Longsight Design Consultancy Ltd

Consulting Civil & Structural Engineers

DESIGN OF STEEL BEAM

AT

YEW TREE COTTAGE

CONTENTS

Pages	Content
01	Loads
02 - 06	Beam 1 – Over Lounge/Dining

References

- BS5628 Part 1 - Masonry
- BS5950 Part 1 – Steelwork
- CADS Smart Engineer
- Corus Blue Book – Section Properties and capacities

Longsight Design Consultancy Ltd

Longsight House, 258 Sackup Lane, Staincross, Barnsley, S75 5AX
Tel: 01226 383038
Mob: 07814 609798
Email: tony.rubino@longsightdesign.co.uk

PROJECT		REF
ELEMENT	CALCS BY	DATE
	CHECKED	DATE

REF	CALCULATIONS	OUTPUT

LOADS

Roof – (dead)		
Tiles + felt + battens	=	0.80 kN/m^2
Rafters	=	0.15 kN/m^2
Total	**=**	**0.95 kN/m^2**
On Plan = 0.95/Cos45	**=**	**1.35 kN/m^2**
Ceiling (dead)		
Joists	=	0.10 kN/m^2
Insulation	=	0.05 kN/m^2
Plaster finish	=	0.20 kN/m^2
Total	**=**	**0.35 kN/m^2**
Internal Wall – (dead)		
100mm Blockwork	=	1.80 kN/m^2
Plaster finish	=	0.40 kN/m^2
Total	**=**	**2.20 kN/m^2**
Internal Partitions – (dead)		
Partitions	=	0.50 kN/m^2
Total	**=**	**0.50 kN/m^2**
First & Attic Floor – (dead)		
Floorboards	=	0.15kN/m^2
Existing joists	=	0.15kN/m^2
Insulation	=	0.10kN/m^2
Plasterboard + skim	=	0.20kN/m^2
Total	**=**	**0.60kN/m^2**
Roof – (Imposed)		
Imposed Load	**=**	**0.60kN/m^2**
Ceiling – (Imposed)		
Imposed Load	**=**	**0.25kN/m^2**
Floor – (Imposed)		
Imposed Load	**=**	**1.50kN/m^2**

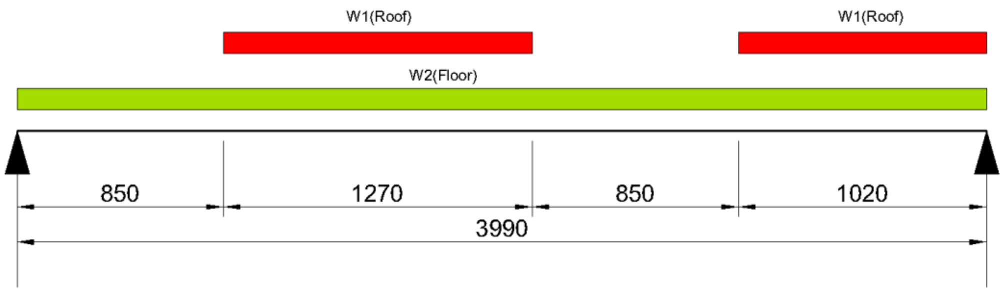
Longsight Design Consultancy Ltd
Longsight House, 258 Sackup Lane, Staincross, Barnsley,
S75 5AX
Tel: 01226 383038
Mob: 07814 609798
Email: tony.rubino@longsightdesign.co.uk

PROJECT		REF
ELEMENT	CALCS BY	DATE
	CHECKED	DATE

REF	CALCULATIONS	OUTPUT

BEAM 1 – OVER LOUNGE/DINING ROOM

Design span to centre of bearing = 3790mm



UDL Loading W1 – (Dead)		
Roof	= 1.35 x (3.4 + 2.6) x 0.50 x 4.1 x 0.75/2.59	= 4.80 kN/m
Ceiling	= 0.35 x (3.4 + 2.6) x 0.50 x 4.1 x 0.75/2.59	= 1.25 kN/m
Int Wall	= 2.20 x (2.2 + 0.3) x 0.50 x 4.1/2.2	= 5,13 kN/m
Int Wall	= 2.20 x 2.1	= 4.62 kN/m
Total		**= 15.80 kN/m**

