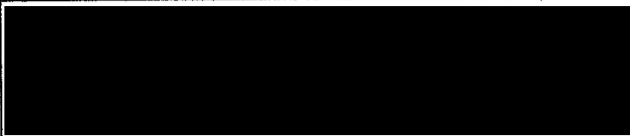




PHILIP WRIGHT
ASSOCIATES

**STRUCTURAL CALCULATIONS
FOR
ASSESSMENT OF EXISTING STEEL FRAMES
BARN 1
WHITTLE HALL FARM
LANGHO**

SHEET NOS 101-122

CONTRACT NO. 2577	PHILIP WRIGHT ASSOCIATES LTD 21 UNION STREET RAMSBOTTOM BURY BL0 9AN
MARCH 2022	



PHILIP WRIGHT
ASSOCIATES LTD

Consulting Structural Engineers

Part of Structure

BARN 1

Contract

WHITTLE HALL FARM

Contract No.

2577

Sheet No.

101

Rev.

Date.

MAR 22

LOADING

ROOF DEAD

CLADDING 0.14
TIMBER PURLINS 0.05
S WT STEEL 0.10 *

TOTAL 0.29 KN/m²

ULT 0.41 KN/m²

IMPOSED

ROOF 0.60

TOTAL 0.60 KN/m²

ULT 0.96 KN/m²

TOTAL 0.89 KN/m²

Y= 1.53

1.37 KN/m²

*S WT INPUTTED IN FRAME

SIPS PANEL SELF SUPPORTING



PHILIP WRIGHT
ASSOCIATES LTD

Consulting Structural Engineers

Part of Structure

Contract

Contract No.

Sheet No.

Date.

MILES HILL FARM

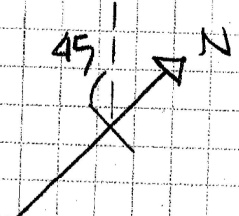
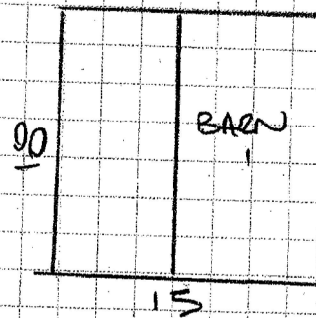
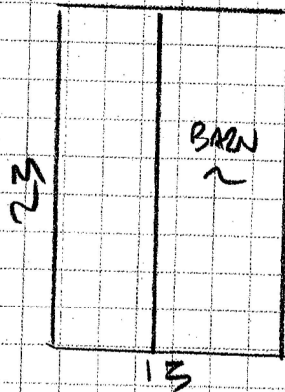
2577

102

Rev.

MAR 21

WIND ANALYSIS



GRID REF. SD 7225 3464

SITE HT 186m

BARN 1

GAUGE . 3.4m
RIDGE . 5.65m

BARN 2

GAUGE . 2.55m
RIDGE . 4.55m

/ MetSPEC /®**DESIGN SUITE**

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METSEC**/BUILDING PRODUCTS/****LIMITED**

Broadwell Road, Oldbury, West Mids. B69 4HF

Tel:0121 601 6000 Fax:0121 601 6111

Email: purlin@metsec.com

Website: <http://www.metsec.com>

Sheet No. of

Job No. 2577

Designer PW

Date 21/03/2022

Registered Details:-

Tel:

Email:

Fax:

BAEN 1

Wind Analysis to BS6399-2 - Wind Loads for Roofs**DATA ENTRY:-**

Width of Bay

15.000 m

Reference Height 5.650m

Length of Bay

18.000 m

Roof Pitch

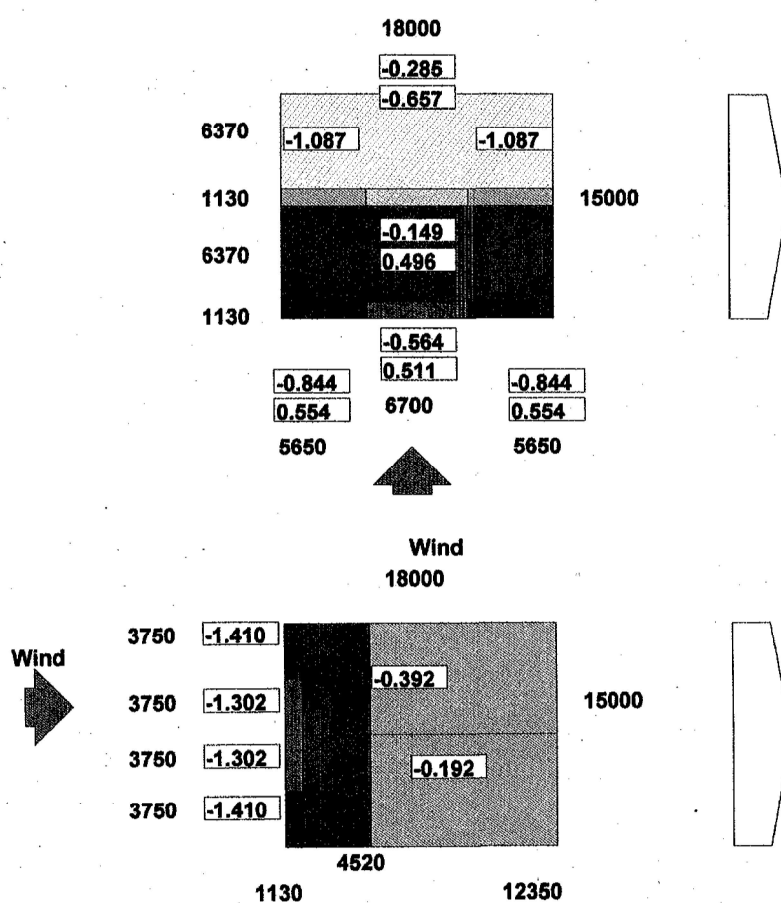
17.000 deg.

