

Doc Ref: 1966
Date: 30th September 2017
Rev: 0

Client

Site Address

**107 Egerton Road North
Chorlton
Manchester
M21 0SF**

Document Title

Structural Calculations

For

Proposed Extension



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Project **107 Egerton Road North, Chorlton, Manchester, M21 0SF**

Section **Structural Calculations for Proposed Extension**

Job Ref. **1966**



Made by **CB** Checked by _____ Date **Sept 2017** Revision **O** Page No. **02**

Design Philosophy

The existing two storey detached dwelling is of a traditional construction with masonry cavity walls, timber floors and traditional timber roof construction.

The proposed works consist of a two-storey side extension and a single storey extension and some internal alterations.

These calculations confirm the adequacy of the proposed new structural members.

The following British Standard codes of practice have been adhered to for the design calculations: -

BS 648: 1964	Schedule of weights of building materials
BS 6399-1:1996	Loading for Buildings - Part 1: Code of practice for dead and imposed loads.
BS 6399-3:1996	Loading for Buildings - Part 3: Code of practice for imposed roof loads.
BS 5628-1:1992	Code of practice for use of masonry - Part 1: Structural use of unreinforced masonry.
BS 5950-1:2000	Structural use of steelwork in buildings.

All dimensions stated are for the purpose of structural calculations only and are **not** to be used for construction or fabrication.

General Notes

1. All pad stone to be loaded centrally with 10mm thick bearing plates.
 2. All new built masonry (if required) to be bonded into existing to ensure load spread. Building contractor to check capacity of existing foundation and underpin as necessary.
 3. All beams to be strapped to the concrete pad stones and masonry supports with BAT straps plugged and screws at 300mm centres. Straps to be shot fired or welded to beam.
 4. Building contractor to site measure steel lengths prior to order. All dimensions stated in this document are for the purpose of structural calculations only and are **not** to be used for construction or fabrication. However, the design spans quoted in these calculations must **not** be exceeded.
 5. **Building contractor to investigate form of existing construction and subsequently install adequate temporary propping prior to commencement of opening up works.**
 6. All steelwork to be grade S275 JR to BS EN 10025 and hollow sections S355.
 7. All welds to be 6mm continuous fillet welds UNO.
 8. If works commence prior to the approval of the structural design the building contractors proceed at their own risk and the engineer shall not be responsible for any remedial or adjustment.
-

