

PRELIMINARY STRUCTURAL REPORT

AT

POPLAR FARM

MOOR GATE

FLEET FEN

Status Design
2 Edinburgh Walk
Holbeach
Spalding PE12 7AP

PRELIMINARY STRUCTURAL REPORT

AT

POPLAR FARM

MOOR GATE

FLEET FEN

Ref: 14020

MAY 2020

INTRODUCTION

On behalf of Status Design, we confirm having visited the site as requested on the 2nd April 2020, the purpose being to obtain structural information of the building, with a view to checking by calculation if the structure is suitable for renovation.

The building takes the form of a pitched roof steel framed building with a lean-to attached to the side elevation, and is typical of an agricultural general purpose building, in this area.

2.

Preliminary Structural Report / 14020

Status Design

SITE WORKS UNDERTAKEN

A dimensional survey took place to establish the size of the building, together with the sizes of supporting steel framework.

Please refer to attached drawing No.d 14020/SK01.

DESK STUDY

Incorporating the new roof covering together with industrial loadings all suitable to gain building regulation approval for domestic occupancy, structural calculations have been prepared to determine if the existing structure is adequate for the proposed conversion.

Please refer to Appendix 1, which includes calculation sheets No.d 14020/1 to 88 inclusive.

3.

Preliminary Structural Report / 14020

Status Design

CONCLUSION

The lean-to structure is suitable for renovation without any structural alterations.

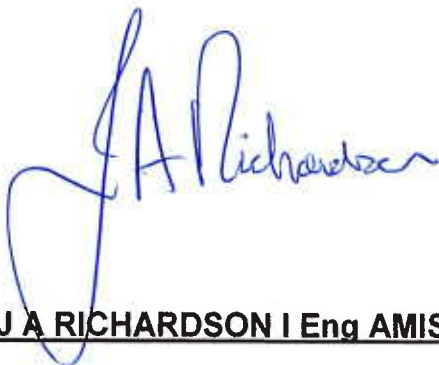
The original pitched steel framed portion, with a central apex, would be satisfactory if we consider stress within the members alone.

However, the deflection generated by increased loadings, together with the internal finishes being more susceptible to movement, it is necessary to reduce these deflections.

Whilst the structural members can remain without changes, it is recommended that a vertical support in the form of a new column is introduced, as shown on sheet No.d 14020/49.

This can easily be incorporated within the new partition walling.

For and on behalf of **SIDEBOTTOM RICHARDSON CHENG LTD**

A handwritten signature in blue ink, appearing to read 'J A Richardson', is written over the printed name 'J A RICHARDSON'.

J A RICHARDSON I Eng AMIStructE

May 2020

PROJECT:

STRUCTURAL REPORT ON EXISTING BUILDING

POPLAR FARM

MOOR GATE

FLEET FEN

NOTES:- [UNPROPPED]

- MAIN CONNECTIONS REQUIRE STIFFENING PLATES [SHEETS 42, 44 & 47]
- DEFLECTION IS ABOVE RECOMMENDED FOR MASONRY CLADDING

IF PROP IS ADDED [SEE SHEET 49 FOR DETAILS]



- CONNECTIONS ARE SATISFACTORY, WITHOUT STIFFENING
- DEFLECTIONS ARE REDUCED TO AN ALLOWABLE AMOUNT

STATUS DESIGN

PROJECT:

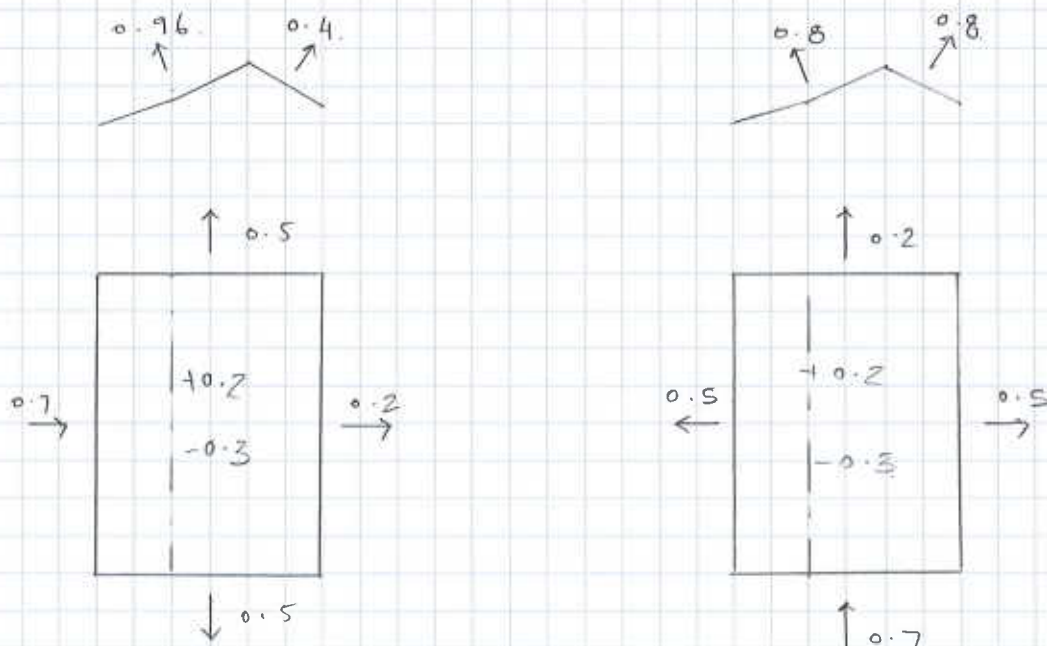
LOADINGS

IMPOSED LOAD = 0.60 kN/m^2

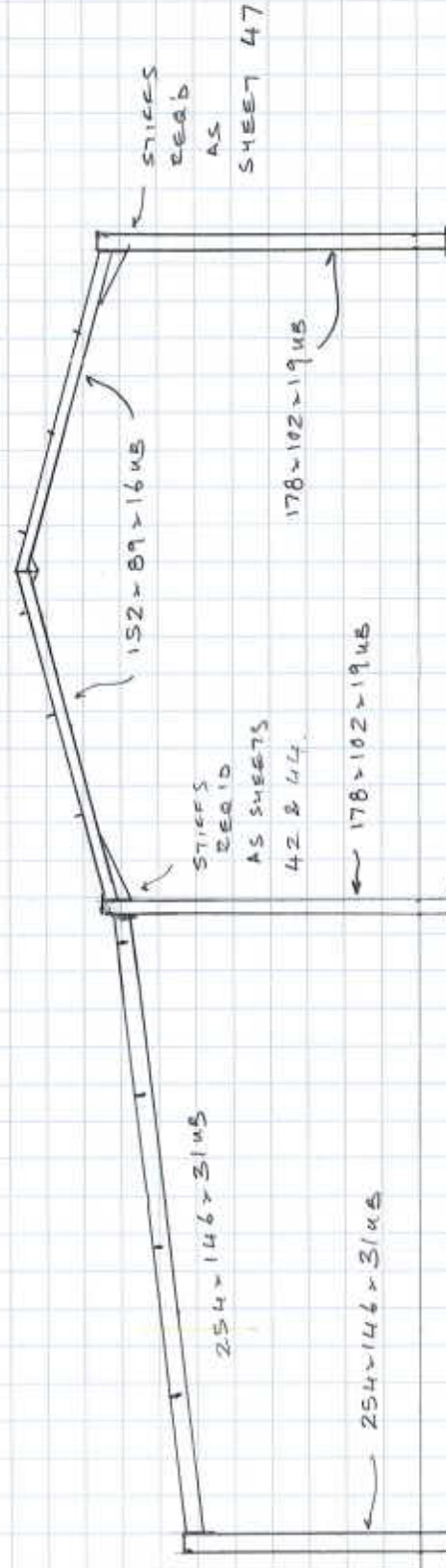
BRITMET PANTILE 2000 = 0.11 kN/m^2
INSULATION = 0.02 kN/m^2
PURLINS = 0.03 kN/m^2
 0.16 kN/m^2

WIND LOADS

BASIC WIND SPEED, $V = 43 \text{ m/s}$
S1 = 1.0
S2 = 0.751
S3 = 1.0
H = 5.40 m
 $V_s = 32.30 \text{ m/s}$
 $q_s = 0.640 \text{ kN/m}^2$



PROJECT:



TYPICAL SECTION THROUGH

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Job Ref : 14020

Sheet : 4

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MasterFrame Data File

Loading Cases and Load Combination

Load Group Labels

Load Group UT	Unity Load Factor (All Cases)
Load Group D1	Dead Load
Load Group L1	Live Load
Load Group W1	Wind Load
Load Group W2	Wind Load
Load Group W3	Wind Load
Load Group W4	Wind Load
Load Group W5	Wind Load

Load Case 001 : Dead plus Live (Ultimate)

Load Combination + 1.00 UT + 1.40 D1 + 1.60 L1

Load Case 002 : Dead Plus Wind Case 1

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W1

Load Case 003 : Dead Plus Wind Case 2

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W2

Load Case 004 : Dead Plus Wind Case 3

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W3

Load Case 005 : Dead Plus Wind Case 4

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W4

Load Case 006 : Dead Plus Wind Case 5

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W5

The Nodal Co-ordinates

Node	X (m)	Y (m)	Z (m)	Node	X (m)	Y (m)	Z (m)
1	0.000	0.000	0.000	2	0.000	3.165	0.000
3	8.340	0.000	0.000	4	8.340	4.010	0.000
5	8.340	4.210	0.000	6	12.745	5.390	0.000
7	17.149	0.000	0.000	8	17.149	4.210	0.000

Member Properties**Members 1 & 7**

M	254x146 UB 31 [S 275]		
A 39.67E-4	Ix 4414E-8	Iy 448.4E-8	J 8.55E-8
E 205.0E6	G 78.85E6		

Member 2 (0.800m Haunch End1 (304.8), 0.500m Haunch End2 (228.6))

MD	152x89 UB 16 [S 275]		
A 20.32E-4	Ix 835.2E-8	Iy 90.6E-8	J 3.56E-8
E 205.0E6	G 78.85E6		

Member 3 (0.500m Haunch End1 (228.6), 0.800m Haunch End2 (304.8))

MD	152x89 UB 16 [S 275]		
A 20.32E-4	Ix 835.2E-8	Iy 90.6E-8	J 3.56E-8
E 205.0E6	G 78.85E6		

Members 4-6

M	178x102 UB 19 [S 275]		
A 24.26E-4	Ix 1357E-8	Iy 137.6E-8	J 4.41E-8

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E 205.0E6

G 78.85E6

Member Loading

Member Self Weight Density Load Included in Load Group D1, defined by Modulus of Elasticity

E kN/mm²Density kN/m³

>= 200.00

77.01

>= 20.00

24.00

>= 2.00

10.00

Member 1

D1 UDLY	-000.793	(kN/m)
L1 UDLY	-002.973	(kN/m)
W1 UDLN	+003.679	(kN/m)
W2 UDLN	+002.093	(kN/m)
W3 UDLN	+003.171	(kN/m)
W4 UDLN	+001.903	(kN/m)
W5 UDLN	+000.317	(kN/m)
UT PartFix	20.00 --- +++	(Mx My Mz)

Member 2

D1 UDLY	-000.793	(kN/m)
L1 UDLY	-002.973	(kN/m)
W1 UDLN	+003.679	(kN/m)
W2 UDLN	+002.093	(kN/m)
W3 UDLN	+003.171	(kN/m)
W4 UDLN	+001.903	(kN/m)
W5 UDLN	+000.317	(kN/m)

Member 3

D1 UDLY	-000.793	(kN/m)
L1 UDLY	-002.973	(kN/m)
W1 UDLN	+001.903	(kN/m)
W2 UDLN	+000.317	(kN/m)
W3 UDLN	+003.171	(kN/m)
W4 UDLN	+003.679	(kN/m)
W5 UDLN	+002.093	(kN/m)

Member 6

W1 UDLX	+001.268	(kN/m)
W2 UDLX	-000.317	(kN/m)
W3 UDLX	+002.220	(kN/m)
W4 UDLX	-001.586	(kN/m)
W5 UDLX	-003.171	(kN/m)

Member 7

W1 UDLX	+001.586	(kN/m)
W2 UDLX	+003.171	(kN/m)
W3 UDLX	-002.220	(kN/m)
W4 UDLX	-001.268	(kN/m)
W5 UDLX	+000.317	(kN/m)

Nodal Loading and Support Conditions

NODES 1, 3 & 7

UT Rs 1 1 1 0 0 0 (Pinned)

NODE 3

UT Rs 0 1 0 0 0 0

25548



14020
6
M+S
APRIL '20

Frame Geometry - (Full Frame) - Front View

Not to Scale

25548



14020
7
Mas
APRIL '20

Frame Geometry - (Full Frame) - Front View

Not to Scale

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Nodal Deflections (001 : Dead plus Live (Ultimate))

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	-0.26	0.00	2	18.05	-0.11	-0.45	18.05
3	0.00	0.00	-0.12	0.00	4	18.02	-0.42	-0.54	18.03
5	20.11	-0.43	-0.66	20.11	6	34.12	-53.21	0.09	63.21
7	0.00	0.00	-1.18	0.00	8	48.18	-0.24	0.39	48.18

Nodal Deflections (002 : Dead Plus Wind Case 1)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	0.22	0.00	2	-15.03	0.06	0.35	15.03
3	0.00	0.00	0.18	0.00	4	-15.03	0.26	0.28	15.03
5	-16.09	0.26	0.33	16.10	6	-20.87	18.46	-0.18	27.86
7	0.00	0.00	0.45	0.00	8	-25.67	0.09	0.02	25.67

Nodal Deflections (003 : Dead Plus Wind Case 2)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	0.07	0.00	2	-6.36	0.03	0.17	6.36
3	0.00	0.00	0.07	0.00	4	-6.42	0.11	0.14	6.42
5	-6.97	0.12	0.17	6.97	6	-9.12	8.11	-0.13	12.21
7	0.00	0.00	0.23	0.00	8	-11.29	0.00	0.02	11.29

Nodal Deflections (004 : Dead Plus Wind Case 3)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	0.29	0.00	2	-15.67	0.05	0.30	15.67
3	0.00	0.00	0.22	0.00	4	-15.60	0.22	0.23	15.60
5	-16.48	0.23	0.27	16.48	6	-20.74	16.76	-0.09	26.66
7	0.00	0.00	0.41	0.00	8	-25.02	0.13	0.00	25.02

Nodal Deflections (005 : Dead Plus Wind Case 4)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	0.39	0.00	2	-19.24	0.02	0.29	19.24
3	0.00	0.00	0.25	0.00	4	-19.23	0.14	0.33	19.23
5	-20.45	0.14	0.37	20.45	6	-27.95	28.38	0.03	39.83
7	0.00	0.00	0.93	0.00	8	-35.46	0.14	-0.27	35.46

Nodal Deflections (006 : Dead Plus Wind Case 5)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	0.23	0.00	2	-10.57	-0.02	0.11	10.57
3	0.00	0.00	0.13	0.00	4	-10.62	-0.01	0.19	10.62

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Nodal Deflections (006 : Dead Plus Wind Case 5)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \curvearrowright$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \curvearrowright$	δXY
5	-11.33	-0.01	0.21	11.33	6	-16.20	18.04	0.09	24.25
7	0.00	0.00	0.71	0.00	8	-21.07	0.05	-0.27	21.07

Member Forces Ultimate (001 : Dead plus Live (Ultimate))

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	2	8.742C	26.329	-19.128	36.476	26.542
	4	3.448C	-25.920	-17.416	@ 4.191	@ 4.191
2	5	15.054C	22.968	-29.379	16.983	11.413
	6	8.104C	-2.975	16.206	@ 4.013	@ 2.964
3	6	8.506C	1.475	16.206	16.397	7.513
	8	15.456C	-24.462	-36.198	@ 0.274	@ 1.322
4	3	52.622C	-2.555	0.000		4.470
	4	51.573C	-2.555	-10.244	@	2.446
5	4	26.133C	-8.598	-27.659		4.470
	5	26.080C	-8.598	-29.379	@	2.446
6	7	28.730C	8.598	0.000		14.795
	8	27.629C	8.598	36.198	@	2.442
7	1	28.429C	-6.044	0.000		1.358
	2	27.076C	-6.044	-19.128	@	1.836

Member Forces Ultimate (002 : Dead Plus Wind Case 1)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	2	1.190T	-16.858	9.490	-25.488	18.964
	4	2.115T	17.191	10.886	@ 4.108	@ 4.191
2	5	8.242T	-13.744	14.044	-8.140	7.580
	6	9.333T	5.671	-4.363	@ 3.238	@ 2.736
3	6	10.918T	0.246	-4.363		3.306
	8	9.827T	8.320	15.164	@	3.283
4	3	31.512T	0.568	0.000		1.024
	4	32.261T	0.568	2.277	@	2.486
5	4	15.371T	4.405	13.163		1.024
	5	15.408T	4.405	14.044	@	2.486
6	7	9.793T	0.135	0.000	0.005	3.718
	8	10.580T	-7.339	-15.164	@ 0.084	@ 2.652

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Member Forces Ultimate (002 : Dead Plus Wind Case 1)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
7	1	15.925T	6.512	0.000	9.549	0.988
	2	16.892T	-0.515	9.490	@ 2.912	@ 1.741

Member Forces Ultimate (003 : Dead Plus Wind Case 2)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	2	5.252C	-7.484	3.311	-11.898	8.920
	4	4.327C	7.951	5.266	@ 4.024	@ 4.108
2	5	1.348C	-6.676	6.559	-4.380	4.218
	6	0.257C	2.613	-2.704	@ 3.283	@ 2.736
3	6	1.084T	2.392	-2.704		2.239
	8	0.007C	0.343	3.530		@ 2.827
4	3	13.659T	0.474	0.000	7.165	0.836
	4	14.409T	0.474	1.899	@ 4.010	@ 2.446
5	4	6.062T	-3.030	7.165	7.165	0.836
	5	6.100T	-3.030	6.559	@ 4.010	@ 2.446
6	7	0.457C	-1.773	0.000	-3.540	2.083
	8	0.329T	0.096	-3.530	@ 3.957	@ 2.316
7	1	5.950T	8.071	0.000	7.337	0.871
	2	6.917T	-5.979	3.311	@ 1.804	@ 1.646

Member Forces Ultimate (004 : Dead Plus Wind Case 3)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	2	8.574T	-13.795	7.030	-21.371	15.970
	4	9.499T	14.291	9.107	@ 4.108	@ 4.191
2	5	14.354T	-11.207	11.599	-6.110	5.596
	6	15.445T	4.964	-2.635	@ 3.147	@ 2.736
3	6	15.858T	-3.422	-2.635	-4.286	2.152
	8	14.767T	12.746	18.621	@ 0.957	@ 3.556
4	3	27.014T	0.075	0.000		0.171
	4	27.763T	0.075	0.299		@ 2.687
5	4	14.502T	10.965	9.406		0.171
	5	14.540T	10.965	11.599		@ 2.687
6	7	15.347T	2.119	0.000	0.723	3.355
	8	16.134T	-10.965	-18.621	@ 0.674	@ 2.863

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Member Forces Ultimate (004 : Dead Plus Wind Case 3)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
7	1	13.622T	-2.697	0.000	-1.170	0.107
	2	14.589T	7.139	7.030	@ 0.855	@ 2.469

Member Forces Ultimate (005 : Dead Plus Wind Case 4)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	2	1.047T	-4.791	-7.124	-14.408	10.847
	4	1.971T	8.415	8.067	@ 3.018	@ 3.772
2	5	5.568T	-8.091	10.631		4.797
	6	6.660T	-0.015	-7.854		@ 3.010
3	6	5.760T	-3.343	-7.854	-9.166	5.789
	8	4.669T	16.068	21.156	@ 0.775	@ 1.505
4	3	16.644T	0.476	0.000		0.853
	4	17.393T	0.476	1.907		@ 2.446
5	4	9.219T	3.285	9.974		0.853
	5	9.257T	3.285	10.631		@ 2.446
6	7	15.942T	-9.699	0.000		11.844
	8	16.729T	-0.351	-21.156		@ 2.316
7	1	3.905T	-5.060	0.000	-7.212	0.757
	2	4.872T	0.558	-7.124	@ 2.849	@ 1.741

Member Forces Ultimate (006 : Dead Plus Wind Case 5)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	2	5.395C	4.583	-13.303	2.973	1.651
	4	4.470C	-0.825	2.446	@ 7.125	@ 1.928
2	5	4.021C	-1.023	3.146		1.589
	6	2.930C	-3.073	-6.195		@ 3.375
3	6	4.074C	-1.196	-6.195	-6.546	5.004
	8	5.165C	8.091	9.522	@ 0.593	@ 1.687
4	3	1.209C	0.381	0.000	3.975	0.665
	4	0.460C	0.381	1.529	@ 4.010	@ 2.446
5	4	0.089C	-4.149	3.975	3.975	0.665
	5	0.052C	-4.149	3.146	@ 4.010	@ 2.446
6	7	5.692T	-11.607	0.000	-15.173	10.353
	8	6.478T	7.083	-9.522	@ 2.610	@ 2.231

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Member Forces Ultimate (006 : Dead Plus Wind Case 5)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
7	1 2	6.070C 5.103C	-3.501 -4.906	0.000 -13.303		0.883 @ 1.836

Support Reactions (001 : Dead plus Live (Ultimate))

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)
1 7	6.044 -8.598	28.429 28.730	0.000 0.000	3 Total	2.555 0.000	52.622 109.781	0.000 0.000

Support Reactions (002 : Dead Plus Wind Case 1)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)
1 7	-6.512 -0.135	-15.925 -9.793	0.000 0.000	3 Total	-0.568 -7.215	-31.512 -57.230	0.000 0.000

Support Reactions (003 : Dead Plus Wind Case 2)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)
1 7	-8.071 1.773	-5.950 0.457	0.000 0.000	3 Total	-0.474 -6.772	-13.659 -19.152	0.000 0.000

Support Reactions (004 : Dead Plus Wind Case 3)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)
1 7	2.697 -2.119	-13.622 -15.347	0.000 0.000	3 Total	-0.075 0.503	-27.014 -55.983	0.000 0.000

Support Reactions (005 : Dead Plus Wind Case 4)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)
1 7	5.060 9.699	-3.905 -15.942	0.000 0.000	3 Total	-0.476 14.284	-16.644 -36.491	0.000 0.000

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Support Reactions (006 : Dead Plus Wind Case 5)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	R _x → (kN)	R _y ↑ (kN)	M _z ↻ (kN.m)		R _x → (kN)	R _y ↑ (kN)	M _z ↻ (kN.m)
1	3.501	6.070	0.000	3	-0.381	1.209	0.000
7	11.607	-5.692	0.000	Total	14.726	1.587	0.000

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Axial with Moments (Member)
Member SBL1Id 1 @ Level 1
Between 0.000 and 2.000 m, in Load Case 1

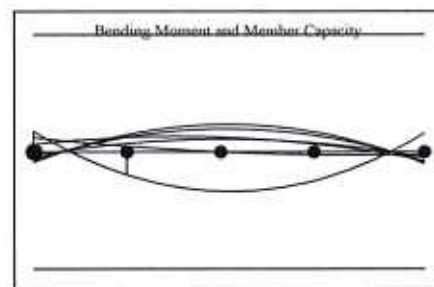
Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)

UT PartFix 20.00 --- +++ (Mt My Mz)



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	2 4	8.742C 3.448C	26.329 -25.920	-19.128 -17.416	@ 36.476 4.191	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (31.14 kg/m)

254x146 UB 31 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

8.49, 36.5, 275, 8.74, 36.47, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx

13.862 / 248.886 =

0.056

Low Shear

Mcx = py.Sxx ≤ 1.2 py.Zxx

275 x 393.1 ≤ 1.2 x 275 x 351.18 =

108.103 kN.m

Pz = Ag.py

39.67 x 275 =

1090.925 kN

n = F/Pz

8.742 / 1090.925 =

0.008

OK

Srx = Fn(Sxx, n)

393.1, 0.008

393.06 cm³

Mrx = Srx.py

393.06 x 275

108.091 kN.m

(Mx/Mrx)² + (My/Mry)²(21.058/108.091)² + (0)² =

0.038

OK

Compression Resistance Pc

λx = Lex/rxx

100x1x8.383/10.55 =

79.5

OK

Pcx = Area.pcx

39.67x204.544/10 =

811.426 kN

Table 24 a

λy = Ley/ryy

100x1x2/3.36 =

59.5

OK

Pcy = Area.pcy

39.67x221.39/10 =

878.235 kN

Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M2 + .5M3 + .15M4)/Mmax

0.2 + (.15x7 + .5x4 + .15x13)/21 ≥ 0.44

0.44

Table 18

my = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0

1

Table 26

mx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x22 + .6x36 + .1x23)/36 ≥ .8x36/36

0.925

Table 26

myx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0

1

Table 26

Lateral Buckling Check Mb

Le = 1.00 L

1 x 2 =

2 m

λ = Le/ryy

2 / 3.36

59.52

OK

v = Fn(x, Le, ryy, λ)

29.496, 2, 3.36, 59.52

0.955

Table 19

λLT = u.v.λ.√βw

0.88 x 0.955 x 59.52√1

50.03

pb = Fn(py, λLT)

275, 50.03

237.91 N/mm²

Table 16

Mb = Sxx.pb ≤ Mc

393.1 x 237.91 ≤ 108.103 =

93.524 kN.m

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb

0.44x21.1/93.5

0.099

rc = Fc/Pcy

8.7/878.2

0.010

λr = (rbλLT + rcλy)/(rb + rc)

(0.099x50 + 0.01x59.5)/(0.099 + 0.01)

50.892

λro = 17.15E (2rb + rc)/(rb + rc)

17.15x1(2x0.099 + 0.01)/(0.099 + 0.01)

32.735

Mob = Mb(1 - Fc/Pcy)

93.524(1 - 8.7/878.2)

92.593

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	108.103(1-8.7/878.2) ^{1/2}	107.563	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	108.103(1-8.7/811.4)/(1+0.5•8.7/811.4)	106.365	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	20.255(1-8.7/878.2)/(1+1.0(8.7/878.2))	19.856	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, E, M_{xy}, M_{ob})$	50.892, 32.735, 1.000, 107.563, 92.593	102.788	
$M_{ax} = \text{fn}(\lambda_x, E, M_{ox}, M_{ox})$	79.457, 1.000, 108.091, 106.365	106.524	
$M_{ay} = \text{fn}(\lambda_y, E, M_{oy}, M_{oy})$	59.524, 1.000, 20.255, 19.856	20.009	
$m_x \cdot M_x/M_{ax}$	0.925x36.5/106.5	0.317	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	0.44x21.1/102.8	0.090	OK
$m_x \cdot M_x/M_{ax}$	0.925x36.5/106.5	0.183	OK
Compare with Simplified to 4.8.3.3	0.36, 0.109, 0.11	0.36	
Compare with MoreExact to 4.8.3.3	0.325, 0.109, 0.087	0.325	

