

Structural Inspection

Client: A Wykes

Project: Pretty Oak Farm
Upton Lane
Stoke Golding
Nuneaton
CV13 6EU

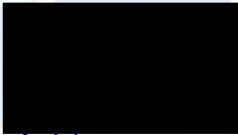
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1.0 Introduction

- 1.1. Further to instructions, I visited Pretty Oak Farm, Stoke Golding on 24 September 2024.
- 1.2. My brief was to undertake a visual structural appraisal of an existing agricultural building to determine the existing condition and to form an opinion on the suitability for future conversion for residential use in accordance with the Class Q of the Town and Country Planning (General Permitted Development) (England) Order 2015.
- 1.3. My inspection was limited to elements of the structure which were visible, exposed or to which access was available.

2.0 Description

- 2.1. The agricultural building inspected is an independent structure located to the south of Upton Lane. [Figure 1]



Figure 1

- 2.2. The building is rectangular on plan, with an overall length of approximately 18.15 m divided into three equal bays, and an overall width of approximately 9.4 m. Height to low eaves is approximately 4.5 m
- 2.3. The construction comprises a mono-pitched, hot-rolled steel framed building, with knee bracing to the higher eaves to provide lateral stability. There is a further brace to the low eaves to the western gable end frame, and a diagonal brace within the roof plane.
- 2.4. The roof comprises profiled steel sheet cladding supported on timber purlins spanning between main frames.
- 2.5. The wall cladding comprises a combination of profiled steel sheeting and vertical timber boarding at high level, with aggregate concrete blockwork and horizontally spanning concrete panels from floor level.

- 2.6. The two bays to the western end of the south-facing elevation together with the gable contain unclad sections between the upper and lower walls.
- 2.7. The building is divided into two sections by a full-height partition wall. The south-eastern bay is fully enclosed and includes a first floor mezzanine accessed via a roller shutter door.
- 2.8. The floor comprises a cast *in situ* concrete ground slab.

3.0 Observations

- 3.1. The building appears to be in a relatively good condition generally relative to age and exposure conditions, with no evidence of damage or adverse lateral or longitudinal deflection or distortion.
- 3.2. The steel column sections are galvanized and remain in good condition without signs of corrosion. The rafter sections are unpainted and contain superficial surface rusting.
- 3.3. There is some distortion of the bolted joint connection between two of the rafters and columns, which appears to be due to the original construction, rather than to any imposed stresses.
- 3.4. No defects were observed to the blockwork or concrete panel walls.

4.0 Discussion

- 4.1. In the absence of any significant distortion or deflection, the building can be considered to be functioning adequately, and conversion into residential accommodation will not create any excessive adverse effects.
- 4.2. The current open aspects equate to only approximately 10% of the total wall area, but any proposals will need to include fully enclosing the building, and this may attract a small increase in lateral wind loading.
- 4.3. Consequently, to determine the adequacy of the existing frame, a preliminary two-dimensional analysis has been undertaken for the application of dead, imposed and wind loading conditions. This has not taken into consideration any stiffness afforded by the rafter to column joints, or of the internal division wall or first floor construction, both of which will add to the overall stiffness and stability, and so the analysis may be considered to be conservative.
- 4.4. The results suggest the existing frame is satisfactory generally when subject to vertical loading.
- 4.5. The addition of lateral restraints between the bottom flange of the rafter members and purlins may be required when the frame is subject to maximum wind loading conditions, but these are considered to be minor structural elements.
- 4.6. Remedial works to improve the rafter to column joints will also be required to alleviate the distortion, which will probably include replacement of the bolts.
- 4.7. Any proposals to replace roof or wall cladding to provide necessary insulation requirements will need to be of lightweight materials to avoid imposing any significant additional loading onto the existing frame.

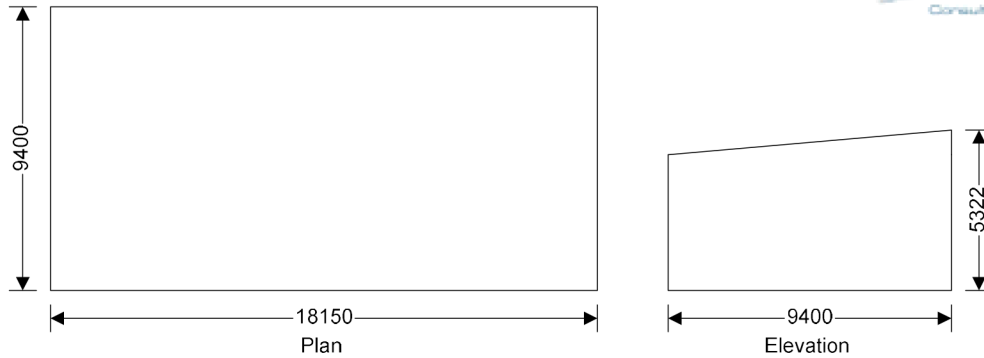
- 4.8. Surface rusting will need to be removed from steelwork with the addition of paint protection.
- 4.9. The addition of additional significant structural elements is not considered to be necessary.