Roof Type

Ridged Duopitch roof

Bay type

Single bay building

**NB: All dimensions are in millimetres and wind loads in kN/m²**

Wind Analysis to BS6399-2 - Wind Loads for Walls

DATA ENTRY:-

Short Face 1 or 3

15.000 m

Long Face 2 or 4

18.000 m

Reference Face

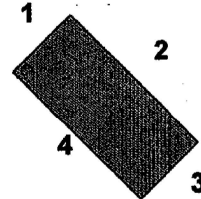
Face 1 (Gable)

Reference Height

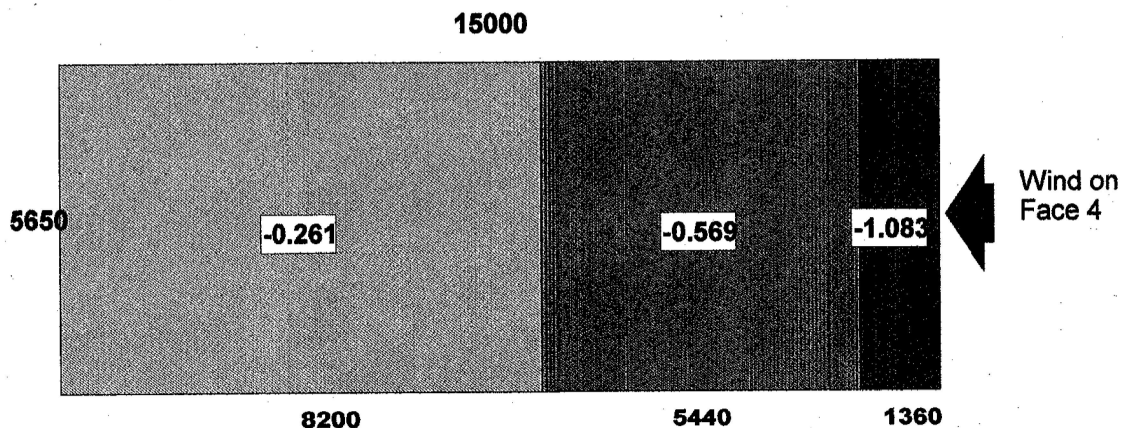
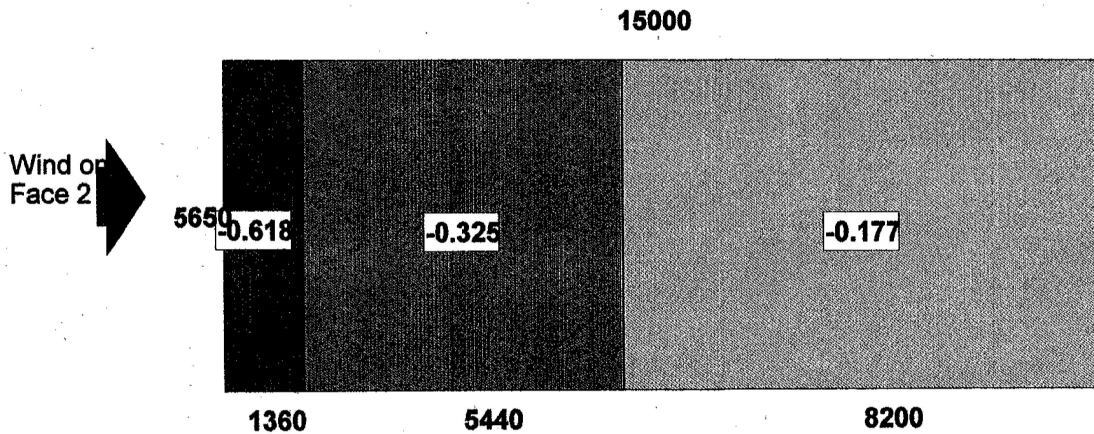
5.650 m

Gap Between Buildings

0.000 m



Reference Face



Suction(kN/m²) On Reference Face1

Pressure (kN/m²) On Reference Face = +0.939

Pressure/Suction (kN/m²) On Opposite(Leeward) Face = -0.261

Note: The above loads are not applicable to parapets which must be designed separately.

NB: All dimensions are in millimetres and wind loads in kN/m²

Wind Analysis to BS6399-2 - Wind Loads for Walls

DATA ENTRY:-

Short Face 1 or 3

15.000 m

Long Face 2 or 4

18.000 m

Reference Face

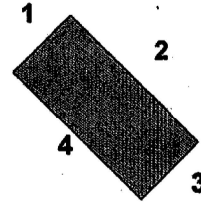
Face 2 (Side)

Reference Height

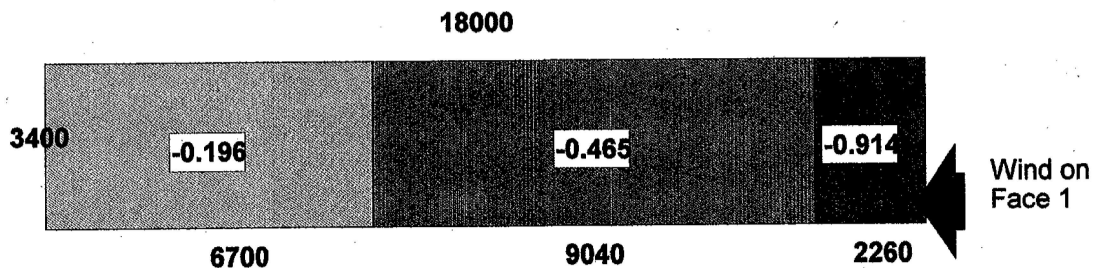
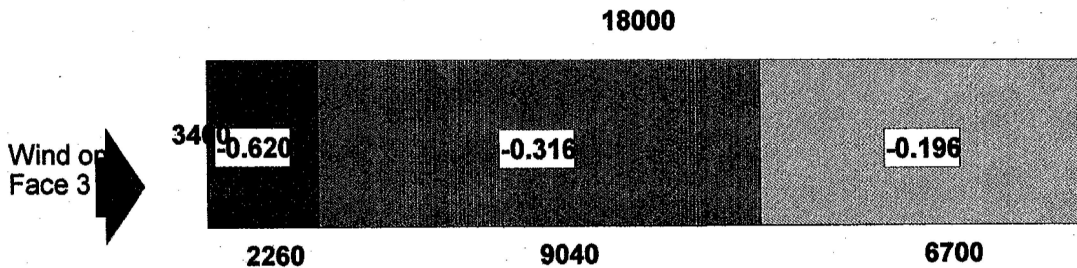
3.400 m

Gap Between Buildings

0.000 m



Reference Face



Suction(kN/m²) On Reference Face2

Pressure (kN/m²) On Reference Face = +0.452

Pressure/Suction (kN/m²) On Opposite(Leeward) Face = -0.112

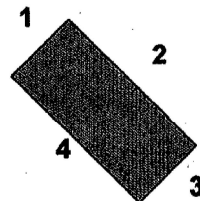
Note: The above loads are not applicable to parapets which must be designed separately.