Project **107 Egerton Road North, Chorlton, Manchester, M21 0SF**

Section **Structural Calculations for Proposed Extension**

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Design Loadings

Building construction: -

DL UDL

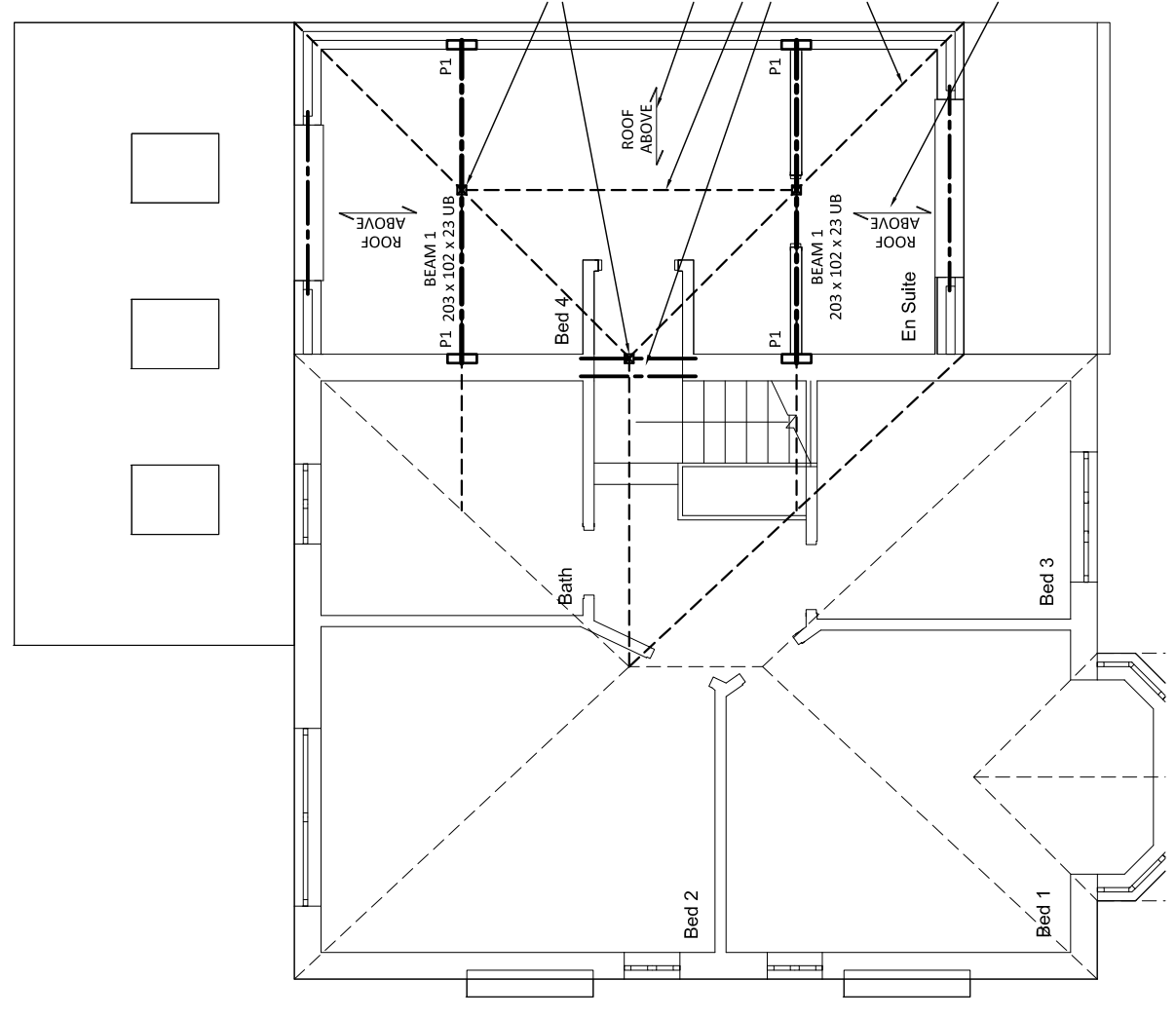
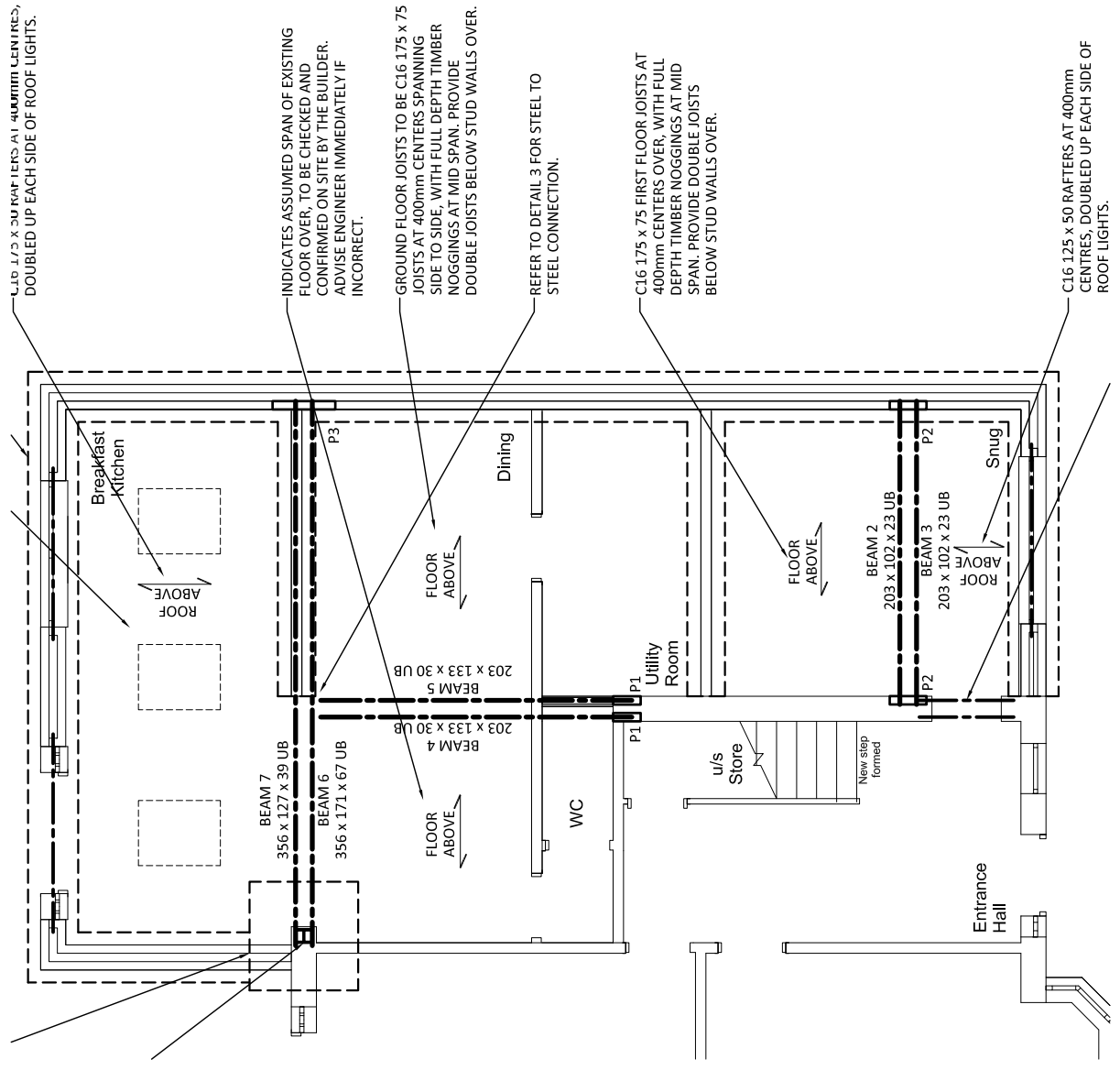
Pitched Roof: -	Tiles, timber battens & felt	= 0.60 kN/m ²	
	Timber rafters & purlins	= 0.15 kN/m ²	
	Ceilings, services & insulation	= 0.20 kN/m ²	
	Total On Slope	= 0.95 kN/m ²	
	Total On Plan (1 / cos 30°)		= 1.20 kN/m²