5.0 Conclusion

- 5.1. The existing building is considered to be structurally suitable and sufficiently robust and strong enough, subject to building operations reasonably necessary, for conversion from use as an agricultural building to use as residential accommodation.

Appendix – Preliminary Frame Analysis

WIND LOADING



Building data

Type of roof;	Monopitch
Length of building;	L = 18150 mm
Width of building;	W = 9400 mm
Height to low eaves;	H = 4500 mm
Pitch of roof;	$\alpha_0 = 5.0$ deg
Reference height;	H _r = 5322 mm

Dynamic classification

Building type factor (Table 1);	K _b = 2.0
Dynamic augmentation factor (1.6.1);	C _r = $[K_b \times (H_r / (0.1 \text{ m}))^{0.75}] / (800 \times \log(H_r / (0.1 \text{ m}))) = \mathbf{0.03}$

Site wind speed

Location;	Leicester
Basic wind speed (Figure 6 BS6399:Pt 2)	V _b = 21.0 m/s
Site altitude	Δ _S = 89 m
Upwind distance from sea to site	d _{sea} = 110 km
Direction factor	S _d = 1.00
Seasonal factor	S _s = 1.00
Probability factor	S _p = 1.00
Critical gap between buildings;	g = 5000 mm
Topography not significant	
Altitude factor;	S _a = $1 + 0.001 \times \Delta_S / 1\text{m} = \mathbf{1.09}$
Site wind speed	V _s = V _b × S _a × S _d × S _s × S _p = 22.9 m/s
Terrain category;	Country

Dynamic pressure - windward wall - Wind 0 deg and roof

Reference height (at which q is sought);	H _{ref} = 4500 mm
Effective height;	H _e = max(H _{ref} - H _d , 0.4 × H _{ref}) = 4500 mm
Fetch factor (Table 22);	S _c = 0.856
Turbulence factor (Table 22);	S _t = 0.196
Gust peak factor;	g _t = 3.44
Terrain and building factor;	S _b = S _c × (1 + (g _t × S _t) + S _n) = 1.43
Effective wind speed;	V _e = V _s × S _b = 32.7 m/s
Dynamic pressure;	q _s = 0.613 kg/m ³ × V _e ² = 0.657 kN/m ²

Dynamic pressure - windward wall - Wind 90 deg and roof

Reference height (at which q is sought);	H _{ref} = 5322 mm
Effective height;	H _e = max(H _{ref} - H _d , 0.4 × H _{ref}) = 5322 mm
Fetch factor (Table 22);	S _c = 0.890
Turbulence factor (Table 22);	S _t = 0.191
Gust peak factor;	g _t = 3.44
Terrain and building factor;	S _b = S _c × (1 + (g _t × S _t) + S _n) = 1.47
Effective wind speed;	V _e = V _s × S _b = 33.7 m/s
Dynamic pressure;	q _s = 0.613 kg/m ³ × V _e ² = 0.697 kN/m ²

