

## **MasterSeries – MasterPort Lite** **Sample Output**

The following output is from the MasterPort Lite Design program.

### **Contents**

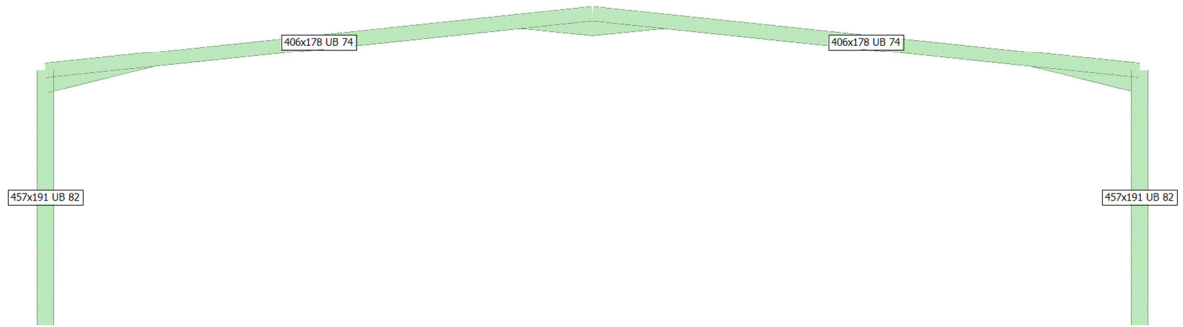
- 2 Frame Geometry and Loading
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- 4 Bending Moment and Deflection Diagrams
- 5 Column Design to EC
- 6 Rafter Design to EC

# MasterSeries Sample Output

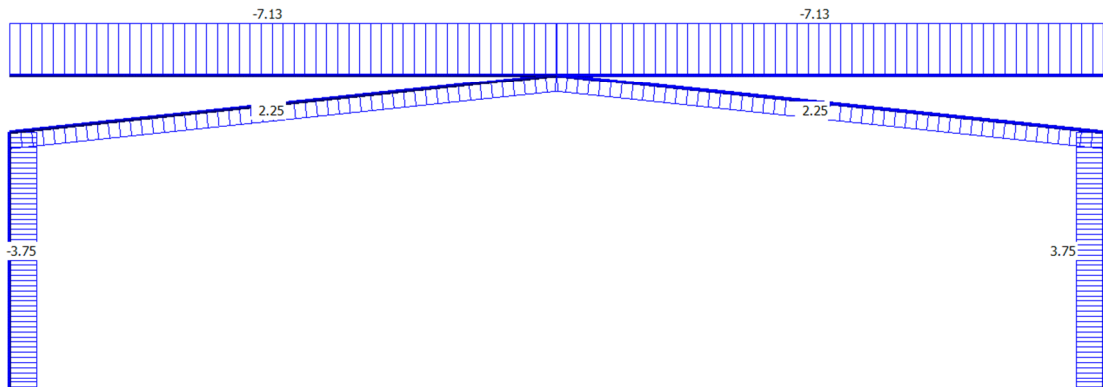
3 Castle Street  
Carrickfergus  
County Antrim BT38 7BE

Tel: 028 9036 5950

Job ref : Single Bay Portal  
Sheet : Calcs / 2 -  
Made By : GHB  
Date : 21 June 2015/ Version 2017.11  
Checked : ATW  
Approved : MOG



**Frame Geometry - (Full Frame) - Front View**



**Load Diagram - 006 : Dead Plus Live Plus Wind On Gable (Ultimate) - All Groups  
Frame Geometry - (Full Frame) - Front View**

# MasterSeries Sample Output

3 Castle Street  
 Carrickfergus  
 County Antrim BT38 7BE  
  
 Tel: 028 9036 5950

Job ref : Single Bay Portal  
 Sheet : Calcs / 3 -  
 Made By : GHB  
 Date : 21 June 2015/ Version 2017.11  
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### Member Forces Ultimate (001 : 1.25 (Dead+Services) + 1.5 Live)