First Floor: -	Floor boards	= 0.12 kN/m ²	
	Timber joists	= 0.18 kN/m ²	
	Ceilings, services & insulation	= 0.20 kN/m ²	
	Total		= 0.50 kN/m²

Walls: -	Facing Brickwork	= 2.00 kN/m²	
	Brickwork + Plaster x 1	= 2.20 kN/m²	

LL UDL

Pitched Roof: -	Domestic loading	= 0.60 kN/m²	
First Floor: -	Domestic loading	= 1.50 kN/m²	

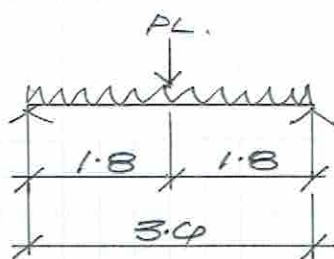


Calculation Sheet

Project Title	10 Egerton Road North, Chorlton, M21 0SF			
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BEAM (B1).



LOADING

LIDL DL ONLY
SW + CASING =

$$\text{SAY} = 0.30 \text{ kN/m}$$

PL.

DL.

ROOF

$$= 1.20 \times 5.4 / 2 \times 3.5 / 2$$

$$= 5.67 \text{ kN}$$

TL

ROOF

$$= 0.60 \times 2.7 \times 1.75$$

$$= 2.83 \text{ kN}$$

ASSUME BEAM UNRESTRAINED

$$L_{EF} = 4.72 \text{ m.}$$

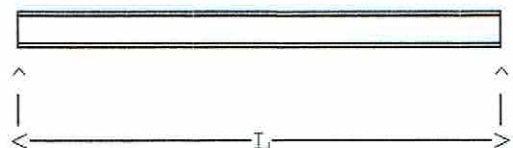
FROM SCALE DRAWING:-

USE 203 x 102 UP 23.

Office: 1367

Location: BEAM <B1>.

Simply supported steel beam



Beam span

 $L=3.6 \text{ m}$

Young's Modulus

 $E=205 \text{ kN/mm}^2$

Dead load factor

 $\gamma_{md}=1.4$

Imposed load factor

 $\gamma_{mi}=1.6$

Distance from left support

 $L_c(1)=1.8 \text{ m}$

Unfactored dead load

 $G_{kc}(1)=5.67 \text{ kN}$

Unfactored imposed load

 $Q_{kc}(1)=2.83 \text{ kN}$

Office: 1367

Dist. from left support to start Lau(1)=0 m
Distance from left support to end Lbu(1)=3.6 m
Unfactored dead load Gku(1)=0.30 kN/m
Unfactored imposed load Qku(1)=0 kN/m
Greatest effective length Le=4.726 m

UNIVERSAL BEAM

203 x 102 x 23 UB Grade 43

DESIGN
SUMMARY

Shear force	6.989 kN
Shear capacity	181.05 kN
Applied moment	11.9 kNm
Moment capacity	64.35 kNm
Buckling resistance	22.611 kNm
Unfactored DL defln	1.4292 mm
Unfactored LL defln	0.63745 mm
Limiting deflection	10 mm
DL shear at LHE	3.375 kN
LL shear at LHE	1.415 kN
DL shear at RHE	3.375 kN
LL shear at RHE	1.415 kN

Unfactored
end shears

No408

Calculation Sheet

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BEAM <B2>

SPAN - 3.0 M.

LOADING (ALLOW 20% WINDOW OPENING OVER)

LIDL DL

$$\begin{aligned}
 \text{MAIN ROOF} &= 1.20 \times 2.2 / 2 \text{ SAY} &= 1.32 \text{ KN/M} \\
 \text{WALL 1st-R} &= 2.0 \times 2.5 \times 80\% &= 4.0 \text{ u} \\
 \text{SW + CASING} &= &\text{SAY} = 0.30 \text{ u} \\
 & &5.62 \text{ KN/M}
 \end{aligned}$$

LIDL IL

$$\text{MAIN ROOF} = 0.60 \times 1.1 = 0.66 \text{ KN/M}$$

ASSUME BEAM UNRESTRAINED. $LEF = 4.720 \text{ M}$

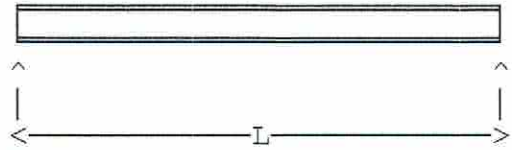
FROM SCALE OUTPUT:-

USE 203 x 102 UB 23.