Size effect factors

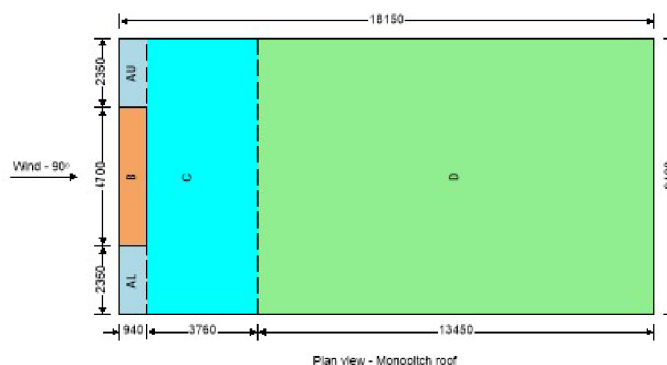
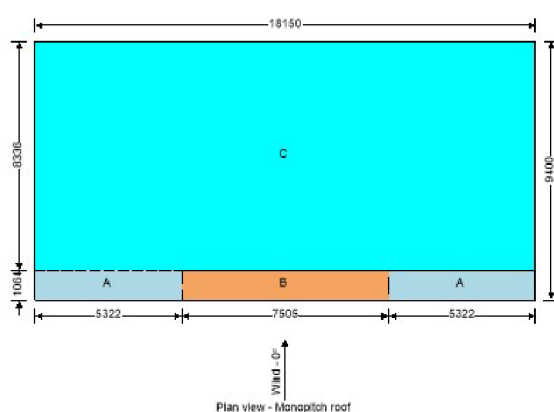
Diagonal dimension for gable wall;	$a_{eg} = 10.4 \text{ m}$
External size effect factor gable wall;	$C_{aeg} = 0.945$
Diagonal dimension for upper wall;	$a_{esU} = 18.9 \text{ m}$
External size effect factor upper wall;	$C_{aesU} = 0.900$
Diagonal dimension for lower wall;	$a_{esL} = 18.7 \text{ m}$
External size effect factor lower wall;	$C_{aesL} = 0.900$
Diagonal dimension for roof;	$a_{er} = 20.5 \text{ m}$
External size effect factor roof;	$C_{aer} = 0.894$
Room/storey volume for internal size effect factor;	$V_i = 0.125 \text{ m}^3$
Diagonal dimension for internal size effect factors;	$a_i = 10 \times (V_i)^{1/3} = 5.000 \text{ m}$
Internal size effect factor;	$C_{ai} = 1.000$

Roof load case 1 - Wind 0, $c_{pi} 0.20$, $-c_{pe}$

Zone	Ext pressure coefficient, c_{pe}	Dynamic pressure, q_s (kN/m^2)	External size factor, C_{ae}	Net Pressure, p (kN/m^2)	Area, A_{ref} (m^2)	Net force, F_w (kN)
A (-ve)	-1.80	0.70	0.894	-1.26	11.37	-14.34
B (-ve)	-1.20	0.70	0.894	-0.89	8.02	-7.11
C (-ve)	-0.60	0.70	0.894	-0.51	151.87	-77.92

Roof load case 2 - Wind 90, $c_{pi} 0.20$, $-c_{pe}$

Zone	Ext pressure coefficient, c_{pe}	Dynamic pressure, q_s (kN/m^2)	External size factor, C_{ae}	Net Pressure, p (kN/m^2)	Area, A_{ref} (m^2)	Net force, F_w (kN)
AU (-ve)	-2.20	0.70	0.894	-1.51	2.22	-3.35
AL (-ve)	-2.10	0.70	0.894	-1.45	2.22	-3.21
B (-ve)	-1.10	0.70	0.894	-0.82	4.43	-3.66
C (-ve)	-0.70	0.70	0.894	-0.58	35.48	-20.41
D (-ve)	-0.70	0.70	0.894	-0.58	126.91	-73.02