Load Case No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kNm)	Maximum Moment (kNm @m)	Maximum Deflection (mm@m)
1	5	114.601C	146.239	-690.802	339.341	55.236
	7	98.146C	-10.316	334.235	@ 14.027	@ 10.407
2	6	114.601C	146.239	-690.802	339.341	55.236
	7	98.146C	-10.316	334.235	@ 14.027	@ 10.407
3	1	164.578C	-98.686	0.000		27.568
	3	158.115C	-98.686	-634.156		@ 4.048
4	2	164.578C	-98.686	0.000		27.568
	4	158.115C	-98.686	-634.156		@ 4.048
5	3	158.115C	-98.686	-634.156		27.568
	5	157.417C	-98.686	-690.802		@ 4.048
6	4	158.115C	-98.686	-634.156		27.568
	6	157.417C	-98.686	-690.802		@ 4.048

### Member Forces Ultimate (006 : Dead Plus Live Plus Wind On Gable (Ultimate))

Load Case No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kNm)	Maximum Moment (kNm @m)	Maximum Deflection (mm@m)
1	5	51.830C	82.702	-392.181	201.946	32.513
	7	39.138C	-4.114	200.480	@ 14.329	@ 10.407
2	6	51.830C	82.702	-392.181	201.946	32.513
	7	39.138C	-4.114	200.480	@ 14.329	@ 10.407
3	1	94.828C	-69.151	0.000		17.119
	3	88.365C	-45.053	-366.937		@ 3.984
4	2	94.828C	-69.151	0.000		17.119
	4	88.365C	-45.053	-366.937		@ 3.984
5	3	88.365C	-45.053	-366.937		17.119
	5	87.667C	-42.901	-392.181		@ 3.984
6	4	88.365C	-45.053	-366.937		17.119
	6	87.667C	-42.901	-392.181		@ 3.984

### Support Reactions Serviceability (002 : Dead + Services + Live (Service))

Node	Node0			Node	Node0		
	Rx → (kN)	Ry ↑ (kN)	Mz ↗ (kNm)		Rx → (kN)	Ry ↑ (kN)	Mz ↗ (kNm)
1	82.254	120.862	-73.145	2	-82.254	120.862	73.145
Total	0.000	241.725	0.000				

### Support Reactions Serviceability (007 : Dead Plus Live Plus Wind On Gable (Serviceability))

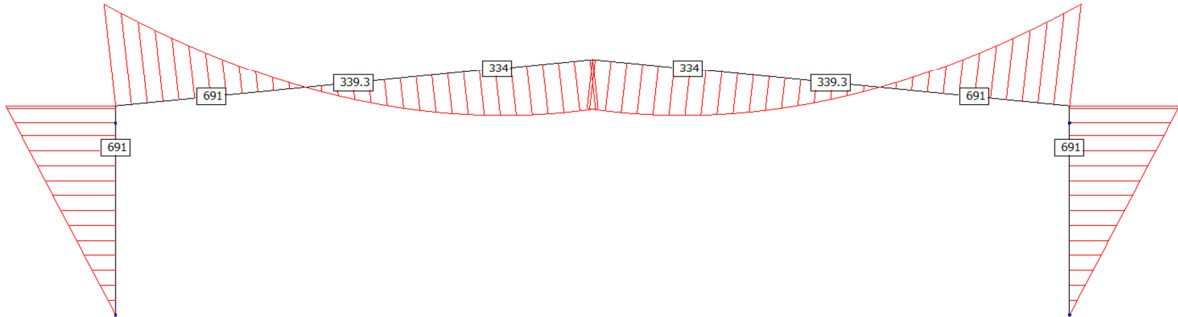
Node	Node0			Node	Node0		
	Rx → (kN)	Ry ↑ (kN)	Mz ↗ (kNm)		Rx → (kN)	Ry ↑ (kN)	Mz ↗ (kNm)
1	62.201	75.862	-49.970	2	-62.201	75.862	49.970
Total	0.000	151.725	0.000				

