

STRUCTURAL CALCULATIONS

243 Stand Lane Radcliffe Manchester M26 1JA

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Thank you for using beamcalc.co.uk for your scheme. Please take the time to read these important notes and ensure that these are passed on to your Architect, Principle Designer, Project Manager, Principal Contractor and Client.

These calculation sheets have been produced with professional care based upon the information and/or plans you provided to (us – defined as Beam Calculation Ltd). We assume that all information provided to us by the (client – defined as the person procuring our service) is accurate and a true reflection of the intended works. The information within this document relates to Part A of the Building Regulations only.

The calculations contained within this document have been carried out using industry standard computer software which outputs structural calculations in accordance with either British Standards or Eurocodes. Loading used have been derived from British Standards and/or manufacturers declared details. Where required we may make assumptions, which we will clearly mark on our sheets. It is the responsibility of the person carrying out the building work or the clients appointed principle contractor and all other contractors to check that our assumptions are reflected on-site and report any discrepancies (our assumptions) back to us before work proceeds.

The dimensions provided on our calculation sheets is the clear span of the structural member and allowances should be made when ordering beams. All structural steel specified within our calculation sheets is hot rolled grade S355 unless noted within the calculation document, this should be noted before ordering. Steel beams will need a minimum of 200mm bearing length in addition to the the clear span, when spanning in the plane of the wall and 100mm when spanning perpendicular, unless we specify otherwise. R1 bearing will always be left or to the bottom on plan. R2 bearing will always be right or to the top on plan.

Timber members are required to have a minimum of 50mm end bearings. All steel beam spans and other structural members must be accurately measured on site by the person carrying out the building work before any materials are ordered as is standard building practice. Beam Calculation Ltd will take no liability for abortive works due to members being ordered based upon sizes given on our sheets.

Dimensions given for pad stones is the minimum size required by calculation, we aim to keep the size as close to the support conditions as practical and to recognized standardized dimension. Where this is not possible we would recommend using 140mm deep reinforced concrete lintels with a minimum strength of 50N/mm² cut to size. Naylor or similar with BBA approval. All pad stones are to be factory made 50N/mm² units with BBA approval. We will under no circumstances accept cast in situ pad stones.

Beam Calculation Ltd calculation service has been carried out on the strict understanding that all work we are asked to carry out is subject to a Building Regulation application and approval with either a Local Authority Building Control department or an Approved Building Inspector. In all cases approval must be gained by the Building Control Body who is appointed on the scheme before any structural works are carried out based upon our calculation sheets. We accept no liability for abortive works due to works being carried before Building Control approval is gained for the calculations contained within this document. If you make amendments to the scheme we must be notified immediately as we will take no liability for changes made to the design by third parties before or after our calculations have been approved by the Building Control Body. Changes made at this stage will incur additional fees. If changes are made to the design by third parties and Building Control ask for further justification additional fees will apply. We may not be in a position to justify the changes made. We would strongly suggest changes are discussed with us prior to them being implemented on site.

We assume that all building work is being carried out by a competent contractor who is experienced in structural alterations, domestic building works and the requirements of the Building Regulations 2010 and associated Approved Document requirements. The contractor is responsible for all on site safety, temporary propping arrangements, lifting operations and associated safe working methods as the CDM regulations imposes. All information we provide to the client must be passed on to the client appointed principle designer and the client appointed principle contractor and all other contractors.

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Registered Office: 1st Floor, 2 Woodberry Grove, Finchley, London, N12 0DR
VAT Reg No. 300 723455

Steel beams which are placed onto masonry increase local pressure and redistribute loadings onto that masonry and subsequently down through the foundations. The foundations on site should be exposed and checked by a suitably qualified person to ensure they are adequate to sustain additional loading before beams are installed as local underpinning may be required. If masonry supporting beams is in poor condition, then this may need to be locally rebuilt with suitable masonry, such as class B engineering bricks achieving a minimum compressive strength of 50N/mm² in accordance with BS3921. If we have indicated that a beam is to sit on a wall we have assumed that the wall supporting the beam is load-bearing, is in good condition and has adequate foundations with ground conditions which achieve a minimum of 100kN/m². This must be verified on site by the person carrying out the work and a suitably qualified person before building work commences.

We assume for loading/foundation calculation purposes that the ground has a minimum bearing capacity of 100kN/m² at 900mm below ground level which must be verified and approved on site by your Building Control Surveyor before ANY foundation trenches are covered over or filled with concrete.