NB: All dimensions are in millimetres and wind loads in kN/m²

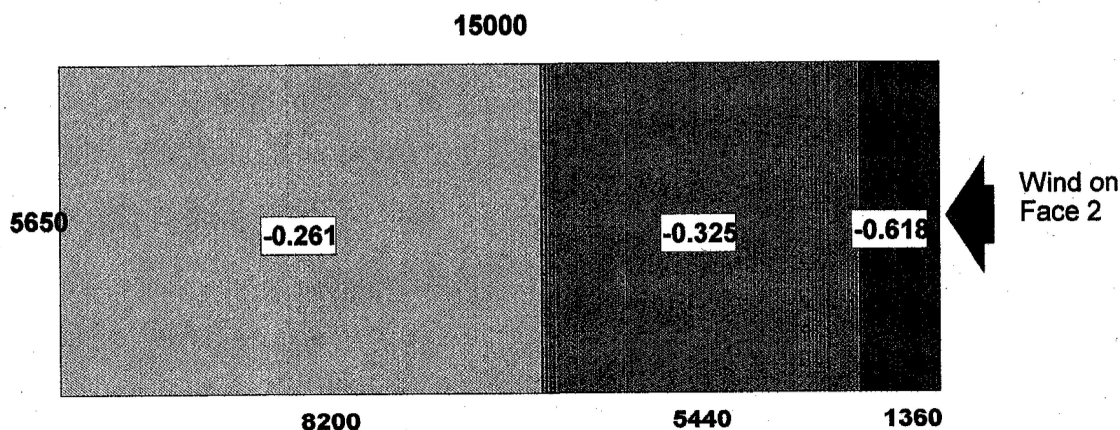
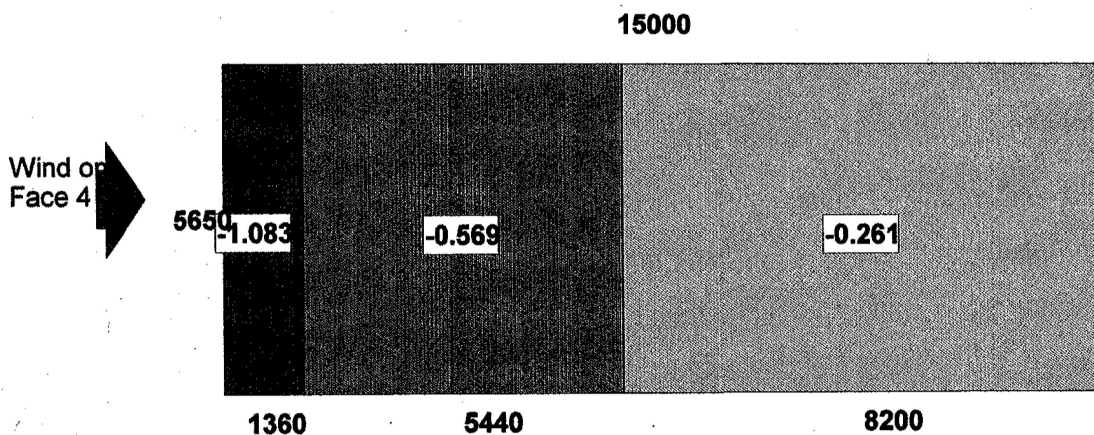
Wind Analysis to BS6399-2 - Wind Loads for Walls

DATA ENTRY:-

Short Face 1 or 3	15.000 m
Long Face 2 or 4	18.000 m
Reference Face	Face 3 (Gable)
Reference Height	5.650 m
Gap Between Buildings	0.000 m



Reference Face



Suction(kN/m²) On Reference Face3

Pressure (kN/m²) On Reference Face = +0.636

Pressure/Suction (kN/m²) On Opposite(Leeward) Face = -0.177

Note: The above loads are not applicable to parapets which must be designed separately.

Wind Analysis to BS6399-2 - Wind Loads for Walls

DATA ENTRY:-

Short Face 1 or 3

15.000 m

Long Face 2 or 4

18.000 m

Reference Face

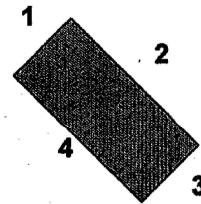
Face 4 (Side)

Reference Height

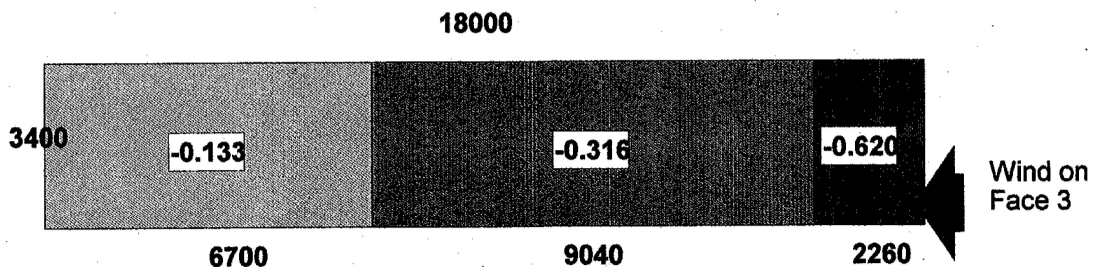
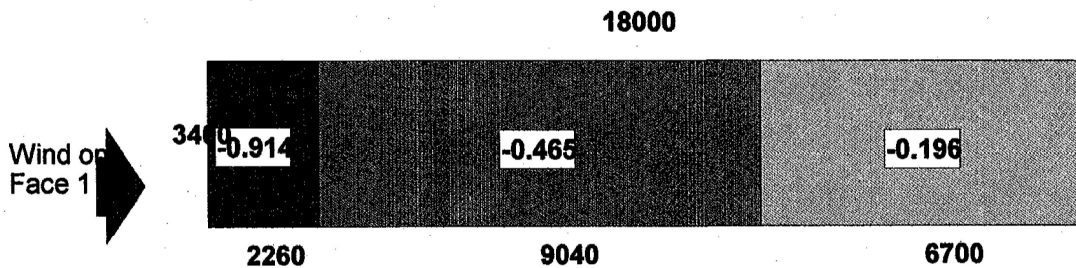
3.400 m

Gap Between Buildings

0.000 m



Reference Face



Suction (kN/m²) On Reference Face 4

Pressure (kN/m²) On Reference Face = +0.791

Pressure/Suction (kN/m²) On Opposite (Leeward) Face = -0.196

Note: The above loads are not applicable to parapets which must be designed separately.