# MasterSeries Sample Output

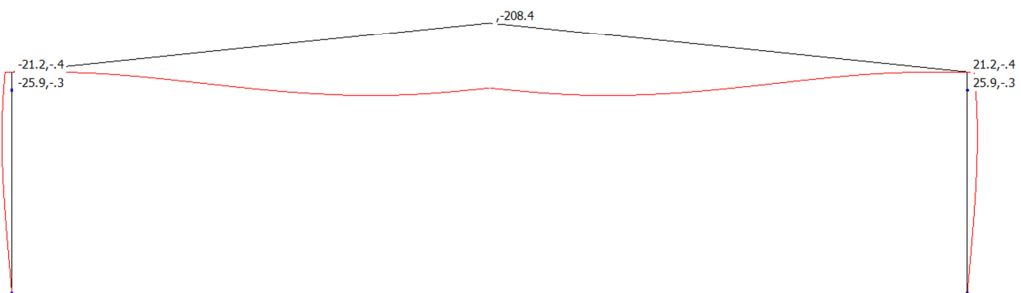
3 Castle Street  
Carrickfergus  
County Antrim BT38 7BE

Tel: 028 9036 5950

Job ref : Single Bay Portal  
Sheet : Calcs / 4 -  
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**Load Case 001 : 1.25 (Dead+Services) + 1.5 Live  
Bending Moment Diagram (Major Axis) - (Full Frame) - Front View**



**Load Case 002 : Dead + Services + Live (Service)  
Deflected Shape - (Full Frame) - Front View**

# MasterSeries Sample Output

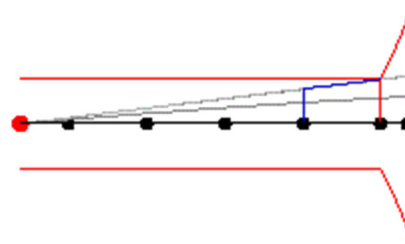
3 Castle Street  
 Carrickfergus  
 County Antrim BT38 7BE  
  
 Tel: 028 9036 5950

Job ref : Single Bay Portal  
 Sheet : Calcs / 5 -  
 Made By : GHB  
 Date : 21 June 2015/ Version 2017.11  
 Checked : ATW  
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## AXIAL WITH MOMENTS (MEMBER) Column 1 : Members 3 & 5 (N.1-N.5) Between 5.050 and 6.426 m, in Load Case 1

Member Loading and Member Forces  
 Loading Combination : 1 UT + 1.25 D1 + 1.25 D2 + 1.5 L1

UT Spacing 06.000 [Multiply AllLoads]  
 UT PartFix 20.00 +++ --- (Mt My Mz)



Member Forces in Load Case 1 and Maximum Deflection from Load Case 2						
Member No.	Node End 1 End 2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kNm)	Maximum Moment (kNm)	Maximum Deflection (mm @ m)
	1	164.578C	-98.686	0.000		17.328
	5	157.417C	-98.686	-690.802		@ 4.177

### Classification and Effective Area (EN 1993: 2006)

Section (82.02 kg/m) 457x191 UB 82 [S 355]  
 Class =  $F_n(b/T, d/t, f_y, N, M_y, M_z)$  5.98, 41.17, 355, 164.58, 690.8, 0 (Axial: Non-Slender) Class 1  
 Auto Design Load Cases 1 & 5-6

### Local Capacity Check

$V_{y,Ed}/V_{pl,y,Rd}$  98.686 / 986.1 = 0.1 Low Shear  
 $M_{c,y,Rd} = f_y \cdot W_{pl,y} / \gamma_{M0}$  355 x 1831.3/1 650.112 kN.m  
 $N_{pl,Rd} = A_g \cdot f_y / \gamma_{M0}$  104.48 x 355/1 = 3709.04 kN  
 $n = N_{Ed}/N_{pl,Rd}$  157.417 / 3709.04 = 0.042 OK  
 $W_{pl,N,y} = F_n(W_{pl,y}, A_{v,y})$  1831.3, 48.112, 0.042 1831.3 cm<sup>3</sup>  
 $M_{N,y,Rd} = W_{pl,N,y} \cdot f_y / \gamma_{M0}$  1831.3 x 355/1 650.112 kN.m  
 $(M_{y,Ed}/M_{N,y,Rd} + (M_{z,Ed}/M_{N,z,Rd}))^2 + (0)^2 = 0.952$  OK