Office: 1367

Location: BEAM <B2>.

Simply supported steel beam



Beam span

 $L=3.6 \text{ m}$

Young's Modulus

 $E=205 \text{ kN/mm}^2$

Dead load factor

 $\text{gamd}=1.4$

Imposed load factor

 $\text{gami}=1.6$ Dist. from left support to start $\text{Lau}(1)=0 \text{ m}$ Distance from left support to end $\text{Lbu}(1)=3.6 \text{ m}$ Unfactored dead load $\text{Gku}(1)=5.62 \text{ kN/m}$ Unfactored imposed load $\text{Qku}(1)=0.66 \text{ kN/m}$

Office: 1367

Greatest effective length

Le=4.726 m

UNIVERSAL BEAM

203 x 102 x 23 UB Grade 43

DESIGN
SUMMARY

Shear force	16.063 kN
Shear capacity	181.05 kN
Applied moment	14.457 kNm
Moment capacity	64.35 kNm
Buckling resistance	22.611 kNm
Unfactored DL defln	2.8483 mm
Unfactored LL defln	0.33449 mm
Limiting deflection	10 mm
DL shear at LHE	10.116 kN
LL shear at LHE	1.188 kN
DL shear at RHE	10.116 kN
LL shear at RHE	1.188 kN

Unfactored
end shears

[

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Calculation Sheet

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BEAM CB57.

SPAN - 3.4 M.

LOADING (ALLOW 20% WINDOW OPENING OVER)

LIDL DL

$$\text{LOW ROOF} = 1.20 \times 1.2 / 2 = 0.72 \text{ KN/M}$$

$$\text{WALL 1st-R} = 2.2 \times 2.5 \times 80\% = 4.40 \text{ u}$$

$$\text{WINDOW} = 0.55 \times 2.85 \text{ m}^2 \times 1/3.5 = 0.44 \text{ u}$$

$$\text{SW + CASING} = \text{SAY } = 0.30 \text{ u}$$

$$5.80 \text{ KN/M}$$

LIDL IL

$$\text{LOW ROOF} = 0.60 \times 0.4 = 0.24 \text{ KN/M}$$

ASSUME BEAM UNRESTRAINED LEF = 4.720 M

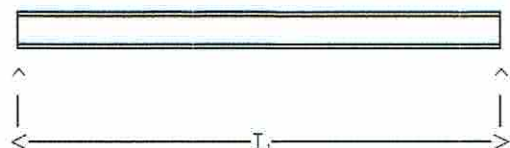
— FROM SCALE OUTPUT:—

USE 203 x 102 L1873.

Office: 1367

Location: BEAM <B3>.

Simply supported steel beam



Beam span

$L=3.6$ m

Young's Modulus

$E=205$ kN/mm²

Dead load factor

$g_{md}=1.4$

Imposed load factor

$g_{mi}=1.6$

Dist. from left support to start $L_{au}(1)=0$ m

Distance from left support to end $L_{bu}(1)=3.6$ m

Unfactored dead load $G_{ku}(1)=5.86$ kN/m

Unfactored imposed load $Q_{ku}(1)=0.36$ kN/m

Greatest effective length		Le=4.726 m	Office: 1367
UNIVERSAL BEAM	203 x 102 x 23 UB Grade 43		
DESIGN	Shear force	15.804 kN	
SUMMARY	Shear capacity	181.05 kN	
	Applied moment	14.224 kNm	
	Moment capacity	64.35 kNm	
	Buckling resistance	22.611 kNm	
	Unfactored DL defln	2.9699 mm	
	Unfactored LL defln	0.18245 mm	
	Limiting deflection	10 mm	
Unfactored end shears	DL shear at LHE	10.548 kN	
	LL shear at LHE	0.648 kN	
	DL shear at RHE	10.548 kN	
	LL shear at RHE	0.648 kN	
			No408

Calculation Sheet



Project Title

10 Egerton Road North, Chorlton, M21 0SF

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Sheet No.

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Checked by

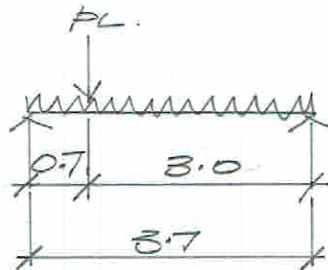
1966

Sep 17

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BEAM <B4>



LOADING

LIDL DL

MAIN ROOF = $1.15 \times 3.2/2$ SAY

= 1.84 kN/m

WALL 1st - R = 2.4×3.0 SAY

= 7.20 u

1st FLR = $0.5 \times 2.7/2$

= 0.67 u

SWT + CASINGT =

SAY = $\frac{0.40 \text{ u}}{10.11 \text{ kN/m}}$

LIDL IL

MAIN ROOF = 0.85×1.4

= 1.30 kN/m

1st FLR = 1.6×1.35

= 2.02 u
3.88 kN/m

PL

STUD WALL = $0.55 \times 3.0 \times 2.7/2$

= 2.22 kN

BEAM RESTRAINED BY FLOOR DIAPHRAGM ACTION

LEF = 3.7m

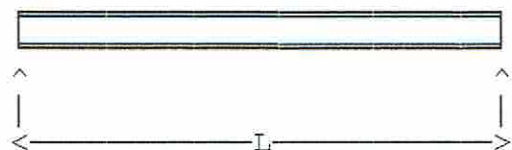
FROM SCALE OUTPUT :-

USE 203x133 LRB 30.