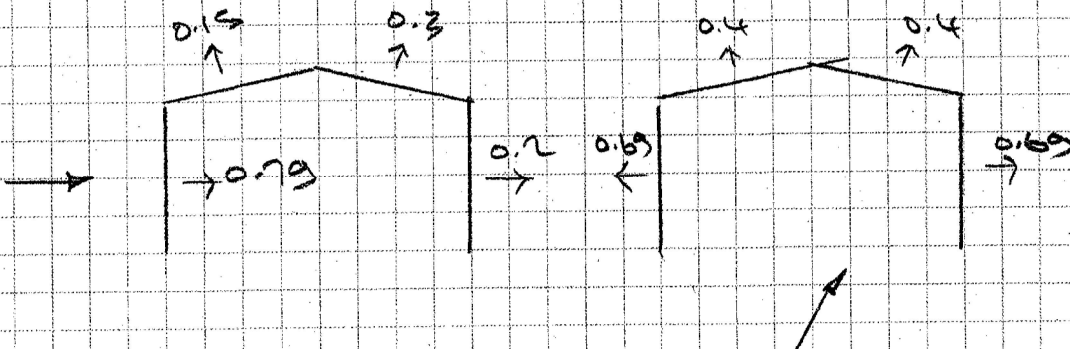


CTRS 4570

DL - 0.20

LL - 0.60 w/s

WIND LOAD



column	-	254	146	31	08	ok	✓
RAFTER		254	146	31	08	ok	✓

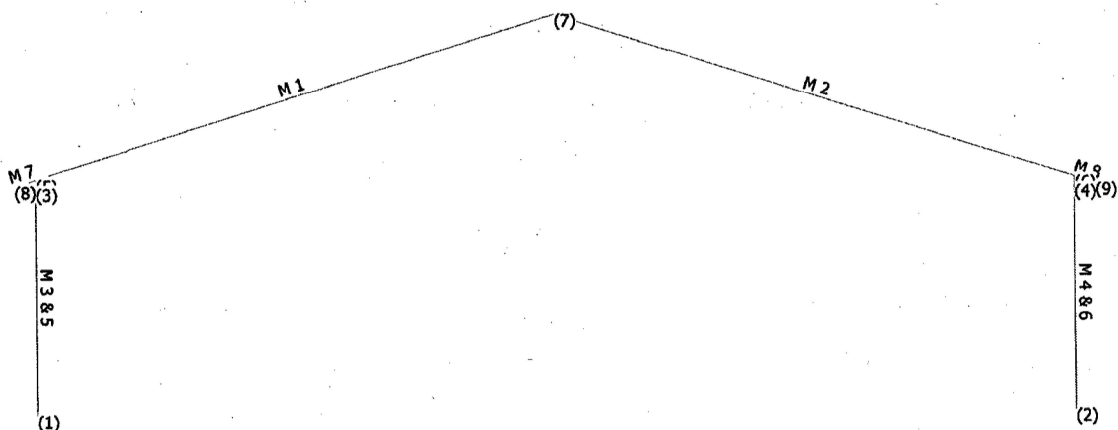
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25554

Wellington St
Westhoughton,
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Y
|
Z — X

**Frame Geometry - (Full Frame) - Front View****Not to Scale**

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MasterPort 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 D2	Services
Load Group L1	Live Load
Load Group W1	Wind Load
Load Group W2	Wind Load
Load Group W3	Wind Load

Load Case 001 : 1.4 (Dead+Services) + 1.6 Live

Load Combination + 1.00 UT + 1.40 D1 + 1.40 D2 + 1.60 L1

Load Case 002 : Dead + Services + Live (Service)

Load Combination + 1.00 UT + 1.00 D1 + 1.00 D2 + 1.00 L1

Load Case 003 : Live Only (Service)

Load Combination + 1.00 UT + 1.00 L1

Load Case 004 : (Sway Stability)

Load Combination + 1.00 UT
Notional Loads Apply horizontal notional loads at 0.0 degrees from X axis equal to 0.5% of the factored vertical loads in case 1

Level	@ (m)	F (kN)	Level	@ (m)	F (kN)	Level	@ (m)	F (kN)
0	0.000	0.007	1	3.274	0.007	2	3.305	0.009
3	3.400	0.239	4	5.765	0.229			

Node	F (kN)	Node	F (kN)	Node	F (kN)	Node	F (kN)
1	0.003	2	0.003	3	0.004	4	0.004
5	0.119	6	0.119	7	0.229	8	0.005
9	0.005						

Load Case 005 : 1.4 (Dead+Services) + 1.6 Live + Notional -->

Load Combination + 1.00 UT + 1.40 D1 + 1.40 D2 + 1.60 L1
Notional Loads Apply horizontal notional loads at 0.0 degrees from X axis equal to 0.5% of the factored vertical loads in case 1

Level	@ (m)	F (kN)	Level	@ (m)	F (kN)	Level	@ (m)	F (kN)
0	0.000	0.007	1	3.274	0.007	2	3.305	0.009
3	3.400	0.239	4	5.765	0.229			

Node	F (kN)	Node	F (kN)	Node	F (kN)	Node	F (kN)
1	0.003	2	0.003	3	0.004	4	0.004
5	0.119	6	0.119	7	0.229	8	0.005
9	0.005						

Load Case 006 : 1.4WIND SIDE - 1.0D (Ultimate)

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W1

Load Case 007 : 1.4WIND SIDE - 1.0D (Serviceability)

Load Combination + 1.00 UT + 1.00 D1 + 1.00 W1

Load Case 008 : 1.4WIND END - 1.0D (Ultimate)