### Compression Resistance N.b.Rd

$\lambda_y = \sqrt{A \cdot f_y / N_{cr}}$   $\sqrt{104.48 \times 355 / 15673.3}$  0.487  
 $N_{b,y,Rd} = A_{eff} \cdot c \cdot f_y / \gamma_{M1}$  104.48 x 0.928 x 355 / 10/1 = 3443.490 kN Curve a  
 $\lambda_z = \sqrt{A \cdot f_y / N_{crz}}$   $\sqrt{104.48 \times 355 / 20510.79}$  0.426  
 $N_{b,z,Rd} = A_{eff} \cdot c \cdot f_y / \gamma_{M1}$  104.48 x 0.916 x 355 / 10/1 = 3396.493 kN Curve b  
 $Let = K_t \cdot L_x$  1 x 7 = 7  
 $\lambda_T = \sqrt{A \cdot f_y / N_{crT}}$   $\sqrt{104.48 \times 355 / 2545.78}$  1.207  
 $N_{b,T,Rd} = A_{eff} \cdot c \cdot f_y / \gamma_{M1}$  104.48 x 0.474 x 355 / 10/1 = 1759.280 kN Curve b

### Equivalent Uniform Moment Factor C1

$C_1 = f_n(M_1, M_2, \sim y)$  -498.5, -634.1, 0.786 1.110 Not Loaded  
 $C_{mLT} = \text{Max}(0.6 + 0.4 \sim y, 0.4)$   $M = -634.07, \sim y = 0.786$  0.914 Table B.3  
 $C_{mz} = \text{Max}(0.6 + 0.4 \sim y, 0.4)$   $M = 0, \sim y = 1.000$  1 Table B.3  
 $C_{my} = \text{Max}(0.6 + 0.4 \sim y, 0.4)$   $M = -690.8, \sim y = 0.000$  0.6 Table B.3

### Lateral Buckling Check M.b.Rd

$Le = 1.00 L$  1 x 1.376 = 1.376 m  
 $M_{cr} = F_n(C_1, Le, I_z, I_y, I_w, E)$  1.110, 1.376, 1874, 69.21, 0.9201, 210000 5182.951 kN.m  
 $\lambda_{LT} = \sqrt{W_{pl,y} / M_{cr}}$   $\sqrt{1831.3 \times 355 / 5182.951}$  0.354  
 $C_{LT} = F_n(\lambda_{LT}, \lambda_{LT5950})$  0.354, 0.369 1.000 Curve d  
 $C_{LT,mod} = F_n(C_{LT}, \lambda_{LT}, k_c, f)$  1.000, 0.354, 0.756, 0.882 1.000 6.3.2.3  
 $M_{b,Rd} = C \cdot W_{pl,y} \cdot f_y \leq M_{c,y,Rd}$  1.000 x 1831 x 355  $\leq$  650.112 = 650.112 kN.m

### Buckling Resistance

$U_{N,y} = N_{Ed} / (C_y \cdot N_{Rk} / \gamma_{M1})$  164.578 / 3443.49 0.048 OK  
 $U_{N,z} = N_{Ed} / (C_z \cdot N_{Rk} / \gamma_{M1})$  164.578 / 3396.493 0.048 OK  
 $U_{M,y} = M_{y,Ed} / (C_{LT} \cdot M_{y,Rk} / \gamma_{M1})$  634.155 / 650.112 0.975 OK  
 $U_{M,z} = M_{z,Ed} / (M_{z,Rk} / \gamma_{M1})$  0 / 107.885 0.000 OK

<b>MasterSeries Sample Output</b> 3 Castle Street Carrickfergus County Antrim BT38 7BE  Tel: 028 9036 5950	Job ref : Single Bay Portal Sheet : Calcs / 6 - Made By : GHB Date : 21 June 2015/ Version 2017.11 Checked : ATW Approved : MOG
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$k_y y = C_{my} \{1 + (\lambda_y - 0.2) U_{N,y}\}$	0.608	
$k_z z = C_{mz} \{1 + (2\lambda_z - 0.6) U_{N,z}\}$	1.012	
$k_y z = 0.6 k_z z$	0.607	
$k_z y = 0.6 k_y y$	0.365	
$U_{N,y} + k_y y \cdot U_{M,y} + k_y z \cdot U_{M,z}$	0.048 + 0.608 x 0.975 + 0.607 x 0.000	0.641 OK
$U_{N,z} + k_z y \cdot U_{M,y} + k_z z \cdot U_{M,z}$	0.048 + 0.365 x 0.975 + 1.012 x 0.000	0.404 OK