If we specify multiple steel beams these are to be bolted together using M16 8.8 grade bolts at 1.0m MAX and CHS to suit the supported wall dimensions. These are for holding in place only and should not be assumed to allow load transfer. Where load sharing systems using multiple beams has been specified then battening with PFC sections and individual beam to PFC bolting should be adopted. Through bolting multiple beams is not acceptable for load sharing.

Where we have provided a steel beam splice calculation for a beam the splices should be 1/3 and 2/3 of the beam span. Under no circumstances should the splice detail be used at half span.

Masonry should be tied to steel columns with either Ancon or Hilti proprietary steel frame cramp fixings in strict accordance with the manufacturers detail. Where columns are to be fixed back to masonry - such as in a sway frame situation steel lugs should be welded to the columns at 600mm vertical centers and fixed back to the masonry with 2 M16 resin anchors per lugs.

Multiple timber members should be bolted at 600mm with M12 8.8 bolts and 50mm shear connector plates. Additional bolts should be provided at point load locations. If a timber wall plate is to sit directly onto the top flange of a steel beam then it should be bolted at 600mm (staggered pattern) with M12 4.6 bolts. Timber floor joists are required to be provided with full depth noggins (minimum section thickness as main member) at 1/3 and 2/3 floor joist span positions.

We assume for calculation purposes that bi-fold doors are supported on a side and bottom rail and the top rail is not taking the load of the door. If the door manufacturers data sheets state otherwise we should be notified as further checks will be required.

All beams within our calculations have been designed as laterally unrestrained, unless restraint is provided by a connected perpendicular beam and the exposed section height / the web thickness is <27mm. We will then assume restraint has been provided at that position. Or, we will assume full restraint if a fully load sharing system has been specified as above. The ends of all steel beams should be fully built into the masonry, where this is not possible then the beams should be either bolted down into the pad stones or lateral restraint straps should be provided to strap the beam down onto the masonry.

Masonry over-sailing the beam flange will be permitted to a maximum of 33mm. A 203UC therefore will support MAX of 265mm walling above. An 8mm plate must be welded to the top flange to match the cavity width for anything wider.

If you have any problems interpreting any of our information or wish to seek further clarification, we can be contacted on the following, where we will be happy to assist you:

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DESIGN STANDARDS AND LOADINGS

Design standards and loading used throughout calculation sheets have been based upon the following documents.

BS 5950:1 Structural use of Steelwork in Buildings

BS 8118:1 Structural Use of Concrete

BS 5628: 1 Structural use of Masonry

BS 5268:2 Structural use of Timber

BS 6399:2 Code of practice for dead and imposed loads

Dead Loadings

Pitched Roof (kN/m ²)	Service Loads
Concrete Tiles	0.55 kN/m ²
Battens and Felt	0.05 kN/m ²
Trusses	0.23 kN/m ²
Ceiling Board 12.5mm	0.15 kN/m ²
Insulation	0.02 kN/m ²
	1.0 kN/m²

Flat Roof

EPDM	0.02 kN/m ²
Built up Felt	0.42 kN/m ²
Timbers	0.11 kN/m ²
Insulation	0.08 kN/m ²
Ply	0.15 kN/m ²
Ceiling Board 12.5mm	0.15 kN/m ²

0.91 kN/m² / 0.51 kN/m²

First Floor

Boarding (22mm)	0.15 kN/m ²
Joists	0.15 kN/m ²
Ceiling Board 12.5mm	0.15 kN/m ²
Insulation	0.02 kN/m ²
Lath and Plaster	0.50 kN/m ²

0.82 kN/m² / 0.47 kN/m²

External Cavity Walls

Brick 102.5mm	2.25 kN/m ²
Block (100mm)	1.25 kN/m ²
Plaster	0.25 kN/m ²
Insulation	0.02 kN/m ²

3.77 kN/m²

Dense Blocks

4.5 kN/m²

Stone + Light Block

3.82 kN/m²

External Walls Solid

Brick 225mm	4.5 kN/m ²
Plaster	0.25 x 2 kN/m ²

5.00 kN/m²

External Walls Timber (Tile Hung)

Tile Hanging	0.55 kN/m ²
Timber Stud (100mm)	0.15 kN/m ²
Plasterboard 12.5mm	0.15 kN/m ²
Insulation	0.02 kN/m ²