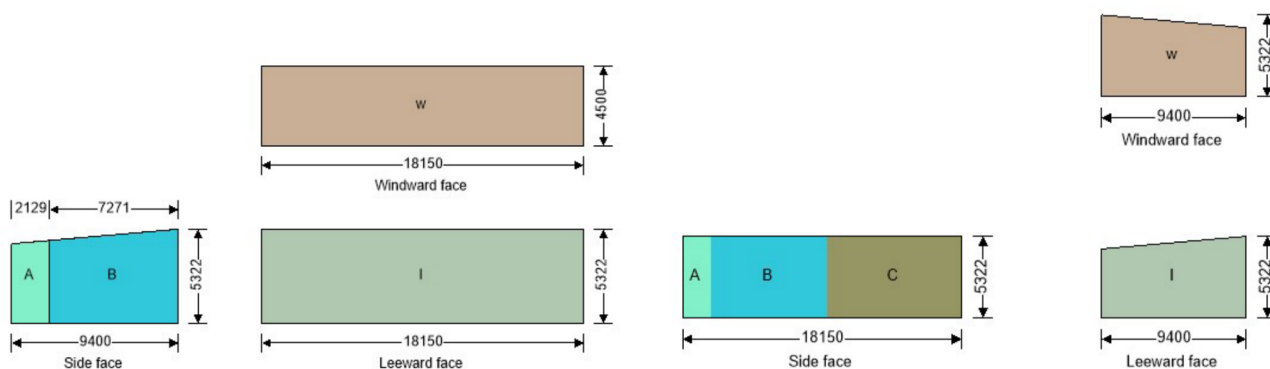


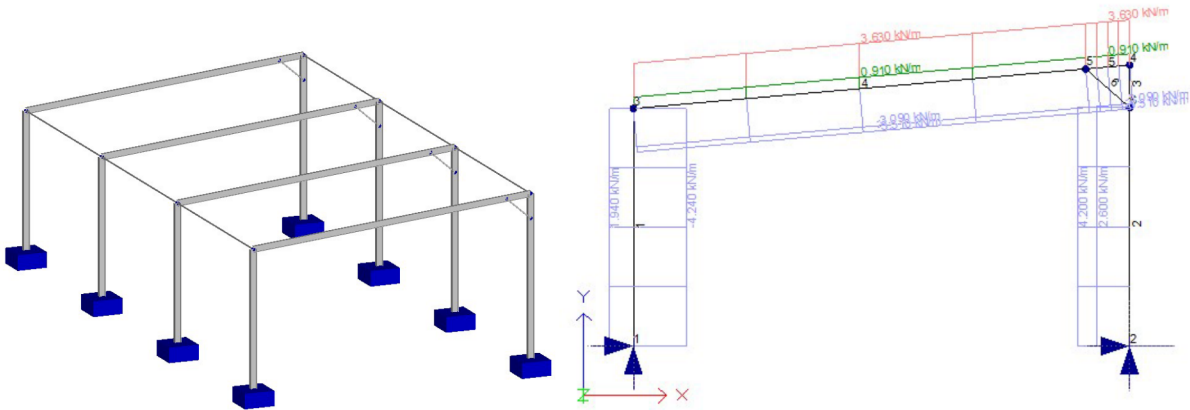
Walls load case 1 - Wind 0, c_{pi} 0.20, $-c_{pe}$

Zone	Ext pressure coefficient, c_{pe}	Dynamic pressure, q_s (kN/m ²)	External size factor, C_{ae}	Net Pressure, p (kN/m ²)	Area, A_{ref} (m ²)	Net force, F_w (kN)
A	-1.56	0.70	0.945	-1.17	9.78	-11.43
B	-0.89	0.70	0.945	-0.72	36.39	-26.34
w	0.76	0.66	0.900	0.32	81.68	25.96
I	-0.50	0.66	0.900	-0.43	96.60	-41.26

Walls load case 2 - Wind 90, c_{pi} 0.20, $-c_{pe}$

Zone	Ext pressure coefficient, c_{pe}	Dynamic pressure, q_s (kN/m ²)	External size factor, C_{ae}	Net Pressure, p (kN/m ²)	Area, A_{ref} (m ²)	Net force, F_w (kN)
A _U	-1.58	0.70	0.900	-1.13	10.01	-11.31
B _U	-0.89	0.70	0.900	-0.70	40.02	-28.00
C _U	-0.87	0.70	0.900	-0.69	46.57	-32.02
w	0.65	0.70	0.945	0.29	46.17	13.29
I	-0.50	0.70	0.945	-0.47	46.17	-21.63





Joints

Joint ref	X pos (m)	Y pos (m)	Z pos (m)	Joint ref	X pos (m)	Y pos (m)	Z pos (m)	Joint ref	X pos (m)	Y pos (m)	Z pos (m)
1	0.000	0.000	0.000	2	9.400	0.000	0.000	3	0.000	4.500	0.000
4	9.400	5.322	0.000	5	8.567	5.250	0.000	6	9.400	4.522	0.000

Members

Mbr ref	Member type	Start joint	Start fixity	End joint	End fixity	Orient (°)	Directional behaviour	Length (m)	P-Delta behaviour	Slope (°)
1	Columns	1	Fixed	3	Fixed	0.0	Normal	4.500	Normal	90.0
2	Columns	2	Fixed	6	Fixed	0.0	Normal	4.522	Normal	90.0
3	Columns	6	Fixed	4	Fixed	0.0	Normal	0.800	Normal	90.0
4	Rafters	3	Fixed	5	Fixed	0.0	Normal	8.600	Normal	5.0
5	Rafters	5	Fixed	4	Fixed	0.0	Normal	0.836	Normal	4.9
6	Brace	5	Fixed	6	Fixed	0.0	Normal	1.106	Normal	-41.2

Supports

Joint ref	Support type	X Trans. (kN/mm)	Y Trans. (kN/mm)	Z Trans. (kN/mm)
1	Pinned Base	Fixed	Fixed	Partial Fixity
2	Pinned Base	Fixed	Fixed	Partial Fixity