Office: 1367

Location: BEAM <B4>.

Simply supported steel beam



Beam span

$L=3.7$ m

Young's Modulus

$E=205$ kN/mm²

Dead load factor

$g_{md}=1.4$

Imposed load factor

$g_{mi}=1.6$

Distance from left support

$L_c(1)=0.7$ m

Unfactored dead load

$G_{kc}(1)=2.22$ kN

Unfactored imposed load

$Q_{kc}(1)=0$ kN

Office: 1367

Dist. from left support to start Lau(1)=0 m
Distance from left support to end Lbu(1)=3.7 m
Unfactored dead load Gku(1)=10.11 kN/m
Unfactored imposed load Qku(1)=3.38 kN/m
Greatest effective length Le=3.7 m

UNIVERSAL BEAM

203 x 133 x 30 UB Grade 43

DESIGN
SUMMARY

Shear force	38.71 kN
Shear capacity	218.38 kN
Applied moment	34.563 kNm
Moment capacity	86.35 kNm
Buckling resistance	50.468 kNm
Unfactored DL defln	4.369 mm
Unfactored LL defln	1.3893 mm
Limiting deflection	10.278 mm
DL shear at LHE	20.503 kN
LL shear at LHE	6.253 kN
DL shear at RHE	19.124 kN
LL shear at RHE	6.253 kN

Unfactored
end shears

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Calculation Sheet



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BEAM LBS7.

SPAN - 3.7 M.

LOADING.

LIDL DL.

MAIN ROOF	= $1.20 \times 3.4/2$ SAY	= 2.10 kN/m
WALL 1st - R	= 2.4×3.0	= 7.20 u
1st FLR	= $0.50 \times 3.4/2$	= 0.90 u
SXT CASING	=	SAY = 0.40 u
		<u>10.60 kN/m</u>

LIDL IL

MAIN ROOF	= 0.60×1.8	= 1.08 kN/m
1st FLR	= 1.5×1.8	= 2.70 u
		<u>3.78 kN/m</u>

BEAM RESTRAINED BY FLOOR DIAPHRAGM ACTION.
LEF = 3.7m.

FROM SCALE OUTPUT:-

USE 203 x 133 UB 30

Location: BEAM <B5>.

Simply supported steel beam



Beam span

L=3.7 m

Young's Modulus

E=205 kN/mm²

Dead load factor

gamd=1.4

Imposed load factor

gami=1.6

Dist. from left support to start Lau(1)=0 m

Distance from left support to end Lbu(1)=3.7 m

Unfactored dead load Gku(1)=10.66 kN/m

Unfactored imposed load Qku(1)=3.78 kN/m

Office: 1367 2

Greatest effective length

Le=3.7 m

UNIVERSAL BEAM

203 x 133 x 30 UB Grade 43

DESIGN
SUMMARY

Shear force	38.798 kN
Shear capacity	218.38 kN
Applied moment	35.888 kNm
Moment capacity	86.35 kNm
Buckling resistance	50.468 kNm
Unfactored DL defln	4.3818 mm
Unfactored LL defln	1.5538 mm
Limiting deflection	10.278 mm
DL shear at LHE	19.721 kN
LL shear at LHE	6.993 kN
DL shear at RHE	19.721 kN
LL shear at RHE	6.993 kN

Unfactored
end shears

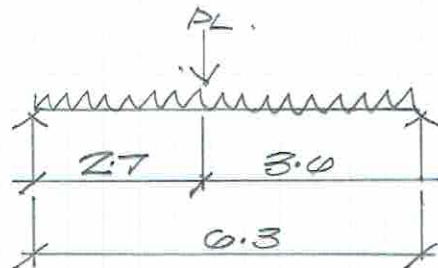
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BEAM <B6>



LOADING (ALLOW 15% WINDOW OPENINGS OVER).

LIDL DL.

$$\text{MAIN ROOF} = 1.20 \times 2.2/2 \text{ SAY} = 1.32 \text{ KN/M}$$

$$\text{WALL 1st-R} = 2.4 \times 2.8 \times 85\% = 5.10 \text{ u}$$

$$\text{SW + CASING} = \text{SAY} = 0.75 \text{ u} \quad 7.17 \text{ KN/M}$$

LIDL IL

$$\text{MAIN ROOF} = 0.60 \times 1.1 = 0.66 \text{ KN/M}$$

PL

$$\text{REACTN <B4> + <B5> DL} = 13.12 + 13.72 = 36.84 \text{ KN}$$

$$\text{RHE IL} = 6.25 + 4.99 = 11.24 \text{ u}$$

BEAM RESTRAINED BY BEAMS <B4> + <B5>

$$\text{LEF} = 4.41 \text{ M.}$$

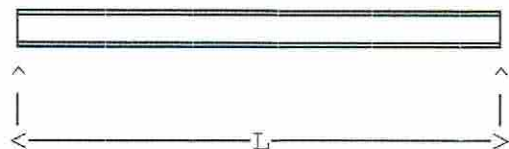
FROM SCALE OUTPUT:-

USE 350x171 UB 67.