0.87 kN/m²

Timber Framed Buildings (Inner Leaf)

Timber Framing (150mm)	0.30 kN/m ²
Plasterboard 15mm	0.17 kN/m ²
Insulation	0.06 kN/m ²
OSB Sheathing 15mm	0.105 kN/m ²

0.63 kN/m²

Stud Partitions

Timber Stud (100mm)	0.15 kN/m ²
Plasterboard X 2 12.5mm	0.50 kN/m ²

0.65 kN/m²

Imposed Loadings

Snow (Generic)	0.75 kN/m ²
Storage	0.25 kN/m ²
Domestic Floor	1.5 kN/m ²
Wind	0.8 kN/m ²

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ProSteel Project Summary

Project started 5 Apr 2022 DR
Site address: 243 Stand Lane Radcliffe Manchester M26 1JA
Job: Steel Calculations
Client: John Leacock

ITEMS:

- 1: Beam: Rear Beam (Consider Inner Leaf)
Span: 3.734 m.
Reactions (unfactored/factored): R1: 25.58/37.35 kN R2: 25.58/37.35 kN
Use 203 x 133 x 30 UB S355
Bearing R1:

USE 300L x 100W x 140D 40N/mm2 CONCRETE PAD STONE
BLOCK NIB MUST BE NOT LESS THAN 7N/mm2 BLOCK
Bearing R2:
USE 300L x 100W x 140D 40N/mm2 CONCRETE PAD STONE

- 2: Beam: Rear Beam (Consider Outer Leaf)
Span: 3.734 m.
Reactions (unfactored/factored): R1: 15.26/21.66 kN R2: 15.27/21.67 kN
Use 203 x 133 x 30 UB S355
Bearing R1:

USE 300L x 100W x 140D 40N/mm2 CONCRETE PAD STONE
BLOCK NIB MUST BE NOT LESS THAN 7N/mm2 BLOCK
Bearing R2:
USE 300L x 100W x 140D 40N/mm2 CONCRETE PAD STONE

- 3: Beam: Structural Ridge Beam
Span: 2.738 m.
Reactions (unfactored/factored): R1: 6.19/9.11 kN R2: 6.19/9.11 kN
Use 152 x 89 x 16 UB S355
Bearing R1:

USE 215 x 102 x 65 SOLID ENGINEER BRICK
Bearing R2:
USE 215 x 102 x 65 SOLID ENGINEER BRICK

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Beam: Rear Beam (Consider Inner Leaf)

Span: 3.734 m.

Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp
U D o.w.	0.3	0		L	0.56	0.56
U D Masonry	2.0*3.0	0		L	11.20	11.20
U L Joists	1.5*(3.5/2)	0		L	4.90	4.90
U D Joists	0.5*(3.5/2)	0		L	1.63	1.63
U L Roof	0.75*2.0	0		L	2.80	2.80
U D Roof	1.2*2.0	0		L	4.48	4.48

Unfactored reactions (kN) Total:

25.58 **25.58**

Dead: 17.88 17.88

Live: 7.70 7.70

Total load: 51.2/74.7 kN Unfactored/Factored

Factored reactions:

37.35 **37.35**

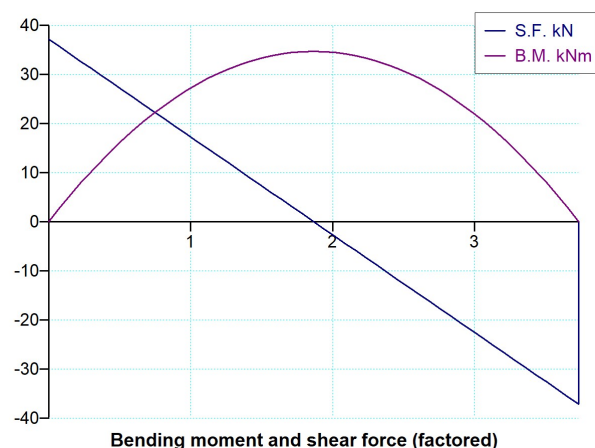
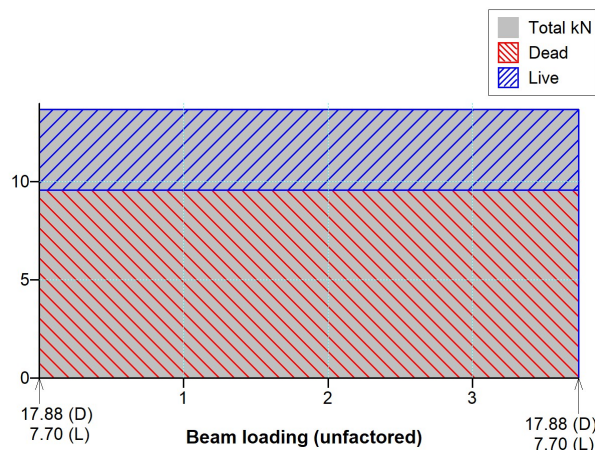
Load types: U: UDL D: Dead; L: Live (positions in m. from R1)