Load Combination + 1.00 UT + 1.00 D1 + 1.40 W2

Load Case 009 : 1.4WIND END - 1.0D (Serviceability)

Load Combination + 1.00 UT + 1.00 D1 + 1.00 W2

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Load Case 010 : Dead plus Live plus Wind (1.2 D1 + 1.2 L1 + 1.2 W3)

Load Combination + 1.00 UT + 1.20 D1 + 1.20 L1 + 1.20 W3

The Nodal Co-ordinates

Node	X (m)	Y (m)	Z (m)	Node	X (m)	Y (m)	Z (m)
1	0.300	0.000	0.000	2	15.300	0.000	0.000
3	0.300	3.274	0.000	4	15.300	3.274	0.000
5	0.300	3.400	0.000	6	15.300	3.400	0.000
7	7.800	5.765	0.000	8	0.000	3.305	0.000
9	15.600	3.305	0.000				

Member Properties**Members 1-2 & 7-8**

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

Members 3-6 (0.126m Haunch at End 2, Depth 251.4mm to 502.8mm)

MH 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 Loading

Note: Partial Fixity - Use 0% in Ultimate, 10% in Sway Stability and 20% in Serviceability Loading Cases

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

E kN/mm ²	Density kN/m ³
≥ 200.00	77.01
≥ 20.00	24.00
≥ 2.00	10.00

Member 1

UT Spacing 04.570 [Multiply AllLoads]	Rafter 1 of Bay 1
D1 UDLY -000.200 [kN/m]	D2 UDLY -000.000 [kN/m]
L1 UDLY -000.600 [kN/m]	W1 UDLN +000.150 [kN/m]
W2 UDLN +000.400 [kN/m]	W3 UDLN -000.500 [kN/m]

Member 2

UT Spacing 04.570 [Multiply AllLoads]	Rafter 2 of Bay 1
D1 UDLY -000.200 [kN/m]	D2 UDLY -000.000 [kN/m]
L1 UDLY -000.600 [kN/m]	W1 UDLN +000.300 [kN/m]
W2 UDLN +000.400 [kN/m]	W3 UDLN +000.300 [kN/m]

Members 3 & 5

UT Spacing 04.570 [Multiply AllLoads]	Column 1
UT PartFix 20.00 +++ --- (0/10/20)	W1 UDLX +000.790 [kN/m]
W2 UDLX -000.700 [kN/m]	W3 UDLY +000.790 [kN/m]

Members 4 & 6

UT Spacing 04.570 [Multiply AllLoads]	Column 2
UT PartFix 20.00 +++ --- (0/10/20)	W1 UDLX +000.200 [kN/m]
W2 UDLX +000.700 [kN/m]	W3 UDLX +000.200 [kN/m]

Member 7

UT Spacing 04.570 [Multiply AllLoads]	Rafter 1 of Bay 1
D1 UDLY -000.200 [kN/m]	D2 UDLY -000.000 [kN/m]
L1 UDLY -000.600 [kN/m]	W1 UDLN +000.600 [kN/m]
W2 UDLN +000.700 [kN/m]	

Member 8

UT Spacing 04.570 [Multiply AllLoads]	Rafter 2 of Bay 1
---------------------------------------	-------------------

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D1 UDLY -000.200
L1 UDLY -000.600
W2 UDLN +000.700

[kN/m]
[kN/m]
[kN/m]

D2 UDLY -000.000
W1 UDLN +000.400

[kN/m]
[kN/m]

Member Orientation

Members 2, 4 & 6 B +180.00

Nodal Loading and Support Conditions

NODES 1-2

UT Rs 1 1 1 1 1 1 (20.00% Fixity)

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Nodal Deflections Serviceability (002 : Dead + Services + Live (Service))

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	0.00	0.00	2	0.00	0.00	0.00	0.00
3	-13.36	-0.13	-0.06	13.36	4	13.36	-0.13	0.06	13.36
5	-13.20	-0.13	-0.08	13.20	6	13.20	-0.13	0.08	13.20
7	0.00	-42.72	0.00	42.72	8	-13.34	0.28	-0.08	13.34
9	13.34	0.28	0.08	13.34					

Nodal Deflections Serviceability (003 : Live Only (Service))

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	0.00	0.00	2	0.00	0.00	0.00	0.00
3	-9.21	-0.09	-0.04	9.22	4	9.21	-0.09	0.04	9.22
5	-9.11	-0.09	-0.05	9.11	6	9.11	-0.09	0.05	9.11
7	0.00	-29.45	0.00	29.45	8	-9.20	0.20	-0.05	9.20
9	9.20	0.20	0.05	9.20					

Nodal Deflections Serviceability (004 : (Sway Stability))

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	0.00	0.00	2	0.00	0.00	0.00	0.00
3	0.77	0.00	-0.01	0.77	4	0.77	0.00	-0.01	0.77
5	0.79	0.00	-0.01	0.79	6	0.79	0.00	-0.01	0.79
7	0.80	0.00	0.01	0.80	8	0.78	0.05	-0.01	0.78
9	0.78	-0.05	-0.01	0.78					

Nodal Deflections Serviceability (007 : 1.4WIND SIDE - 1.0D (Serviceability))

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	0.00	0.00	2	0.00	0.00	0.00	0.00
3	13.94	-0.01	-0.19	13.94	4	14.35	-0.01	-0.20	14.35
5	14.35	-0.01	-0.19	14.35	6	14.79	-0.01	-0.20	14.79
7	14.58	-0.76	0.12	14.60	8	14.04	0.96	-0.19	14.08
9	14.46	-1.05	-0.20	14.50					

Nodal Deflections Serviceability (009 : 1.4WIND END - 1.0D (Serviceability))

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	0.00	0.00	2	0.00	0.00	0.00	0.00
3	0.12	0.01	-0.01	0.12	4	1.24	0.02	-0.01	1.24
5	0.14	0.01	-0.01	0.14	6	1.25	0.02	-0.01	1.25
7	0.70	-1.47	0.00	1.62	8	0.13	0.07	-0.01	0.14
9	1.24	-0.01	-0.01	1.24					

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Date : 22 March 2022 / Ver. 2021.10.20
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Member Forces Ultimate (001 : 1.4 (Dead+Services) + 1.6 Live)