Office: 1367

Location: BEAM <B6>.

Simply supported steel beam



Beam span

$L=6.3$ m

Young's Modulus

$E=205$ kN/mm²

Dead load factor

$\gamma_{md}=1.4$

Imposed load factor

$\gamma_{mi}=1.6$

Distance from left support

$L_c(1)=2.7$ m

Unfactored dead load

$G_{kc}(1)=38.84$ kN

Unfactored imposed load

$Q_{kc}(1)=13.24$ kN

Office: 1367

Dist. from left support to start Lau(1)=0 m
 Distance from left support to end Lbu(1)=6.3 m
 Unfactored dead load Gku(1)=7.17 kN/m
 Unfactored imposed load Qku(1)=0.66 kN/m
 Greatest effective length Le=4.41 m

UNIVERSAL BEAM

356 x 171 x 67 UB Grade 43

DESIGN

Shear force 78.123 kN

SUMMARY

Shear capacity 545.65 kN

Applied moment 166.7 kNm

Moment capacity 333.03 kNm

Buckling resistance 194.36 kNm

Unfactored DL defln 8.6105 mm

Unfactored LL defln 2.0179 mm

Limiting deflection 17.5 mm

Unfactored end shears	[	DL shear at LHE	44.78 kN
		LL shear at LHE	9.6447 kN
		DL shear at RHE	39.231 kN
		LL shear at RHE	7.7533 kN

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Calculation Sheet



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BEAM CB77

SPAN = 4.3 M.

LOADING (ALLOW 15% WINDOW OPENINGS OVER)

LDL DL

LOW ROOF	$= 1.20 \times 2.7/2$	$= 1.62 \text{ KN/M}$
WALL 1st-R	$= 2.2 \times 2.5 \times 85\%$	$= 4.67 \text{ u}$
WINDOWS	$= 0.55 \times 3.5 \text{ m}^2 \times 1/0.5$	$= 0.29 \text{ u}$
SW + CASING	$=$	SAY $= 0.75 \text{ u}$
		<u>7.33 KN/M</u>

LDL FU

LOW ROOF	$= 0.60 \times 1.35$	$= 0.81 \text{ KN/M}$
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ASSUME BEAM UNRESTRAINED.

$$L_{EF} = 8.272 \text{ M.}$$

FROM SCALE OUTPUT :-

USE 350x171 UB 51.



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Cheadle, Cheshire
SK8 1PY

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Calcs for

Beam 7

Start page no./Revision

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01/10/2017

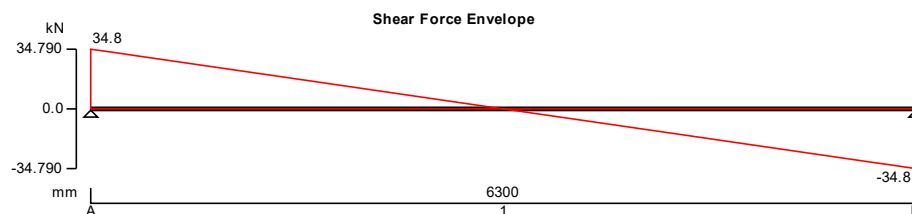
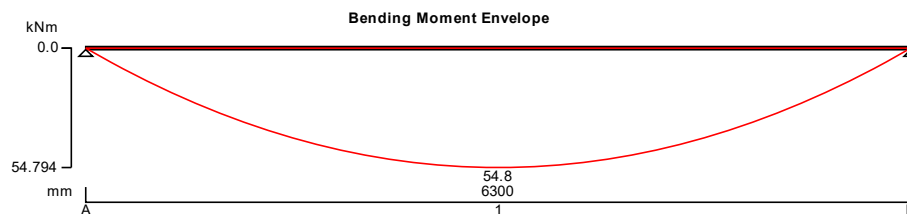
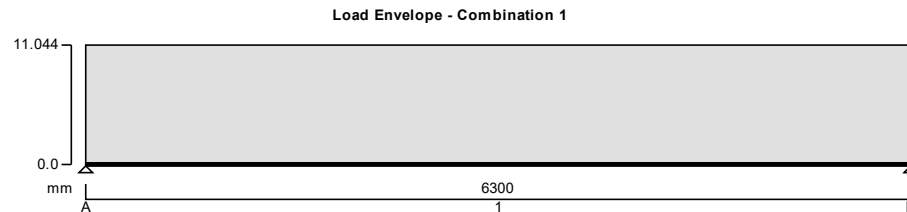
Approved by