Maximum B.M. (factored) = 34.87 kNm at 1.87 m. from R1

Maximum S.F. (factored) = 37.35 kN at 0.00 m. from R1

Live load deflection = $10.4 \times 10^8 / EI$ at 1.87 m. from R1 (E in N/mm^2 , I in cm^4)

Total deflection = $34.7 \times 10^8 / EI$ at 1.87 m. from R1



Beam calculation to BS5950-1:2000 using S355 steel

SECTION SIZE : 203 x 133 x 30 UB S355

D=206.8 mm B=133.9 mm t=6.4 mm T=9.6 mm $I_x=2,900 \text{ cm}^4$ $r_y=3.17 \text{ cm}$ $S_x=314 \text{ cm}^3$ $x=21.5$

Section classification: T = 9.6mm $p_y = 355 \text{ N/mm}^2$ $e = \sqrt{(275/355)} = 0.88$

(Table 11) Flange: $b/T = 66.9/9.6 = 6.97$ ($\leq 9e$: Class 1 plastic)

Web: $d/t = 172.4/6.4 = 26.9$ ($\leq 80e$: Class 1 plastic)

For design purposes section classification is Class 2, compact

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Shear

Shear capacity = $0.6 p_y \cdot t \cdot D = 0.6 \times 355 \times 6.4 \times 206.8/1000 = 282 \text{ kN}$ (≥ 37.3) OK

Bending

Maximum moment = 34.87 kNm at 1.87 m. from R1

Moment capacity, $M_c = p_y \cdot S_x = 355 \times 314/1000 = 111.5 \text{ kNm}$ OK

Lateral-torsional buckling

Beam is laterally restrained at supports only

Restraint condition at R1 and R2: Compression flange laterally unrestrained; both flanges free to rotate on plan.

Partial torsional restraint by dead bearing of bottom flange to support (1.2L+2D) [BS5950 Table 13]

Effective length = 1.2L+2D

Bending strength, $p_b = 141.2 \text{ N/mm}^2$

Maximum moment within segment, $M_x = 34.87 \text{ kNm}$

Equivalent uniform moment factor, $m_{LT} = 0.925$ ($M_2=26.1$, $M_3=34.9$, $M_4=26.1$)

Equivalent uniform moment = $0.925 \times 34.87 = 32.25 \text{ kNm}$

Buckling resistance moment, $M_b = p_b \cdot S_x = 141.2 \times 314/1000 = 44.33 \text{ kNm}$ OK

Web capacity

Check unstiffened web capacity with load of 37.35 kN

$C1 = 78.2 \text{ kN}$; $C2 = 2.27 \text{ kN/mm}$; $C4 = 261$; $K = \min\{0.5+(a_e/1.4d), 1.0\}$; $p_{yw} = 355 \text{ N/mm}^2$
(for derivation of C factors see *Steelwork Design Guide to BS5950-1:2000 6th ed.*)

Minimum required stiff bearing length, $b_1 = 0 \text{ mm}$; $a_e = 0 \text{ mm}$; $K = 0.500$

Bearing capacity, $P_w = C1 + b_1 \cdot C2 = 78.2 \text{ kN}$

Buckling capacity, $P_x = K \cdot (C4 \cdot P_w) = 0.500 \cdot (261 \times 78.2) = 71.5 \text{ kN} \ll \ll$

Deflection

LL deflection = $10.44 \times 1e8/205,000 \times 2,900 = 1.8 \text{ mm}$ (L/2126) OK

TL deflection = $34.67 \times 1e8/205,000 \times 2,900 = 5.8 \text{ mm}$ (L/640)

Bearings

R1: User-entered

Factored reaction = $17.88 \times 1.4 + 7.70 \times 1.6 = 37.35 \text{ kN}$

USE 300L x 100W x 140D 40N/mm² CONCRETE PAD STONE

BLOCK NIB MUST BE NOT LEST THAN 7N/mm² BLOCK

R2: User-entered

Factored reaction = $17.88 \times 1.4 + 7.70 \times 1.6 = 37.35 \text{ kN}$

USE 300L x 100W x 140D 40N/mm² CONCRETE PAD STONE

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Beam: Rear Beam (Consider Outer Leaf)

Span: 3.734 m.

Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp
U D o.w.	0.3	0		L	0.56	0.56
U D Masonry	2.0*3.0	0		L	11.20	11.20
P L Ridge Reaction	3	1.869			1.50	1.50
P D Ridge Reaction	4	1.869			2.00	2.00
Unfactored reactions (kN) Total:					15.26	15.27
Dead:					13.76	13.76
Live:					1.50	1.50
Factored reactions:					21.66	21.67

Total load: 30.52/43.33 kN Unfactored/Factored

Factored reactions:

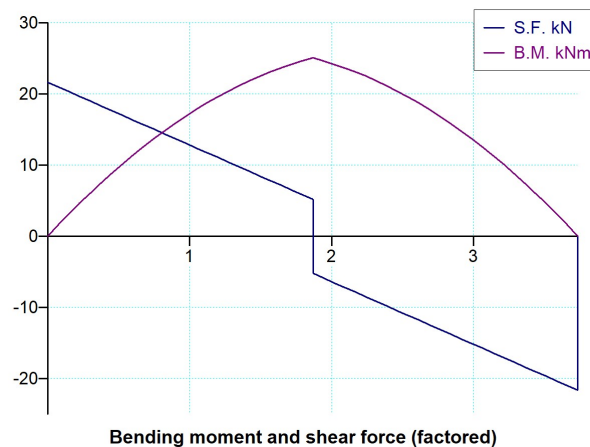
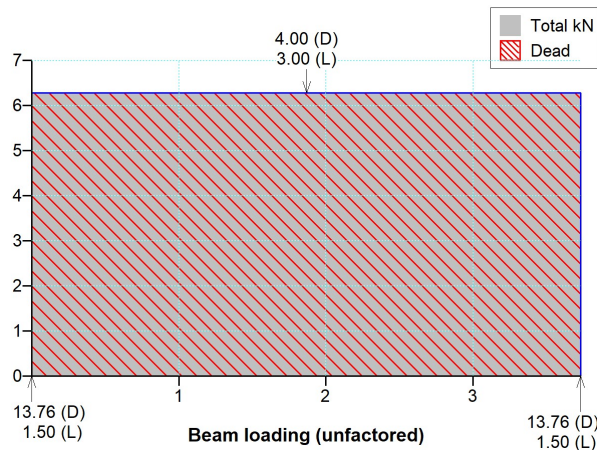
Load types: U: UDL P: PL D: Dead; L: Live (positions in m. from R1)

Maximum B.M. (factored) = 25.08 kNm at 1.87 m. from R1

Maximum S.F. (factored) = -21.67 kN at R2

Live load deflection = $3.25 \times 10^8 / EI$ at 1.87 m. from R1 (E in N/mm^2 , I in cm^4)

Total deflection = $23.5 \times 10^8 / EI$ at 1.87 m. from R1



Beam calculation to BS5950-1:2000 using S355 steel

SECTION SIZE : 203 x 133 x 30 UB S355

D=206.8 mm B=133.9 mm t=6.4 mm T=9.6 mm $I_x=2,900 \text{ cm}^4$ $r_y=3.17 \text{ cm}$ $S_x=314 \text{ cm}^3$ $x=21.5$

Section classification: T = 9.6mm $p_y = 355 \text{ N/mm}^2$ $e = \sqrt{(275/355)} = 0.88$

(Table 11)

Flange: $b/T = 66.9/9.6 = 6.97 (<=9e: \text{Class 1 plastic})$

Web: $d/t = 172.4/6.4 = 26.9 (<=80e: \text{Class 1 plastic})$

For design purposes section classification is Class 2, compact

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Shear

Shear capacity = $0.6 p_y \cdot t \cdot D = 0.6 \times 355 \times 6.4 \times 206.8/1000 = 282 \text{ kN}$ (≥ 21.7) OK

Bending

Maximum moment = 25.08 kNm at 1.87 m. from R1

Moment capacity, $M_c = p_y \cdot S_x = 355 \times 314/1000 = 111.5 \text{ kNm}$ OK

Lateral-torsional buckling

Beam is laterally restrained at supports only

Restraint condition at R1 and R2: Compression flange laterally unrestrained; both flanges free to rotate on plan.