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	5	36.861C	36.468	-82.517	37.028	12.390
	7	23.069C	-7.274	32.275	@ 6.527	@ 5.347
2	6	36.861C	36.468	-82.517	37.028	12.390
	7	23.069C	-7.274	32.275	@ 6.527	@ 5.347
3	1	49.146C	-24.189	0.000		6.826
	3	47.762C	-24.189	-79.202		@ 1.965
4	2	49.146C	-24.189	0.000		6.826
	4	47.762C	-24.189	-79.202		@ 1.965
5	3	47.762C	-24.189	-79.202		6.826
	5	47.699C	-24.189	-82.242		@ 1.965
6	4	47.762C	-24.189	-79.202		6.826
	6	47.699C	-24.189	-82.242		@ 1.965
7	5	0.554T	-1.749	0.275		0.000
	8	0.000C	0.000	0.000		@ 0.000
8	6	0.554T	1.749	-0.275		0.000
	9	0.000C	0.000	0.000		@ 0.000

Member Forces Ultimate (005 : 1.4 (Dead+Services) + 1.6 Live + Notional -->)

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	5	36.708C	36.363	-81.695	37.168	12.659
	7	22.916C	-7.378	32.275	@ 6.527	@ 5.347
2	6	37.014C	36.573	-83.340	36.892	12.120
	7	23.223C	-7.169	32.275	@ 6.606	@ 5.347
3	1	49.000C	-23.947	0.000		6.758
	3	47.617C	-23.947	-78.408		@ 1.965
4	2	49.291C	-24.431	0.000		6.894
	4	47.908C	-24.431	-79.995		@ 1.965
5	3	47.617C	-23.950	-78.408		6.758
	5	47.553C	-23.950	-81.419		@ 1.965
6	4	47.908C	-24.428	-79.995		6.894
	6	47.845C	-24.428	-83.065		@ 1.965
7	5	0.550T	-1.750	0.276		0.000
	8	0.004C	-0.001	0.000		@ 0.000
8	6	0.558T	1.748	-0.275		0.000
	9	0.004T	-0.001	0.000		@ 0.000

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Member Forces Ultimate (006 : 1.4WIND SIDE - 1.0D (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	5	0.109T	-3.101	27.392		12.075
	7	2.893T	-4.383	-2.037	@	3.303
2	6	2.928C	-1.015	-18.685		13.332
	7	0.144C	5.250	-2.037	@ 1.258	@ 3.617
3	1	0.435T	16.721	0.000		3.261
	3	1.423T	0.171	27.656	@ 3.303	@ 1.866
4	2	0.548C	-7.692	0.000		1.800
	4	0.440T	-3.502	-18.326	@	1.932
5	3	1.423T	0.171	27.656		3.261
	5	1.468T	-0.464	27.638	@ 3.303	@ 1.866
6	4	0.440T	-3.502	-18.326		1.800
	6	0.485T	-3.341	-18.756	@	1.932
7	5	0.112T	-1.561	0.246		0.000
	8	0.000C	0.000	0.000	@	0.000
8	6	0.112T	-0.452	0.071		0.000
	9	0.000C	0.000	0.000	@	0.000

Member Forces Ultimate (008 : 1.4WIND END - 1.0D (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	5	13.084T	-6.465	11.100		1.237
	7	15.868T	4.832	4.680	@ 4.482	@ 4.561
2	6	12.986T	-6.153	8.651		2.231
	7	15.770T	5.143	4.680	@ 4.247	@ 4.247
3	1	7.353T	-4.267	0.000		0.186
	3	8.341T	10.397	10.035	@ 0.950	@ 2.685
4	2	9.713T	-5.118	0.000		0.220
	4	10.701T	9.546	7.249	@ 1.146	@ 1.244
5	3	8.341T	10.397	10.035		0.186
	5	8.386T	10.960	11.378	@ 0.950	@ 2.685
6	4	10.701T	9.546	7.249		0.220
	6	10.747T	10.109	8.484	@ 1.146	@ 1.244
7	5	0.112T	-1.762	0.277		0.000
	8	0.000C	0.000	0.000	@	0.000
8	6	0.112T	-1.056	0.166		0.000
	9	0.000C	0.000	0.000	@	0.000

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Member Forces Ultimate (010 : Dead plus Live plus Wind (1.2 D1 + 1.2 L1 + 1.2 W3))

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	5	27.730C	37.952	-51.333	50.355	29.890
	7	16.969C	-17.742	28.133	@ 5.347	@ 4.482
2	6	34.838C	25.993	-92.946		16.989
	7	24.077C	4.800	28.133		@ 2.359
3	1	47.205C	-15.035	0.000		4.243
	3	46.020C	-15.035	-49.229		@ 1.965
4	2	37.937C	-29.138	0.000		7.904
	4	36.752C	-25.547	-89.529		@ 1.965
5	3	46.020C	-15.035	-49.229		4.243
	5	45.965C	-15.035	-51.118		@ 1.965
6	4	36.752C	-25.547	-89.529		7.904
	6	36.697C	-25.409	-92.731		@ 1.965
7	5	0.432T	-1.364	0.215		0.000
	8	0.000C	0.000	0.000		@ 0.000
8	6	0.432T	1.365	-0.215		0.000
	9	0.000C	0.000	0.000		@ 0.000

Support Reactions (001 : 1.4 (Dead+Services) + 1.6 Live)

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	24.189	49.146	0.000	2	-24.189	49.146	0.000
Total	0.000	98.291	0.000				

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

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	18.237	32.049	-10.788	2	-18.237	32.049	10.788
Total	0.000	64.097	0.000				

Support Reactions (003 : Live Only (Service))

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	12.576	21.388	-7.439	2	-12.576	21.388	7.439
Total	0.000	42.775	0.000				

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Support Reactions (004 : (Sway Stability))

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	-0.246	-0.118	0.210	2	-0.246	0.118	0.210
Total	-0.491	0.000	0.421				

Support Reactions (005 : 1.4 (Dead+Services) + 1.6 Live + Notional -->)

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	23.943	49.000	0.000	2	-24.435	49.291	0.000
Total	-0.491	98.291	0.000				

Support Reactions (006 : 1.4WIND SIDE - 1.0D (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	-16.721	-0.435	0.000	2	-7.692	0.548	0.000
Total	-24.413	0.113	0.000				