Approved date

STEEL BEAM ANALYSIS & DESIGN (BS5950)

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

TEDDS calculation version 3.0.05



Support conditions

Support A

Vertically restrained

Rotationally free

Support B

Vertically restrained

Rotationally free

Applied loading

Beam loads

Dead self weight of beam $\times 1$

Dead full UDL 6.58 kN/m

Imposed full UDL 0.81 kN/m

Load combinations

Load combination 1

Support A

Dead $\times 1.40$

Imposed $\times 1.60$



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Span 1

Dead $\times$ 1.40

Imposed $\times$ 1.60

Support B

Dead $\times$ 1.40

Imposed $\times$ 1.60

Analysis results

Maximum moment

$M_{\max} = 54.8 \text{ kNm}$

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

Maximum moment span 1 segment 1

$M_{s1_seg1_max} = 54.8 \text{ kNm}$

$M_{s1_seg1_min} = 0 \text{ kNm}$

Maximum moment span 1 segment 2

$M_{s1_seg2_max} = 54.8 \text{ kNm}$

$M_{s1_seg2_min} = 0 \text{ kNm}$

Maximum shear

$V_{\max} = 34.8 \text{ kN}$

$V_{\min} = -34.8 \text{ kN}$

Maximum shear span 1 segment 1

$V_{s1_seg1_max} = 34.8 \text{ kN}$

$V_{s1_seg1_min} = 0 \text{ kN}$

Maximum shear span 1 segment 2

$V_{s1_seg2_max} = 0 \text{ kN}$

$V_{s1_seg2_min} = -34.8 \text{ kN}$

Deflection segment 3

$\delta_{\max} = 7.6 \text{ mm}$

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

Maximum reaction at support A

$R_{A_max} = 34.8 \text{ kN}$

$R_{A_min} = 34.8 \text{ kN}$

Unfactored dead load reaction at support A

$R_{A_Dead} = 21.9 \text{ kN}$

Unfactored imposed load reaction at support A

$R_{A_Imposed} = 2.6 \text{ kN}$

Maximum reaction at support B

$R_{B_max} = 34.8 \text{ kN}$

$R_{B_min} = 34.8 \text{ kN}$

Unfactored dead load reaction at support B

$R_{B_Dead} = 21.9 \text{ kN}$

Unfactored imposed load reaction at support B

$R_{B_Imposed} = 2.6 \text{ kN}$

Section details

Section type

UKB 356x127x39 (Tata Steel Advance)

Steel grade

S275

From table 9: Design strength p_y

Thickness of element

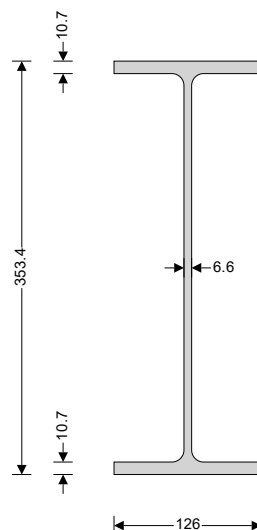
$\max(T, t) = 10.7 \text{ mm}$

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 plus midspan

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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 $d = 311.6 \text{ mm}$
 $d / t = 47.2 \times \varepsilon \leq 80 \times \varepsilon$ Class 1 plastic

Outstand flanges - Table 11

Width of section $b = B / 2 = 63 \text{ mm}$
 $b / T = 5.9 \times \varepsilon \leq 9 \times \varepsilon$ Class 1 plastic
Section is class 1 plastic

Shear capacity - Section 4.2.3

Design shear force $F_v = \max(\text{abs}(V_{\max}), \text{abs}(V_{\min})) = 34.8 \text{ kN}$
 $d / t < 70 \times \varepsilon$

Web does not need to be checked for shear buckling

Shear area $A_v = t \times D = 2332 \text{ mm}^2$
Design shear resistance $P_v = 0.6 \times p_y \times A_v = 384.9 \text{ kN}$

PASS - Design shear resistance exceeds design shear force

Moment capacity at span 1 segment 1 - Section 4.2.5

Design bending moment $M = \max(\text{abs}(M_{s1_seg1_max}), \text{abs}(M_{s1_seg1_min})) = 54.8 \text{ kNm}$
Moment capacity low shear - cl.4.2.5.2 $M_c = \min(p_y \times S_{xx}, 1.2 \times p_y \times Z_{xx}) = 181.1 \text{ kNm}$

Effective length for lateral-torsional buckling - Section 4.3.5

Effective length for lateral torsional buckling $L_E = 1.0 \times L_{s1_seg1} = 3150 \text{ mm}$
Slenderness ratio $\lambda = L_E / r_{yy} = 117.475$