UDL Loading W1 – (Imposed)		
Roof	= 0.60 x (3.4 + 2.6) x 0.50 x 4.1 x 0.75/2.59	= 2.13 kN/m
Ceiling	= 0.25 x (3.4 + 2.6) x 0.50 x 4.1 x 0.75/2.59	= 0.90 kN/m
Total		**= 3.03 kN/m**

UDL Loading W2 – (Dead)		
Floor	= 0.60 x 3.30 x 0.50	= 0.99 kN/m
Studwork	= 0.50 x 3.30 x 0.50	= 0.83 kN/m
Total		**= 1.82 kN/m**

UDL Loading W1 – (Imposed)		
Floor	= 1.50 x 3.30 x 0.50	= 2.48 kN/m
Total		**= 2.48 kN/m**

See CADS Printout

ADOPT 200 x 100 x 10 CELSIUS RHS (S355)

Longsight Design Consultancy Ltd

Longsight House, 258 Sackup Lane, Staincross, Barnsley,
S75 5AX
Tel: 01226 383038
Mob: 07814 609798
Email: tony.rubino@longsightdesign.co.uk

PROJECT		REF
ELEMENT	CALCS BY	DATE
	CHECKED	DATE

REF	CALCULATIONS	OUTPUT

BEAM 1 – OVER LOUNGE/DINING ROOM

CHECK BEARING ON WALL

Maximum ULS LHS reaction from CADS **= 39.4 kN**

Assume internal wall is Blockwork assumed characteristic strength of 4.00N/mm^2
f_k = 4.00N/mm^2

$$\text{Allowable stress under bearing} = \frac{1.00f_k}{\gamma_m} = \frac{1.00 * 4}{3.5} = \mathbf{1.143N/mm^2}$$

$$\text{Minimum Length of padstone reqd} = \frac{39.4 \times 1000}{140 \times 1.143} = 247\text{mm}$$

ADOPT A MINIMUM 440mm LONG x 215mm DEEP x 140mm WIDE CONCRETE PADSTONE UNDER BEAM BEARING

Maximum ULS RHS reaction from CADS **= 51.1 kN**

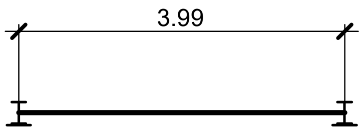
Assume internal wall is Blockwork assumed characteristic strength of 4.00N/mm^2
f_k = 4.00N/mm^2

$$\text{Allowable stress under bearing} = \frac{1.00f_k}{\gamma_m} = \frac{1.00 * 4}{3.5} = \mathbf{1.143N/mm^2}$$

$$\text{Minimum Length of padstone reqd} = \frac{51.1 \times 1000}{100 \times 1.43} = 448\text{mm}$$

ADOPT A MINIMUM 500mm LONG x 215mm DEEP x 100mm WIDE CONCRETE PADSTONE UNDER BEAM BEARING

SHS/RHS bending check (Hot rolled sections only)

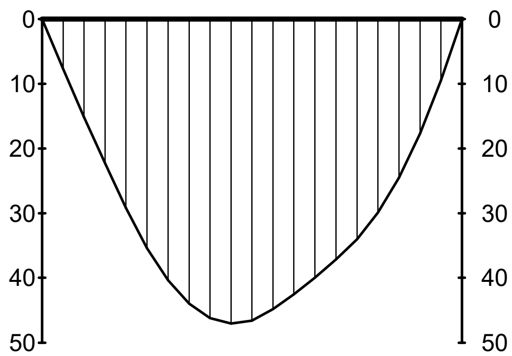


Calculations in accordance with BS5950:Part1:2000 and the SCI 'Steelwork Design Guide to BS5950'