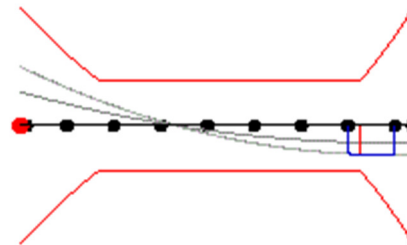
**Deflection Check - Load Case 2**

In-span $\delta \leq \text{Span}/360$	$17.33 \leq 7000 / 360$	17.33 mm	OK
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**AXIAL WITH MOMENTS (MEMBER)**  
**Rafter 1 of Bay 1 : Member 1 (N.5-N.7)**  
**Between 12.600 and 14.400 m, in Load Case 5**

Member Loading and Member Forces  
 Loading Combination : 1 UT + 1.25 D1 + 1.25 D2 + 1.5 L1

UT Spacing 06.000 [Multiply AllLoads]  
 D1 UDLY -000.350 [ kN/m ]  
 D2 UDLY -000.200 [ kN/m ]  
 L1 UDLY -000.600 [ kN/m ]



Member Forces in Load Case 5 and Maximum Deflection from Load Case 2						
Member No.	Node End 1 / End 2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kNm)	Maximum Moment (kNm)	Maximum Deflection (mm @ m)
1	5	114.175C	145.865	-685.168	339.733	37.796
	7	97.720C	-10.690	334.232	@ 14.027	@ 10.407

**Classification and Effective Area (EN 1993: 2006)**

Section (74.18 kg/m) 406x178 UB 74 [S 355]  
 Class =  $f_n(b/t, d/t, f_y, N, M_y, M_z)$  5.61, 37.94, 355, 114.17, 685.17, 0 (Axial: Non-Slender) Class 1  
 Auto Design Load Cases 1 & 5-6

**Local Capacity Check**

$V_{y,Ed}/V_{pl,y,Rd}$	10.07 / 857.632 =	0.012	Low Shear
$M_{c,y,Rd} = f_y \cdot W_{pl,y} / \gamma_{M0}$	355 x 1500.8/1	532.784 kN.m	
$N_{pl,Rd} = A_g \cdot f_y / \gamma_{M0}$	94.5 x 355/1 =	3354.75 kN	
$n = N_{Ed}/N_{pl,Rd}$	97.72 / 3354.75 =	0.029	OK
$W_{pl,N,y} = F_n(W_{pl,y,r}, A_{v,y,r})$	1500.8, 41.844, 0.029	1500.8 cm <sup>3</sup>	
$M_{N,y,Rd} = W_{pl,N,y} \cdot f_y / \gamma_{M0}$	1500.8 x 355/1	532.784 kN.m	
$(M_{y,Ed}/M_{N,y,Rd} + (M_{z,Ed}/M_{N,z,Rd}))$	$(334.828/532.784)^2 + (0)^2 =$	0.395	OK

**Compression Resistance N.b.Rd**

$\lambda_y = \sqrt{A \cdot f_y / N_{cr}}$	$\sqrt{94.5 \times 355 / 2488.18}$	1.161	
$N_{b,y,Rd} = \text{Area} \cdot c \cdot f_y / \gamma_{M1}$	$94.5 \times 0.555 \times 355 / 10/1 =$	1861.847 kN	Curve a
$\lambda_z = \sqrt{A \cdot f_y / N_{crz}}$	$\sqrt{94.5 \times 355 / 9886.52}$	0.583	
$N_{b,z,Rd} = \text{Area} \cdot c \cdot f_y / \gamma_{M1}$	$94.5 \times 0.846 \times 355 / 10/1 =$	2837.235 kN	Curve b
Let = $K_t \cdot L_x$	$1 \times 15.083 =$	15.083	
$\lambda_T = \sqrt{A \cdot f_y / N_{crT}}$	$\sqrt{94.5 \times 355 / 1841.4}$	1.35	
$N_{b,T,Rd} = \text{Area} \cdot c \cdot f_y / \gamma_{M1}$	$94.5 \times 0.404 \times 355 / 10/1 =$	1354.161 kN	Curve b