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Axial with Moments (Member)
Member SBL1Id 1 @ Level 1
Between 2.000 and 4.000 m, in Load Case 1

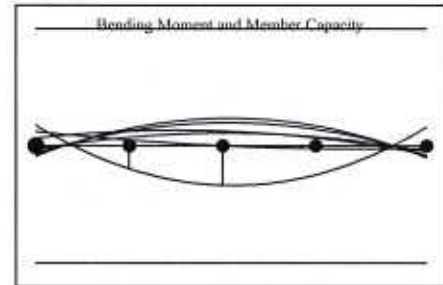
Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)

UT PartFix 20.00 --- +++ (Mt My Mz)



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	2 4	8.742C 3.448C	26.329 -25.920	-19.128 -17.416	@ 36.476 4.191	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (31.14 kg/m)

254x146 UB 31 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

8.49, 36.5, 275, 8.74, 36.47, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx	1.396 / 248.886 =	0.006	Low Shear
Mcx = py.Sxx ≤ 1.2 py.Zxx	275 x 393.1 ≤ 1.2 x 275 x 351.18 =	108.103 kN.m	
Pz = Ag.py	39.67 x 275 =	1090.925 kN	
n = F/Pz	8.742 / 1090.925 =	0.008	OK
Srx = Fn(Sxx, n)	393.1, 0.008	393.06 cm³	
Mrx = Srx.py	393.06 x 275	108.091 kN.m	
(Mx/Mrx) ² + (My/Mry) ²	(36.315/108.091) ² + (0) ² =	0.113	OK

Compression Resistance Pc

λx = Lex/rxx	100x1x8.383/10.55 =	79.5	OK
Pcx = Area.pcx	39.67x204.544/10 =	811.426 kN	Table 24 a
λy = Ley/ryy	100x1x2/3.36 =	59.5	OK
Pcy = Area.pcy	39.67x221.39/10 =	878.235 kN	Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M2 + .5M3 + .15M4)/Mmax	0.2 + (.15x27 + .5x32 + .15x35)/36 ≥ 0.44	0.894	Table 18
mx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26
my = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x22 + .6x36 + .1x23)/36 ≥ .8x36/36	0.925	Table 26
myx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26

Lateral Buckling Check Mb

Le = 1.00 L	1 x 2 =	2 m	
λ = Le/ryy	2 / 3.36	59.52	OK
v = Fn (x, Le, ryy, λ)	29.496, 2, 3.36, 59.52	0.955	Table 19
λLT = u.v.λ.√βw	0.88 x 0.955 x 59.52√1	50.03	
pb = Fn (py, λLT)	275, 50.03	237.91 N/mm²	Table 16
Mb = Sxx.pb ≤ Mc	393.1 x 237.91 ≤ 108.103 =	93.524 kN.m	

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb	0.894x36.3/93.5	0.347	
rc = Fe/Pcy	8.7/878.2	0.010	
λr = (rbλLT + rcλy)/(rb + rc)	(0.347x50 + 0.01x59.5)/(0.347 + 0.01)	50.290	
λro = 17.15ε (2rb + rc)/(rb + rc)	17.15x1(2x0.347 + 0.01)/(0.347 + 0.01)	33.822	
Mob = Mb(1 - Fe/Pcy)	93.524(1 - 8.7/878.2)	92.593	

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	108.103(1-8.7/878.2) ^{1/2}	107.563	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	108.103(1-8.7/811.4)/(1+0.5•8.7/811.4)	106.365	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	20.255(1-8.7/878.2)/(1+1.0(8.7/878.2))	19.856	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, \epsilon, M_{xy}, M_{ob})$	50.290, 33.822, 1.000, 107.563, 92.593	103.181	
$M_{ax} = \text{fn}(\lambda_x, \epsilon, M_{rx}, M_{ox})$	79.457, 1.000, 108.091, 106.365	106.524	
$M_{ay} = \text{fn}(\lambda_y, \epsilon, M_{ry}, M_{oy})$	59.524, 1.000, 20.255, 19.856	20.009	
$m_x \cdot M_x/M_{ax}$	0.925x36.5/106.5	0.317	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	0.894x36.3/103.2	0.315	OK
$m_x \cdot M_x/M_{ax}$	0.925x36.5/106.5	0.315	OK
Compare with Simplified to 4.8.3.3	0.36, 0.357, 0.358	0.36	
Compare with MoreExact to 4.8.3.3	0.325, 0.357, 0.305	0.357	

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Axial with Moments (Member)
Member SBL1Id 1 @ Level 1
Between 4.000 and 6.000 m, in Load Case 1

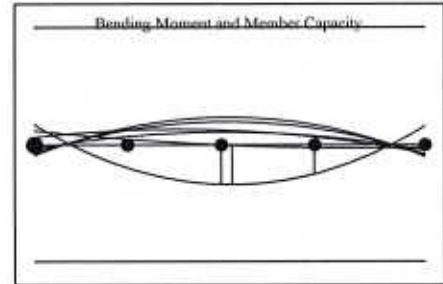
Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)

UT PartFix 20.00 --- +++ (Mt My Mz)



Member Forces in Load Case 1						
Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	2 4	8.742C 3.448C	26.329 -25.920	-19.128 -17.416	@ 36.476 4.191	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (31.14 kg/m)

254x146 UB 31 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

8.49, 36.5, 275, 8.74, 36.47, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx	0.043 / 248.886 =	0	Low Shear
Mcx = py.Sxx ≤ 1.2 py.Zxx	275 x 393.1 ≤ 1.2 x 275 x 351.18 =	108.103 kN.m	
Pz = Ag.py	39.67 x 275 =	1090.925 kN	
n = F/Pz	8.742 / 1090.925 =	0.008	OK
Srx = Fn(Sxx, n)	393.1, 0.008	393.06 cm ³	
Mrx = Srx.py	393.06 x 275	108.091 kN.m	
(Mx/Mrx) ² + (My/Mry) ²	(36.47/108.091) ² + (0) ² =	0.114	OK

Compression Resistance Pc

λx = Lex/rxx	100x1x8.383/10.55 =	79.5	OK
Pcx = Area.pcx	39.67x204.544/10 =	811.426 kN	Table 24 a
λy = Ley/ryy	100x1x2/3.36 =	59.5	OK
Pcy = Area.pcy	39.67x221.39/10 =	878.235 kN	Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M2 + .5M3 + .15M4)/Mmax	0.2 + (.15x36 + .5x35 + .15x31)/36 ≥ 0.44	0.953	Table 18
mx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26
my = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x22 + .6x36 + .1x23)/36 ≥ .8x36/36	0.925	Table 26
myx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26

Lateral Buckling Check Mb

Le = 1.00 L	1 x 2 =	2 m	
λ = Le/ryy	2 / 3.36	59.52	OK
v = Fn (x, Le, ryy, λ)	29.496, 2, 3.36, 59.52	0.955	Table 19
λLT = u.v.λ.√βw	0.88 x 0.955 x 59.52√1	50.03	
pb = Fn (py, λLT)	275, 50.03	237.91 N/mm ²	Table 16
Mb = Sxx.pb ≤ Mc	393.1 x 237.91 ≤ 108.103 =	93.524 kN.m	

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb	0.953x36.5/93.5	0.371	
rc = Fc/Pey	8.7/878.2	0.010	
λr = (rbλLT + rcλy)/(rb + rc)	(0.371x50 + 0.01x59.5)/(0.371 + 0.01)	50.273	
λro = 17.15E (2rb + rc)/(rb + rc)	17.15x1(2x0.371 + 0.01)/(0.371 + 0.01)	33.852	
Mob = Mb(1 - Fc/Pey)	93.524(1 - 8.7/878.2)	92.593	

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	$108.103(1 - 8.7/878.2)^{1/2}$	107.563	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	$108.103(1 - 8.7/811.4)/(1 + 0.5 \cdot 8.7/811.4)$	106.365	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	$20.255(1 - 8.7/878.2)/(1 + 1.0(8.7/878.2))$	19.856	
$M_{ab} = \text{fn}(\lambda_{rx}, \lambda_{ry}, \lambda_{ro}, \lambda_{ro}, M_{xy}, M_{ob})$	50.273, 33.852, 1.000, 107.563, 92.593	103.192	
$M_{ax} = \text{fn}(\lambda_{rx}, \lambda_{ry}, M_{rx}, M_{ox})$	79.457, 1.000, 108.091, 106.365	106.524	
$M_{ay} = \text{fn}(\lambda_{rx}, \lambda_{ry}, M_{ry}, M_{oy})$	59.524, 1.000, 20.255, 19.856	20.009	
$m_x \cdot M_x/M_{ax}$	$0.925 \times 36.5/106.5$	0.317	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	$0.953 \times 36.5/103.2$	0.337	OK
$m_x \cdot M_x/M_{ax}$	$0.925 \times 36.5/106.5$	0.317	OK
Compare with Simplified to 4.8.3.3	0.36, 0.381, 0.382	0.382	
Compare with MoreExact to 4.8.3.3	0.324, 0.381, 0.327	0.381	

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Axial with Moments (Member)
Member SBL1Id 1 @ Level 1
Between 6.000 and 8.383 m, in Load Case 1

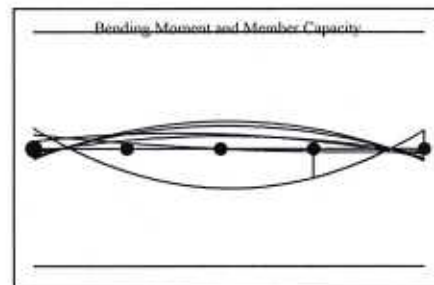
Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)

UT PartFix 20.00 --- +++ (Mt My Mz)



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	2 4	8.742C 3.448C	26.329 -25.920	-19.128 -17.416	@ 36.476 4.191	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (31.14 kg/m)

254x146 UB 31 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

8.49, 36.5, 275, 8.74, 36.47, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx

11.07 / 248.886 =

0.044

Low Shear

Mcx = py.Sxx ≤ 1.2 py.Zxx

275 x 393.1 ≤ 1.2 x 275 x 351.18 =

108.103 kN.m

Pz = Ag.py

39.67 x 275 =

1090.925 kN

n = F/Pz

8.742 / 1090.925 =

0.008

OK

Srx = Fn(Sxx, n)

393.1, 0.008

393.06 cm³

Mrx = Srx.py

393.06 x 275

108.091 kN.m

(Mx/Mrx)² + (My/Mry)²(26.644/108.091)² + (0)² =

0.061

OK

Compression Resistance Pc

λx = Lex/rxx

100x1x8.383/10.55 =

79.5

OK

Pcx = Area.pcx

39.67x204.544/10 =

811.426 kN

Table 24 a

λy = Ley/ryy

100x1x2.383/3.36 =

70.9

OK

Pcy = Area.pcy

39.67x200.1/10 =

793.794 kN

Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M2 + .5M3 + .15M4)/Mmax

0.2 + (.15x19 + .5x9 + .15x3)/27 ≥ 0.44

0.494

Table 18

my = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0

1

Table 26

mx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x22 + .6x36 + .1x23)/36 ≥ .8x36/36

0.925

Table 26

myx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0

1

Table 26

Lateral Buckling Check Mb

Le = 1.00 L

1 x 2.383 =

2.383 m

λ = Le/ryy

2.383 / 3.36

70.91

OK

v = Fn(x, Le, ryy, λ)

29.496, 2.383, 3.36, 70.91

0.939

Table 19

λLT = u.v.λ.√βw

0.88 x 0.939 x 70.91√1

58.59

pb = Fn(py, λLT)

275, 58.59

216.75 N/mm²

Table 16

Mb = Sxx.pb ≤ Mc

393.1 x 216.75 ≤ 108.103 =

85.204 kN.m

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb

0.494x26.6/85.2

0.154

rc = Fc/Pcy

8.7/793.8

0.011

λr = (rbλLT + rcλy)/(rb + rc)

(0.154x58.6 + 0.011x70.9)/(0.154 + 0.011)

59.406

λro = 17.15E (2rb + rc)/(rb + rc)

17.15x1(2x0.154 + 0.011)/(0.154 + 0.011)

33.158

Mob = Mb(1 - Fc/Pcy)

85.204(1 - 8.7/793.8)

84.266

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$M_{xy} = M_{cx}(1 - F_o/P_{cy})^{1/2}$	$108.103(1 - 8.7/793.8)^{1/2}$	107.506	
$M_{ox} = M_{cx}(1 - F_o/P_{cx})/(1 + 0.5F_o/P_{cx})$	$108.103(1 - 8.7/811.4)/(1 + 0.5 \cdot 8.7/811.4)$	106.365	
$M_{oy} = M_{cy}(1 - F_o/P_{cy})/(1 + k_y(F_o/P_{cy}))$	$20.255(1 - 8.7/793.8)/(1 + 1.0(8.7/793.8))$	19.814	
$M_{ab} = \text{fn}(\lambda_{rx}, \lambda_{ro}, E, M_{xy}, M_{ob})$	59.406, 33.158, 1.000, 107.506, 84.266	96.211	
$M_{ax} = \text{fn}(\lambda_{rx}, E, M_{rx}, M_{ox})$	79.457, 1.000, 108.091, 106.365	106.524	
$M_{ay} = \text{fn}(\lambda_{ry}, E, M_{ry}, M_{oy})$	70.914, 1.000, 20.255, 19.814	19.910	
$m_x \cdot M_x/M_{ax}$	$0.925 \times 36.5/106.5$	0.317	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	$0.494 \times 26.6/96.2$	0.137	OK
$m_x \cdot M_x/M_{ax}$	$0.925 \times 36.5/106.5$	0.231	OK
Compare with Simplified to 4.8.3.3	0.36, 0.165, 0.165	0.36	
Compare with MoreExact to 4.8.3.3	0.325, 0.165, 0.124	0.325	

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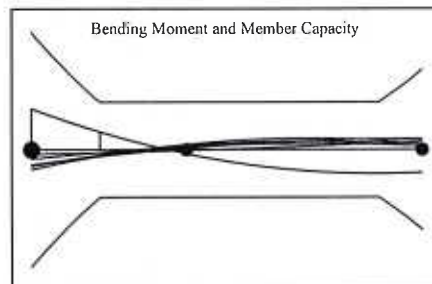
Axial with Moments (Member)
Member SBL1Id 2 @ Level 1
Between 0.000 and 1.800 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)



Member Forces in Load Case 1							
Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)	
2	3 6	15.054C 8.104C	22.968 -2.975	-29.379 16.206	@ 16.983 4.013	@ 0.000 0.000	

Classification and Properties (BS 5950: 2000)

Section (15.95 kg/m) 152x89 UB 16 [S 275]
 Class = $F_n(b/T, d/t, p_y, F, M_x, M_y)$ 5.76, 27.07, 275, 15.05, 29.38, 0 (Axial: Non-Slender) Plastic
 Sec. Depth = $F_n(X)$ X = 0.8 m 152.4 mm
 Auto Design Load Cases 1-6

Local Capacity Check

F_{vx}/P_{vx} 18.416 / 113.157 = 0.163 Low Shear
 $M_{cx} = p_y.S_{xx} \leq 1.2 p_y.Z_{xx}$ 275 x 123.3 ≤ 1.2 x 275 x 109.49 = 33.908 kN.m
 $P_z = A_g.p_y$ 27.17 x 275 = 747.175 kN
 $n = F/P_z$ 15.054 / 747.175 = 0.020 OK
 $S_{rx} = F_n(S_{xx}, n)$ 304.2, 0.02 123.13 cm³
 $M_{rx} = S_{rx}.p_y$ 123.13 x 275 33.862 kN.m
 $(M_x/M_{rx})^{2.1} + (M_y/M_{ry})^{2.2}$ (12.826/33.862)^{2.1} + (0)^{2.2} = 0.143 OK

Compression Resistance P_c

$\lambda_x = L_{ex}/r_{xx}$ 100x1x4.56/12.17 = 37.5 OK
 $P_{cx} = A_{area}.p_{cx}$ 27.17x261.993/10 = 711.835 kN Table 24 a
 $\lambda_y = L_{ey}/r_{yy}$ 100x1x1.8/1.82 = 99 OK
 $P_{cy} = A_{area}.p_{cy}$ 27.17x142.76/10 = 387.880 kN Table 24 b

Equivalent Uniform Moment Factors m_{LT} , m_x , m_y and m_{yx}

$m_{LT} = 0.2 + (.15M_2 + .5M_3 + .15M_4)/M_{1max}$ 0.2 + (.15x20 + .5x11 + .15x4)/29 ≥ 0.44 1 Table 18
 $m_y = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{1max}$ 0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0 1 Table 26
 $m_x = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{1max}$ 0.2 + (.1x-7 + .6x8 + .1x16)/29 ≥ .8x16/29 0.433 Table 26
 $m_{yx} = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{1max}$ 0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0 1 Table 26

Lateral Buckling Check M_b @ 0 m

$L_e = 1.00 L$ 1 x 1.8 = 1.8 m
 $\lambda = L_e/r_{yy}$ 1.8 / 1.82 98.95 OK
 $v = F_n(x, L_e, r_{yy}, \lambda)$ 43.616, 1.8, 1.82, 98.95 0.944 Table 19
 $\lambda_{LT} = u.v.\lambda.\sqrt{\beta_w}$ 0.864 x 0.944 x 98.95√1 80.75
 $p_b = F_n(p_y, \lambda_{LT})$ 275, 80.75 163.16 N/mm² Table 16
 $M_b = S_{xx}.p_b \leq M_c$ 304.2 x 163.16 ≤ 83.655 = 49.633 kN.m

Combined Axial Compression and Bending to Annex I @ 0 m

$r_b = m_{LT}.M_{LT}/M_b$ 1x-29.4/49.6 0.592
 $r_c = F_c/P_{cy}$ 15.1/387.9 0.039
 $\lambda_r = (r_b\lambda_{LT} + r_c\lambda_y)/(r_b + r_c)$ (0.592x80.75 + 0.039x99)/(0.592 + 0.039) 81.868
 $\lambda_{ro} = 17.15_E (2r_b + r_c)/(r_b + r_c)$ 17.15x1(2x0.592 + 0.039)/(0.592 + 0.039) 33.245

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$M_{ob} = M_b(1 - F_o/P_{cy})$	49.633(1-15.1/387.9)	47.706	
$M_{xy} = M_{cx}(1 - F_o/P_{cy})^{1/2}$	83.655(1-15.1/387.9) ^{1/2}	82.016	
$M_{ox} = M_{cx}(1 - F_o/P_{cx})/(1 + 0.5F_o/P_{cx})$	83.655(1-15.1/711.8)/(1+0.5*15.1/711.8)	81.029	
$M_{oy} = M_{cy}(1 - F_o/P_{cy})/(1 + k_y(F_o/P_{cy}))$	6.689(1-15.1/387.9)/(1+1.0(15.1/387.9))	6.189	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, E, M_{xy}, M_{ob})$	81.868, 33.245, 1.000, 82.016, 47.706	50.392	
$M_{ax} = \text{fn}(\lambda_x, E, M_{rx}, M_{ox})$	37.466, 1.000, 33.862, 81.029	82.846	
$M_{ay} = \text{fn}(\lambda_y, E, M_{ry}, M_{oy})$	98.955, 1.000, 6.682, 6.189	6.189	
$m_x \cdot M_x/M_{ax}$	0.433x29.4/82.8	0.154	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	1x-29.4/50.4	0.583	OK
$m_x \cdot M_x/M_{ax}$	0.433x29.4/82.8	0.154	OK
Compare with Simplified to 4.8.3.3	0.214, 0.631, 0.631	0.631	
Compare with MoreExact to 4.8.3.3	0.175, 0.631, 0.363	0.631	

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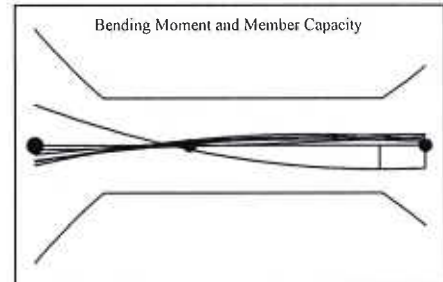
Axial with Moments (Member)
Member SBL1Id 2 @ Level 1
Between 1.800 and 4.560 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)



Member Forces in Load Case 1							
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)	
2	5 6	15.054C 8.104C	22.968 -2.975	-29.379 16.206	@ 16.983 4.013	@ 0.000 0.000	

Classification and Properties (BS 5950: 2000)

Section (15.95 kg/m)

152x89 UB 16 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

5.76, 27.07, 275, 15.05, 29.38, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx	0.044 / 113.157 =	0	Low Shear
Mcx = py.Sxx ≤ 1.2 py.Zxx	275 x 123.3 ≤ 1.2 x 275 x 109.49 =	33.908 kN.m	
Pz = Ag.py	20.32 x 275 =	558.8 kN	
n = F/Pz	15.054 / 558.8 =	0.027	OK
Srx = Fn(Sxx, n)	123.3, 0.027	123.13 cm³	
Mrx = Srx.py	123.13 x 275	33.862 kN.m	
(Mx/Mrx) ² + (My/Mry) ²	(16.982/33.862)² + (0)¹ =	0.252	OK

Compression Resistance Pc

λx = Lex/rxx	100x1x4.56/6.41 =	71.2	OK
Pcx = Area.pcx	20.32x221.362/10 =	449.808 kN	Table 24 a
λy = Ley/ryy	100x1x2.76/2.1 =	131.3	OK
Pcy = Area.pcy	20.32x93.3/10 =	189.588 kN	Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (15M₂ + 5M₃ + 15M₄)/Mmax	0.2 + (15x10 + 5x15 + 15x17)/17 ≥ 0.44	1	Table 18
my = 0.2 + (1M₂ + 6M₃ + 1M₄)/Mmax	0.2 + (1x0 + 6x0 + 1x0)/0 ≥ 0.8x0/0	1	Table 26
mx = 0.2 + (1M₂ + 6M₃ + 1M₄)/Mmax	0.2 + (1x-7 + 6x8 + 1x16)/29 ≥ 0.8x16/29	0.433	Table 26
myx = 0.2 + (1M₂ + 6M₃ + 1M₄)/Mmax	0.2 + (1x0 + 6x0 + 1x0)/0 ≥ 0.8x0/0	1	Table 26

Lateral Buckling Check Mb

Le = 1.00 L	1 x 2.76 =	2.76 m	
λ = Le/ryy	2.76 / 2.1	131.29	OK
v = Fn(x, Le, ryy, λ)	19.539, 2.76, 2.1, 131.29	0.744	Table 19
λLT = u.v.λ.√βw	0.891 x 0.744 x 131.29√1	87.04	
pb = Fn(py, λLT)	275, 87.04	149.54 N/mm²	Table 16
Mb = Sxx.pb ≤ Mc	123.3 x 149.54 ≤ 33.908 =	18.438 kN.m	

Simplified Approach

py.Zx	275x109.49	30.109 kN.m	
F/Pc + mx.Mx/py.Zx	15.054/189.588 + 0.433x17/30.1	0.324	OK
F/Pcy + mLT.MLT/Mb	15.054/189.588 + 1x17/18.4	1.000	OK

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More Exact Approach

$\text{Max} = \text{M}_{cx} / (1 + 5F/P_{cx})$	$33.9 / (1 + 5 \times 15.1 / 449.8)$	33.349 kN.m	
$F/P_{cx} + m_x \cdot \text{M}_x / \text{Max}$	$15.1 / 449.8 + 0.433 \times 17 / 33.3$	0.254	OK
$F/P_{cy} + m_{LT} \cdot \text{M}_{LT} / \text{Mb}$	$15.1 / 189.6 + 1 \times 17 / 18.4$	1.000	OK

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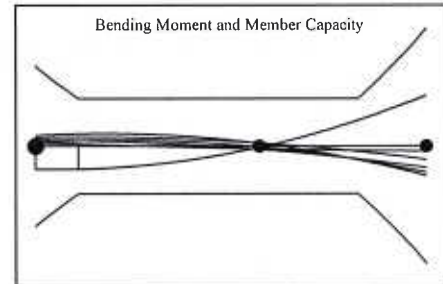
Axial with Moments (Member)
Member SBL1Id 3 @ Level 1
Between 0.000 and 2.600 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 { kN/m }

L1 UDLY -002.973 { kN/m }



Member Forces in Load Case 1							
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)	
3	6 8	8.506C 15.456C	1.475 -24.462	16.206 -36.198	@ 16.397 0.274	@ 0.000 0.000	

Classification and Properties (BS 5950: 2000)

Section (15.95 kg/m)

152x89 UB 16 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

5.76, 27.07, 275, 15.46, 36.2, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx	1.37 / 113.157 =	0.012	Low Shear
Mcx = py.Sxx ≤ 1.2 py.Zxx	275 x 123.3 ≤ 1.2 x 275 x 109.49 =	33.908 kN.m	
Pz = Ag.py	20.32 x 275 =	558.8 kN	
n = F/Pz	15.456 / 558.8 =	0.028	OK
Srx = Fn(Sxx, n)	123.3, 0.028	123.12 cm³	
Mrx = Srx.py	123.12 x 275	33.859 kN.m	
(Mx/Mrx) ^{Z1} + (My/Mry) ^{Z2}	(16.23/33.859) ² + (0) ¹ =	0.23	OK

Compression Resistance Pc

λx = Lex/rxx	100x1x4.559/6.41 =	71.2	OK
Pcx = Area.pcx	20.32x221.39/10 =	449.865 kN	Table 24 a
λy = Ley/ryy	100x1x2.6/2.1 =	123.7	OK
Pcy = Area.pcy	20.32x102.82/10 =	208.931 kN	Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M2 + .5M3 + .15M4)/Mmax	0.2 + (.15x16 + .5x13 + .15x8)/16 ≥ 0.44	1	Table 18
my = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26
mx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x14 + .6x5 + .1x-12)/36 ≥ .8x14/36	0.314	Table 26
myx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26

Lateral Buckling Check Mb

Le = 1.00 L	1 x 2.6 =	2.6 m	
λ = Le/ryy	2.6 / 2.1	123.68	OK
v = Fn (x.Le,ryy,λ)	19.539, 2.6, 2.1, 123.68	0.76	Table 19
λLT = u.v.λ.√βw	0.891 x 0.76 x 123.68√1	83.68	
pb = Fn (py,λLT)	275, 83.68	156.69 N/mm²	Table 16
Mb = Sxx.pb ≤ Mc	123.3 x 156.69 ≤ 33.908 =	19.320 kN.m	

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb	1x16.2/19.3	0.840	
rc = Fc/Pcy	15.5/208.9	0.074	
λr = (rbλLT + rcλy)/(rb + rc)	(0.84x83.7 + 0.074x123.7)/(0.84 + 0.074)	86.918	
λro = 17.15E (2rb + rc)/(rb + rc)	17.15x1(2x0.84 + 0.074)/(0.84 + 0.074)	32.912	
Mob = Mb(1 - Fc/Pcy)	19.320(1 - 15.5/208.9)	17.891	