Partial torsional restraint by dead bearing of bottom flange to support (1.2L+2D) [BS5950 Table 13]

Effective length = 1.2L+2D

Bending strength, $p_b = 141.2 \text{ N/mm}^2$

Maximum moment within segment, $M_x = 25.08 \text{ kNm}$

Equivalent uniform moment factor, $m_{LT} = 0.896$ ($M_2=16.4$, $M_3=25.1$, $M_4=16.4$)

Equivalent uniform moment = $0.896 \times 25.08 = 22.47 \text{ kNm}$

Buckling resistance moment, $M_b = p_b \cdot S_x = 141.2 \times 314/1000 = 44.33 \text{ kNm}$ OK

Web capacity

Check unstiffened web capacities with loads of 21.66 kN and 21.67 kN

$C1 = 78.2 \text{ kN}$; $C2 = 2.27 \text{ kN/mm}$; $C4 = 261$; $K = \min\{0.5+(a_e/1.4d), 1.0\}$; $p_{yw} = 355 \text{ N/mm}^2$
(for derivation of C factors see *Steelwork Design Guide to BS5950-1:2000 6th ed.*)

R1: Minimum required stiff bearing length, $b_1 = 0 \text{ mm}$; $a_e = 0 \text{ mm}$; $K = 0.500$

Bearing capacity, $P_w = C1 + b_1 \cdot C2 = 78.2 \text{ kN}$

Buckling capacity, $P_x = K \cdot (C4 \cdot P_w) = 0.500 \cdot (261 \times 78.2) = 71.5 \text{ kN} \lll$

R2: Minimum required stiff bearing length, $b_1 = 0 \text{ mm}$; $a_e = 0 \text{ mm}$; $K = 0.500$

Bearing capacity, $P_w = C1 + b_1 \cdot C2 = 78.2 \text{ kN}$

Buckling capacity, $P_x = K \cdot (C4 \cdot P_w) = 0.500 \cdot (261 \times 78.2) = 71.5 \text{ kN} \lll$

Deflection

LL deflection = $3.25 \times 1e8/205,000 \times 2,900 = 0.5 \text{ mm}$ (L/6823) OK

TL deflection = $23.54 \times 1e8/205,000 \times 2,900 = 4.0 \text{ mm}$ (L/943)

Bearings

R1: User-entered

Factored reaction = $13.76 \times 1.4 + 1.50 \times 1.6 = 21.66 \text{ kN}$

USE 300L x 100W x 140D 40N/mm² CONCRETE PAD STONE
BLOCK NIB MUST BE NOT LEST THAN 7N/mm² BLOCK

R2: User-entered

Factored reaction = $13.76 \times 1.4 + 1.50 \times 1.6 = 21.67 \text{ kN}$

USE 300L x 100W x 140D 40N/mm² CONCRETE PAD STONE

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Beam: Structural Ridge Beam

Span: 2.738 m.

Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp
U D o.w.	0.2	0		L	0.27	0.27
U L Roof Live	$0.75 \times (4.335/2)$	0		L	2.23	2.23
U D Roof Dead	$1.2 \times (4.335/2) / \cos 15$	0		L	3.69	3.69
Unfactored reactions (kN) Total:					6.19	6.19
Dead:					3.96	3.96
Live:					2.23	2.23
Factored reactions:					9.11	9.11

Total load: 12.37/18.21 kN Unfactored/Factored

Factored reactions:

