (g_k \times 1.4) + (q_k \times 1.6)$ = **12.8** kN/m

Masonry bearing type

Bearing type **Type 2**

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

Check design bearing without a spreader

Design bearing stress $f_{ca} = F / (B \times l_b) + f / t$ = **2.531** N/mm^2

Allowable bearing stress $f_{cp} = \gamma_{bear} \times f_k / \gamma_m$ = **1.457** 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 = **140** mm

Edge distance $s_{edge} = \max(0\ \text{mm}, x_{edge} - (l_s - B) / 2)$ = **601** mm

Spreader bearing type

Bearing type **Type 2**

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

Check design bearing with a spreader

Loading acts at midpoint of spreader

Design bearing stress $f_{ca} = F / (l_s \times t) + f / t$ = **0.923** N/mm^2

Allowable bearing stress $f_{cp} = \gamma_{bear} \times f_k / \gamma_m$ = **1.457** 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} = **23.41**

Eccentricity at top of wall e_x = **1.3** mm

From BS5628:1 Table 7

Capacity reduction factor β = **0.61**

Length of bearing distributed at 0.4 × h l_d = **1762** mm

Maximum bearing stress $f_{ca} = F / (l_d \times t) + f / t$ = **0.261** N/mm^2

Allowable bearing stress $f_{cp} = \beta \times f_k / \gamma_m$ = **0.597** N/mm^2

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

www.allcottassociates.co.uk

Castlemead
Lower Castle Street
Bristol
BS1 3AG
Tel: 0117 3224931

Exchange House
494 Midsummer Boulevard
Milton Keynes
MK9 2EA
Tel. 01908 483559

15 Wheeler Gate
Nottingham
NG1 2NA
Tel. 0115 901 7074

Birmingham Office
2 Victoria Works
Vittoria Street
Birmingham
B1 3PE
Tel: 0121 718 7008

Oxford Office
John Eccles House
Robert Robinson Avenue
Oxford OX4 4GP
Tel. 01865 479670

Fosse Way,
Unit 3, First Floor,
The Fosse,
Radford Semele
Warwickshire CV31 1XN
Tel. 0333 200 7198

Atlantic House
Imperial Way
Reading
RG2 0TD
Tel: 0118 9680805

The Balance
7th Floor
2 Pinfold Street
The Balance
Sheffield S1 2GU
Tel: 0114 3583487

Email: info@allcottassociates.co.uk

ALLCOTT ASSOCIATES