Support Reactions (007 : 1.4WIND SIDE - 1.0D (Serviceability))

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	-10.583	3.730	7.610	2	-6.855	2.443	7.312
Total	-17.438	6.172	14.921				

Support Reactions (008 : 1.4WIND END - 1.0D (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	4.267	-7.353	0.000	2	-5.118	-9.713	0.000
Total	-0.851	-17.066	0.000				

Support Reactions (009 : 1.4WIND END - 1.0D (Serviceability))

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	4.655	-2.159	-0.565	2	-5.262	-3.939	1.267
Total	-0.608	-6.098	0.701				

Support Reactions (010 : Dead plus Live plus Wind (1.2 D1 + 1.2 L1 + 1.2 W3))

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	15.035	47.205	0.000	2	-29.138	37.937	0.000
Total	-14.104	85.143	0.000				

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List of Checks - Results Summary

Column 2 : M 4 & 6 (N.2-N.6)	00.000 to 01.900 m, in Case 002	0.365	A+M Pass
	01.900 to 03.100 m, in Case 010	0.684	A+M Pass
	03.100 to 03.400 m, in Case 010	0.843	A+M Pass
Column 2 : M 4 & 6 (N.2-N.6)	01.900 to 03.400 m, in Case 010	0.964	App-G Pass
Rafter 2 of Bay 1 : M 2 (N.6-N.7)	00.132 to 01.550 m, in Case 010	0.712	A+M Pass
	01.550 to 03.100 m, in Case 010	0.406	A+M Pass
	03.100 to 04.650 m, in Case 010	0.367	A+M Pass
	04.650 to 06.200 m, in Case 010	0.367	A+M Pass
	06.200 to 07.750 m, in Case 010	0.367	A+M Pass
Rafter 2 of Bay 1 : M 2 (N.6-N.7)	00.132 to 03.100 m, in Case 010	0.836	App-G Pass
	03.100 to 07.864 m, in Case 006	0.293	App-G Pass
Rafter 2 of Bay 1 : M 8 (N.6-N.9)	00.000 to 00.315 m, in Case 007	0.697	A+M Pass

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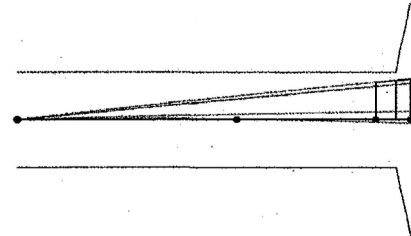
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Axial with Moments (Member)
Column 2 : Members 4 & 6 (N.2-N.6)
Between 3.100 and 3.400 m, in Load Case 10

Member Loading and Member Forces

Loading Combination : 1 UT + 1.2 D1 + 1.2 L1 + 1.2 W3
UT Spacing 04.570 [Multiply All Loads]
UT PartFix 20.00 +++ --- (Mt My Mz)
W3 UDLX +000.200 [kN/m]

**Member Forces in Load Case 10 and Maximum Deflection from Load 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)
	2 6	37.937C 36.697C	-29.138 -25.409	0.000 -92.731		@ 3.444 2.063

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, 37.94, 92.73, 0 (Axial: Non-Slender) Plastic
Auto Design Load Cases 1, 5-6, 8 & 10

Local Capacity Check

Fvx/Pvx 25.55 / 248.886 = 0.103 Low Shear
Mcx = py.Sxx ≤ 1.2 py.Zxx 275 x 393.1 ≤ 1.2 x 275 x 352.49 = 108.103 kN.m
Pz = Ag.py 39.67 x 275 = 1090.925 kN
n = F/Pz 37.937 / 1090.925 = 0.035 OK
Srx = Fn(Sxx, n) 393.1, 0.035 392.31 cm²
Mrx = Srx.py 392.31 x 275 107.884 kN.m
(Mx/Mrx)^{Z1} + (My/Mry)^{Z2} (89.528/107.884)² + (0)¹ = 0.689 OK

Compression Resistance Pc

λx = Lex/rxx 100x1x3.4/10.55 = 32.2
Pcx = Area.pcx 39.67x265.72/10 = 1054.110 kN Table 24 a
λy = Ley/ryy 100x1x0.3/3.36 = 8.9
Pcy = Area.pcy 39.67x275/10 = 1090.925 kN Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (1.5M2 + 5M3 + 1.5M4)/Mmax 0.2 + (1.5x87 + 5x89 + 1.5x91)/93 ≥ 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 + (1x-24 + 6x-48 + 1x-71)/93 ≥ .8x71/93 0.613 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 0.3 = 0.3 m
λ = Le/ryy 0.3 / 3.36 = 8.93
v = Fn (x.Le,ryy,λ) 29.688, 0.3, 3.36, 8.93 0.999 Table 19
λLT = u.v.λ.√βw 0.88 x 0.999 x 8.93√1 7.85
pb = Fn (py,λLT) 275, 7.85 275 N/mm² Table 16
Mb = Sxx.pb ≤ Mc 393.1 x 275 ≤ 108.103 = 108.103 kN.m

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb 1x-89.5/108.1 0.828
rc = F/Pcy 37.9/1090.9 0.035
λr = (rbλLT + rcλy)/(rb + rc) (0.828x7.85 + 0.035x8.9)/(0.828 + 0.035) 7.893
λro = 17.15E (2rb + rc)/(rb + rc) 17.15x1(2x0.828 + 0.035)/(0.828 + 0.035) 33.609
Mob = Mb(1 - F/Pcy) 108.103(1 - 37.9/1090.9) 104.343