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	$33.908(1 - 15.5/208.9)^{1/2}$	32.629	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	$33.908(1 - 15.5/449.9)/(1 + 0.5 \cdot 15.5/449.9)$	32.190	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	$6.682(1 - 15.5/208.9)/(1 + 1.0(15.5/208.9))$	5.761	
$M_{ab} = \text{fn}(\lambda_{rx}, \lambda_{ro}, \epsilon, M_{xy}, M_{ob})$	86.918, 32.912, 1.000, 32.629, 17.891	17.891	
$M_{ax} = \text{fn}(\lambda_{rx}, \epsilon, M_{rx}, M_{ox})$	71.155, 1.000, 33.859, 32.190	32.546	
$M_{ay} = \text{fn}(\lambda_{ry}, \epsilon, M_{ry}, M_{oy})$	123.679, 1.000, 6.682, 5.761	5.761	
$m_x \cdot M_x/M_{ax}$	$0.314 \times 16.2/32.5$	0.156	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	$1 \times 16.2/17.9$	0.907	OK
$m_x \cdot M_x/M_{ax}$	$0.314 \times 16.2/32.5$	0.156	OK
Compare with Simplified to 4.8.3.3	0.243, 0.914, 0.914	0.914	
Compare with MoreExact to 4.8.3.3	0.187, 0.914, 0.504	0.914	

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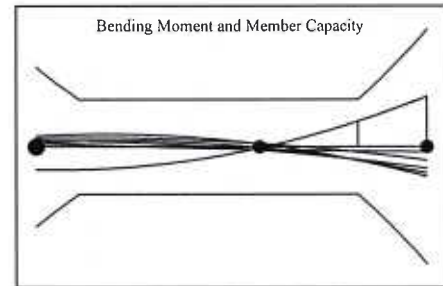
Axial with Moments (Member)
Member SBL1Id 3 @ Level 1
Between 2.600 and 4.559 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
3	6 8	8.506C 15.456C	1.475 -24.462	16.206 -36.198	@ 16.397 0.274	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (15.95 kg/m) 152x89 UB 16 [S 275]
 Class = $F_n(b/T, d/t, p_y, F, M_x, M_y)$ 5.76, 27.07, 275, 15.46, 36.2, 0 (Axial: Non-Slender) Plastic
 Sec. Depth = $F_n(X)$ X = 3.759 m 152.4 mm
 Auto Design Load Cases 1-6

Local Capacity Check

F_v/P_v 19.912 / 113.157 = 0.176 Low Shear
 $M_{cx} = p_y.S_{xx} \leq 1.2 p_y.Z_{xx}$ 275 x 123.3 ≤ 1.2 x 275 x 109.49 = 33.908 kN.m
 $P_z = A_g.p_y$ 27.17 x 275 = 747.175 kN
 $n = F/P_z$ 15.456 / 747.175 = 0.021 OK
 $S_{rx} = F_n(S_{xx}, n)$ 304.1, 0.021 123.12 cm³
 $M_{rx} = S_{rx}.p_y$ 123.12 x 275 33.859 kN.m
 $(M_x/M_{rx})^{2.1} + (M_y/M_{ry})^{2.2}$ (18.451/33.859)² + (0)¹ = 0.297 OK

Compression Resistance P_c

$\lambda_x = L_{ex}/r_{xx}$ 100 x 1 x 4.559 / 12.17 = 37.5 OK
 $P_{cx} = A_{ea}.p_{cx}$ 27.17 x 261.992 / 10 = 711.832 kN Table 24 a
 $\lambda_y = L_{ey}/r_{yy}$ 100 x 1 x 1.959 / 1.82 = 107.7 OK
 $P_{cy} = A_{ea}.p_{cy}$ 27.17 x 127 / 10 = 345.071 kN Table 24 b

Equivalent Uniform Moment Factors m_{LT} , m_x , m_y and m_{yx}

$m_{LT} = 0.2 + (.15M_2 + .5M_3 + .15M_4)/M_{max}$ 0.2 + (.15x6 + .5x15 + .15x25)/36 ≥ 0.44 1 Table 18
 $m_y = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ 0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0 1 Table 26
 $m_x = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ 0.2 + (.1x14 + .6x5 + .1x-12)/36 ≥ .8x14/36 0.314 Table 26
 $m_{yx} = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ 0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0 1 Table 26

Lateral Buckling Check M_b @ 4.559 m

$L_e = 1.00 L$ 1 x 1.959 = 1.959 m
 $\lambda = L_e/r_{yy}$ 1.959 / 1.82 107.7 OK
 $v = F_n(x, L_e, r_{yy}, \lambda)$ 43.607, 1.959, 1.82, 107.7 0.936 Table 19
 $\lambda_{LT} = u.v.\lambda.\sqrt{\beta_w}$ 0.864 x 0.936 x 107.7 / 1 87.06
 $p_b = F_n(p_y, \lambda_{LT})$ 275, 87.06 149.5 N/mm² Table 16
 $M_b = S_{xx}.p_b \leq M_c$ 304.1 x 149.5 ≤ 83.628 = 45.464 kN.m

Combined Axial Compression and Bending to Annex I @ 4.559 m

$r_b = m_{LT}.M_{LT}/M_b$ 1 x -36.2/45.5 0.796
 $r_c = F_c/P_{cy}$ 15.5/345.1 0.045
 $\lambda_c = (r_b\lambda_{LT} + r_c\lambda_y)/(r_b + r_c)$ (0.796*87.1 + 0.045*107.7)/(0.796 + 0.045) 88.162
 $\lambda_{c0} = 17.15\epsilon_2(2r_b + r_c)/(r_b + r_c)$ 17.15*1(2*0.796 + 0.045)/(0.796 + 0.045) 33.386

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$M_{ob} = M_b(1 - F_c/P_{cy})$	45.464(1-15.5/345.1)	43.427	
$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	83.628(1-15.5/345.1) ^{1/2}	81.733	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	83.628(1-15.5/711.8)/(1+0.5*15.5/711.8)	80.933	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	6.689(1-15.5/345.1)/(1+1.0(15.5/345.1))	6.116	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, \epsilon, M_{xy}, M_{ob})$	88.162, 33.386, 1.000, 81.733, 43.427	43.427	
$M_{ax} = \text{fn}(\lambda_x, \epsilon, M_{rx}, M_{ox})$	37.468, 1.000, 33.859, 80.933	82.796	
$M_{ay} = \text{fn}(\lambda_y, \epsilon, M_{ry}, M_{oy})$	107.696, 1.000, 6.682, 6.116	6.116	
$m_x \cdot M_x / M_{ax}$	0.314x36.2/82.8	0.137	OK
$m_{LT} \cdot M_{LT} / M_{ab}$	1x-36.2/43.4	0.833	OK
$m_x \cdot M_x / M_{ax}$	0.314x36.2/82.8	0.137	OK
Compare with Simplified to 4.8.3.3	0.201, 0.841, 0.841	0.841	
Compare with MoreExact to 4.8.3.3	0.159, 0.841, 0.447	0.841	

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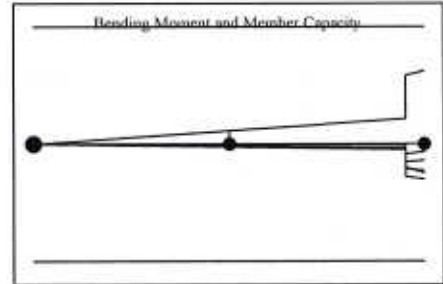
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Axial with Moments (Member)
Member SCL1Id 4 @ Level 1
Between 0.000 and 2.105 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

**Member Forces in Load Case 1**

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
	3 5	52.622C 26.080C	-2.555 -8.598	0.000 -29.379		0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (19.04 kg/m)

178x102 UB 19 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

6.41, 30.58, 275, 52.62, 29.38, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx

2.555 / 140.818 =

0.018

Low Shear

M_{cx} = p_y.S_{xx} ≤ 1.2 p_y.Z_{xx}

275 x 171.3 ≤ 1.2 x 275 x 152.63 =

47.108 kN.m

Pz = A_g.p_y

24.26 x 275 =

667.15 kN

n = F/Pz

52.622 / 667.15 =

0.079

OK

S_{rx} = F_n(S_{xx}, n)

171.3, 0.079

169.39 cm³M_{rx} = S_{rx}.p_y

169.39 x 275

46.583 kN.m

(M_x/M_{rx})² + (M_y/M_{ry})²(5.377/46.583)² + (0)² =

0.013

OK

Compression Resistance P_cλ_x = L_{ex}/r_{xx}

100x1x4.21/7.48 =

56.3

OK

P_{cx} = A_{area}.p_{cx}

24.26x244.084/10 =

592.147 kN

Table 24 a

λ_y = L_{ey}/r_{yy}

100x1x2.105/2.38 =

88.4

OK

P_{cy} = A_{area}.p_{cy}

24.26x163.71/10 =

397.161 kN

Table 24 b

Equivalent Uniform Moment Factors m_{LT}, m_x, m_y and m_{yx}m_{LT} = 0.2 + (0.15M₂ + 0.5M₃ + 0.15M₄)/M_{max}

0.2 + (0.15x1 + 0.5x3 + 0.15x4)/5 ≥ 0.44

0.6

Table 18

m_y = 0.2 + (0.1M₂ + 0.6M₃ + 0.1M₄)/M_{max}

0.2 + (0.1x0 + 0.6x0 + 0.1x0)/0 ≥ 0.8x0/0

1

Table 26

m_x = 0.2 + (0.1M₂ + 0.6M₃ + 0.1M₄)/M_{max}

0.2 + (0.1x-3 + 0.6x-5 + 0.1x-8)/29 ≥ 0.8x8/29

0.346

Table 26

m_{yx} = 0.2 + (0.1M₂ + 0.6M₃ + 0.1M₄)/M_{max}

0.2 + (0.1x0 + 0.6x0 + 0.1x0)/0 ≥ 0.8x0/0

1

Table 26

Lateral Buckling Check M_bL_e = 1.00 L

1 x 2.105 =

2.105 m

λ = L_e/r_{yy}

2.105 / 2.38

88.45

OK

v = F_n(x, L_e, r_{yy}, λ)

22.562, 2.105, 2.38, 88.45

0.867

Table 19

λ_{LT} = u.v.λ.√β_w

0.889 x 0.867 x 88.45√1

68.22

p_b = F_n(p_y, λ_{LT}, τ)

275, 68.22

192.77 N/mm²

Table 16

M_b = S_{xx}.p_b ≤ M_c

171.3 x 192.77 ≤ 47.108 =

33.022 kN.m

Combined Axial Compression and Bending to Annex Ir_b = m_{LT}.M_{LT}/M_b

0.6x-5.4/33

0.098

r_c = F_o/P_{cy}

52.6/397.2

0.132

λ_r = (r_bλ_{LT} + r_cλ_y)/(r_b + r_c)

(0.098x68.22 + 0.132x88.4)/(0.098 + 0.132)

79.860

λ_{ro} = 17.15ε (2r_b + r_c)/(r_b + r_c)

17.15x1(2x0.098 + 0.132)/(0.098 + 0.132)

24.431

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$M_{ob} = M_b(1 - F_c/P_{cy})$	33.022(1-52.6/397.2)	28.647	
$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	47.108(1-52.6/397.2) ^{1/2}	43.876	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	47.108(1-52.6/592.1)/(1+0.5*52.6/592.1)	41.095	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	8.973(1-52.6/397.2)/(1+1.0(52.6/397.2))	6.873	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, \epsilon, M_{xy}, M_{ob})$	79.860, 24.431, 1.000, 43.876, 28.647	30.383	
$M_{ax} = \text{fn}(\lambda_x, \epsilon, M_{rx}, M_{ox})$	56.283, 1.000, 46.583, 41.095	43.455	
$M_{ay} = \text{fn}(\lambda_y, \epsilon, M_{ry}, M_{oy})$	88.445, 1.000, 8.973, 6.873	6.873	
$m_x \cdot M_x/M_{ax}$	0.346x29.4/43.5	0.234	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	0.6x-5.4/30.4	0.106	OK
$m_x \cdot M_x/M_{ax}$	0.346x29.4/43.5	0.043	OK
Compare with Simplified to 4.8.3.3	0.375, 0.23, 0.23	0.375	
Compare with MoreExact to 4.8.3.3	0.315, 0.23, 0.079	0.315	

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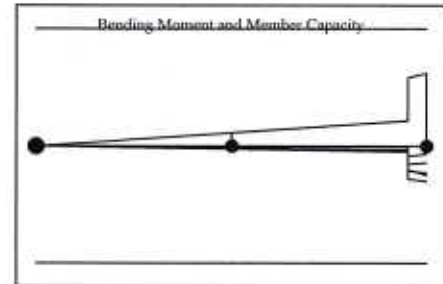
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Axial with Moments (Member)
Member SCL1Id 4 @ Level 1
Between 2.105 and 4.210 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

**Member Forces in Load Case 1**

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
	3 5	52.622C 26.080C	-2.555 -8.598	0.000 -29.379		@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (19.04 kg/m)

178x102 UB 19 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

6.41, 30.58, 275, 52.62, 29.38, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx	8.598 / 140.818 =	0.061	Low Shear
Mcx = py.Sxx ≤ 1.2 py.Zxx	275 x 171.3 ≤ 1.2 x 275 x 152.63 =	47.108 kN.m	
Pz = Ag.py	24.26 x 275 =	667.15 kN	
n = F/Pz	52.622 / 667.15 =	0.079	OK
Srx = Fn(Sxx, n)	171.3, 0.079	169.39 cm³	
Mrx = Srx.py	169.39 x 275	46.583 kN.m	
(Mx/Mrx) ^{Z1} + (My/Mry) ^{Z2}	(29.379/46.583) ² + (0) ¹ =	0.398	OK

Compression Resistance Pc

λx = Lex/rxx	100x1x4.21/7.48 =	56.3	OK
Pcx = Area.pcx	24.26x244.084/10 =	592.147 kN	Table 24 a
λy = Ley/ryy	100x1x2.105/2.38 =	88.4	OK
Pcy = Area.pcy	24.26x163.71/10 =	397.161 kN	Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M2 + .5M3 + .15M4)/Mmax	0.2 + (.15x7 + .5x8 + .15x9)/29 ≥ 0.44	0.44	Table 18
my = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26
mx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x-3 + .6x-5 + .1x-8)/29 ≥ .8x8/29	0.346	Table 26
myx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26

Lateral Buckling Check Mb

Le = 1.00 L	1 x 2.105 =	2.105 m	
λ = Le/ryy	2.105 / 2.38	88.45	OK
v = Fn(x.Le, ryy, λ)	22.562, 2.105, 2.38, 88.45	0.867	Table 19
λLT = u.v.λ.√βw	0.889 x 0.867 x 88.45√1	68.22	
pb = Fn(py, λLT)	275, 68.22	192.77 N/mm²	Table 16
Mb = Sxx.pb ≤ Mc	171.3 x 192.77 ≤ 47.108 =	33.022 kN.m	

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb	0.44x-29.4/33	0.391	
rc = F/Pcy	52.6/397.2	0.132	
λr = (rbλLT + rcλy)/(rb + rc)	(0.391x68.2 + 0.132x88.4)/(0.391 + 0.132)	73.336	
λro = 17.15ε (2rb + rc)/(rb + rc)	17.15x1(2x0.391 + 0.132)/(0.391 + 0.132)	29.963	

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$M_{ob} = M_b(1 - F_c/P_{cy})$	33.022(1-52.6/397.2)	28.647	
$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	47.108(1-52.6/397.2) ^{1/2}	43.876	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	47.108(1-52.6/592.1)/(1+0.5•52.6/592.1)	41.095	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	8.973(1-52.6/397.2)/(1+1.0(52.6/397.2))	6.873	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, E, M_{xy}, M_{ob})$	73.336, 29.963, 1.000, 43.876, 28.647	32.651	
$M_{ax} = \text{fn}(\lambda_x, E, M_{rx}, M_{ox})$	56.283, 1.000, 46.583, 41.095	43.455	
$M_{ay} = \text{fn}(\lambda_y, E, M_{ry}, M_{oy})$	88.445, 1.000, 8.973, 6.873	6.873	
$m_x \cdot M_x/M_{ax}$	0.346x29.4/43.5	0.234	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	0.44x-29.4/32.7	0.396	OK
$m_x \cdot M_x/M_{ax}$	0.346x29.4/43.5	0.234	OK
Compare with Simplified to 4.8.3.3	0.375, 0.524, 0.524	0.524	
Compare with MoreExact to 4.8.3.3	0.314, 0.524, 0.315	0.524	

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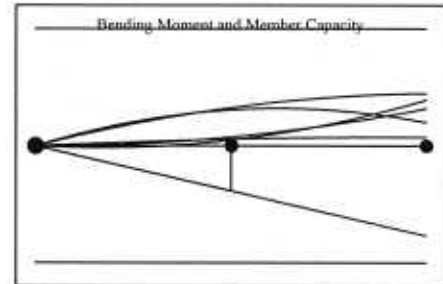
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Axial with Moments (Member)
Member SCL1Id 5 @ Level 1
Between 0.000 and 2.105 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
6	7 8	28.730C 27.629C	8.598 8.598	0.000 36.198		@ 0.000

Classification and Properties (BS 5950: 2000)

Section (19.04 kg/m) 178x102 UB 19 [S 275]
Class = Fn(b/T,d/t,py,F,Mx,My) 6.41, 30.58, 275, 28.73, 36.2, 0 (Axial: Non-Slender) Plastic
Auto Design Load Cases 1-6

Local Capacity Check

Fvx/Pvx 8.598 / 140.818 = 0.061 Low Shear
M_{cx} = p_y.S_{xx} ≤ 1.2 p_y.Z_{xx} 275 x 171.3 ≤ 1.2 x 275 x 152.63 = 47.108 kN.m
P_z = A_g.p_y 24.26 x 275 = 667.15 kN
n = F/P_z 28.73 / 667.15 = 0.043 OK
S_{rx} = F_n(S_{xx}, n) 171.3, 0.043 170.73 cm³
M_{rx} = S_{rx}.p_y 170.73 x 275 46.951 kN.m
(M_x/M_{rx})² + (M_y/M_{ry})² (18.098/46.951)² + (0)² = 0.149 OK

Compression Resistance P_c

λ_x = L_{ex}/r_{xx} 100x1x4.21/7.48 = 56.3 OK
P_{cx} = A_{area}.p_{cx} 24.26x244.084/10 = 592.147 kN Table 24 a
λ_y = L_{ey}/r_{yy} 100x1x2.105/2.38 = 88.4 OK
P_{cy} = A_{area}.p_{cy} 24.26x163.71/10 = 397.161 kN Table 24 b

Equivalent Uniform Moment Factors m_{LT}, m_x, m_y and m_{yx}

m_{LT} = 0.2 + (.15M₂ + .5M₃ + .15M₄)/M_{max} 0.2 + (.15x5 + .5x9 + .15x14)/18 ≥ 0.44 0.6 Table 18
m_y = 0.2 + (.1M₂ + .6M₃ + .1M₄)/M_{max} 0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0 1 Table 26
m_x = 0.2 + (.1M₂ + .6M₃ + .1M₄)/M_{max} 0.2 + (.1x9 + .6x18 + .1x27)/36 ≥ .8x27/36 0.6 Table 26
m_{yx} = 0.2 + (.1M₂ + .6M₃ + .1M₄)/M_{max} 0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0 1 Table 26

Lateral Buckling Check M_b

L_e = 1.00 L 1 x 2.105 = 2.105 m
λ = L_e/r_{yy} 2.105 / 2.38 88.45 OK
v = F_n (x.L_e,r_{yy},λ) 22.562, 2.105, 2.38, 88.45 0.867 Table 19
λ_{LT} = u.v.λ.√β_w 0.889 x 0.867 x 88.45√1 68.22
p_b = F_n (p_y,λ_{LT}) 275, 68.22 192.77 N/mm² Table 16
M_b = S_{xx}.p_b ≤ M_c 171.3 x 192.77 ≤ 47.108 = 33.022 kN.m

Combined Axial Compression and Bending to Annex I

r_b = m_{LT}.M_{LT}/M_b 0.6x18.1/33 0.329
r_c = F_c/P_{cy} 28.7/397.2 0.072
λ_r = (r_bλ_{LT} + r_cλ_y)/(r_b + r_c) (0.329x68.2 + 0.072x88.4)/(0.329 + 0.072) 71.868
λ_{ro} = 17.15_E (2r_b + r_c)/(r_b + r_c) 17.15x1(2x0.329 + 0.072)/(0.329 + 0.072) 31.208
M_{ob} = M_b(1 - F_c/P_{cy}) 33.022(1 - 28.7/397.2) 30.634

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	47.108(1-28.7/397.2) ^{1/2}	45.372	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	47.108(1-28.7/592.1)/(1+0.5•28.7/592.1)	43.760	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	8.973(1-28.7/397.2)/(1+1.0(28.7/397.2))	7.762	
$M_{ab} = \text{fn}(\lambda_{rx}, \lambda_{ro}, \epsilon, M_{xy}, M_{ob})$	71.868, 31.208, 1.000, 45.372, 30.634	34.798	
$M_{ax} = \text{fn}(\lambda_{rx}, \epsilon, M_{rx}, M_{ox})$	56.283, 1.000, 46.951, 43.760	45.132	
$M_{ay} = \text{fn}(\lambda_{ry}, \epsilon, M_{ry}, M_{oy})$	88.445, 1.000, 8.973, 7.762	7.762	
$m_x \cdot M_x / M_{ax}$	0.6x36.2/45.1	0.481	OK
$m_{LT} \cdot M_{LT} / M_{ab}$	0.6x18.1/34.8	0.312	OK
$m_x \cdot M_x / M_{ax}$	0.6x36.2/45.1	0.241	OK
Compare with Simplified to 4.8.3.3	0.59, 0.401, 0.401	0.59	
Compare with MoreExact to 4.8.3.3	0.521, 0.401, 0.248	0.521	

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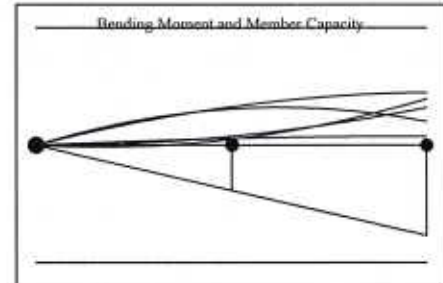
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Axial with Moments (Member)**Member SCL1Id 5 @ Level 1****Between 2.105 and 4.210 m, in Load Case 1****Member Loading and Member Forces**

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

**Member Forces in Load Case 1**

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
6	7 8	28.730C 27.629C	8.598 8.598	0.000 36.198		@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (19.04 kg/m)

178x102 UB 19 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

6.41, 30.58, 275, 28.73, 36.2, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx

8.598 / 140.818 =

0.061

Low Shear

Mcx = py.Sxx ≤ 1.2 py.Zxx

275 x 171.3 ≤ 1.2 x 275 x 152.63 =

47.108 kN.m

Pz = Ag.py

24.26 x 275 =

667.15 kN

n = F/Pz

28.73 / 667.15 =

0.043

OK

Srx = Fn(Sxx, n)

171.3, 0.043

170.73 cm³

Mrx = Srx.py

170.73 x 275

46.951 kN.m

(Mx/Mrx)^{Z1} + (My/Mry)^{Z2}(36.198/46.951)² + (0)¹ =

0.594

OK

Compression Resistance Pc

λx = Lex/rxx

100x1x4.21/7.48 =

56.3

OK

Pcx = Area.pcx

24.26x244.084/10 =

592.147 kN

Table 24 a

λy = Ley/ryy

100x1x2.105/2.38 =

88.4

OK

Pcy = Area.pcy

24.26x163.71/10 =

397.161 kN

Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M2 + .5M3 + .15M4)/Mmax

0.2 + (.15x23 + .5x27 + .15x32)/36 ≥ 0.44

0.8

Table 18

my = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0

1

Table 26

mx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x9 + .6x18 + .1x27)/36 ≥ .8x27/36

0.6

Table 26

myx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0

1

Table 26

Lateral Buckling Check Mb

Le = 1.00 L

1 x 2.105 =

2.105 m

λ = Le/ryy

2.105 / 2.38

88.45

OK

v = Fn(x, Le, ryy, λ)

22.562, 2.105, 2.38, 88.45

0.867

Table 19

λLT = u.v.λ.√βw

0.889 x 0.867 x 88.45√1

68.22

pb = Fn(py, λLT)

275, 68.22

192.77 N/mm²

Table 16

Mb = Sxx.pb ≤ Mc

171.3 x 192.77 ≤ 47.108 =

33.022 kN.m

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb

0.8x36.2/33

0.877

rc = Fc/Pcy

28.7/397.2

0.072

λr = (rbλLT + rcλy)/(rb + rc)

(0.877x68.2 + 0.072x88.4)/(0.877 + 0.072)

69.763

λro = 17.15g (2rb + rc)/(rb + rc)

17.15x1(2x0.877 + 0.072)/(0.877 + 0.072)

32.993

Mob = Mb(1 - Fc/Pcy)

33.022(1 - 28.7/397.2)

30.634

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	$47.108(1 - 28.7/397.2)^{1/2}$	45.372	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	$47.108(1 - 28.7/592.1)/(1 + 0.5 \cdot 28.7/592.1)$	43.760	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	$8.973(1 - 28.7/397.2)/(1 + 1.0(28.7/397.2))$	7.762	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, E, M_{xy}, M_{ob})$	69.763, 32.993, 1.000, 45.372, 30.634	35.589	
$M_{ax} = \text{fn}(\lambda_x, E, M_{rx}, M_{ox})$	56.283, 1.000, 46.951, 43.760	45.132	
$M_{ay} = \text{fn}(\lambda_y, E, M_{ry}, M_{oy})$	88.445, 1.000, 8.973, 7.762	7.762	
$m_x \cdot M_x/M_{ax}$	0.6x36.2/45.1	0.481	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	0.8x36.2/35.6	0.814	OK
$m_x \cdot M_x/M_{ax}$	0.6x36.2/45.1	0.481	OK
Compare with Simplified to 4.8.3.3	0.59, 0.949, 0.949	0.949	
Compare with MoreExact to 4.8.3.3	0.521, 0.949, 0.662	0.949	

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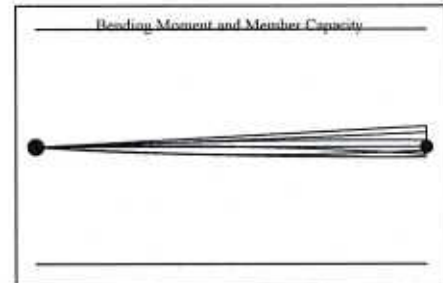
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Axial with Moments (Member)

Member SCL1Id 6 @ Level 1 in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

**Member Forces in Load Case 1**

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
7	1 2	28.429C 27.076C	-6.044 -6.044	0.000 -19.128		0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (31.14 kg/m)