Span		= 3.99 m
Section size		- 200x100x10.0 RHS
Section class		- 1 (Plastic)
Steel grade		- S 355
Design strength of steel		= 355 N/mm^2
Design forces	- maximum span moment	= 47.1 kNm
	- left support reaction	= 39.4 kN
	- right support reaction	= 51.1 kN

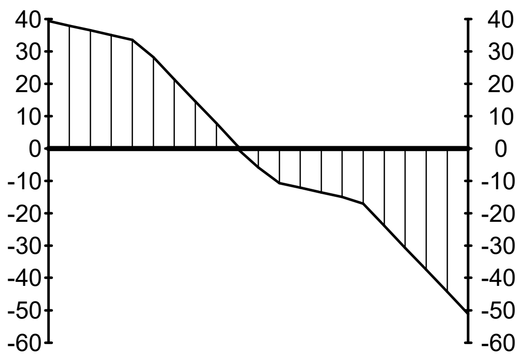
Load Description	**Type**	**A**	**B**	**C**	**Gk**	**Qk**
W1	P_UDL	0.85	1.27		15.8	3.03
W1	P_UDL	2.97	1.02		15.8	3.03
W2	UDL	0	3.99		1.82	2.48
Seld wt	UDL	0	3.99		0.5	0.0

Moment (1.4Gk+1.6Qk) kNm

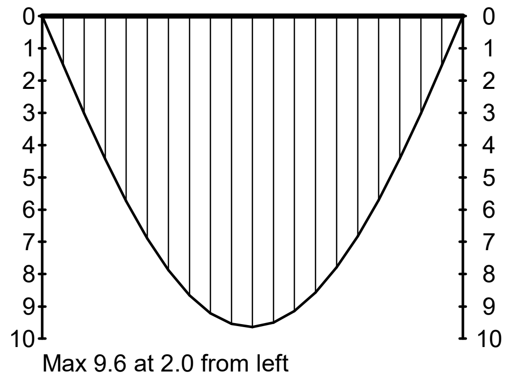


Max 47.1 at 1.8 from left

(39.4) **Shear (1.4Gk+1.6Qk) kN** (-51.1)



Deflection (1.0Gk+1.0Qk) mm



End restraint type: (As defined in Table 13)
Left hand end - Compression flange laterally unrestrained. Both flanges free to rotate on plan. Partial torsional restraint against rotation about longitudinal axis provided only by pressure of bottom flange onto supports.
Right hand end - Compression flange laterally unrestrained. Both flanges free to rotate on plan. Partial torsional restraint against rotation about longitudinal axis provided only by pressure of bottom flange onto supports.

Section unrestrained over its length.

Determine capacity of the section

Shear capacity

In accordance with clause 4.2.3.

P_v = 0.6*py*(D/D+B)*A

hence P_v = $0.6*p_y*(D/(D+B))*A/10^3$ = 779.6 kN

The maximum applied shear force is less than 0.6*Pv, hence section subject to LOW SHEAR.

Moment capacity

The section capacity for low shear in accordance with clause 4.2.5 is

M_{cx} = $p_y*S_{xx}/10^6$ = 121.1 kNm

but limited to M_{cx} = $1.2*p_y*Z_{xx}/10^6$ = 113.3 kNm

Lateral torsional buckling

Determine effective length of beam

Effective length for left hand restraint condition

L_e left = 1.2*span+2*D

where - D = Beam depth
and for the right hand restraint condition

L_e right = 1.2*span+2*D

where - D = Beam depth
the average of this giving the effective length of the beam as

L_e = 5188 mm

The limiting slenderness ratio for an RHS section with a depth to breadth ratio of 2 from table 15 is 340(275/py) = 263.38 .

The actual slenderness ratio 130.352 is not greater than the limiting slenderness ratio and in accordance with clause 4.3.6.1. no check is required for lateral torsional buckling.

Deflection

The maximum deflections for E = 205000 N/mm^2
I_{xx} = 2660 cm^4

for total load δ_{tot} = 9.6 mm
(span / 416)
and for imposed load δ_{imp} = 2.6 mm
(span / 1535)