**Equivalent Uniform Moment Factor C1**

$C_1 = f_n(M_1, M_2, \sim y)$	328.8, 339.1, 0.970	1.014	Not Loaded
$C_{mLT} = \text{Max}(0.6 + 0.4 \sim y, 0.4)$	$M = 339.11, \sim y = 0.970$	1	Table B.3
$C_{mz} = \text{Max}(0.6 + 0.4 \sim y, 0.4)$	$M = 0, \sim y = 1.000$	1	Table B.3
$C_{my} = \text{Max}(0.1(1 - \sim y) - 0.8 a_s, 0.4)$	$M_h = -685.17, M_s = 119.64, \sim y = -0.488, a_s = -0.175$	0.4	Table B.3

**Lateral Buckling Check M.b.Rd**

$l_e = 1.00 L$	$1 \times 1.8 =$	1.8 m
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<b>MasterSeries Sample Output</b> 3 Castle Street Carrickfergus County Antrim BT38 7BE  Tel: 028 9036 5950	Job ref : Single Bay Portal Sheet : Calcs / 7 - Made By : GHB Date : 21 June 2015/ Version 2017.11 Checked : ATW Approved : MOG
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$M_{cr} = F_n(C_1, L_e, I_z, I_t, I_w, E)$	1.014, 1.800, 1546, 62.77, 0.6071, 210000	2112.568 kN.m	
$\lambda_{LT} = \sqrt{W_{pl,y}/M_{cr}}$	$\sqrt{1500.8 \times 355 / 2112.568}$	0.502	
$C_{LT} = F_n(\lambda_{LT}, \lambda_{LT,5950})$	0.502, 0.498	0.883	Curve b
$C_{LT,mod} = F_n(C_{LT}, \lambda_{LT}, k_c, f)$	0.883, 0.502, 0.809, 0.934	0.883	6.3.2.3
$M_{b,Rd} = C W_{pl,y} \cdot f_y \leq M_{c,y,Rd}$	$0.883 \times 1501 \times 355 \leq 532.784 =$	470.578 kN.m	

**Buckling Resistance**

$U_{N,y} = N_{Ed}/(C_y \cdot N_{Rk}/\gamma_{M1})$	114.175 / 1861.847	0.061	OK
$U_{N,z} = N_{Ed}/(C_z \cdot N_{Rk}/\gamma_{M1})$	114.175 / 2837.235	0.040	OK
$U_{M,y} = M_{y,Ed}/(C_{LT} \cdot M_{y,Rk}/\gamma_{M1})$	334.828 / 470.578	0.712	OK
$U_{M,z} = M_{z,Ed}/(M_{z,Rk}/\gamma_{M1})$	0 / 94.785	0.000	OK
$k_y = C_{my} \{1 + 0.8 U_{N,y}\}$		0.420	
$k_z = C_{mz} \{1 + (2\lambda_z - 0.6) U_{N,z}\}$		1.023	
$k_y z = 0.6 k_z z$		0.614	
$k_z y = 1 - \{0.1 / (C_{mLT} - 0.25)\} U_{N,z}$		0.995	
$U_{Ny} + k_y y \cdot U_{M,y} + k_y z \cdot U_{M,z}$	$0.061 + 0.420 \times 0.712 + 0.614 \times 0.000$	0.360	OK
$U_{Nz} + k_z y \cdot U_{M,y} + k_z z \cdot U_{M,z}$	$0.040 + 0.995 \times 0.712 + 1.023 \times 0.000$	0.748	OK

**Deflection Check - Load Case 2**

In-span $\delta \leq \text{Span}/360$	$37.8 \leq 15083 / 360$	37.8 mm	OK
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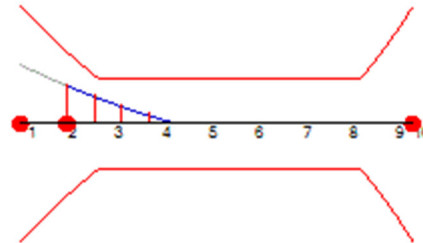
**APPENDIX-BB STABILITY (MEMBER) :**  
**Rafter 1 of Bay 1 : Member 1 (N.5-N.7)**  
**Between 1.800 and 6.003 m, in Load Case 1**