254x146 UB 31 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

8.49, 36.5, 275, 28.43, 19.13, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check F_{vx}/P_{vx} $6.044 / 248.886 =$

0.024

Low Shear

 $M_{cx} = p_y.S_{xx} \leq 1.2 p_y.Z_{xx}$ $275 \times 393.1 \leq 1.2 \times 275 \times 351.18 =$

108.103 kN.m

 $P_z = A_g p_y$ $39.67 \times 275 =$

1090.925 kN

 $n = F/P_z$ $28.429 / 1090.925 =$

0.026

OK

 $S_{rx} = F_n(S_{xx}, n)$ $393.1, 0.026$ 392.65 cm³ $M_{rx} = S_{rx}.p_y$ 392.65×275

107.98 kN.m

 $(M_x/M_{rx})^{2.1} + (M_y/M_{ry})^{2.2}$ $(19.128/107.98)^{2.1} + (0)^{2.2} =$

0.031

OK

Compression Resistance P_c $\lambda_x = L_{ex}/r_{xx}$ $100 \times 1 \times 3.165 / 10.55 =$

30

OK

 $P_{cx} = A_{area}.p_{cx}$ $39.67 \times 267.209 / 10 =$

1060.020 kN

Table 24 a

 $\lambda_y = L_{ey}/r_{yy}$ $100 \times 1 \times 3.165 / 3.36 =$

94.2

OK

 $P_{cy} = A_{area}.p_{cy}$ $39.67 \times 152.02 / 10 =$

603.065 kN

Table 24 b

Equivalent Uniform Moment Factors m_{LT} , m_x , m_y and m_{yx} $m_{LT} = 0.2 + (0.15M_2 + 0.5M_3 + 0.15M_4)/M_{max}$ $0.2 + (0.15 \times 5 + 0.5 \times 10 + 0.15 \times 14) / 19 \geq 0.44$

0.6

Table 18

 $m_y = 0.2 + (0.1M_2 + 0.6M_3 + 0.1M_4)/M_{max}$ $0.2 + (0.1 \times 0 + 0.6 \times 0 + 0.1 \times 0) / 0 \geq 0.8 \times 0 / 0$

1

Table 26

 $m_x = 0.2 + (0.1M_2 + 0.6M_3 + 0.1M_4)/M_{max}$ $0.2 + (0.1 \times 5 + 0.6 \times 10 + 0.1 \times 14) / 19 \geq 0.8 \times 14 / 19$

0.6

Table 26

 $m_{yx} = 0.2 + (0.1M_2 + 0.6M_3 + 0.1M_4)/M_{max}$ $0.2 + (0.1 \times 0 + 0.6 \times 0 + 0.1 \times 0) / 0 \geq 0.8 \times 0 / 0$

1

Table 26

Lateral Buckling Check M_b $L_e = 1.00 L$ $1 \times 3.165 =$

3.165 m

 $\lambda = L_e/r_{yy}$ $3.165 / 3.36$

94.2

OK

 $v = F_n(x, L_e, r_{yy}, \lambda)$ $29.496, 3.165, 3.36, 94.2$

0.902

Table 19

 $\lambda_{LT} = u.v.\lambda.\sqrt{\beta_w}$ $0.88 \times 0.902 \times 94.2 \sqrt{1}$

74.8

 $p_b = F_n(p_y, \lambda_{LT}, \tau)$ $275, 74.8$ 176.87 N/mm²

Table 16

 $M_b = S_{xx}.p_b \leq M_c$ $393.1 \times 176.87 \leq 108.103 =$

69.526 kN.m

Combined Axial Compression and Bending to Annex I $r_b = m_{LT}.M_{LT}/M_b$ $0.6 \times 19.1 / 69.5$

0.165

 $r_c = F_c/P_{cy}$ $28.4 / 603.1$

0.047

 $\lambda_r = (r_b\lambda_{LT} + r_c\lambda_y) / (r_b + r_c)$ $(0.165 \times 74.8 + 0.047 \times 94.2) / (0.165 + 0.047)$

79.110

 $\lambda_{r0} = 17.15 \epsilon (2r_b + r_c) / (r_b + r_c)$ $17.15 \times 1 (2 \times 0.165 + 0.047) / (0.165 + 0.047)$

30.491

 $M_{ob} = M_b(1 - F_c/P_{cy})$ $69.526 (1 - 28.4 / 603.1)$

66.249

 $M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$ $108.103 (1 - 28.4 / 603.1)^{1/2}$

105.524

 $M_{ox} = M_{cx}(1 - F_c/P_{cx}) / (1 + 0.5F_c/P_{cx})$ $108.103 (1 - 28.4 / 1060) / (1 + 0.5 \times 28.4 / 1060)$

103.811

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$M_{oy} = M_{cv}(1 - F_c/P_{cy}) / (1 + k_y(F_c/P_{cy}))$	20.255(1-28.4/603.1)/(1+1.0(28.4/603.1))	18.432	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, \epsilon, M_{xy}, M_{ob})$	79.110, 30.491, 1.000, 105.524, 66.249	71.296	
$M_{ax} = \text{fn}(\lambda_x, \epsilon, M_{rx}, M_{ox})$	30.000, 1.000, 107.980, 103.811	107.200	
$M_{ay} = \text{fn}(\lambda_y, \epsilon, M_{ry}, M_{oy})$	94.196, 1.000, 20.255, 18.432	18.432	
$m_x \cdot M_x / M_{ax}$	0.6x19.1/107.2	0.107	OK
$m_{LT} \cdot M_{LT} / M_{ab}$	0.6x-19.1/71.3	0.161	OK
$m_x \cdot M_x / M_{ax}$	0.6x19.1/107.2	0.107	OK
Compare with Simplified to 4.8.3.3	0.166, 0.212, 0.212	0.212	
Compare with MoreExact to 4.8.3.3	0.135, 0.212, 0.111	0.212	

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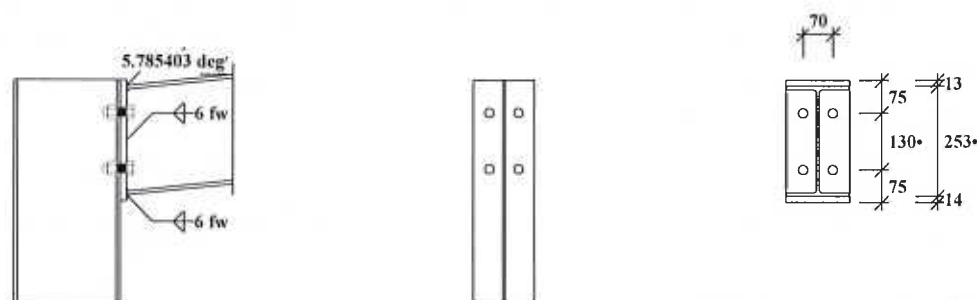
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Welds grd E 35 Plates S 275
 Beam 254x146 UB 31 [S275]
 Column 254x146 UB 31 [S275]
 Top 13 above top flange

End-Plate 280 x 150 x 15 mm (5 kg)
 4 No. M20 Grade 8.8 Bolts in 22 mm holes

Eaves joint at : End 1 of Member SBL1Id 1 - Level 1
Beam to Column Flange End-Plated Connection to BS 5950
Loading Case 001 : Dead plus Live (Ultimate)
Basic Data

Integrated Applied Forces at Column/Right Rafter Interface

Right Rafter Forces M, F _{vr} , F _r	15.9 kNm, 25.5 kN, 8.7 kN
Resultant Forces M, F _v , F	15.9 kNm, 26.3 kN, 6.1 kN
Load directions	Top of Joint in Tension, Rafter moving Down and in Compression.
Design to	BS 5950-1: 2000 and the SCI Green Book: SCI-P-207/95

Basic Dimensions

Column-254x146UB31 [28]	D=251.4, B=146.1, T=8.6, t=6.0, r=7.6, p _y =275
Rafter-254x146UB31 [28]	D=251.4, B=146.1, T=8.6, t=6.0, r=7.6, p _y =275
Bolts 20 mm Ø in 22 mm holes	Grade 8.8 Bolts

Plates S 275, Welds E 35

Rafter Capacities M _c , F _{vc} , F _c	108.8 kN.m, 250.2 kN, 1093.1 kN	M _c = 108.8 kN.m	OK
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Summary of Results (Unity Ratios)

Moment Capacity 22.0 kNm (for 1 rows of bolts) (Modified Applied Moment M _m =15.1 kNm)	0.69	OK
Shear Capacity	0.11	OK
Flange Welds	0.26	OK
Web Welds	0.31, 0.12	OK

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Eaves joint at : End 1 of Member SBL1Id 1 - Level 1
Beam to Column Flange End-Plated Connection to BS 5950
Loading Case 002 : Dead Plus Wind Case 1
Basic Data

Integrated Applied Forces at Column/Right Rafter Interface

Right Rafter Forces M, F _{vr} , F _r	-7.4 kNm, -16.3 kN, -1.2 kN	
Resultant Forces M, F _v , F	-7.4 kNm, -16.4 kN, 0.5 kN	
Load directions	Bottom of Joint in Tension, Rafter moving Up and in Compression.	
Design to	BS 5950-1: 2000 and the SCI Green Book: SCI-P-207/95	
Rafter Capacities M _c , F _{vc} , F _c	108.8 kN.m, 250.2 kN, 1093.1 kN	M _c = 108.8 kN.m OK

Summary of Results (Unity Ratios)

Moment Capacity 14.3 kNm (for 1 rows of bolts) (Modified Applied Moment M _m =7.3 kNm)	0.51	OK
Shear Capacity	0.07	OK
Flange Welds	0.13	OK
Web Welds	0.31	OK

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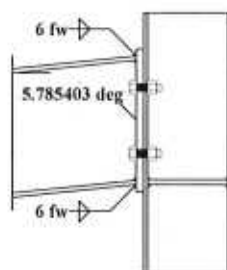
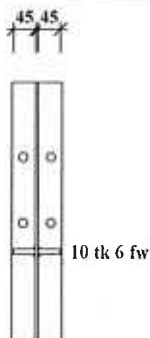
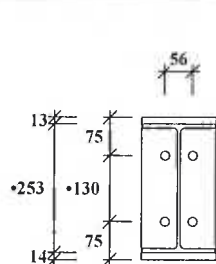
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End-Plate 280 x 150 x 15 mm (5 kg)
4 No. M16 Grade 8.8 Bolts in 18 mm holes

Welds grd E 35 Plates S 275
Beam 254x146 UB 31 [S275]
Column 178x102 UB 19 [S275]
Top 84 above top flange

Beam to Column Flange Joint at : End 2 of Member SBL1Id 1 - Level 1
Beam to Column Flange End-Plated Connection to BS 5950
Loading Case 001 : Dead plus Live (Ultimate)
Basic Data

Integrated Applied Forces at Column/Left Rafter Interface

Left Rafter Forces M, F_{vr}, F_r 15.1 kNm, 25.4 kN, 3.4 kN
 Resultant Forces M, F_v, F 15.1 kNm, 24.9 kN, 6.0 kN
 Load directions Top of Joint in Tension, Rafter moving Down and in Compression.
 Design to BS 5950-1: 2000 and the SCI Green Book: SCI-P-207/95

Basic Dimensions

Column-178x102UB19 [28] D=177.8, B=101.2, T=7.9, t=4.8, r=7.6, py=275
 Rafter-254x146UB31 [28] D=251.4, B=146.1, T=8.6, t=6.0, r=7.6, py=275
 Bolts 16 mm Ø in 18 mm holes Grade 8.8 Bolts
 Plates S 275, Welds E 35
 Rafter Capacities M_c, F_{vc}, F_c 108.8 kN.m, 250.2 kN, 1093.1 kN

M_c = 108.8 kN.m

OK

Summary of Results (Unity Ratios)

Moment Capacity 17.4 kNm (for 1 rows of bolts) (Modified Applied Moment M _m =14.4 kNm)	0.83	OK
Shear Capacity	0.15	OK
Flange Welds	0.25	OK
Web Welds	0.30, 0.11	OK
Column Compression stiff Web Weld	0.15	OK

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Beam to Column Flange Joint at : End 2 of Member SBL1Id 1 - Level 1**Beam to Column Flange End-Plated Connection to BS 5950****Loading Case 002 : Dead Plus Wind Case 1****Basic Data****Integrated Applied Forces at Column/Left Rafter Interface**

Left Rafter Forces M, Fvr, Fr	-9.4 kNm, -16.8 kN, -2.1 kN	
Resultant Forces M, Fv, F	-9.4 kNm, -16.5 kN, -3.8 kN	
Load directions	Bottom of Joint in Tension, Rafter moving Up and in Tension.	
Design to	BS 5950-1: 2000 and the SCI Green Book: SCI-P-207/95	
Rafter Capacities Mc, Fvc, Fc	108.8 kN.m, 250.2 kN, 1093.1 kN	Mc = 108.8 kN.m OK

Summary of Results (Unity Ratios)

Tensile Capacity		0.04	OK
Moment Capacity 17.9 kNm (for 1 rows of bolts) (Modified Applied Moment Mm=9.8 kNm)		0.55	OK
Shear Capacity		0.10	OK
Shear Capacity (Fv & T)		0.07	OK
Column Tension Stiffener at row 0	0.00, 0.15, 0.01, 0.06, 0.22	0.22	OK
Flange Welds	0.17	0.17	OK
Web Welds	0.31, 0.07	0.31	OK

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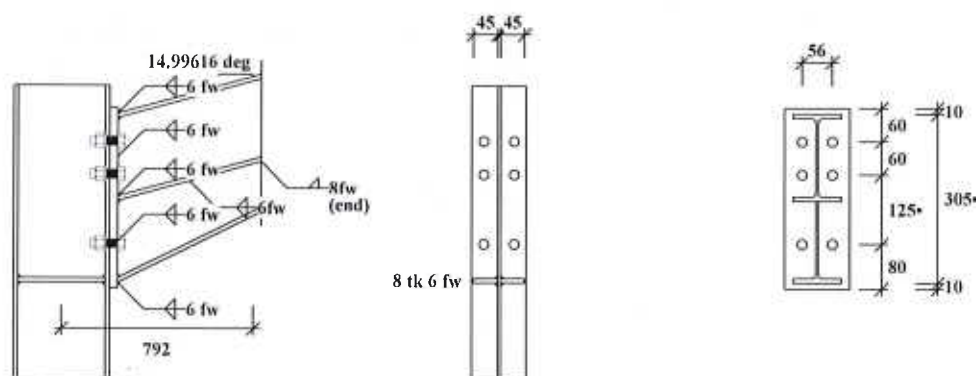
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Welds grd E 35 Plates S 275

Beam 152x89 UB 16 [S275]

Haunch 152x89 UB 16 [S275]

Column 178x102 UB 19 [S275]

Top 50 above top flange

End-Plate 325 x 120 x 15 mm (5 kg)
6 No. M16 Grade 8.8 Bolts in 18 mm holes

Eaves joint at : End 1 of Member SBL1Id 2 - Level 1
Beam to Column Flange End-Plated Connection to BS 5950
Loading Case 001 : Dead plus Live (Ultimate)
Basic Data

Integrated Applied Forces at Column/Right Rafter Interface

Right Rafter Forces M, F_{vr}, F_r 27.3 kNm, 22.4 kN, 15.1 kN
 Resultant Forces M, F_v, F 27.3 kNm, 25.6 kN, 8.7 kN
 Load directions Top of Joint in Tension, Rafter moving Down and in Compression.
 Design to BS 5950-1: 2000 and the SCI Green Book: SCI-P-207/95

Basic Dimensions

Column-178x102UB19 [28] D=177.8, B=101.2, T=7.9, t=4.8, r=7.6, p_y=275
 Rafter-152x89UB16 [28] D=152.4, B=88.7, T=7.7, t=4.5, r=7.6, p_y=275
 Haunch-152x89UB16 [28] D=152.4, B=88.7, T=7.7, t=4.5, r=7.6, p_y=275
 Bolts 16 mm Ø in 18 mm holes Grade 8.8 Bolts
 Plates S 275, Welds E 35
 Rafter Capacities M_c, F_{vc}, F_c 83.8 kN.m, 226.6 kN, 747.7 kN

M_c = 83.8 kN.m**OK****Summary of Results (Unity Ratios)**

Moment Capacity 32.5 kNm (for 2 rows of bolts) (Modified Applied Moment M _m =25.3 kNm)	0.78	OK
Shear Capacity	0.12	OK
Flange Welds	0.62	OK
Web Welds	0.34, 0.11	OK
Haunch Welds	0.96	OK
Column Compression stiff Web Weld	0.22	OK
End of Haunch Compression Zone	0.04, 0.04	OK

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Eaves joint at : End 1 of Member SBL1Id 2 - Level 1
Beam to Column Flange End-Plated Connection to BS 5950
Loading Case 002 : Dead Plus Wind Case 1
Basic Data

Integrated Applied Forces at Column/Right Rafter Interface

Right Rafter Forces M, F _v , F _r	-12.8 kNm, -13.4 kN, -8.2 kN	
Resultant Forces M, F _v , F	-12.8 kNm, -15.0 kN, -4.5 kN	
Load directions	Bottom of Joint in Tension, Rafter moving Up and in Tension.	
Design to	BS 5950-1: 2000 and the SCI Green Book: SCI-P-207/95	
Rafter Capacities M _c , F _{vc} , F _c	83.8 kN.m, 226.6 kN, 747.7 kN	Mc = 83.8 kN.m OK

Summary of Results (Unity Ratios)

Tensile Capacity		0.02	OK
Moment Capacity 21.5 kNm (for 2 rows of bolts) (Modified Applied Moment M _m =13.1 kNm)		0.61	OK
Moment Capacity 21.5 kNm (for the 1 rows of bolts required in the tension zone)		0.61	OK
Shear Capacity		0.05	OK
Shear Capacity (F _v & T)		0.04	OK
Column Tension Stiffener at row 0	0.00, 0.16, 0.93, 0.93	0.93	OK
Beam Tension Stiffener at row 1	0.10, 0.44, 0.90	0.90	OK
Flange Welds	0.32	0.32	OK
Web Welds	0.29, 0.05	0.29	OK
Haunch Welds	0.96	0.96	OK

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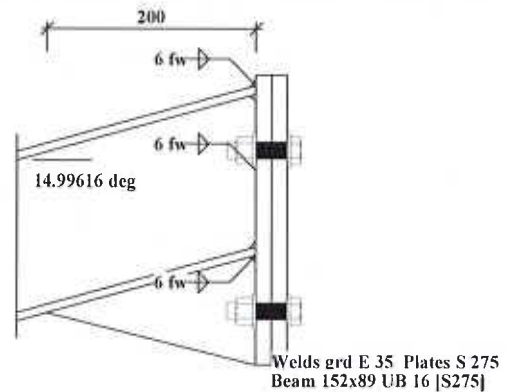
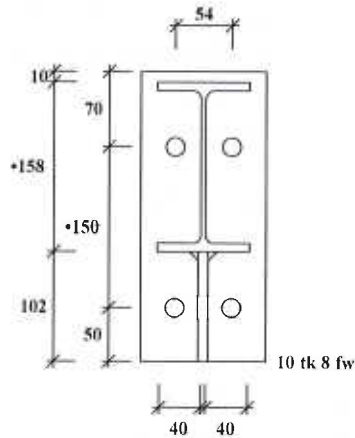
Sheet : 46

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End-Plate 270 x 120 x 15 mm (4 kg)
4 No. M16 Grade 8.8 Bolts in 18 mm holes

Apex joint at : End 2 of Member SBL1Id 2 - Level 1
Beam to Beam End-Plated Connection to BS 5950
Loading Case 001 : Dead plus Live (Ultimate)
Basic Data

Integrated Applied Forces at End-plate Interface

Left Rafter Forces M, F_{vr}, F_r -16.2 kNm, 3.0 kN, 8.1 kN
 Resultant Forces M, F_v, F -16.2 kNm, 0.8 kN, 8.6 kN
 Load directions Bottom of Joint in Tension, Rafter moving Down and in Compression.
 Design to BS 5950-1: 2000 and the SCI Green Book: SCI-P-207/95

Basic Dimensions

Rafter-152x89UB16 [28]	D=152.4, B=88.7, T=7.7, t=4.5, r=7.6, p _y =275		
Bolts 16 mm Ø in 18 mm holes	Grade 8.8 Bolts		
Plates S 275, Welds E 35			
Rafter Capacities M _c , F _{vc} , F _c	35.4 kN.m, 117.1 kN, 565.4 kN	M _c = 35.4 kN.m	OK

Summary of Results (Unity Ratios)

Moment Capacity 36.2 kNm (for 1 rows of bolts) (Modified Applied Moment M _m =15.6 kNm)	0.43	OK
Shear Capacity	0.00	OK
Extended End-plate Stiffener	0.47, 0.88, 0.88	OK
Flange Welds	0.43	OK
Web Welds	0.00, 0.00	OK

SIDEBOTTOM RICHARDSON CHENG LTD.³

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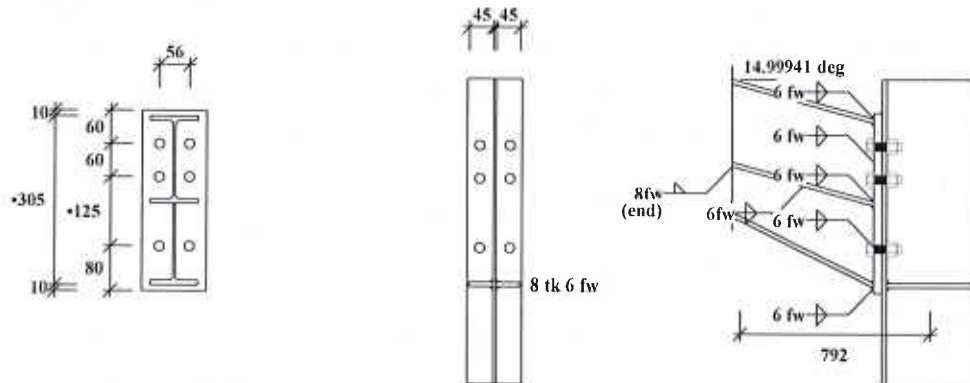
Sheet : 47

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Date : 09 April 2020 / Ver. 2017.14

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End-Plate 325 x 120 x 15 mm (5 kg)
6 No. M16 Grade 8.8 Bolts in 18 mm holes

Welds grd E 35 Plates S 275
Beam 152x89 UB 16 [S275]
Haunch 152x89 UB 16 [S275]

Column 178x102 UB 19 [S275]
Top 70 above top flange

Eaves joint at : End 2 of Member SBL1Id 3 - Level 1
Beam to Column Flange End-Plated Connection to BS 5950
Loading Case 001 : Dead plus Live (Ultimate)
Basic Data

Integrated Applied Forces at Column/Left Rafter Interface

Left Rafter Forces M, Fvr, Fr	34.0 kNm, 23.9 kN, 15.5 kN
Resultant Forces M, Fv, F	34.0 kNm, 27.1 kN, 8.7 kN
Load directions	Top of Joint in Tension, Rafter moving Down and in Compression.
Design to	BS 5950-1: 2000 and the SCI Green Book: SCI-P-207/95

Basic Dimensions

Column-178x102UB19 [28]	D=177.8, B=101.2, T=7.9, t=4.8, r=7.6, py=275
Rafter-152x89UB16 [28]	D=152.4, B=88.7, T=7.7, t=4.5, r=7.6, py=275
Haunch-152x89UB16 [28]	D=152.4, B=88.7, T=7.7, t=4.5, r=7.6, py=275
Bolts 16 mm Ø in 18 mm holes	Grade 8.8 Bolts
Plates S 275, Welds E 35	
Rafter Capacities Mc, Fvc, Fc	83.8 kN.m, 226.6 kN, 747.7 kN

Mc = 83.8 kN.m **OK****Summary of Results (Unity Ratios)**

Moment Capacity 32.5 kNm (for 2 rows of bolts) (Modified Applied Moment Mm=32.0 kNm)	0.98	OK
Shear Capacity	0.13	OK
Flange Welds	0.78	OK
Web Welds	0.34, 0.11	OK
Haunch Welds	0.96	OK
Column Compression stiff Web Weld	0.27	OK
End of Haunch Compression Zone	0.06, 0.06	OK

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Eaves joint at : End 2 of Member SBL1Id 3 - Level 1
Beam to Column Flange End-Plated Connection to BS 5950
Loading Case 005 : Dead Plus Wind Case 4
Basic Data

Integrated Applied Forces at Column/Left Rafter Interface

Left Rafter Forces M, F _{vr} , F _r	-19.7 kNm, -15.7 kN, -4.7 kN	
Resultant Forces M, F _v , F	-19.7 kNm, -16.4 kN, -0.5 kN	
Load directions	Bottom of Joint in Tension, Rafter moving Up and in Tension.	
Design to	BS 5950-1: 2000 and the SCI Green Book: SCI-P-207/95	
Rafter Capacities M _c , F _{vc} , F _c	83.8 kN.m, 226.6 kN, 747.7 kN	M _c = 83.8 kN.m OK

Summary of Results (Unity Ratios)