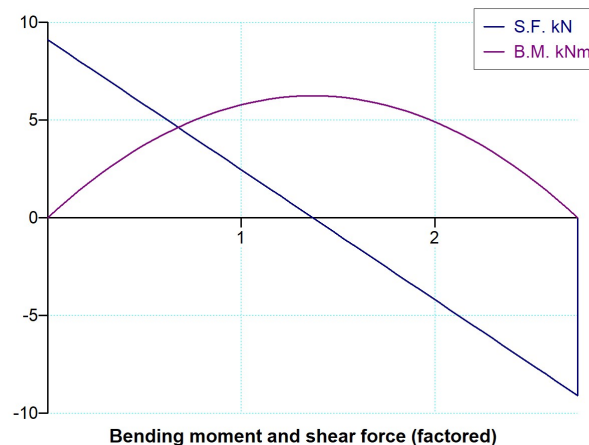
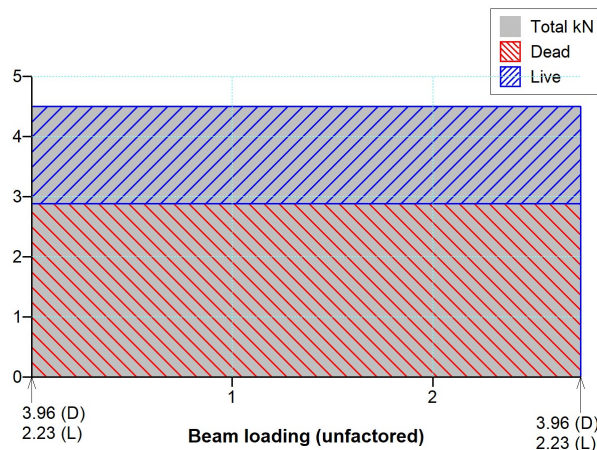
Load types: U: UDL D: Dead; L: Live (positions in m. from R1)

Maximum B.M. (factored) = 6.23 kNm at 1.37 m. from R1

Maximum S.F. (factored) = -9.10 kN at R2

Live load deflection = $1.19 \times 10^8 / EI$ at 1.37 m. from R1 (E in N/mm^2 , I in cm^4)

Total deflection = $3.31 \times 10^8 / EI$ at 1.37 m. from R1



Beam calculation to BS5950-1:2000 using S355 steel

SECTION SIZE : 152 x 89 x 16 UB S355

D=152.4 mm B=88.7 mm t=4.5 mm T=7.7 mm $I_x=834 \text{ cm}^4$ $r_y=2.10 \text{ cm}$ $S_x=123 \text{ cm}^3$ $x=19.6$

Section classification:
(Table 11)

$T = 7.7 \text{ mm}$ $p_y = 355 \text{ N/mm}^2$ $e = \sqrt{(275/355)} = 0.88$

Flange: $b/T = 44.3/7.7 = 5.76$ ($\leq 9e$: Class 1 plastic)

Web: $d/t = 121.8/4.5 = 27.1$ ($\leq 80e$: Class 1 plastic)

For design purposes section classification is Class 2, compact

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Shear

Shear capacity = $0.6 p_y t D = 0.6 \times 355 \times 4.5 \times 152.4/1000 = 146 \text{ kN}$ (≥ 9.10) OK

Bending

Maximum moment = 6.232 kNm at 1.37 m. from R1

Moment capacity, $M_c = p_y S_x = 355 \times 123/1000 = 43.66 \text{ kNm}$ OK

Lateral-torsional buckling

Beam is laterally restrained at supports only

Restraint condition at R1 and R2: Compression flange laterally unrestrained; both flanges free to rotate on plan.

Partial torsional restraint by dead bearing of bottom flange to support (1.2L+2D) [BS5950 Table 13]

Effective length = 1.2L+2D

Bending strength, $p_b = 133.4 \text{ N/mm}^2$

Maximum moment within segment, $M_x = 6.232 \text{ kNm}$

Equivalent uniform moment factor, $m_{LT} = 0.925$ ($M_2=4.67$, $M_3=6.23$, $M_4=4.67$)

Equivalent uniform moment = $0.925 \times 6.232 = 5.765 \text{ kNm}$

Buckling resistance moment, $M_b = p_b S_x = 133.4 \times 123/1000 = 16.40 \text{ kNm}$ OK

Web capacity

Check unstiffened web capacity with load of 9.105 kN

$C1 = 48.9 \text{ kN}$; $C2 = 1.60 \text{ kN/mm}$; $C4 = 129$; $K = \min\{0.5+(a_e/1.4d), 1.0\}$; $p_{yw} = 355 \text{ N/mm}^2$
(for derivation of C factors see *Steelwork Design Guide to BS5950-1:2000 6th ed.*)

Minimum required stiff bearing length, $b_1 = 0 \text{ mm}$; $a_e = 0 \text{ mm}$; $K = 0.500$