Member Loading and Member Forces  
 Loading Combination : 1 UT + 1.25 D1 + 1.25 D2 + 1.5 L1

UT Spacing 06.000 [Multiply AllLoads]  
 D1 UDLY -000.350 [kN/m]  
 D2 UDLY -000.200 [kN/m]  
 L1 UDLY -000.600 [kN/m]

Lateral and Torsional Restraints  
 Purlins @ 1.8, 3.6, 5.4, 7.2, 9, 10.8, 12.6, 14.4 and 15.083 m

Stays @ 1.8 and 15.083 m



**Member Forces in Load Case 1**

Member No.	Node End 1 / End 2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kNm)	Maximum Moment (kNm)	Maximum Deflection (mm @ m)
1	5	114.601C	146.239	-690.802	339.341	0.000
	7	98.146C	-10.316	334.235	@ 14.027	@ 10.407

**Classification and Effective Area (EN 1993: 2006)**

Section (74.18 kg/m) 406x178 UB 74 [S 355]  
 Class =  $F_n(b/T, d/t, f_y, N, M_y, M_z)$  5.61, 37.94, 355, 114.6, 690.8, 0 (Axial: Non-Slender) Class 1

Auto Design Load Cases 1 & 5-6

**Tension Side Lateral Restraint Spacing Check, Lm**

$L_m = f_n(N_{Ed}, A, C_1, W_{pl,y}, I_T)$  114.6, 94.5, 1.28, 1500.8, 62.8 1.614m  
 $L_m < s$  1.614 < 1.800 - Effect of tension side lateral restraints ignored

**Compression Resistance N.b.Rd**

$\lambda_z = \sqrt{A \cdot f_y / N_{crz}}$   $\sqrt{94.5 \times 355 / 1813.3}$  1.36  
 $N_{b,z,Rd} = \text{Area} \cdot c \cdot f_y / \gamma_{M1}$   $94.5 \times 0.399 \times 355 / 10 / 1 =$  1338.474 kN Curve b  
 $i_s = F_n(i_y, i_z, a)$  170.0, 40.4, 247.7 174.7 mm  
 $N_{crT} = F_n(E, I_z, I_t, I_w, L_t, a, i_s)$  210, 1546, 63, 0.607, 4203, 0, 175 3992.9 kN  
 $\lambda_T = \sqrt{A \cdot f_y / N_{crT}}$   $\sqrt{94.5 \times 355 / 10 / 3992.93}$  0.917  
 $N_{b,T,Rd} = \text{Area} \cdot c \cdot f_y / \gamma_{M1}$   $94.5 \times 0.65 \times 355 / 10 / 1 =$  2182.247 kN Curve b

**Lateral Buckling Resistance Moment Mb**

$M_{cr0} = f_n(L_t, E, I_z, I_t, I_w)$  4.203, 210, 1546, 62.77, 0.6071 470.194 kN.m  
 $M_{cr} = C_1 \cdot M_{cr0}$  1.750 • 470.2 822.741 kN.m

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$\lambda_{LT} = \sqrt{W_y \cdot f_y / M_{cr}}$	$\sqrt{1500.8 \times 355 / 2112.568}$	0.805	
$C_{LT} = F_n(\lambda_{LT}, \Phi_{LT}, \beta)$	0.805, 0.565, 0.750	0.722	Curve b
$C_{LT.mod} = F_n(C_{LT}, \lambda_{LT}, k_c, f)$	0.722, 0.805, 0.809, 0.934	0.722	6.3.2.3
$M_{b,Rd} = C \cdot W_{pl,y} \cdot f_y$	$0.722 \times 1501 \times 355$	384.424 kN.m	

**Combined Axial and Bending 6.62**

$k_{zy}$	$1 - \{0.1 / (C_{mLT} - 0.25)\} \cdot N_{Ed} / N_{b,z,Rd}$	0.993	
$N_{Ed} / N_{b,z,Rd} + k_{zy} \cdot M_{y,Ed} / M_{b,Rd}$	$114.601 / 1338.474 + 0.993 \times 298.827 / 384.424 =$	0.858	OK