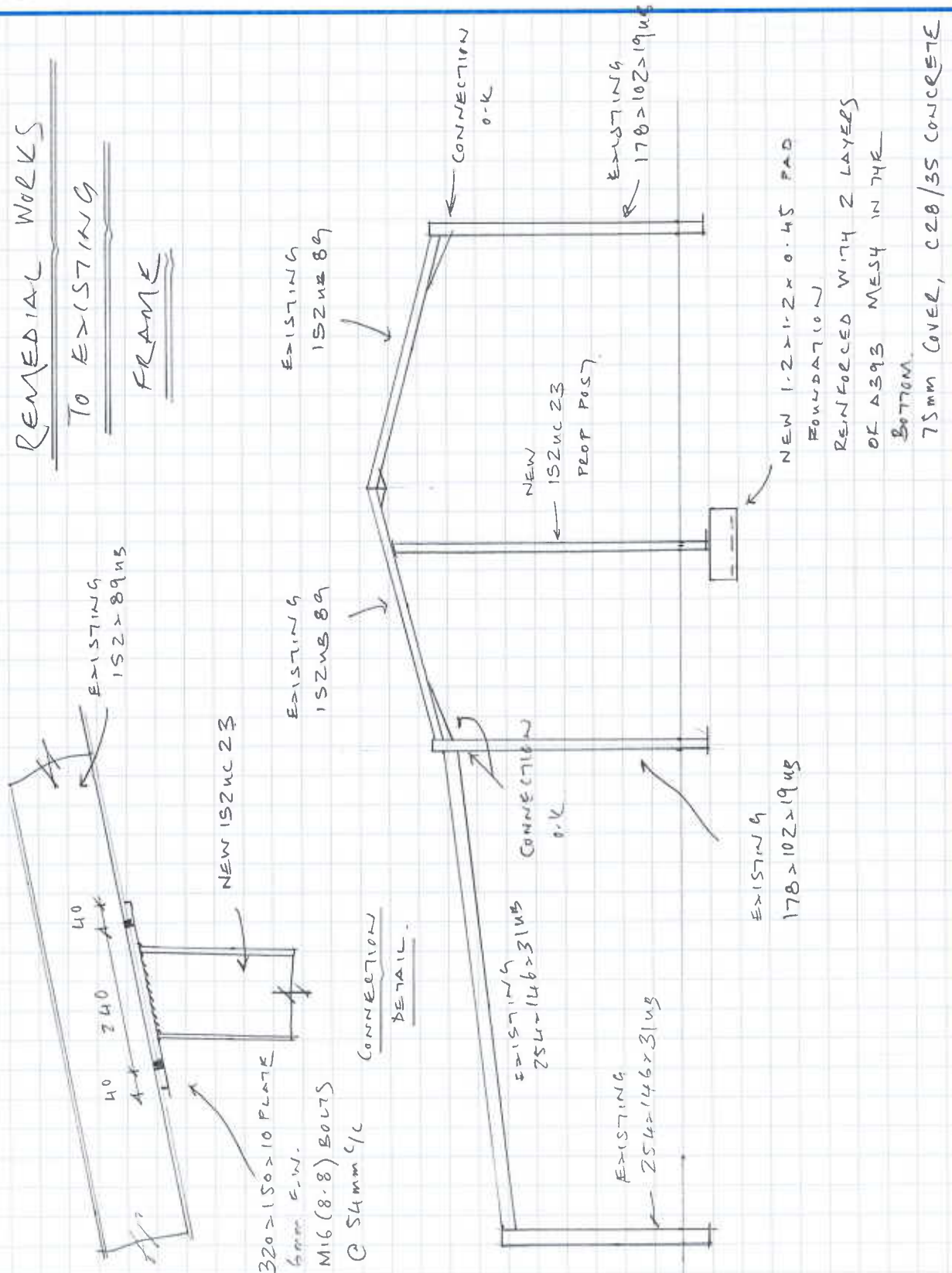
Tensile Capacity		0.00	OK
Moment Capacity 23.1 kNm (for 2 rows of bolts) (Modified Applied Moment M _m =19.7 kNm)		0.86	OK
Moment Capacity 21.9 kNm (for the 1 rows of bolts required in the tension zone)		0.90	OK
Shear Capacity		0.06	OK
Shear Capacity (F _v & T)		0.05	OK
Column Tension Stiffener at row 0	0.00, 0.16, 0.93, 0.93	0.93	OK
Beam Tension Stiffener at row 1	0.10, 0.44, 0.90	0.90	OK
Flange Welds	0.48	0.48	OK
Web Welds	0.29, 0.05	0.29	OK
Haunch Welds	0.96	0.96	OK

PROJECT:

REMEDIAL WORKS

TO EXISTING

FRAME


$$178 > 10Z > 1945$$

NEW 1.2 x 1.2 x 0.45 PAD
FOUNDATION
REINFORCED WITH 2 LAYERS
OF A393 MESH IN THE
BOTTOM.
75mm COVER, C28/35 CON

PROJECT:

PAD FOUNDATION TO NEW 'PROP' COLUMN

SUMMARY OF UNFACTORED FOUNDATION LOADS

DEAD + IMP	↓ = 28.3 kN	→ = 0.3 kN	*
DEAD + WC1	↑ = 9.6 kN	→ = 0.8 kN	
DEAD + WC2	↑ = 3.9 kN	→ = 0.4 kN	
DEAD + WC3	↑ = 8.1 kN	→ = 0.6 kN	
DEAD + WC4	↑ = 12.5 kN	→ = 0.3 kN	*
DEAD + WC5	↑ = 6.9 kN	→ = 0.1 kN	

TRY BASE SIZE

$$\begin{aligned} \text{SELF WT OF BASE} &= 1.2 \times 1.2 \times 0.45 \times 25 = 16.20 \text{ kN} \\ \text{WT OF BACKFILL} &= 1.2 \times 1.2 \times 0.45 \times 18 = 11.66 \text{ kN} \\ &27.86 \text{ kN} \end{aligned}$$

DEAD + IMP

$$\text{TOTAL VERTICAL LOAD} = 28.3 + 27.86 = 56.16 \text{ kN}$$

$$\text{MOMENT DUE TO HORIZONTAL THRUST} = 0.3 \times 0.45 = 0.135 \text{ kNm}$$

$$e = \frac{0.135}{56.16} = 0.002 \text{ m} < L/6$$

$$p = \frac{56.16}{1.2 \times 1.2} \left(1 \pm 6 \times \frac{0.002}{1.2} \right) = 39.39 \text{ kN/m}^2 \quad \checkmark$$

DEAD + WC4

$$\text{TOTAL VERTICAL LOAD} = 27.86 - 12.5 = 15.36 \text{ kN}$$

$$\text{MOMENT DUE TO HORIZONTAL THRUST} = 0.3 \times 0.45 = 0.135 \text{ kNm}$$

$$e = \frac{0.135}{15.36} = 0.009 \text{ m} < L/6$$

$$p = \frac{15.36}{1.2 \times 1.2} \left(1 \pm 6 \times \frac{0.009}{1.2} \right) = 11.15 \text{ kN/m}^2 \quad \checkmark$$

∴ PROVIDE A 1.2 x 1.2 x 0.45 PAD FOUNDATION

REINFORCED WITH 2 LAYERS OF A393

MESH IN THE BOTTOM, 75mm COVER, C28/35 CONCRETE

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MasterFrame Data File

Loading Cases and Load Combination

Load Group Labels

Load Group UT	Unity Load Factor (All Cases)
Load Group D1	Dead Load
Load Group L1	Live Load
Load Group W1	Wind Load
Load Group W2	Wind Load
Load Group W3	Wind Load
Load Group W4	Wind Load
Load Group W5	Wind Load

Load Case 001 : Dead plus Live (Ultimate)

Load Combination + 1.00 UT + 1.40 D1 + 1.60 L1

Load Case 002 : Dead Plus Wind Case 1

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W1

Load Case 003 : Dead Plus Wind Case 2

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W2

Load Case 004 : Dead Plus Wind Case 3

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W3

Load Case 005 : Dead Plus Wind Case 4

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W4

Load Case 006 : Dead Plus Wind Case 5

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W5

The Nodal Co-ordinates

Node	X (m)	Y (m)	Z (m)	Node	X (m)	Y (m)	Z (m)
1	8.340	0.000	0.000	2	11.740	0.000	0.000
3	0.000	0.000	0.000	4	0.000	3.165	0.000
5	8.340	4.010	0.000	6	17.149	0.000	0.000
7	8.340	4.210	0.000	8	11.740	5.121	0.000
9	12.745	5.390	0.000	10	17.149	4.210	0.000

Member Properties**Members 1 & 7**

M	...	254x146 UB 31 [S 275]	
A	39.67E-4	Ix 4414E-8	Iy 448.4E-8
E	205.0E6	G 78.85E6	J 8.55E-8

Members 2-3 (0.800m Haunch End1 (304.8), 0.500m Haunch End2 (228.6))

MD	...	152x89 UB 16 [S 275]	
A	20.32E-4	Ix 835.2E-8	Iy 90.6E-8
E	205.0E6	G 78.85E6	J 3.56E-8

Member 4 (0.500m Haunch End1 (228.6), 0.800m Haunch End2 (304.8))

MD	...	152x89 UB 16 [S 275]	
A	20.32E-4	Ix 835.2E-8	Iy 90.6E-8
E	205.0E6	G 78.85E6	J 3.56E-8

Members 5 & 8-9

M	...	178x102 UB 19 [S 275]	
---	-----	-----------------------	--

SIDEBOTTOM RICHARDSON CHENG LTD.³**Consulting Structural and Civil Engineers****15 High Street, Spalding****Lincolnshire PE11 1TW****Telephone: 01775 712660****Job Ref : 14020****Sheet : 52****Made by : MAS****Date : 22 April 2020 / Ver. 2017.14****Checked :****Approved :**A 24.26E-4
E 205.0E6Ix 1357E-8
G 78.85E6

Iy 137.6E-8

J 4.41E-8

Member 6M
A 29.24E-4
E 205.0E6

152x152 UC 23 [S 275]

Ix 1251E-8
G 78.85E6

Iy 400.8E-8

J 4.63E-8

Member Loading

Member Self Weight Density Load Included in Load Group D1, defined by Modulus of Elasticity

E kN/mm²Density kN/m³

>= 200.00

77.01

>= 20.00

24.00

>= 2.00

10.00

Member 1

D1	UDLY	-000.793	{	kN/m	}
L1	UDLY	-002.973	{	kN/m	}
W1	UDLN	+003.679	{	kN/m	}
W2	UDLN	+002.093	{	kN/m	}
W3	UDLN	+003.171	{	kN/m	}
W4	UDLN	+001.903	{	kN/m	}
W5	UDLN	+000.317	{	kN/m	}
UT	PartFix	20.00	---	+++	{Mx My Mz}

Members 2-3

D1	UDLY	-000.793	{	kN/m	}
L1	UDLY	-002.973	{	kN/m	}
W1	UDLN	+003.679	{	kN/m	}
W2	UDLN	+002.093	{	kN/m	}
W3	UDLN	+003.171	{	kN/m	}
W4	UDLN	+001.903	{	kN/m	}
W5	UDLN	+000.317	{	kN/m	}

Member 4

D1	UDLY	-000.793	{	kN/m	}
L1	UDLY	-002.973	{	kN/m	}
W1	UDLN	+001.903	{	kN/m	}
W2	UDLN	+000.317	{	kN/m	}
W3	UDLN	+003.171	{	kN/m	}
W4	UDLN	+003.679	{	kN/m	}
W5	UDLN	+002.093	{	kN/m	}

Member 7

W1	UDLX	+001.586	{	kN/m	}
W2	UDLX	+003.171	{	kN/m	}
W3	UDLX	-002.220	{	kN/m	}
W4	UDLX	-001.268	{	kN/m	}
W5	UDLX	+000.317	{	kN/m	}

Member 9

W1	UDLX	+001.268	{	kN/m	}
W2	UDLX	-000.317	{	kN/m	}
W3	UDLX	+002.220	{	kN/m	}
W4	UDLX	-001.586	{	kN/m	}
W5	UDLX	-003.171	{	kN/m	}

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Member Orientation

Member 6 @ +180.00

Nodal Loading and Support Conditions

NODES 1-3 & 6

UT Rs 1 1 1 0 0 0 (Pinned)

NODE 1

UT Rs 0 1 0 0 0 0

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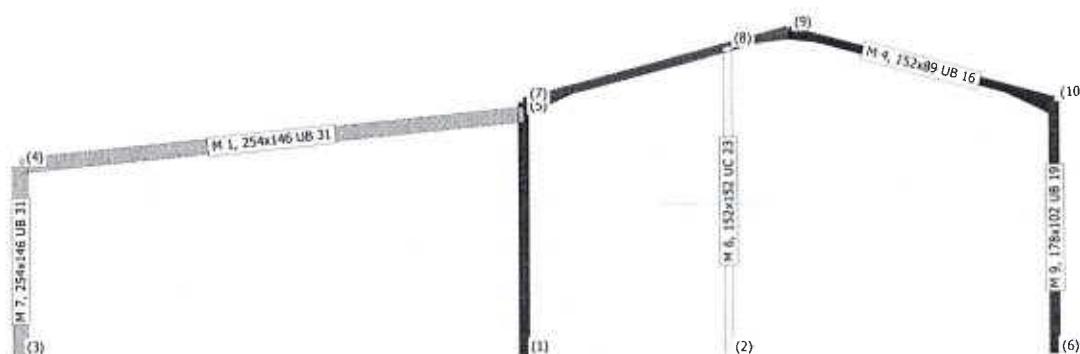
Sheet : 54

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Frame Geometry - (Full Frame) - Front View

Not to Scale

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Nodal Deflections (001 : Dead plus Live (Ultimate))

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	-0.41	0.00	2	0.00	0.00	-0.25	0.00
3	0.00	0.00	-0.29	0.00	4	19.75	-0.11	-0.50	19.75
5	19.70	-0.27	-0.02	19.70	6	0.00	0.00	-0.54	0.00
7	19.77	-0.28	-0.03	19.78	8	19.73	-0.23	-0.16	19.73
9	20.99	-5.01	-0.31	21.58	10	22.24	-0.16	0.16	22.24

Nodal Deflections (002 : Dead Plus Wind Case 1)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	0.26	0.00	2	0.00	0.00	0.23	0.00
3	0.00	0.00	0.18	0.00	4	-13.29	0.07	0.34	13.29
5	-13.27	0.19	0.04	13.28	6	0.00	0.00	0.17	0.00
7	-13.44	0.20	0.05	13.44	8	-13.36	0.09	0.00	13.36
9	-13.38	0.24	0.01	13.38	10	-13.34	0.06	0.08	13.34

Nodal Deflections (003 : Dead Plus Wind Case 2)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	0.10	0.00	2	0.00	0.00	0.10	0.00
3	0.00	0.00	0.04	0.00	4	-5.34	0.03	0.17	5.34
5	-5.39	0.08	0.03	5.40	6	0.00	0.00	0.10	0.00
7	-5.51	0.08	0.04	5.51	8	-5.52	0.04	-0.02	5.52
9	-5.40	-0.43	-0.03	5.41	10	-5.29	-0.01	0.05	5.29

Nodal Deflections (004 : Dead Plus Wind Case 3)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	0.29	0.00	2	0.00	0.00	0.22	0.00
3	0.00	0.00	0.25	0.00	4	-14.25	0.06	0.29	14.25
5	-14.16	0.17	0.03	14.16	6	0.00	0.00	0.17	0.00
7	-14.27	0.17	0.03	14.27	8	-14.14	0.07	0.03	14.14
9	-14.38	1.11	0.08	14.42	10	-14.50	0.11	0.05	14.50

Nodal Deflections (005 : Dead Plus Wind Case 4)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\Phi Z \nearrow$	δXY
1	0.00	0.00	0.39	0.00	2	0.00	0.00	0.25	0.00
3	0.00	0.00	0.39	0.00	4	-19.39	0.02	0.30	19.39
5	-19.37	0.06	0.05	19.37	6	0.00	0.00	0.59	0.00
7	-19.52	0.06	0.04	19.53	8	-19.52	0.11	0.15	19.52
9	-20.55	3.98	0.25	20.93	10	-21.57	0.10	-0.16	21.57

SIDEBOTTOM RICHARDSON CHENG LTD.³

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Nodal Deflections (006 : Dead Plus Wind Case 5)

Node	Nodal Def. (mm and Degrees)				Node	Nodal Def. (mm and Degrees)			
	$\delta X \rightarrow$	$\delta Y \uparrow$	$\phi Z \curvearrowright$	δXY		$\delta X \rightarrow$	$\delta Y \uparrow$	$\phi Z \curvearrowright$	δXY
1	0.00	0.00	0.23	0.00	2	0.00	0.00	0.13	0.00
3	0.00	0.00	0.25	0.00	4	-11.44	-0.02	0.12	11.44
5	-11.49	-0.05	0.04	11.49	6	0.00	0.00	0.52	0.00
7	-11.60	-0.05	0.02	11.60	8	-11.69	0.06	0.13	11.69
9	-12.56	3.31	0.20	12.99	10	-13.52	0.03	-0.20	13.52

Member Forces Ultimate (001 : Dead plus Live (Ultimate))

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	4	9.304C	27.231	-20.610	38.873	28.788
	5	4.010C	-25.018	-11.335	@ 4.359	@ 4.275
2	7	6.255C	7.435	-2.562	-11.193	4.086
	8	0.891C	-12.589	-11.632	@ 3.485	@ 3.203
3	8	7.516C	13.248	-10.169	-11.193	4.086
	9	5.931C	7.329	0.535	@ 3.485	@ 3.203
4	9	1.473C	9.312	0.535	8.157	7.735
	10	8.422C	-16.625	-16.136	@ 1.641	@ 1.915
5	1	34.388C	2.393	0.000	9.502	4.070
	5	33.339C	2.393	9.598	@ 3.970	@ 2.406
6	2	28.285C	-0.286	0.000		0.960
	8	26.671C	-0.286	-1.463	@	@ 2.970
7	3	29.384C	-6.512	0.000		1.463
	4	28.030C	-6.512	-20.610	@	@ 1.836
8	5	8.853C	-4.118	-1.738	9.502	4.070
	7	8.800C	-4.118	-2.562	@ 3.970	@ 2.406
9	6	19.339C	3.833	0.000		6.595
	10	18.238C	3.833	16.136	@	@ 2.442

Member Forces Ultimate (002 : Dead Plus Wind Case 1)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	4	2.098T	-17.531	12.136	-25.693	19.139
	5	3.023T	16.517	7.888	@ 4.275	@ 4.275
2	7	5.311T	-6.960	3.165	4.760	1.261
	8	6.153T	8.026	5.040	@ 3.485	@ 1.619
3	8	8.183T	-2.542	1.080	4.760	1.261
	9	8.432T	1.887	0.739	@ 3.485	@ 1.619

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Job Ref : 14020

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Member Forces Ultimate (002 : Dead Plus Wind Case 1)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
4	9	8.246T	-2.581	0.739	-1.142	0.837
	10	7.155T	5.493	7.378	@ 1.459	@ 3.556
5	1	23.439T	-1.344	0.000	-5.336	2.279
	5	24.188T	-1.344	-5.390	@ 3.970	@ 2.406
6	2	9.580T	0.773	0.000		2.598
	8	10.733T	0.773	3.960		@ 2.970
7	3	16.686T	7.348	0.000		1.176
	4	17.653T	0.321	12.136		@ 1.772
8	5	8.060T	3.329	2.499	-5.336	2.279
	7	8.097T	3.329	3.165	@ 3.970	@ 2.406
9	6	6.371T	1.984	0.000	1.109	0.715
	10	7.158T	-5.489	-7.378	@ 1.095	@ 3.242

Member Forces Ultimate (003 : Dead Plus Wind Case 2)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	4	4.767C	-7.828	4.726	-11.913	8.942
	5	3.843C	7.607	3.801	@ 4.275	@ 4.191
2	7	2.690C	-3.418	1.394	1.853	1.064
	8	1.848C	3.753	1.984	@ 3.485	@ 1.830
3	8	0.935C	-1.271	-0.159	1.853	1.064
	9	0.686C	0.848	-0.379	@ 3.485	@ 1.830
4	9	0.170C	1.077	-0.379	0.912	1.106
	10	1.262C	-0.972	-0.139	@ 2.371	@ 2.325
5	1	9.774T	-0.427	0.000	2.090	0.719
	5	10.524T	-0.427	-1.711	@ 4.010	@ 2.406
6	2	3.936T	0.418	0.000		1.406
	8	5.089T	0.418	2.142		@ 2.970
7	3	6.341T	8.519	0.000	8.173	0.970
	4	7.307T	-5.532	4.726	@ 1.931	@ 1.646
8	5	2.568T	-3.483	2.090	2.090	0.719
	7	2.605T	-3.483	1.394	@ 4.010	@ 2.406
9	6	2.052C	-0.901	0.000	-0.915	0.597
	10	1.265C	0.967	0.139	@ 2.021	@ 2.063

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Member Forces Ultimate (004 : Dead Plus Wind Case 3)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	4	9.333T	-14.364	9.240	-21.549	16.138
	5	10.258T	13.722	6.551	@ 4.275	@ 4.275
2	7	11.824T	-5.405	2.272	4.968	0.868
	8	12.666T	7.077	5.215	@ 3.485	@ 3.379
3	8	14.424T	-1.980	1.914	4.968	0.868
	9	14.673T	1.709	1.773	@ 3.485	@ 3.379
4	9	13.563T	-5.855	1.773	-3.060	1.924
	10	12.472T	10.313	11.936	@ 1.641	@ 1.687
5	1	20.112T	-1.567	0.000	-6.221	2.666
	5	20.862T	-1.567	-6.283	@ 3.970	@ 2.406
6	2	8.050T	0.645	0.000		2.166
	8	9.203T	0.645	3.301		@ 2.970
7	3	14.265T	-1.999	0.000	-0.643	0.244
	4	15.232T	7.838	9.240	@ 0.633	@ 2.216
8	5	8.243T	10.022	0.268	-6.221	2.666
	7	8.281T	10.022	2.272	@ 3.970	@ 2.406
9	6	12.403T	3.707	0.000	2.211	0.937
	10	13.190T	-9.378	-11.936	@ 1.179	@ 3.368

Member Forces Ultimate (005 : Dead Plus Wind Case 4)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	4	1.539T	-5.346	-5.751	-14.823	11.714
	5	2.464T	7.859	4.779	@ 3.353	@ 3.940
2	7	1.231T	0.045	-3.170	7.741	3.435
	8	2.074T	6.279	7.961	@ 3.485	@ 3.062
3	8	5.286T	-7.042	6.203	7.741	3.435
	9	5.535T	-5.200	-0.165	@ 3.485	@ 3.062
4	9	2.195T	-7.270	-0.165	-6.372	6.392
	10	1.104T	12.140	10.937	@ 1.687	@ 1.961
5	1	7.059T	-2.042	0.000	-8.107	3.493
	5	7.808T	-2.042	-8.189	@ 3.970	@ 2.406
6	2	12.546T	0.343	0.000		1.153
	8	13.699T	0.343	1.758		@ 2.970
7	3	4.507T	-4.626	0.000	-6.028	0.660
	4	5.474T	0.992	-5.751	@ 2.595	@ 1.741

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Member Forces Ultimate (005 : Dead Plus Wind Case 4)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
8	5	0.237T	1.201	-3.410	-8.107	3.493
	7	0.275T	1.201	-3.170	@ 3.970	@ 2.406
9	6	11.226T	-7.272	0.000	-11.908	7.683
	10	12.012T	2.076	-10.937	@ 3.284	@ 2.273

Member Forces Ultimate (006 : Dead Plus Wind Case 5)

Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	4	5.327C	4.356	-13.161	1.548	2.124
	5	4.402C	-1.051	0.692	@ 6.706	@ 2.263
2	7	6.769C	3.588	-4.940	4.965	3.010
	8	5.927C	2.006	4.905	@ 3.520	@ 2.922
3	8	3.832C	-5.771	4.965	4.965	3.010
	9	3.583C	-6.239	-1.283	@ 3.520	@ 2.922
4	9	6.222C	-3.612	-1.283	-4.485	5.289
	10	7.313C	5.675	3.420	@ 1.778	@ 2.097
5	1	6.606C	-1.125	0.000		1.934
	5	5.857C	-1.125	-4.510		@ 2.446
6	2	6.901T	-0.012	0.000		0.039
	8	8.054T	-0.012	-0.060		@ 2.970
7	3	5.838C	-3.456	0.000		0.872
	4	4.871C	-4.861	-13.161		@ 1.836
8	5	5.255C	-5.610	-3.818		1.934
	7	5.217C	-5.610	-4.940		@ 2.446
9	6	2.803T	-10.157	0.000	-11.620	7.895
	10	3.589T	8.532	-3.420	@ 2.273	@ 2.147

Support Reactions (001 : Dead plus Live (Ultimate))

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↗ (kN.m)
1	-2.393	34.388	0.000	2	-0.286	28.285	0.000
3	6.512	29.384	0.000	6	-3.833	19.339	0.000
Total	0.000	111.396	0.000				

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Support Reactions (002 : Dead Plus Wind Case 1)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)
1	1.344	-23.439	0.000	2	0.773	-9.580	0.000
3	-7.348	-16.686	0.000	6	-1.984	-6.371	0.000
Total	-7.215	-56.077	0.000				

Support Reactions (003 : Dead Plus Wind Case 2)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)
1	0.427	-9.774	0.000	2	0.418	-3.936	0.000
3	-8.519	-6.341	0.000	6	0.901	2.052	0.000
Total	-6.772	-17.999	0.000				

Support Reactions (004 : Dead Plus Wind Case 3)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)
1	1.567	-20.112	0.000	2	0.645	-8.050	0.000
3	1.999	-14.265	0.000	6	-3.707	-12.403	0.000
Total	0.503	-54.830	0.000				

Support Reactions (005 : Dead Plus Wind Case 4)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)
1	2.042	-7.059	0.000	2	0.343	-12.546	0.000
3	4.626	-4.507	0.000	6	7.272	-11.226	0.000
Total	14.284	-35.338	0.000				

Support Reactions (006 : Dead Plus Wind Case 5)

Node	Support Reactions (kN and kN.m)			Node	Support Reactions (kN and kN.m)		
	Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)		Rx→ (kN)	Ry↑ (kN)	Mz↻ (kN.m)
1	1.125	6.606	0.000	2	-0.012	-6.901	0.000
3	3.456	5.838	0.000	6	10.157	-2.803	0.000
Total	14.726	2.740	0.000				

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Axial with Moments (Member)
Member SBL1Id 1 @ Level 1
Between 0.000 and 2.000 m, in Load Case 1

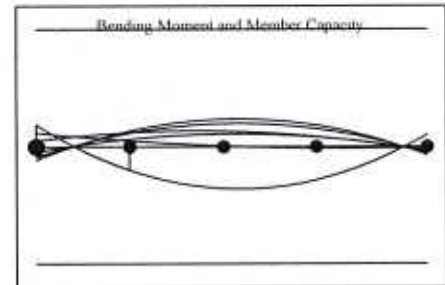
Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)

UT PartFix 20.00 --- +++ (Mt My Mz)



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	4 5	9.304C 4.010C	27.231 -25.018	-20.610 -11.335	@ 38.873 4.359	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (31.14 kg/m) 254x146 UB 31 [S 275]
Class = Fn(b/T,d/t,py,F,Mx,My) 8.49, 36.5, 275, 9.3, 38.86, 0 (Axial: Non-Slender) Plastic
Auto Design Load Cases 1-6

Local Capacity Check

Fvx/Pvx 14.765 / 248.886 = 0.059 Low Shear
Mxx = py.Sxx ≤ 1.2 py.Zxx 275 x 393.1 ≤ 1.2 x 275 x 351.18 = 108.103 kN.m
Pz = Ag.py 39.67 x 275 = 1090.925 kN
n = F/Pz 9.304 / 1090.925 = 0.009 OK
Srx = Fn(Sxx, n) 393.1, 0.009 393.05 cm³
Mrx = Srx.py 393.05 x 275 108.089 kN.m
(Mx/Mrx)² + (My/Mry)² (21.38/108.089)² + (0)² = 0.039 OK

Compression Resistance Pc

λx = Lex/rxx 100x1x8.383/10.55 = 79.5 OK
Pcx = Area.pcx 39.67x204.544/10 = 811.426 kN Table 24 a
λy = Ley/ryy 100x1x2/3.36 = 59.5 OK
Pcy = Area.pcy 39.67x221.39/10 = 878.235 kN Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M2 + .5M3 + .15M4)/Mmax 0.2 + (.15x8 + .5x4 + .15x13)/21 ≥ 0.44 0.44 Table 18
my = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax 0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0 1 Table 26
mx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax 0.2 + (.1x23 + .6x39 + .1x27)/39 ≥ .8x39/39 0.928 Table 26
myx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax 0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0 1 Table 26