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$M_{xy} = M_{cx}(1 - F_o/P_{cy})^{1/2}$	$108.103(1 - 37.9/1090.9)^{1/2}$	106.206	
$M_{ox} = M_{cx}(1 - F_o/P_{cx})/(1 + 0.5F_o/P_{cx})$	$108.103(1 - 37.9/1054.1)/(1 + 0.5 \cdot 37.9/1054.1)$	102.370	
$M_{oy} = M_{cy}(1 - F_o/P_{cy})/(1 + k_y(F_o/P_{cy}))$	$20.216(1 - 37.9/1090.9)/(1 + 1.0(37.9/1090.9))$	18.857	
$M_{ab} = \text{fn}(\lambda_x, \lambda_{ro}, E, M_{xy}, M_{ob})$	7.893, 33.609, 1.000, 106.206, 104.343	106.206	
$M_{ax} = \text{fn}(\lambda_x, E, M_{rx}, M_{ox})$	32.235, 1.000, 107.884, 102.370	106.672	
$M_{ay} = \text{fn}(\lambda_y, E, M_{ry}, M_{oy})$	8.932, 1.000, 20.216, 18.857	20.216	
$m_x \cdot M_x / M_{ax}$	$0.613 \times 89.5 / 106.7$	0.514	OK
$m_{LT} \cdot M_{LT} / M_{ab}$	$1 \times 89.5 / 106.2$	0.843	OK
$m_x \cdot M_x / M_{ax}$	$0.613 \times 89.5 / 106.7$	0.514	OK
Compare with Simplified to 4.8.3.3	0.602, 0.863, 0.864	0.864	
Compare with MoreExact to 4.8.3.3	0.553, 0.863, 0.875	0.875	

Deflection Check - Load Case 2

In-span $\delta \leq \text{Span}/360$	$3.44 \leq 3400 / 360$	3.44 mm	OK
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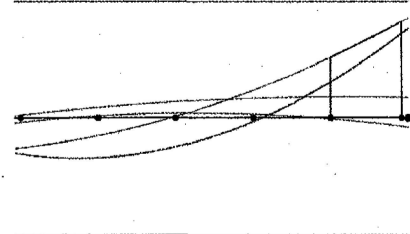
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Axial with Moments (Member)
Rafter 2 of Bay 1 : Member 2 (N.6-N.7)
Between 0.132 and 1.550 m, in Load Case 10

Member Loading and Member Forces

Loading Combination : 1 UT + 1.2 D1 + 1.2 L1 + 1.2 W3
UT Spacing 04.570 [Multiply All Loads]
D1 UDLY -000.200 [kN/m]
L1 UDLY -000.600 [kN/m]
W3 UDLN +000.300 [kN/m]

**Member Forces in Load Case 10 and Maximum Deflection from Load 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)
2	6 7	34.838C 24.077C	25.993 4.800	-92.946 28.133	@	7.265 5.347

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, 34.84, 92.95, 0 (Axial: Non-Slender) Plastic
Auto Design Load Cases 1, 5-6, 8 & 10

Local Capacity Check

Fvx/Pvx 25.636 / 248.886 = 0.103 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 34.838 / 1090.925 = 0.032 OK
Srx = Fn(Sxx, n) 393.1, 0.032 392.43 cm³
Mrx = Srx.py 392.43 x 275 107.919 kN.m
(Mx/Mrx)² + (My/Mry)² + (0)¹ = 0.688 OK

Compression Resistance Pc

λx = Lex/rxx 100x1x7.864/10.55 = 74.5
Pcx = Area.pcx 39.67x214.854/10 = 852.325 kN Table 24 a
λy = Ley/ryy 100x1x1.418/3.36 = 42.2
Pcy = Area.pcy 39.67x247.29/10 = 980.995 kN Table 24 b

Equivalent Uniform Moment Factors mLT, mx, my and myx

mLT = 0.2 + (1.5M2 + 5M3 + 1.5M4)/Mmax 0.2 + (1.5x81 + 5x72 + 1.5x64)/90 ≥ 0.44 0.844 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 + (1x47 + 6x12 + 1x13)/93 ≥ 0.8x47/93 0.405 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 1.418 = 1.418 m
λ = Le/ryy 1.418 / 3.36 = 42.2
v = Fn (x, Le, ryy, λ) 29.496, 1.418, 3.36, 42.2 0.976 Table 19
λLT = u.v.λ.√βw 0.88 x 0.976 x 42.2√1 36.26
pb = Fn (py, λLT) 275, 36.26 270.53 N/mm² Table 16
Mb = Sxx.pb ≤ Mc 393.1 x 270.53 ≤ 108.103 = 106.345 kN.m

Combined Axial Compression and Bending to Annex I

rb = mLT.MLT/Mb 0.844x89.5/106.3 0.711
rc = Fc/Pcy 34.8/981 0.036
λr = (rbλLT + rcλy)/(rb + rc) (0.711x36.3 + 0.036x42.2)/(0.711 + 0.036) 36.539
λro = 17.15E (2rb + rc)/(rb + rc) 17.15x1(2x0.711 + 0.036)/(0.711 + 0.036) 33.484
Mob = Mb(1 - Fc/Pcy) 106.345(1 - 34.8/981) 102.568

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$M_{xy} = M_{cx}(1 - F_o/P_{oy})^{1/2}$	$108.103(1 - 34.8/981)^{1/2}$	106.166	
$M_{ox} = M_{cx}(1 - F_o/P_{cx})/(1 + 0.5F_o/P_{cx})$	$108.103(1 - 34.8/852.3)/(1 + 0.5 \cdot 34.8/852.3)$	101.607	
$M_{oy} = M_{cy}(1 - F_o/P_{cy})/(1 + k_y(F_o/P_{cy}))$	$20.255(1 - 34.8/981)/(1 + 1.0(34.8/981))$	18.866	
$M_{ab} = \text{fn}(\lambda_{rx}, \lambda_{ro}, E, M_{xy}, M_{ob})$	36.539, 33.484, 1.000, 106.166, 102.568	106.166	
$M_{ax} = \text{fn}(\lambda_{rx}, E, M_{rx}, M_{ox})$	74.540, 1.000, 107.919, 101.607	102.643	
$M_{ay} = \text{fn}(\lambda_{ry}, E, M_{ry}, M_{oy})$	42.202, 1.000, 20.255, 18.866	19.748	
$m_x \cdot M_x / M_{ax}$	$0.405 \times 92.9 / 102.6$	0.367	OK
$m_{LT} \cdot M_{LT} / M_{ab}$	$0.844 \times 89.5 / 106.2$	0.712	OK
$m_x \cdot M_x / M_{ax}$	$0.405 \times 92.9 / 102.6$	0.353	OK
Compare with Simplified to 4.8.3.3	0.431, 0.746, 0.752	0.752	
Compare with MoreExact to 4.8.3.3	0.396, 0.746, 0.744	0.746	

Deflection Check - Load Case 2

In-span $\delta \leq \text{Span}/360$	$7.26 \leq 7864 / 360$	7.26 mm	OK
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