Bearing capacity, $P_w = C1 + b_1 C2 = 48.9 \text{ kN}$

Buckling capacity, $P_x = K/(C4 P_w) = 0.500/(129 \times 48.9) = 39.6 \text{ kN} \ll \ll$

Deflection

LL deflection = $1.19 \times 10^8 / 205,000 \times 834 = 0.7 \text{ mm}$ (L/3936) OK

TL deflection = $3.31 \times 10^8 / 205,000 \times 834 = 1.9 \text{ mm}$ (L/1416)

Bearings

R1: User-entered

Factored reaction = $3.96 \times 1.4 + 2.23 \times 1.6 = 9.11 \text{ kN}$

USE 215 x 102 x 65 SOLID ENGINEER BRICK

R2: User-entered

Factored reaction = $3.96 \times 1.4 + 2.23 \times 1.6 = 9.11 \text{ kN}$

USE 215 x 102 x 65 SOLID ENGINEER BRICK

TIMBER MEMBER DESIGN TO BS5268-2:2002

TEDDS calculation version 1.7.01

Analysis results

Design moment in major axis

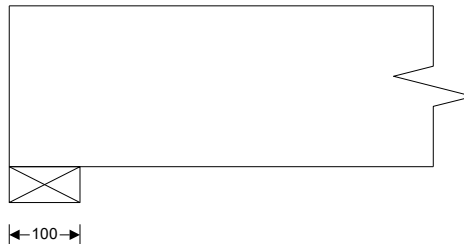
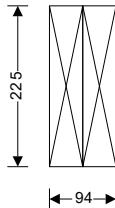
$M_x = 6.230$ kNm

Design shear

$F = 9.100$ kN

Maximum reaction

$R = 9.100$ kN



Timber section details

Breadth of sections

$b = 47$ mm

Depth of sections

$h = 225$ mm

Number of sections in member

$N = 2$

Overall breadth of member

$b_b = N \times b = 94$ mm

Timber strength class

C24

Member details

Service class of timber

1

Load duration

Medium term

Length of bearing

$L_b = 100$ mm

Section properties

Cross sectional area of member

$A = N \times b \times h = 21150$ mm²

Section modulus

$Z_x = N \times b \times h^2 / 6 = 793125$ mm³

$Z_y = h \times (N \times b)^2 / 6 = 331350$ mm³

Second moment of area

$I_x = N \times b \times h^3 / 12 = 89226562$ mm⁴

$I_y = h \times (N \times b)^3 / 12 = 15573450$ mm⁴

Radius of gyration

$i_x = \sqrt{I_x / A} = 65.0$ mm

$i_y = \sqrt{I_y / A} = 27.1$ mm

Modification factors

Duration of loading - Table 17

$K_3 = 1.25$

Bearing stress - Table 18

$K_4 = 1.00$

Total depth of member - cl.2.10.6

$K_7 = (300 \text{ mm} / h)^{0.11} = 1.03$

Load sharing - cl.2.9

$K_8 = 1.00$

Compression perpendicular to grain

Permissible bearing stress (no wane)

$\sigma_{c_adm} = \sigma_{cp1} \times K_3 \times K_4 \times K_8 = 3.000$ N/mm²

Applied bearing stress

$\sigma_{c_a} = R / (N \times b \times L_b) = 0.968$ N/mm²

$\sigma_{c_a} / \sigma_{c_adm} = 0.323$

PASS - Applied compressive stress is less than permissible compressive stress at bearing

Bending parallel to grain

Permissible bending stress

$\sigma_{m_adm} = \sigma_m \times K_3 \times K_7 \times K_8 = 9.676$ N/mm²

Applied bending stress

$$\sigma_{m_a} = M_x / Z_x = 7.855 \text{ N/mm}^2$$

$$\sigma_{m_a} / \sigma_{m_{adm}} = 0.812$$

PASS - Applied bending stress is less than permissible bending stress**Shear parallel to grain**

Permissible shear stress

$$\tau_{adm} = \tau \times K_3 \times K_8 = 0.888 \text{ N/mm}^2$$

Applied shear stress

$$\tau_a = 3 \times F / (2 \times A) = 0.645 \text{ N/mm}^2$$

$$\tau_a / \tau_{adm} = 0.727$$

PASS - Applied shear stress is less than permissible shear stress