Lateral Buckling Check Mb

Le = 1.00 L 1 x 2 = 2 m
λ = Le/ryy 2 / 3.36 59.52 OK
v = Fn(x, Le, ryy, λ) 29.496, 2, 3.36, 59.52 0.955 Table 19
λLT = u.v.λ.√βw 0.88 x 0.955 x 59.52√1 50.03
pb = Fn(py, λLT) 275, 50.03 237.91 N/mm² Table 16
Mb = Sxx.pb ≤ Mc 393.1 x 237.91 ≤ 108.103 = 93.524 kN.m

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb 0.44x21.4/93.5 0.101
rc = Fc/Pcy 9.3/878.2 0.011
λr = (rbλLT + rcλy)/(rb + rc) (0.101x50 + 0.011x59.5)/(0.101 + 0.011) 50.931
λro = 17.15E (2rb + rc)/(rb + rc) 17.15x1(2x0.101 + 0.011)/(0.101 + 0.011) 32.666
Mob = Mb(1 - Fc/Pcy) 93.524(1 - 9.3/878.2) 92.533

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	$108.103(1 - 9.3/878.2)^{1/2}$	107.528	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	$108.103(1 - 9.3/811.4)/(1 + 0.5 \cdot 9.3/811.4)$	106.254	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	$20.255(1 - 9.3/878.2)/(1 + 1.0(9.3/878.2))$	19.831	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, \epsilon, M_{xy}, M_{oh})$	50.931, 32.666, 1.000, 107.528, 92.533	102.742	
$M_{ax} = \text{fn}(\lambda_x, \epsilon, M_{rx}, M_{ox})$	79.457, 1.000, 108.089, 106.254	106.423	
$M_{ay} = \text{fn}(\lambda_y, \epsilon, M_{ry}, M_{oy})$	59.524, 1.000, 20.255, 19.831	19.993	
$m_x \cdot M_x/M_{ax}$	$0.928 \times 38.9/106.4$	0.339	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	$0.44 \times 21.4/102.7$	0.092	OK
$m_x \cdot M_x/M_{ax}$	$0.928 \times 38.9/106.4$	0.186	OK
Compare with Simplified to 4.8.3.3	0.385, 0.111, 0.112	0.385	
Compare with MoreExact to 4.8.3.3	0.347, 0.111, 0.089	0.347	

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Axial with Moments (Member)
Member SBL1Id 1 @ Level 1
Between 2.000 and 4.000 m, in Load Case 1

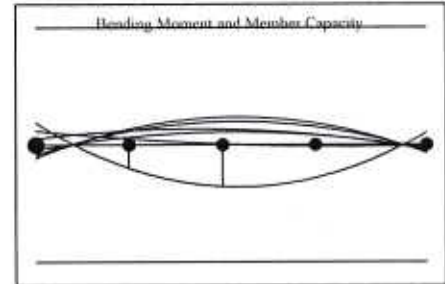
Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)

UT PartFix 20.00 --- +++ (Mt My Mz)



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	4 5	9.304C 4.010C	27.231 -25.018	-20.610 -11.335	@ 38.873 4.359	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (31.14 kg/m) 254x146 UB 31 [S 275]
Class = $F_n(b/T, d/t, p_y, F, M_x, M_y)$ 8.49, 36.5, 275, 9.3, 38.86, 0 (Axial: Non-Slender) Plastic
Auto Design Load Cases 1-6

Local Capacity Check

F_{vx}/P_{vx} 2.299 / 248.886 = 0.009 Low Shear
 $M_{cx} = p_y.S_{xx} \leq 1.2 p_y.Z_{xx}$ 275 x 393.1 $\leq$ 1.2 x 275 x 351.18 = 108.103 kN.m
 $P_z = A_g.p_y$ 39.67 x 275 = 1090.925 kN
 $n = F/P_z$ 9.304 / 1090.925 = 0.009 OK
 $S_{rx} = F_n(S_{xx}, n)$ 393.1, 0.009 393.05 cm³
 $M_{rx} = S_{rx}.p_y$ 393.05 x 275 108.089 kN.m
 $(M_x/M_{rx})^{2.1} + (M_y/M_{ry})^{2.2}$ (38.442/108.089)^{2.1} + (0)^{2.2} = 0.126 OK

Compression Resistance P_c

$\lambda_x = L_{ex}/r_{xx}$ 100x1x8.383/10.55 = 79.5 OK
 $P_{cx} = A_{area}.p_{cx}$ 39.67x204.544/10 = 811.426 kN Table 24 a
 $\lambda_y = L_{ey}/r_{yy}$ 100x1x2/3.36 = 59.5 OK
 $P_{cy} = A_{area}.p_{cy}$ 39.67x221.39/10 = 878.235 kN Table 24 b

Equivalent Uniform Moment Factors m_{LT} , m_x , m_y and m_{yx}

$m_{LT} = 0.2 + (.15M_2 + .5M_3 + .15M_4)/M_{max}$ 0.2 + (.15x28 + .5x33 + .15x37)/38 $\geq$ 0.44 0.881 Table 18
 $m_y = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ 0.2 + (.1x0 + .6x0 + .1x0)/0 $\geq$.8x0/0 1 Table 26
 $m_x = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ 0.2 + (.1x23 + .6x39 + .1x27)/39 $\geq$.8x39/39 0.928 Table 26
 $m_{yx} = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ 0.2 + (.1x0 + .6x0 + .1x0)/0 $\geq$.8x0/0 1 Table 26

Lateral Buckling Check M_b

$L_e = 1.00 L$ 1 x 2 = 2 m
 $\lambda = L_e/r_{yy}$ 2 / 3.36 59.52 OK
 $v = F_n(x, L_e, r_{yy}, \lambda)$ 29.496, 2, 3.36, 59.52 0.955 Table 19
 $\lambda_{LT} = u.v.\lambda.\sqrt{\beta_w}$ 0.88 x 0.955 x 59.52 $\sqrt{1}$ 50.03
 $p_b = F_n(p_y, \lambda_{LT})$ 275, 50.03 237.91 N/mm² Table 16
 $M_b = S_{xx}.p_b \leq M_c$ 393.1 x 237.91 $\leq$ 108.103 = 93.524 kN.m

Combined Axial Compression and Bending to Annex I

$r_b = m_{LT}.M_{LT}/M_b$ 0.881x38.4/93.5 0.362
 $r_c = F_c/P_{cy}$ 9.3/878.2 0.011
 $\lambda_r = (r_b\lambda_{LT} + r_c\lambda_y)/(r_b + r_c)$ (0.362x50 + 0.011x59.5)/(0.362 + 0.011) 50.295
 $\lambda_{ro} = 17.15 \epsilon (2r_b + r_c)/(r_b + r_c)$ 17.15x1(2x0.362 + 0.011)/(0.362 + 0.011) 33.813
 $M_{ob} = M_b(1 - F_c/P_{cy})$ 93.524(1 - 9.3/878.2) 92.533

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	108.103(1-9.3/878.2) ^{1/2}	107.528	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	108.103(1-9.3/811.4)/(1+0.5*9.3/811.4)	106.254	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	20.255(1-9.3/878.2)/(1+1.0(9.3/878.2))	19.831	
$M_{ab} = \text{fn}(\lambda_{rx}, \lambda_{ro}, \epsilon, M_{xy}, M_{ob})$	50.295, 33.813, 1.000, 107.528, 92.533	103.157	
$M_{ax} = \text{fn}(\lambda_{rx}, \epsilon, M_{rx}, M_{ox})$	79.457, 1.000, 108.089, 106.254	106.423	
$M_{ay} = \text{fn}(\lambda_{ry}, \epsilon, M_{ry}, M_{oy})$	59.524, 1.000, 20.255, 19.831	19.993	
$m_x \cdot M_x/M_{ax}$	0.928x38.9/106.4	0.339	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	0.881x38.4/103.2	0.328	OK
$m_x \cdot M_x/M_{ax}$	0.928x38.9/106.4	0.335	OK
Compare with Simplified to 4.8.3.3	0.385, 0.373, 0.374	0.385	
Compare with MoreExact to 4.8.3.3	0.347, 0.373, 0.319	0.373	

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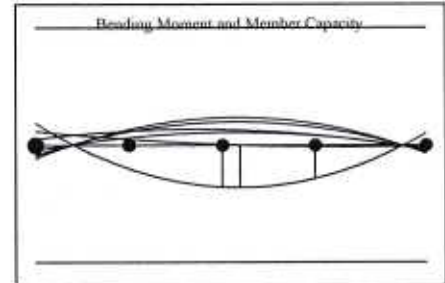
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Axial with Moments (Member)
Member SBL1Id 1 @ Level 1
Between 4.000 and 6.000 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)
L1 UDLY -002.973 (kN/m)
UT PartFix 20.00 --- +++ (Mt My Mz)



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	4 5	9.304C 4.010C	27.231 -25.018	-20.610 -11.335	@ 38.873 4.359	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (31.14 kg/m) 254x146 UB 31 [S 275]
Class = Fn(b/T,d/t,py,F,Mx,My) 8.49, 36.5, 275, 9.3, 38.86, 0 (Axial: Non-Slender) Plastic
Auto Design Load Cases 1-6

Local Capacity Check

Fvx/Pvx 0.1 / 248.886 = 0 Low Shear
Mxx = py.Sxx ≤ 1.2 py.Zxx 275 x 393.1 ≤ 1.2 x 275 x 351.18 = 108.103 kN.m
Pz = Ag.py 39.67 x 275 = 1090.925 kN
n = F/Pz 9.304 / 1090.925 = 0.009 OK
Srx = Fn(Sxx, n) 393.1, 0.009 393.05 cm³
Mrx = Srx.py 393.05 x 275 108.089 kN.m
(Mx/Mrx)²¹ + (My/Mry)²² (38.864/108.089)² + (0)² = 0.129 OK

Compression Resistance Pc

λx = Lex/rxx 100x1x8.383/10.55 = 79.5 OK
Pcx = Area.pcx 39.67x204.544/10 = 811.426 kN Table 24 a
λy = Ley/ryy 100x1x2/3.36 = 59.5 OK
Pcy = Area.pcy 39.67x221.39/10 = 878.235 kN Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M₂ + .5M₃ + .15M₄)/Mmax 0.2 + (.15x39 + .5x38 + .15x35)/39 ≥ 0.44 0.968 Table 18
my = 0.2 + (.1M₂ + .6M₃ + .1M₄)/Mmax 0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0 1 Table 26
mx = 0.2 + (.1M₂ + .6M₃ + .1M₄)/Mmax 0.2 + (.1x23 + .6x39 + .1x27)/39 ≥ .8x39/39 0.928 Table 26
myx = 0.2 + (.1M₂ + .6M₃ + .1M₄)/Mmax 0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0 1 Table 26

Lateral Buckling Check Mb

Le = 1.00 L 1 x 2 = 2 m
λ = Le/ryy 2 / 3.36 = 59.52 OK
v = Fn (x, Le, ryy, λ) 29.496, 2, 3.36, 59.52 0.955 Table 19
λLT = u.v.λ.√βw 0.88 x 0.955 x 59.52√1 50.03
pb = Fn (py, λLT) 275, 50.03 237.91 N/mm² Table 16
Mb = Sxx.pb ≤ Mc 393.1 x 237.91 ≤ 108.103 = 93.524 kN.m

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb 0.968x38.9/93.5 0.402
rc = Fc/Pcy 9.3/878.2 0.011
λr = (rbλLT + rcλy)/(rb + rc) (0.402x50 + 0.011x59.5)/(0.402 + 0.011) 50.269
λro = 17.15E (2rb + rc)/(rb + rc) 17.15x1(2x0.402 + 0.011)/(0.402 + 0.011) 33.860
Mob = Mb(1 - Fc/Pcy) 93.524(1 - 9.3/878.2) 92.533

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	$108.103(1 - 9.3/878.2)^{1/2}$	107.528	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	$108.103(1 - 9.3/811.4)/(1 + 0.5 \cdot 9.3/811.4)$	106.254	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	$20.255(1 - 9.3/878.2)/(1 + 1.0(9.3/878.2))$	19.831	
$M_{ab} = \text{fn}(\lambda_{rx}, \lambda_{ry}, \epsilon, M_{xy}, M_{ob})$	50.269, 33.860, 1.000, 107.528, 92.533	103.175	
$M_{ax} = \text{fn}(\lambda_{rx}, \epsilon, M_{rx}, M_{ox})$	79.457, 1.000, 108.089, 106.254	106.423	
$M_{ay} = \text{fn}(\lambda_{ry}, \epsilon, M_{ry}, M_{oy})$	59.524, 1.000, 20.255, 19.831	19.993	
$m_x \cdot M_x / M_{ax}$	$0.928 \times 38.9 / 106.4$	0.339	OK
$m_{L.T.} \cdot M_{L.T.} / M_{ab}$	$0.968 \times 38.9 / 103.2$	0.365	OK
$m_x \cdot M_x / M_{ax}$	$0.928 \times 38.9 / 106.4$	0.339	OK
Compare with Simplified to 4.8.3.3	0.385, 0.413, 0.414	0.414	
Compare with MoreExact to 4.8.3.3	0.347, 0.413, 0.354	0.413	

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Axial with Moments (Member)
Member SBL1Id 1 @ Level 1
Between 6.000 and 8.383 m, in Load Case 1

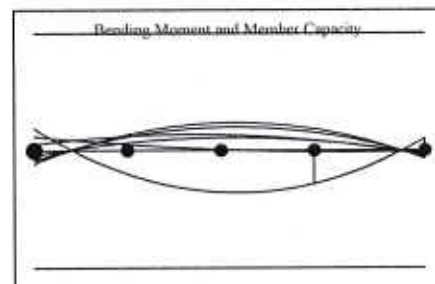
Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)

UT PartFix 20.00 --- +++ (Mt My Mz)



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
1	4 5	9.304C 4.010C	27.231 -25.018	-20.610 +11.335	@ 38.873 4.359	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (31.14 kg/m)

254x146 UB 31 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

8.49, 36.5, 275, 9.3, 38.86, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx	10.167 / 248.886 =	0.041	Low Shear
Mcx = py.Sxx ≤ 1.2 py.Zxx	275 x 393.1 ≤ 1.2 x 275 x 351.18 =	108.103 kN.m	
Pz = Ag.py	39.67 x 275 =	1090.925 kN	
n = F/Pz	9.304 / 1090.925 =	0.009	OK
Srx = Fn(Sxx, n)	393.1, 0.009	393.05 cm³	
Mrx = Srx.py	393.05 x 275	108.089 kN.m	
(Mx/Mrx) ² + (My/Mry) ²	(30.576/108.089) ² + (0) ² =	0.08	OK

Compression Resistance Pc

λx = Lex/rxx	100x1x8.383/10.55 =	79.5	OK
Pcx = Area.pcx	39.67x204.544/10 =	811.426 kN	Table 24 a
λy = Ley/ryy	100x1x2.383/3.36 =	70.9	OK
Pcy = Area.pcy	39.67x200.1/10 =	793.794 kN	Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M2 + .5M3 + .15M4)/Mmax	0.2 + (.15x23 + .5x14 + .15x2)/31 ≥ 0.44	0.557	Table 18
mx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26
my = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x23 + .6x39 + .1x27)/39 ≥ .8x39/39	0.928	Table 26
myx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26

Lateral Buckling Check Mb

Le ≈ 1.00 L	1 x 2.383 =	2.383 m	
λ = Le/ryy	2.383 / 3.36	70.91	OK
v = Fn (x, Le, ryy, λ)	29.496, 2.383, 3.36, 70.91	0.939	Table 19
λLT = u.v.λ.√βw	0.88 x 0.939 x 70.91√1	58.59	
pb = Fn (py, λLT)	275, 58.59	216.75 N/mm²	Table 16
Mb = Sxx.pb ≤ Mc	393.1 x 216.75 ≤ 108.103 =	85.204 kN.m	

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb	0.557x30.6/85.2	0.200	
rc = Fc/Pcy	9.3/793.8	0.012	
λr = (rbλLT + rcλy)/(rb + rc)	(0.2x58.6 + 0.012x70.9)/(0.2 + 0.012)	59.269	
λro = 17.15ε (2rb + rc)/(rb + rc)	17.15x1(2x0.2 + 0.012)/(0.2 + 0.012)	33.350	
Mob = Mb(1 - Fc/Pcy)	85.204(1 - 9.3/793.8)	84.206	

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	$108.103(1 - 9.3/793.8)^{1/2}$	107.467	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	$108.103(1 - 9.3/811.4)/(1 + 0.5 \cdot 9.3/811.4)$	106.254	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	$20.255(1 - 9.3/793.8)/(1 + 1.0(9.3/793.8))$	19.786	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, \epsilon, M_{xy}, M_{ob})$	59.269, 33.350, 1.000, 107.467, 84.206	96.287	
$M_{ax} = \text{fn}(\lambda_x, \epsilon, M_{rx}, M_{ox})$	79.457, 1.000, 108.089, 106.254	106.423	
$M_{ay} = \text{fn}(\lambda_y, \epsilon, M_{ry}, M_{oy})$	70.914, 1.000, 20.255, 19.786	19.888	
$m_x \cdot M_x/M_{ax}$	$0.928 \times 38.9/106.4$	0.339	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	$0.557 \times 30.6/96.3$	0.177	OK
$m_x \cdot M_x/M_{ax}$	$0.928 \times 38.9/106.4$	0.267	OK
Compare with Simplified to 4.8.3.3	0.385, 0.211, 0.211	0.385	
Compare with MoreExact to 4.8.3.3	0.347, 0.211, 0.16	0.347	

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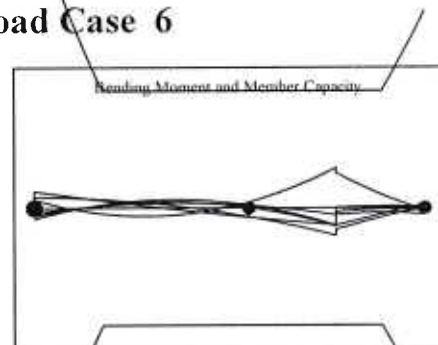
Axial with Moments (Member)
Member SBL1Id 2 @ Level 1
Between 0.000 and 2.500 m, in Load Case 6

Member Loading and Member Forces

Loading Combination : 1 UT + 1 D1 + 1.4 W5

D1 UDLY -000.793 (kN/m)

W5 UDLN +000.317 (kN/m)



Member Forces in Load Case 6						
Mem ber No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
	7 9	6.769C 3.583C	3.588 -6.239	-4.940 -1.283	4.965 3.520	0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (15.95 kg/m)

152x89 UB 16 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

5.76, 27.07, 275, 6.77, 4.97, 0

(Axial: Non-Slender)

Plastic

Sec. Depth = Fn(X)

X = 2.5 m

152.4 mm

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx

2.464 / 113.157 =

0.022

Low Shear

Mcx = py.Sxx ≤ 1.2 py.Zxx

275 x 123.3 ≤ 1.2 x 275 x 109.49 =

33.908 kN.m

Pz = Ag.py

27.17 x 275 =

747.175 kN

n = F/Pz

6.769 / 747.175 =

0.009

OK

Srx = Fn(Sxx, n)

304.2, 0.009

123.27 cm³

Mrx = Srx.py

123.27 x 275

33.898 kN.m

(Mx/Mrx)² + (My/Mry)²

(2.624/33.898)² + (0)¹ =

0.006

OK

Compression Resistance Pc

λx = Lex/rxx

100x1x4.56/12.17 =

37.5

OK

Pcx = Area.pcx

27.17x261.993/10 =

711.835 kN

Table 24 a

λy = Ley/ryy

100x1x2.5/1.82 =

137.4

OK

Pcy = Area.pcy

27.17x86.44/10 =

234.861 kN

Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M₂ + .5M₃ + .15M₄)/Mmax

0.2 + (.15x3 + .5x1 + .15x1)/5 ≥ 0.44

1

Table 18

my = 0.2 + (.1M₂ + .6M₃ + .1M₄)/Mmax

0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0

1

Table 26

mx = 0.2 + (.1M₂ + .6M₃ + .1M₄)/Mmax

0.2 + (.1x-1 + .6x2 + .1x5)/5 ≥ .8x5/5

0.758

Table 26

myx = 0.2 + (.1M₂ + .6M₃ + .1M₄)/Mmax

0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0

1

Table 26

Lateral Buckling Check Mb @ 0 m

Le = 1.00 L

1 x 2.5 =

2.5 m

λ = Le/ryy

2.5 / 1.82

137.44

OK

v = Fn(x, Le, ryy, λ)

43.616, 2.5, 1.82, 137.44

0.904

Table 19

λLT = u.v.λ.√βw

0.864 x 0.904 x 137.44√1

107.37

pb = Fn(py, λLT)

275, 107.37

112.94 N/mm²

Table 16

Mb = Sxx.pb ≤ Mc

304.2 x 112.94 ≤ 83.655 =

34.357 kN.m

Combined Axial Compression and Bending to Annex I @ 0 m

rb = mLT.MLT/Mb

1x-4.9/34.4

0.144

rc = Fc/Pcy

6.8/234.9

0.029

λr = (rbλLT + rcλy)/(rb + rc)

(0.144•107.4 + 0.029•137.4)/(0.144 + 0.029)

112.393

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$\lambda_{ro}=17.15\varepsilon (2r_b+r_c)/(r_b+r_c)$	$17.15 \cdot 1(2 \cdot 0.144+0.029)/(0.144+0.029)$	31.436	
$M_{ob}=M_b(1-F_c/P_{cy})$	$34.357(1-6.8/234.9)$	33.367	
$M_{xy}=M_{cx}(1-F_c/P_{cy})^{1/2}$	$83.655(1-6.8/234.9)^{1/2}$	82.441	
$M_{ox}=M_{cx}(1-F_c/P_{cx})/(1+0.5F_c/P_{cx})$	$83.655(1-6.8/711.8)/(1+0.5 \cdot 6.8/711.8)$	82.467	
$M_{oy}=M_{cy}(1-F_c/P_{cy})/(1+k_y(F_c/P_{cy}))$	$6.689(1-6.8/234.9)/(1+1.0(6.8/234.9))$	6.314	
$M_{ab}=\text{fn}(\lambda_r, \lambda_{ro}, \varepsilon, M_{xy}, M_{ob})$	112.393, 31.436, 1.000, 82.441, 33.367	33.367	
$M_{ax}=\text{fn}(\lambda_x, \varepsilon, M_{rx}, M_{ox})$	37.466, 1.000, 33.898, 82.467	83.297	
$M_{ay}=\text{fn}(\lambda_y, \varepsilon, M_{ry}, M_{oy})$	137.437, 1.000, 6.682, 6.314	6.314	
$m_x.M_x/M_{ax}$	$0.758 \times 4.9/83.3$	0.045	OK
$m_{LT}.M_{LT}/M_{ab}$	$1 \times 4.9/33.4$	0.148	OK
$m_x.M_x/M_{ax}$	$0.758 \times 4.9/83.3$	0.045	OK
Compare with Simplified to 4.8.3.3	0.08, 0.173, 0.173	0.173	
Compare with MoreExact to 4.8.3.3	0.054, 0.173, 0.06	0.173	

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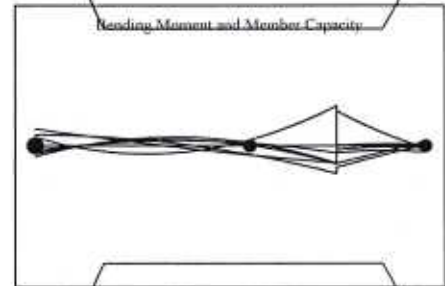
Axial with Moments (Member)
Member SBL1Id 2 @ Level 1
Between 2.500 and 4.560 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
	7 9	6.255C 5.931C	7.435 7.329	-2.562 0.535	-11.193 3.485	0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (15.95 kg/m) 152x89 UB 16 [S 275]
Class = $F_n(b/T, d/t, p_y, F, M_x, M_y)$ 5.76, 27.07, 275, 7.52, 11.63, 0 (Axial: Non-Slender) Plastic
Auto Design Load Cases 1-6

Local Capacity Check

F_{vx}/P_{vx} 13.248 / 113.157 = 0.117 Low Shear
 $M_{cx} = p_y.S_{xx} \leq 1.2 p_y.Z_{xx}$ 275 x 123.3 $\leq$ 1.2 x 275 x 109.49 = 33.908 kN.m
 $P_z = A_g.p_y$ 20.32 x 275 = 558.8 kN
 $n = F/P_z$ 7.516 / 558.8 = 0.013 OK
 $S_{rx} = F_n(S_{xx}, n)$ 123.3, 0.013 123.26 cm³
 $M_{rx} = S_{rx}.p_y$ 123.26 x 275 33.896 kN.m
 $(M_x/M_{rx})^{2.1} + (M_y/M_{ry})^{2.2}$ (11.632/33.896)^{2.1} + (0)^{2.2} = 0.118 OK

Compression Resistance P_c

$\lambda_x = L_{ex}/r_{xx}$ 100x1x4.56/6.41 = 71.2 OK
 $P_{cx} = A_{area}.p_{cx}$ 20.32x221.362/10 = 449.808 kN Table 24 a
 $\lambda_y = L_{ey}/r_{yy}$ 100x1x2.06/2.1 = 98 OK
 $P_{cy} = A_{area}.p_{cy}$ 20.32x144.6/10 = 293.825 kN Table 24 b

Equivalent Uniform Moment Factors m_{LT} , m_x , m_y and m_{yx}

$m_{LT} = 0.2 + (.15M_2 + .5M_3 + .15M_4)/M_{max}$ 0.2 + (.15x6 + .5x10 + .15x4)/10 $\geq$ 0.44 1 Table 18
 $m_y = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ 0.2 + (.1x0 + .6x0 + .1x0)/0 $\geq$.8x0/0 1 Table 26
 $m_x = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ 0.2 + (.1x2 + .6x0 + .1x-10)/12 $\geq$.8x10/12 0.716 Table 26
 $m_{yx} = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ 0.2 + (.1x0 + .6x0 + .1x0)/0 $\geq$.8x0/0 1 Table 26

Lateral Buckling Check M_b

$L_e = 1.00 L$ 1 x 2.06 = 2.06 m
 $\lambda = L_e/r_{yy}$ 2.06 / 2.1 97.99 OK
 $v = F_n(x.L_e, r_{yy}, \lambda)$ 19.539, 2.06, 2.1, 97.99 0.816 Table 19
 $\lambda_{LT} = u.v.\lambda.\sqrt{\beta_w}$ 0.891 x 0.816 x 97.99 $\sqrt{1}$ 71.2
 $p_b = F_n(p_y, \lambda_{LT})$ 275, 71.2 185.49 N/mm² Table 16
 $M_b = S_{xx}.p_b \leq M_c$ 123.3 x 185.49 $\leq$ 33.908 = 22.871 kN.m