Equivalent slenderness - Section 4.3.6.7

Buckling parameter $u = 0.871$
Torsional index $x = 35.217$
Slenderness factor $v = 1 / [1 + 0.05 \times (\lambda / x)^2]^{0.25} = 0.895$
Ratio - cl.4.3.6.9 $\beta_w = 1.000$
Equivalent slenderness - cl.4.3.6.7 $\lambda_{LT} = u \times v \times \lambda \times \sqrt{\beta_w} = 91.600$
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 $\eta_{LT} = \max(\alpha_{LT} \times (\lambda_{LT} - \lambda_{L0}) / 1000, 0) = 0.401$
Euler stress $p_E = \pi^2 \times E / \lambda_{LT}^2 = 241.1 \text{ N/mm}^2$
 $\phi_{LT} = (p_y + (\eta_{LT} + 1) \times p_E) / 2 = 306.4 \text{ N/mm}^2$
Bending strength - Annex B.2.1 $p_b = p_E \times p_y / (\phi_{LT} + (\phi_{LT}^2 - p_E \times p_y)^{0.5}) = 140.3 \text{ N/mm}^2$

 Brennan Consult Ltd Oak House, 2 Gatley Road Cheadle, Cheshire SK8 1PY	Project 107 Egerton Road North, Chorlton, Manchester, M21 0SF				Job no. 1966	
	Calcs for Beam 7				Start page no./Revision 4	
	Calcs by CB	Calcs date 01/10/2017	Checked by CB	Checked date 01/10/2017	Approved by	Approved date

Equivalent uniform moment factor - Section 4.3.6.6

Moment at quarter point of segment $M_2 = 24$ kNm

Moment at centre-line of segment $M_3 = 41.1$ kNm

Moment at three quarter point of segment $M_4 = 51.4$ kNm

Maximum moment in segment $M_{abs} = 54.8$ kNm

Maximum moment governing buckling resistance $M_{LT} = M_{abs} = 54.8$ kNm

Equivalent uniform moment factor for lateral-torsional buckling

$$m_{LT} = \max(0.2 + (0.15 \times M_2 + 0.5 \times M_3 + 0.15 \times M_4) / M_{abs}, 0.44) = 0.781$$

Buckling resistance moment - Section 4.3.6.4

Buckling resistance moment $M_b = p_b \times S_{xx} = 92.4$ kNm

$$M_b / m_{LT} = 118.3 \text{ kNm}$$

PASS - Buckling resistance moment exceeds design bending moment

Check vertical deflection - Section 2.5.2

Consider deflection due to dead and imposed loads

Limiting deflection $\delta_{lim} = L_{s1} / 360 = 17.5$ mm

Maximum deflection span 1 $\delta = \max(\text{abs}(\delta_{max}), \text{abs}(\delta_{min})) = 7.646$ mm

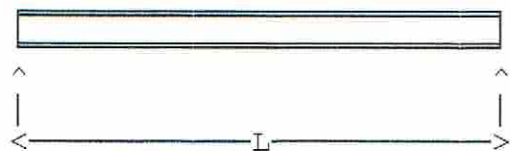
PASS - Maximum deflection does not exceed deflection limit

Location: BEAM <B9>.

TO CALCULATE REACTIONS ONLY.

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Simply supported steel beam



Beam span

L=3.5 m

Young's Modulus

E=205 kN/mm²

Dead load factor

gamd=1.4

Imposed load factor

gami=1.6

Distance from left support

Lc(1)=1.4 m

Unfactored dead load

Gkc(1)=1.24 kN

Unfactored imposed load

Qkc(1)=0.90 kN

Distance from left support

Lc(2)=2.1 m

Unfactored dead load

Gkc(2)=2.44 kN

Unfactored imposed load

Qkc(2)=0.76 kN

Distance from left support

Lc(3)=2.9 m

Unfactored dead load

Gkc(3)=1.73 kN

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Unfactored imposed load	Qkc(3)=1.28 kN
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=3.5 m
Unfactored dead load	Gku(1)=2.0 kN/m
Unfactored imposed load	Qku(1)=0 kN/m
Dist. from left support to start	Lau(2)=0 m
Distance from left support to end	Lbu(2)=1.4 m
Unfactored dead load	Gku(2)=0.45 kN/m
Unfactored imposed load	Qku(2)=0.42 kN/m
Dist. from left support to start	Lau(3)=1.4 m
Distance from left support to end	Lbu(3)=2.9 m
Unfactored dead load	Gku(3)=1.26 kN/m
Unfactored imposed load	Qku(3)=1.17 kN/m
Dist. from left support to start	Lau(4)=2.9 m
Distance from left support to end	Lbu(4)=3.5 m
Unfactored dead load	Gku(4)=0.45 kN/m
Unfactored imposed load	Qku(4)=0.42 kN/m

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UNIVERSAL BEAM

203 x 133 x 30 UB Grade 43

DESIGN
SUMMARY

Shear force	17.082 kN
Shear capacity	218.38 kN
Applied moment	15.573 kNm
Moment capacity	86.35 kNm
Unfactored DL defln	1.6143 mm
Unfactored LL defln	0.61426 mm
Limiting deflection	9.7222 mm
DL shear at LHE	6.7727 kN
LL shear at LHE	2.2324 kN
DL shear at RHE	8.4273 kN
LL shear at RHE	3.3026 kN

Unfactored
end shears

No408