Combined Axial Compression and Bending to Annex I

$r_b = m_{LT}.M_{LT}/M_b$ 1x-11.6/22.9 0.509
 $r_c = F_c/P_{cy}$ 7.5/293.8 0.026
 $\lambda_r = (r_b\lambda_{LT} + r_c\lambda_y)/(r_b + r_c)$ (0.509*71.2 + 0.026*98)/(0.509 + 0.026) 72.487
 $\lambda_{ro} = 17.15\epsilon (2r_b + r_c)/(r_b + r_c)$ 17.15*1(2*0.509 + 0.026)/(0.509 + 0.026) 33.479

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$M_{ob} = M_b(1 - F_c/P_{cy})$	22.871(1-7.5/293.8)	22.286	
$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	33.908(1-7.5/293.8) ^{1/2}	33.471	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	33.908(1-7.5/449.8)/(1+0.5•7.5/449.8)	33.065	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	6.682(1-7.5/293.8)/(1+1.0(7.5/293.8))	6.349	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{r0}, \epsilon, M_{xy}, M_{ob})$	72.487, 33.479, 1.000, 33.471, 22.286	25.240	
$M_{ax} = \text{fn}(\lambda_x, \epsilon, M_{rx}, M_{ox})$	71.170, 1.000, 33.896, 33.065	33.242	
$M_{ay} = \text{fn}(\lambda_y, \epsilon, M_{ry}, M_{oy})$	97.992, 1.000, 6.682, 6.349	6.349	
$m_x \cdot M_x / M_{ax}$	0.716x11.6/33.2	0.250	OK
$m_{LT} \cdot M_{LT} / M_{ab}$	1x-11.6/25.2	0.461	OK
$m_x \cdot M_x / M_{ax}$	0.716x11.6/33.2	0.250	OK
Compare with Simplified to 4.8.3.3	0.302, 0.534, 0.534	0.534	
Compare with MoreExact to 4.8.3.3	0.264, 0.534, 0.352	0.534	

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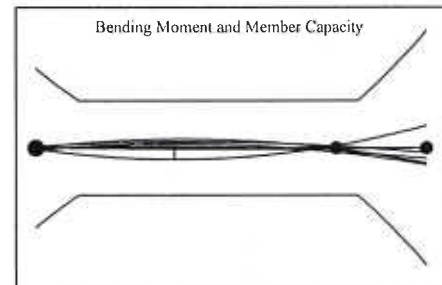
Axial with Moments (Member)
Member SBL1Id 3 @ Level 1
Between 0.000 and 3.500 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 (kN/m)

L1 UDLY -002.973 (kN/m)



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
4	9 10	1.473C 8.422C	-9.312 -16.625	0.535 -16.136	@ 8.157 1.641	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (15.95 kg/m)

152x89 UB 16 [S 275]

Class = Fn(b/T_d,d/t,py,F,Mx,My)

5.76, 27.07, 275, 8.42, 16.14, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

F _{vx} /P _{vx}	0.122 / 113.157 =	0.001	Low Shear
M _{cx} = p _y .S _{xx} ≤ 1.2 p _y .Z _{xx}	275 x 123.3 ≤ 1.2 x 275 x 109.49 =	33.908 kN.m	
P _z = A _g .p _y	20.32 x 275 =	558.8 kN	
n = F/P _z	8.422 / 558.8 =	0.015	OK
S _{rx} = F _n (S _{xx} , n)	123.3, 0.015	123.25 cm ³	
M _{rx} = S _{rx} .p _y	123.25 x 275	33.893 kN.m	
(M _x /M _{rx}) ² + (M _y /M _{ry}) ²	(8.15/33.893) ² + (0) ² =	0.058	OK

Compression Resistance P_c

λ _x = L _{ex} /r _{xx}	100x1x4.559/6.41 =	71.2	OK
P _{cx} = A _{area} .p _{cx}	20.32x221.39/10 =	449.865 kN	Table 24 a
λ _y = L _{ey} /r _{yy}	100x1x3.5/2.1 =	166.5	OK
P _{cy} = A _{area} .p _{cy}	20.32x61.91/10 =	125.796 kN	Table 24 b

Equivalent Uniform Moment Factors m_{LT}, m_x, m_y and m_{yx}

m _{LT} = 0.2 + (0.15M ₂ + 0.5M ₃ + 0.15M ₄)/M _{max}	0.2 + (0.15x7 + 0.5x8 + 0.15x5)/8 ≥ 0.44	1	Table 18
m _y = 0.2 + (0.1M ₂ + 0.6M ₃ + 0.1M ₄)/M _{max}	0.2 + (0.1x0 + 0.6x0 + 0.1x0)/0 ≥ 0.8x0/0	1	Table 26
m _x = 0.2 + (0.1M ₂ + 0.6M ₃ + 0.1M ₄)/M _{max}	0.2 + (0.1x7 + 0.6x7 + 0.1x1)/16 ≥ 0.8x8/16	0.5	Table 26
m _{yx} = 0.2 + (0.1M ₂ + 0.6M ₃ + 0.1M ₄)/M _{max}	0.2 + (0.1x0 + 0.6x0 + 0.1x0)/0 ≥ 0.8x0/0	1	Table 26

Lateral Buckling Check M_b

L _c = 1.00 L	1 x 3.5 =	3.5 m	
λ = L _e /r _{yy}	3.5 / 2.1	166.49	OK
v = F _n (x.L _e ,r _{yy} ,λ)	19.539, 3.5, 2.1, 166.49	0.682	Table 19
λ _{LT} = u.v.λ.√β _w	0.891 x 0.682 x 166.49√1	101.09	
p _b = F _n (p _y ,λ _{LT})	275, 101.09	123.04 N/mm ²	Table 16
M _b = S _{xx} .p _b ≤ M _c	123.3 x 123.04 ≤ 33.908 =	15.171 kN.m	

Combined Axial Compression and Bending to Annex I

r _b = m _{LT} .M _{LT} /M _b	1x8.2/15.2	0.537	
r _c = F _c /P _{cy}	8.4/125.8	0.067	
λ _c = (r _b λ _{LT} + r _c λ _y)/(r _b + r _c)	(0.537•101.1 + 0.067•166.5)/(0.537 + 0.067)	108.340	
λ _{ro} = 17.15√E (2r _b + r _c)/(r _b + r _c)	17.15•1(2•0.537 + 0.067)/(0.537 + 0.067)	32.399	
M _{ob} = M _b (1 - F _c /P _{cy})	15.171(1 - 8.4/125.8)	14.155	

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	$33.908(1 - 8.4/125.8)^{1/2}$	32.753	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	$33.908(1 - 8.4/449.9)/(1 + 0.5 \cdot 8.4/449.9)$	32.964	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	$6.682(1 - 8.4/125.8)/(1 + 1.0(8.4/125.8))$	5.843	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, \epsilon, M_{xy}, M_{ob})$	108.340, 32.399, 1.000, 32.753, 14.155	14.155	
$M_{ax} = \text{fn}(\lambda_x, \epsilon, M_{rx}, M_{ox})$	71.155, 1.000, 33.893, 32.964	33.162	
$M_{ay} = \text{fn}(\lambda_y, \epsilon, M_{ry}, M_{oy})$	166.491, 1.000, 6.682, 5.843	5.843	
$m_x \cdot M_x/M_{ax}$	$0.5 \times 8.2/33.2$	0.123	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	$1 \times 8.2/14.2$	0.576	OK
$m_x \cdot M_x/M_{ax}$	$0.5 \times 8.2/33.2$	0.123	OK
Compare with Simplified to 4.8.3.3	0.202, 0.604, 0.604	0.604	
Compare with MoreExact to 4.8.3.3	0.14, 0.604, 0.247	0.604	

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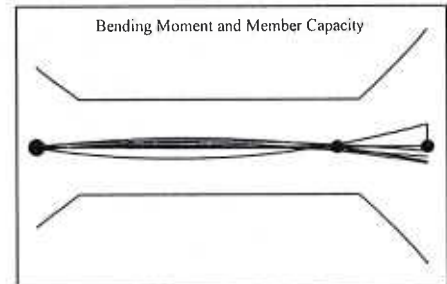
Axial with Moments (Member)
Member SBL1Id 3 @ Level 1
Between 3.500 and 4.559 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

D1 UDLY -000.793 { kN/m }

L1 UDLY -002.973 { kN/m }



Member Forces in Load Case 1						
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
4	9 10	1.473C 8.422C	9.312 -16.625	-0.535 -16.136	@ 8.157 1.641	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (15.95 kg/m)	152x89 UB 16 [S 275]		
Class = Fn(b/T,d/t,py,F,Mx,My)	5.76, 27.07, 275, 8.42, 16.14, 0	(Axial: Non-Slender)	Plastic
Sec. Depth = Fn(X)	Moment Capacity X = 4.559 m	304.7 mm	
Sec. Depth = Fn(X)	Lateral Buckling X = 4.559 m	304.7 mm	
Auto Design Load Cases	1-6		

Local Capacity Check @ 4.559 m

Fvx/Pvx	16.624 / 226.265 =	0.073	Low Shear
Mcx = py.Sxx ≤ 1.2 py.Zxx	275 x 304.1 ≤ 1.2 x 275 x 264.05 =	83.628 kN.m	
Pz = Ag.py	27.17 x 275 =	747.175 kN	
n = F/Pz	8.422 / 747.175 =	0.011	OK
Srx = Fn(Sxx, n)	304.1, 0.011	304.05 cm³	
Mrx = Srx.py	304.05 x 275	83.613 kN.m	
(Mx/Mrx)² + (My/Mry)²	(16.129/83.613)² + (0)² =	0.037	OK

Compression Resistance Pc

λx = Lex/rxx	100x1x4.559/12.17 =	37.5	OK
Pcx = Area.pcx	27.17x261.992/10 =	711.832 kN	Table 24 a
λy = Ley/ryy	100x1x1.059/1.82 =	58.2	OK
Pcy = Area.pcy	27.17x223.61/10 =	607.555 kN	Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M₂ + .5M₃ + .15M₄)/Mmax	0.2 + (.15x5 + .5x8 + .15x12)/16 ≥ 0.44	1	Table 18
mx = 0.2 + (.1M₂ + .6M₃ + .1M₄)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26
my = 0.2 + (.1M₂ + .6M₃ + .1M₄)/Mmax	0.2 + (.1x7 + .6x7 + .1x-1)/16 ≥ .8x8/16	0.5	Table 26
myx = 0.2 + (.1M₂ + .6M₃ + .1M₄)/Mmax	0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0	1	Table 26

Lateral Buckling Check Mb @ 4.559 m

Le = 1.00 L	1 x 1.059 =	1.059 m	
λ = Le/ryy	1.059 / 1.82	58.22	OK
v = Fn(x, Le, ryy, λ)	43.607, 1.059, 1.82, 58.22	0.979	Table 19
λLT = u.v.λ.√βw	0.864 x 0.979 x 58.22√1	49.24	
pb = Fn(py, λLT)	275, 49.24	239.83 N/mm²	Table 16
Mb = Sxx.pb ≤ Mc	304.1 x 239.83 ≤ 83.628 =	72.931 kN.m	

Combined Axial Compression and Bending to Annex I @ 4.559 m

rb = mLT.MLT/Mb	1x-16.1/72.9	0.221	
rc = Fc/Pcy	8.4/607.6	0.014	
λr = (rbλLT + rcλy)/(rb + rc)	(0.221 + 49.2 + 0.014 * 58.2)/(0.221 + 0.014)	49.770	

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$\lambda_{ro}=17.15 \epsilon (2r_b+r_c)/(r_b+r_c)$	$17.15 \cdot 1(2 \cdot 0.221+0.014)/(0.221+0.014)$	33.288	
$M_{ob}=M_b(1-F_c/P_{cy})$	$72.931(1-8.4/607.6)$	71.920	
$M_{xy}=M_{cx}(1-F_c/P_{cy})^{1/2}$	$83.628(1-8.4/607.6)^{1/2}$	83.046	
$M_{ox}=M_{cx}(1-F_c/P_{cx})/(1+0.5F_c/P_{cx})$	$83.628(1-8.4/711.8)/(1+0.5 \cdot 8.4/711.8)$	82.152	
$M_{oy}=M_{cy}(1-F_c/P_{cy})/(1+k_y(F_c/P_{cy}))$	$6.689(1-8.4/607.6)/(1+1.0(8.4/607.6))$	6.506	
$M_{ab}=fn(\lambda_r, \lambda_{ro}, \epsilon, M_{xy}, M_{ob})$	49.770, 33.288, 1.000, 83.046, 71.920	79.943	
$M_{ax}=fn(\lambda_x, \epsilon, M_{rx}, M_{ox})$	37.468, 1.000, 83.613, 82.152	83.181	
$M_{ay}=fn(\lambda_y, \epsilon, M_{ry}, M_{oy})$	58.218, 1.000, 6.689, 6.506	6.580	
$m_x, M_x/M_{ax}$	$0.5 \times 16.1/83.2$	0.097	OK
$m_{LT}, M_{LT}/M_{ab}$	$1 \times 16.1/79.9$	0.202	OK
$m_x, M_x/M_{ax}$	$0.5 \times 16.1/83.2$	0.097	OK
Compare with Simplified to 4.8.3.3	0.125, 0.235, 0.235	0.235	
Compare with MoreExact to 4.8.3.3	0.109, 0.235, 0.196	0.235	

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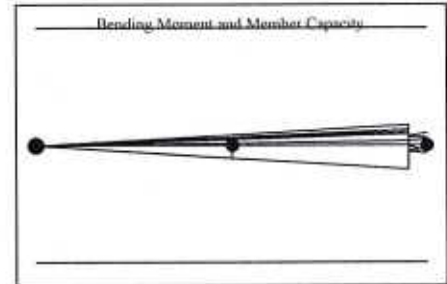
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Axial with Moments (Member)
Member SCL1Id 4 @ Level 1
Between 0.000 and 2.105 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

**Member Forces in Load Case 1**

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
	1 7	34.388C 8.800C	2.393 -4.118	0.000 -2.562	@ 9.502 3.970	@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (19.04 kg/m)

178x102 UB 19 [S 275]

Class = Fn(b/T, d/t, py, F, Mx, My)

6.41, 30.58, 275, 34.39, 9.6, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check F_{vx}/P_{vx} $2.393 / 140.818 =$

0.017

Low Shear

 $M_{cx} = p_y.S_{xx} \leq 1.2 p_y.Z_{xx}$ $275 \times 171.3 \leq 1.2 \times 275 \times 152.63 =$

47.108 kN.m

 $P_z = A_g p_y$ $24.26 \times 275 =$

667.15 kN

 $n = F/P_z$ $34.388 / 667.15 =$

0.052

OK

 $S_{rx} = F_n(S_{xx}, n)$ $171.3, 0.052$ 170.49 cm³ $M_{rx} = S_{rx} p_y$ 170.49×275

46.884 kN.m

 $(M_x/M_{rx})^{2.1} + (M_y/M_{ry})^{2.2}$ $(5.038/46.884)^{2.1} + (0)^{2.2} =$

0.012

OK

Compression Resistance P_c $\lambda_x = L_{ex}/r_{xx}$ $100 \times 1 \times 4.21 / 7.48 =$

56.3

OK

 $P_{cx} = A_{area} p_{cx}$ $24.26 \times 244.084 / 10 =$

592.147 kN

Table 24 a

 $\lambda_y = L_{ey}/r_{yy}$ $100 \times 1 \times 2.105 / 2.38 =$

88.4

OK

 $P_{cy} = A_{area} p_{cy}$ $24.26 \times 163.71 / 10 =$

397.161 kN

Table 24 b

Equivalent Uniform Moment Factors m_{LT} , m_x , m_y and m_{yx} $m_{LT} = 0.2 + (0.15M_2 + 0.5M_3 + 0.15M_4)/M_{max}$ $0.2 + (0.15 \times 1 + 0.5 \times 3 + 0.15 \times 4) / 5 \geq 0.44$

0.6

Table 18

 $m_y = 0.2 + (0.1M_2 + 0.6M_3 + 0.1M_4)/M_{max}$ $0.2 + (0.1 \times 0 + 0.6 \times 0 + 0.1 \times 0) / 0 \geq 0.8 \times 0 / 0$

1

Table 26

 $m_x = 0.2 + (0.1M_2 + 0.6M_3 + 0.1M_4)/M_{max}$ $0.2 + (0.1 \times 3 + 0.6 \times 5 + 0.1 \times 8) / 10 \geq 0.8 \times 8 / 10$

0.63

Table 26

 $m_{yx} = 0.2 + (0.1M_2 + 0.6M_3 + 0.1M_4)/M_{max}$ $0.2 + (0.1 \times 0 + 0.6 \times 0 + 0.1 \times 0) / 0 \geq 0.8 \times 0 / 0$

1

Table 26

Lateral Buckling Check M_b $L_e = 1.00 L$ $1 \times 2.105 =$

2.105 m

 $\lambda = L_e/r_{yy}$ $2.105 / 2.38$

88.45

OK

 $v = F_n(x, L_e, r_{yy}, \lambda)$ $22.562, 2.105, 2.38, 88.45$

0.867

Table 19

 $\lambda_{LT} = u.v.\lambda.\sqrt{\beta_w}$ $0.889 \times 0.867 \times 88.45 \sqrt{1}$

68.22

 $p_b = F_n(p_y, \lambda_{LT})$ $275, 68.22$ 192.77 N/mm²

Table 16

 $M_b = S_{xx}.p_b \leq M_c$ $171.3 \times 192.77 \leq 47.108 =$

33.022 kN.m

Combined Axial Compression and Bending to Annex I $r_b = m_{LT}.M_{LT}/M_b$ $0.6 \times 5 / 33$

0.092

 $r_c = F_e/P_{cy}$ $34.4 / 397.2$

0.087

 $\lambda_c = (r_b \lambda_{LT} + r_c \lambda_y) / (r_b + r_c)$ $(0.092 \times 68.22 + 0.087 \times 88.45) / (0.092 + 0.087)$

78.051

 $\lambda_{re} = 17.15 E (2r_b + r_c) / (r_b + r_c)$ $17.15 \times 1 (2 \times 0.092 + 0.087) / (0.092 + 0.087)$

25.965

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$M_{ob} = M_b(1 - F_c/P_{cy})$	33.022(1-34.4/397.2)	30.163	
$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	47.108(1-34.4/397.2) ^{1/2}	45.022	
$M_{ox} = M_{cx}(1 - F_c/P_{cy})/(1 + 0.5F_c/P_{cx})$	47.108(1-34.4/592.1)/(1 + 0.5*34.4/592.1)	43.120	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	8.973(1-34.4/397.2)/(1 + 1.0(34.4/397.2))	7.543	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{r02}, M_{xy}, M_{ob})$	78.051, 25.965, 1.000, 45.022, 30.163	32.329	
$M_{ax} = \text{fn}(\lambda_x, \epsilon, M_{rx}, M_{ox})$	56.283, 1.000, 46.884, 43.120	44.738	
$M_{ay} = \text{fn}(\lambda_y, \epsilon, M_{ry}, M_{oy})$	88.445, 1.000, 8.973, 7.543	7.543	
$m_x \cdot M_x/M_{ax}$	0.63x9.6/44.7	0.135	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	0.6x5/32.3	0.094	OK
$m_x \cdot M_x/M_{ax}$	0.63x9.6/44.7	0.071	OK
Compare with Simplified to 4.8.3.3	0.231, 0.178, 0.178	0.231	
Compare with MoreExact to 4.8.3.3	0.19, 0.178, 0.07	0.19	

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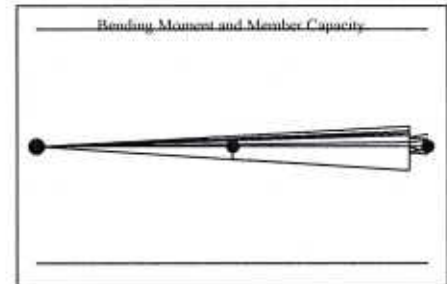
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Axial with Moments (Member)
Member SCL1Id 4 @ Level 1
Between 2.105 and 4.210 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1

**Member Forces in Load Case 1**

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kNm)	Maximum Moment (kNm @ m)	Maximum Deflection (mm @ m)
	1 7	34.388C 8.800C	2.393 -4.118	0.000 -2.562	9.502 3.970 @	0.000 0.000 @

Classification and Properties (BS 5950: 2000)

Section (19.04 kg/m)

178x102 UB 19 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

6.41, 30.58, 275, 34.39, 9.6, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check F_{vx}/P_{vx} $4.118 / 140.818 =$

0.029

Low Shear

 $M_{cx} = p_y, S_{xx} \leq 1.2 p_y, Z_{xx}$ $275 \times 171.3 \leq 1.2 \times 275 \times 152.63 =$

47.108 kN.m

 $P_z = A_g p_y$ $24.26 \times 275 =$

667.15 kN

 $n = F/P_z$ $34.388 / 667.15 =$

0.052

OK

 $S_{rx} = F_n(S_{xx}, n)$ $171.3, 0.052$ 170.49 cm³ $M_{rx} = S_{rx} p_y$ 170.49×275

46.884 kN.m

 $(M_x/M_{rx})^{2.1} + (M_y/M_{ry})^{2.2}$ $(9.598/46.884)^{2.1} + (0)^{2.2} =$

0.042

OK

Compression Resistance P_c $\lambda_x = L_{ex}/r_{xx}$ $100 \times 1 \times 4.21 / 7.48 =$

56.3

OK

 $P_{cx} = A_{area} p_{cx}$ $24.26 \times 244.084 / 10 =$

592.147 kN

Table 24 a

 $\lambda_y = L_{ey}/r_{yy}$ $100 \times 1 \times 2.105 / 2.38 =$

88.4

OK

 $P_{cy} = A_{area} p_{cy}$ $24.26 \times 163.71 / 10 =$

397.161 kN

Table 24 b

Equivalent Uniform Moment Factors m_{LT} , m_x , m_y and m_{yx} $m_{LT} = 0.2 + (.15M_2 + .5M_3 + .15M_4)/M_{max}$ $0.2 + (.15 \times 6 + .5 \times 8 + .15 \times 9) / 9 \geq 0.44$

0.886

Table 18

 $m_y = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ $0.2 + (.1 \times 0 + .6 \times 0 + .1 \times 0) / 0 \geq .8 \times 0 / 0$

1

Table 26

 $m_x = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ $0.2 + (.1 \times 3 + .6 \times 5 + .1 \times 8) / 10 \geq .8 \times 8 / 10$

0.63

Table 26

 $m_{yx} = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ $0.2 + (.1 \times 0 + .6 \times 0 + .1 \times 0) / 0 \geq .8 \times 0 / 0$

1

Table 26

Lateral Buckling Check M_b $L_e = 1.00 L$ $1 \times 2.105 =$

2.105 m

 $\lambda = L_e/r_{yy}$ $2.105 / 2.38$

88.45

OK

 $v = F_n(x, L_e, r_{yy}, \lambda)$ $22.562, 2.105, 2.38, 88.45$

0.867

Table 19

 $\lambda_{LT} = u.v.\lambda.\sqrt{\beta_w}$ $0.889 \times 0.867 \times 88.45 \sqrt{1}$

68.22

 $p_b = F_n(p_y, \lambda_{LT})$ $275, 68.22$ 192.77 N/mm²

Table 16

 $M_b = S_{xx}.p_b \leq M_c$ $171.3 \times 192.77 \leq 47.108 =$

33.022 kN.m

Combined Axial Compression and Bending to Annex I $r_b = m_{LT}.M_{LT}/M_b$ $0.886 \times 9.6 / 33$

0.257

 $r_c = F_c/P_{cy}$ $34.4 / 397.2$

0.087

 $\lambda_r = (r_b \lambda_{LT} + r_c \lambda_y) / (r_b + r_c)$ $(0.257 \times 68.22 + 0.087 \times 88.4) / (0.257 + 0.087)$

73.312

 $\lambda_{ro} = 17.15 \epsilon (2r_b + r_c) / (r_b + r_c)$ $17.15 \times 1 (2 \times 0.257 + 0.087) / (0.257 + 0.087)$

29.984

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$M_{ob} = M_b(1 - F_c/P_{cy})$	33.022(1-34.4/397.2)	30.163	
$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	47.108(1-34.4/397.2) ^{1/2}	45.022	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	47.108(1-34.4/592.1)/(1 + 0.5*34.4/592.1)	43.120	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	8.973(1-34.4/397.2)/(1 + 1.0(34.4/397.2))	7.543	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{ro}, E, M_{xy}, M_{ob})$	73.312, 29.984, 1.000, 45.022, 30.163	33.904	
$M_{ax} = \text{fn}(\lambda_x, E, M_{rx}, M_{ox})$	56.283, 1.000, 46.884, 43.120	44.738	
$M_{ay} = \text{fn}(\lambda_y, E, M_{ry}, M_{oy})$	88.445, 1.000, 8.973, 7.543	7.543	
$m_x \cdot M_x/M_{ax}$	0.63x9.6/44.7	0.135	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	0.886x9.6/33.9	0.251	OK
$m_x \cdot M_x/M_{ax}$	0.63x9.6/44.7	0.135	OK
Compare with Simplified to 4.8.3.3	0.231, 0.344, 0.344	0.344	
Compare with MoreExact to 4.8.3.3	0.19, 0.344, 0.197	0.344	

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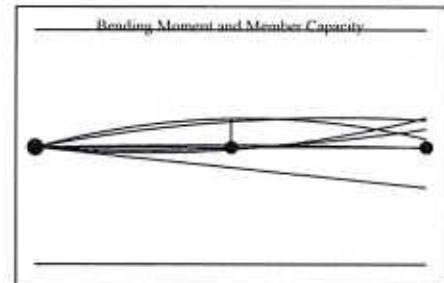
Approved :

Axial with Moments (Member)
Member SCL1Id 7 @ Level 1
Between 0.000 and 2.105 m, in Load Case 6

Member Loading and Member Forces

Loading Combination : 1 UT + 1 D1 + 1.4 W5

W5 UDLX -003.171 (kN/m)



Member Forces in Load Case 6							
Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)	
9	6 10	2.803T 3.589T	-10.157 8.532	0.000 -3.420	@ -11.620 2.273	@ 0.000 0.000	

Classification and Properties (BS 5950: 2000)

Section (19.04 kg/m)

178x102 UB 19 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

6.41, 30.58, 275, 0, 11.62, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx

0.812 / 140.818 =

0.006

Low Shear

Mcx = py.Sxx ≤ 1.2 py.Zxx

275 x 171.3 ≤ 1.2 x 275 x 152.63 =

47.108 kN.m

Ae = Fn(Ag,A.net,py,Us)

24.26, 24.26, 275, 410

24.26 cm²

Pz = Ae.py

24.26 x 275

667.15 kN

n = F/Pz

-3.589 / 667.15 =

0.005

OK

Srx = Fn(Sxx, n)

171.3, 0.005

171.29 cm³

Mrx = Srx.py

171.29 x 275

47.105 kN.m

(Mx/Mrx)² + (My/Mry)²

(11.545/47.105)² + (0)² =

0.06

OK

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (.15M2 + .5M3 + .15M4)/Mmax

0.2 + (.15x5 + .5x8 + .15x11)/12 ≥ 0.44

0.754

Table 18

my = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0

1

Table 26

mx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x-8 + .6x-12 + .1x-10)/12 ≥ .8x12/12

0.953

Table 26

myx = 0.2 + (.1M2 + .6M3 + .1M4)/Mmax

0.2 + (.1x0 + .6x0 + .1x0)/0 ≥ .8x0/0

1

Table 26

Lateral Buckling Check Mb

Le = 1.00 L

1 x 2.105 =

2.105 m

λ = Le/ryy

2.105 / 2.38

88.45

OK

v = Fn(x, Le, ryy, λ)

22.562, 2.105, 2.38, 88.45

0.867

Table 19

λLT = u.v.λ.√βw

0.889 x 0.867 x 88.45√1

68.22

pb = Fn(py, λLT)

275, 68.22

192.77 N/mm²

Table 16

Mb = Sxx.pb ≤ Mc

171.3 x 192.77 ≤ 47.108 =

33.022 kN.m

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb

0.754x-11.5/33

0.264

rc = Fc/Pcy

0/397.2

0.000

λr = (rbλLT + rcλy)/(rb + rc)

(0.264*68.22 + 0*88.4)/(0.264 + 0)

68.222

λro = 17.15E (2rb + rc)/(rb + rc)

17.15*1(2*0.264 + 0)/(0.264 + 0)

34.300

Mob = Mb(1 - Fc/Pcy)

33.022(1 - 0/397.2)

33.022

Mxy = Mox(1 - Fc/Pcy)^{0.5}47.108(1 - 0/397.2)^{0.5}

47.108

Mox = Mox(1 - Fc/Pcy)/(1 + 0.5Fc/Pcy)

47.108(1 - 0/592.1)/(1 + 0.5*0/592.1)

47.108

Moy = Mov(1 - Fc/Pcy)/(1 + ky(Fc/Pcy))

8.973(1 - 0/397.2)/(1 + 1.0(0/397.2))

8.973

Mab = fn(λr, λro, E, Mxy, Mob)

68.222, 34.300, 1.000, 47.108, 33.022

37.830

Max = fn(λx, E, Mox, Moy)

56.283, 1.000, 47.105, 47.108

47.108

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$M_{ay}=f_n(\lambda_y, \epsilon_s, M_{ly}, M_{oy})$	88.445, 1.000, 8.973, 8.973	8.973	
$m_x.M_x/M_{ax}$	0.953x11.6/47.1	0.235	OK
$m_{LT}.M_{LT}/M_{ab}$	0.754x-11.5/37.8	0.230	OK
$m_x.M_x/M_{ax}$	0.953x11.6/47.1	0.233	OK
Compare with Simplified to 4.8.3.3	0.264, 0.264, 0.264	0.264	
Compare with MoreExact to 4.8.3.3	0.235, 0.264, 0.185	0.264	

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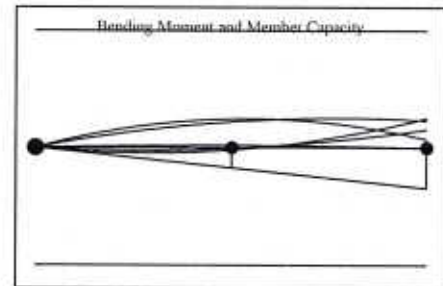
Checked :

Approved :

Axial with Moments (Member)
Member SCL1Id 7 @ Level 1
Between 2.105 and 4.210 m, in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 DI + 1.6 LI

**Member Forces in Load Case 1**

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
9	6 10	19.339C 18.218C	3.833 3.833	0.000 16.136		0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (19.04 kg/m)

178x102 UB 19 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

6.41, 30.58, 275, 19.34, 16.14, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check F_{vx}/P_{vx} $3.833 / 140.818 =$

0.027

Low Shear

 $M_{cx} = p_y.S_{xx} \leq 1.2 p_y.Z_{xx}$ $275 \times 171.3 \leq 1.2 \times 275 \times 152.63 =$

47.108 kN.m

 $P_z = A_g.p_y$ $24.26 \times 275 =$

667.15 kN

 $n = F/P_z$ $19.339 / 667.15 =$

0.029

OK

 $S_{rx} = F_n(S_{xx}, n)$ $171.3, 0.029$ 171.04 cm³ $M_{rx} = S_{rx}.p_y$ 171.04×275

47.037 kN.m

 $(M_x/M_{rx})^{2.1} + (M_y/M_{ry})^{2.2}$ $(16.136/47.037)^{2.1} + (0)^{2.2} =$

0.118

OK

Compression Resistance P_c $\lambda_x = L_{ex}/r_{xx}$ $100 \times 1 \times 4.21 / 7.48 =$

56.3

OK

 $P_{cx} = A_{area}.p_{cx}$ $24.26 \times 244.084 / 10 =$

592.147 kN

Table 24 a

 $\lambda_y = L_{ey}/r_{yy}$ $100 \times 1 \times 2.105 / 2.38 =$

88.4

OK

 $P_{cy} = A_{area}.p_{cy}$ $24.26 \times 163.71 / 10 =$

397.161 kN

Table 24 b

Equivalent Uniform Moment Factors m_{LT} , m_x , m_y and m_{yx} $m_{LT} = 0.2 + (.15M_2 + .5M_3 + .15M_4)/M_{max}$ $0.2 + (.15 \times 10 + .5 \times 12 + .15 \times 14) / 16 \geq 0.44$

0.8

Table 18

 $m_y = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ $0.2 + (.1 \times 0 + .6 \times 0 + .1 \times 0) / 0 \geq .8 \times 0 / 0$

1

Table 26

 $m_x = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ $0.2 + (.1 \times 4 + .6 \times 8 + .1 \times 12) / 16 \geq .8 \times 12 / 16$

0.6

Table 26

 $m_{yx} = 0.2 + (.1M_2 + .6M_3 + .1M_4)/M_{max}$ $0.2 + (.1 \times 0 + .6 \times 0 + .1 \times 0) / 0 \geq .8 \times 0 / 0$

1

Table 26

Lateral Buckling Check M_b $L_e = 1.00 L$ $1 \times 2.105 =$

2.105 m

 $\lambda = L_e/r_{yy}$ $2.105 / 2.38$

88.45

OK

 $v = F_n(x, L_e, r_{yy}, \lambda)$ $22.562, 2.105, 2.38, 88.45$

0.867

Table 19

 $\lambda_{LT} = u.v.\lambda.\sqrt{\beta_w}$ $0.889 \times 0.867 \times 88.45 \sqrt{1}$

68.22

 $p_b = F_n(p_y, \lambda_{LT})$ $275, 68.22$ 192.77 N/mm²

Table 16

 $M_b = S_{xx}.p_b \leq M_c$ $171.3 \times 192.77 \leq 47.108 =$

33.022 kN.m

Combined Axial Compression and Bending to Annex I $r_b = m_{LT}.M_{LT}/M_b$ 0.8×16.133

0.391

 $r_c = F_c/P_{cy}$ $19.3/397.2$

0.049

 $\lambda_r = (r_b\lambda_{LT} + r_c\lambda_y)/(r_b + r_c)$ $(0.391 \times 68.2 + 0.049 \times 88.4) / (0.391 + 0.049)$

70.462

 $\lambda_{ro} = 1.75 \epsilon (2r_b + r_c)/(r_b + r_c)$ $17.15 \times 1(2 \times 0.391 + 0.049) / (0.391 + 0.049)$

32.401

 $M_{ob} = M_b(1 - F_c/P_{cy})$ $33.022(1 - 19.3/397.2)$

31.414

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$M_{xy} = M_{cx}(1 - F_c/P_{cy})^{1/2}$	$47.108(1 - 19.3/397.2)^{1/2}$	45.946	
$M_{ox} = M_{cx}(1 - F_c/P_{cx})/(1 + 0.5F_c/P_{cx})$	$47.108(1 - 19.3/592.1)/(1 + 0.5 \cdot 19.3/592.1)$	44.837	
$M_{oy} = M_{cy}(1 - F_c/P_{cy})/(1 + k_y(F_c/P_{cy}))$	$8.973(1 - 19.3/397.2)/(1 + 1.0(19.3/397.2))$	8.139	
$M_{ab} = \text{fn}(\lambda_x, \lambda_{ro}, E, M_{xy}, M_{ob})$	70.462, 32.401, 1.000, 45.946, 31.414	35.902	
$M_{ax} = \text{fn}(\lambda_x, E, M_{rx}, M_{ox})$	56.283, 1.000, 47.037, 44.837	45.783	
$M_{ay} = \text{fn}(\lambda_y, E, M_{ry}, M_{oy})$	88.445, 1.000, 8.973, 8.139	8.139	
$m_x \cdot M_x/M_{ax}$	$0.6 \times 16.1/45.8$	0.212	OK
$m_{LT} \cdot M_{LT}/M_{ab}$	$0.8 \times 16.1/35.9$	0.360	OK
$m_x \cdot M_x/M_{ax}$	$0.6 \times 16.1/45.8$	0.211	OK
Compare with Simplified to 4.8.3.3	0.279, 0.44, 0.44	0.44	
Compare with MoreExact to 4.8.3.3	0.242, 0.44, 0.288	0.44	

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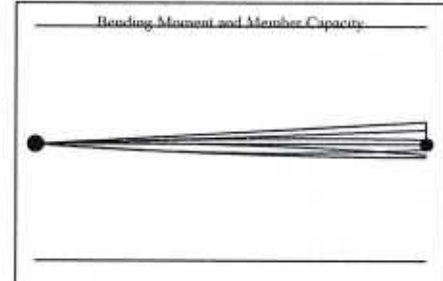
Approved :

Axial with Moments (Member)

Member SCL1d 6 @ Level 1 in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 DI + 1.6 LI

**Member Forces in Load Case 1**

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
7	3 4	29.384C 28.030C	-6.512 -6.512	0.000 -20.610		@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (31.14 kg/m)

254x146 UB 31 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

8.49, 36.5, 275, 29.38, 20.61, 0

(Axial: Non-Slender)

Plastic

Auto Design Load Cases

1-6

Local Capacity Check F_{vx}/P_{vx} $6.512 / 248.886 =$

0.026

Low Shear

 $M_{cx} = p_y.S_{xx} \leq 1.2 p_y.Z_{xx}$ $275 \times 393.1 \leq 1.2 \times 275 \times 351.18 =$

108.103 kN.m

 $P_z = A_g.p_y$ $39.67 \times 275 =$

1090.925 kN

 $n = F/P_z$ $29.384 / 1090.925 =$

0.027

OK

 $S_{rx} = F_n(S_{xx}, n)$ $393.1, 0.027$ 392.62 cm³ $M_{rx} = S_{rx}.p_y$ 392.62×275

107.972 kN.m

 $(M_x/M_{rx})^{2.1} + (M_y/M_{ry})^{2.2}$ $(20.61/107.972)^{2.1} + (0)^{2.2} =$

0.036

OK

Compression Resistance P_c $\lambda_x = L_{ex}/r_{xx}$ $100 \times 1 \times 3.165 / 10.55 =$

30

OK

 $P_{cx} = A_{area}.p_{cx}$ $39.67 \times 267.209 / 10 =$

1060.020 kN

Table 24 a

 $\lambda_y = L_{ey}/r_{yy}$ $100 \times 1 \times 3.165 / 3.36 =$

94.2

OK

 $P_{cy} = A_{area}.p_{cy}$ $39.67 \times 152.02 / 10 =$

603.065 kN

Table 24 b

Equivalent Uniform Moment Factors m_{LT} , m_x , m_y and m_{yx} $m_{LT} = 0.2 + (1.5M_2 + 5M_3 + 1.5M_4)/M_{max}$ $0.2 + (1.5 \times 5 + 5 \times 10 + 1.5 \times 15) / 21 \geq 0.44$

0.6

Table 18

 $m_y = 0.2 + (1M_2 + 6M_3 + 1M_4)/M_{max}$ $0.2 + (1 \times 0 + 6 \times 0 + 1 \times 0) / 0 \geq 0.8 \times 0 / 0$

1

Table 26

 $m_x = 0.2 + (1M_2 + 6M_3 + 1M_4)/M_{max}$ $0.2 + (1 \times 5 + 6 \times 10 + 1 \times 15) / 21 \geq 0.8 \times 15 / 21$

0.6

Table 26

 $m_{yx} = 0.2 + (1M_2 + 6M_3 + 1M_4)/M_{max}$ $0.2 + (1 \times 0 + 6 \times 0 + 1 \times 0) / 0 \geq 0.8 \times 0 / 0$

1

Table 26

Lateral Buckling Check M_b $L_e = 1.00 L$ $1 \times 3.165 =$

3.165 m

 $\lambda = L_e/r_{yy}$ $3.165 / 3.36$

94.2

OK

 $v = F_n(x, L_e, r_{yy}, \lambda)$ $29.496, 3.165, 3.36, 94.2$

0.902

Table 19

 $\lambda_{LT} = u.v.\lambda.\sqrt{\beta_w}$ $0.88 \times 0.902 \times 94.2 \sqrt{1}$

74.8

 $p_b = F_n(p_y, \lambda_{LT})$ $275, 74.8$ 176.87 N/mm²

Table 16

 $M_b = S_{xx}.p_b \leq M_c$ $393.1 \times 176.87 \leq 108.103 =$

69.526 kN.m

Combined Axial Compression and Bending to Annex I $r_b = m_{LT}.M_{LT}/M_b$ $0.6 \times 20.6 / 69.5$

0.178

 $r_c = F_c/P_{cy}$ $29.4 / 603.1$

0.049

 $\lambda_r = (r_b\lambda_{LT} + r_c\lambda_y) / (r_b + r_c)$ $(0.178 \times 74.8 + 0.049 \times 94.2) / (0.178 + 0.049)$

78.973

 $\lambda_{ro} = 17.15 \epsilon_1 (2r_b + r_c) / (r_b + r_c)$ $17.15 \times 1 (2 \times 0.178 + 0.049) / (0.178 + 0.049)$

30.613

 $M_{ob} = M_b (1 - F_c/P_{cy})$ $69.526 (1 - 29.4 / 603.1)$

66.139

 $M_{xy} = M_{cx} (1 - F_c/P_{cy})^{1/2}$ $108.103 (1 - 29.4 / 603.1)^{1/2}$

105.436

 $M_{ox} = M_{cx} (1 - F_c/P_{cx}) / (1 + 0.5 F_c/P_{cx})$ $108.103 (1 - 29.4 / 1060) / (1 + 0.5 \times 29.4 / 1060)$

103.669

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$M_{oy} = M_{cy}(1 - F_c/P_{cy}) / (1 + k_y(F_c/P_{cy}))$	20.255(1-29.4/603.1)/(1+1.0(29.4/603.1))	18.373	
$M_{ab} = \text{fn}(\lambda_r, \lambda_{rox}, M_{xy}, M_{ob})$	78.973, 30.613, 1.000, 105.436, 66.139	71.314	
$M_{ax} = \text{fn}(\lambda_{xs}, M_{rxs}, M_{ox})$	30.000, 1.000, 107.972, 103.669	107.166	
$M_{ay} = \text{fn}(\lambda_{ys}, M_{rys}, M_{oy})$	94.196, 1.000, 20.255, 18.373	18.373	
$m_x.M_x/M_{ax}$	0.6x20.6/107.2	0.115	OK
$m_{LT}.M_{LT}/M_{ab}$	0.6x-20.6/71.3	0.173	OK
$m_x.M_x/M_{ax}$	0.6x20.6/107.2	0.115	OK
Compare with Simplified to 4.8.3.3	0.177, 0.227, 0.227	0.227	
Compare with MoreExact to 4.8.3.3	0.144, 0.227, 0.119	0.227	

SIDEBOTTOM RICHARDSON CHENG LTD.

Consulting Structural and Civil Engineers

15 High Street, Spalding

Lincolnshire PE11 1TW

Telephone: 01775 712660

Job Ref : 14020

Sheet : 87

Made by : MAS

Date : 22 April 2020 / Ver. 2017.14

Checked :

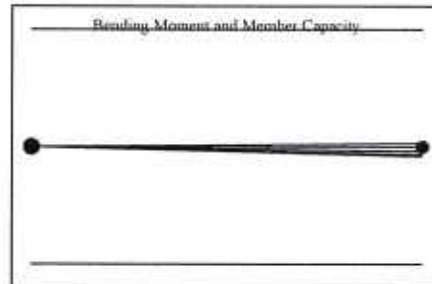
Approved :

Axial with Moments (Member)

Member SCL1Id 5 @ Level 1 in Load Case 1

Member Loading and Member Forces

Loading Combination : 1 UT + 1.4 D1 + 1.6 L1



Member Forces in Load Case 1

Member No.	Node End1 End2	Axial Force (kN)	Shear Force (kN)	Bending Moment (kN.m)	Maximum Moment (kN.m @ m)	Maximum Deflection (mm @ m)
6	2 8	28.285C 26.671C	-0.286 -0.286	0.000 +1.463		@ 0.000 0.000

Classification and Properties (BS 5950: 2000)

Section (22.95 kg/m)

152x152 UC 23 [S 275]

Class = Fn(b/T,d/t,py,F,Mx,My)

11.19, 21.31, 275, 28.29, 1.46, 0

(Axial: Non-Slender) SemiComp

Effective Properties

Area=29.24 cm², Sxx=176.29(182) cm³, Syy=71.41(80.2) cm³

Auto Design Load Cases

1-6

Local Capacity Check

Fvx/Pvx

0.286 / 145.847 =

0.002

Low Shear

Mcx = py.Sxx ≤ 1.2 py.Zxx

275 x 176.29 ≤ 1.2 x 275 x 164.13 =

48.481 kN.m

Pz = Ag.py

29.24 x 275 =

804.1 kN

n = F/Pz

28.285 / 804.1 =

0.035

OK

F/Ag.py+Mx/Mcx+My/Mcy

28.285 / 804.1 + 1.463 / 48.481 + 0 =

0.065

OK

Compression Resistance Pc

λx = Lex/rxx

100x1x5.121/6.54 =

78.3

OK

Pcx = Area.pcx

29.24x184.953/10 =

540.803 kN

Table 24 b

λy = Ley/ryy

100x1x5.121/3.7 =

138.4

OK

Pcy = Area.pcy

29.24x77.83/10 =

227.563 kN

Table 24 c

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT=0.2+(.15M2+.5M3+.15M4)/Mmax

0.2+(.15x0+.5x1+.15x1)/1 ≥ 0.44

0.6

Table 18

my=0.2+(.1M2+.6M3+.1M4)/Mmax

0.2+(.1x0+.6x0+.1x0)/0 ≥ .8x0/0

1

Table 26

mx=0.2+(.1M2+.6M3+.1M4)/Mmax

0.2+(.1x0+.6x-1+.1x-1)/1 ≥ .8x1/1

0.6

Table 26

myx=0.2+(.1M2+.6M3+.1M4)/Mmax

0.2+(.1x0+.6x0+.1x0)/0 ≥ .8x0/0

1

Table 26

Lateral Buckling Check Mb

Le = 1.00 L

1 x 5.121 =

5.121 m

λ = Le/ryy

5.121 / 3.7

138.4

OK

v = Fn (x,Le,ryy,λ)

20.292, 5.121, 3.7, 138.4

0.74

Table 19

λLT= u.v.λ.√βw

0.84 x 0.74 x 138.4√0.969

84.74

pb = Fn (py,λLT)

275, 84.74

154.4 N/mm²

Table 16

Mb = Sxx.pb ≤ Mc

176.29 x 154.4 ≤ 48.481 =

27.220 kN.m

Simplified Approach

py.Zx

275x164.13

45.136 kN.m

F/Pc+mx.Mx/py.Zx

28.285/227.563+0.6x1.5/45.1

0.144

OK

F/Pcy+mLT.MLT/Mb

28.285/227.563+0.6x-1.5/27.2

0.157

OK

More Exact Approach

Max=Mcx/(1+.5F/Pcx)

48.5/(1+.5x28.3/540.8)

47.245 kN.m

F/Pcx+mx.Mx/Max

28.3/540.8+0.6x1.5/47.2

0.071

OK

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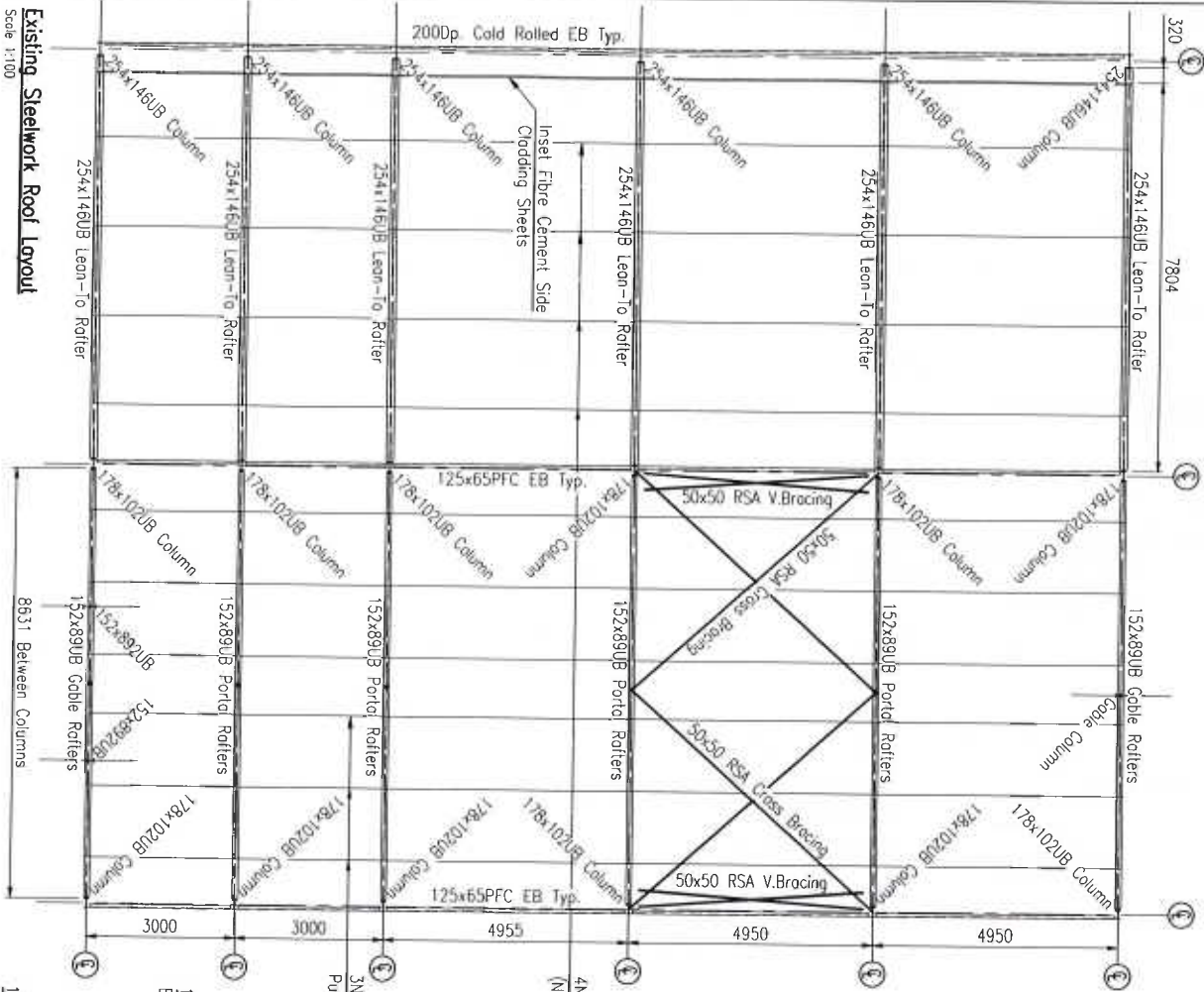
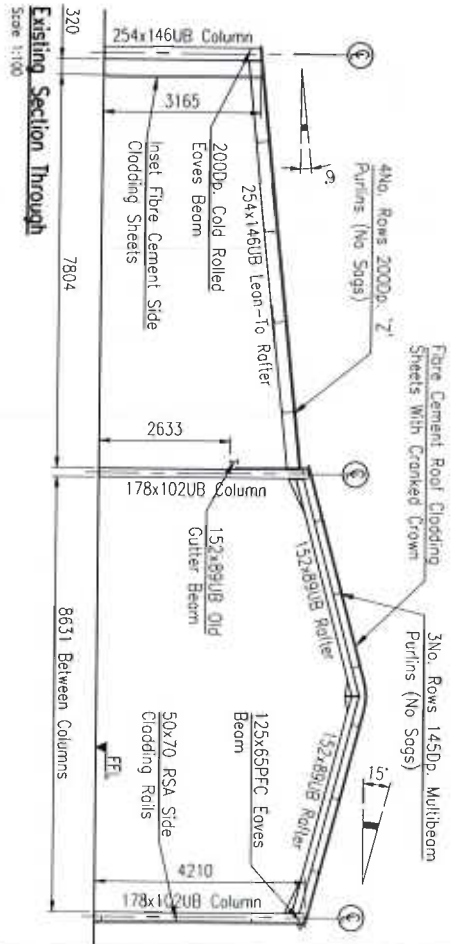
F/Pcy+m_LT.M_LT/Mb

28.3/227.6+0.6x-1.5/27.2

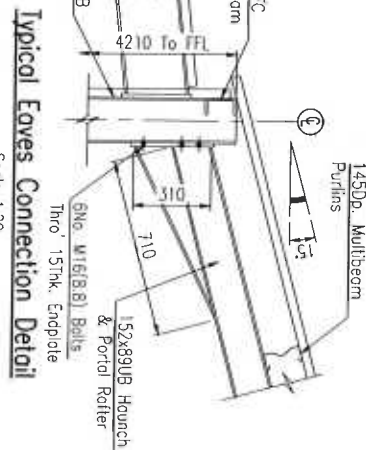
0.157

OK

PLEASE DO NOT SCALE FROM THIS DRAWING



Existing Steelwork Roof Layout
Scale 1:100



Typical Eaves Connection Detail
Scale 1:20

Rev	Date	Revised
1	14/02/20	Initial
2	14/02/20	Revised
3	14/02/20	Revised
4	14/02/20	Revised
5	14/02/20	Revised
6	14/02/20	Revised
7	14/02/20	Revised
8	14/02/20	Revised
9	14/02/20	Revised
10	14/02/20	Revised
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100	14/02/20	Revised

SRC
SIDEBOTTOM
RICHARDSON
CHENG LTD
CONSULTING STRUCTURAL AND CIVIL ENGINEERS
18 High Street
Poplar Farm, Moor Gate
Fleet Fen
For Status Design
Existing Steelwork Roof
Layout & Typical
Section Through

DRG No. 14020/sk01