Member Types

Reference	Shape	Material	Seg no	Start section
Rafters	SW Library	UK-S275	1	203x102 UKB23
Columns	SW Library	UK-S275	1	203x133 UKB30
Brace	SW Library	UK-S275	1	48.3x4.0 CHS

Member Loads

<i>Load reference</i>	<i>Load type</i>	<i>Start pos'n (m)</i>	<i>Start intensity (kN) & (m)</i>	<i>End pos'n (m)</i>	<i>End intensity (kN) & (m)</i>	<i>Direction</i>	<i>Category</i>
<i>Loads on member 1 (Length 4.500m)</i>							
Walls (0)	UL		1.940			Horiz. (+X)	Wind (0)
Walls (90)	UL		-4.240			Horiz. (+X)	Wind (90)
<i>Loads on member 2 (Length 4.522m)</i>							
Walls (0)	UL		2.600			Horiz. (+X)	Wind (0)
Walls (90)	UL		4.200			Horiz. (+X)	Wind (90)
<i>Loads on member 4 (Length 8.600m)</i>							
Roof DL	UL		0.910			Vertical (-Y)	Dead
Roof IL	UL		3.630			Vertical (-Y)	Imposed
Roof (0)	UL		-3.090			Normal	Wind (0)
Roof (90)	UL		-3.510			Normal	Wind (0)
<i>Loads on member 5 (Length 0.836m)</i>							
Roof DL	UL		0.910			Vertical (-Y)	Dead
Roof IL	UL		3.630			Vertical (-Y)	Imposed
Roof (0)	UL		-3.090			Normal	Wind (0)
Roof (90)	UL		-3.510			Normal	Wind (0)

Load Combinations 1 to 5

<i>Load Category</i>			<i>Partial Safety Factors</i>					
<i>No</i>	<i>Name</i>	<i>Type</i>	<i>Sub type</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
	Combination reference			1	2	3	4	5
	Limit state			ULS	ULS	ULS	SLS	SLS
	Elastic analysis			Linear	Linear	Linear	Linear	Linear
	Plastic analysis			No	No	No	No	No
1	Self Weight	Permanent	Self weight	0.00	0.00	0.00	0.00	0.00
2	Dead	Permanent	Permanent	1.40	1.00	1.00	1.00	1.00
3	Imposed	Variable	Cat B: office	1.60	0.00	0.00	1.00	0.00
4	Wind (0)	Variable	Wind	0.00	1.40	0.00	0.00	1.00
5	Wind (90)	Variable	Wind	0.00	0.00	1.40	0.00	0.00

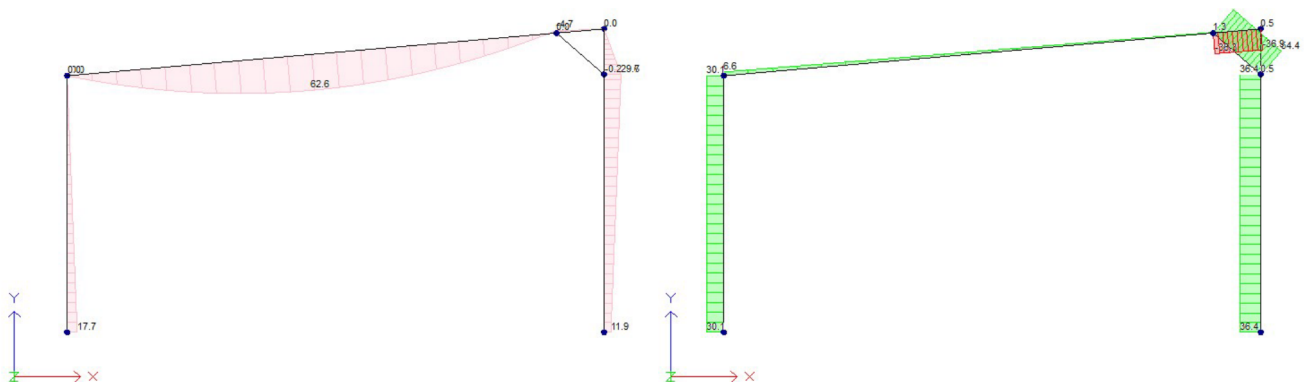
Load Combination 6

<i>Load Category</i>			<i>PSFs</i>	
<i>No</i>	<i>Name</i>	<i>Type</i>	<i>Sub type</i>	<i>6</i>
	Combination reference			6
	Limit state			SLS
	Elastic analysis			Linear
	Plastic analysis			No
1	Self Weight	Permanent	Self weight	0.00
2	Dead	Permanent	Permanent	1.00
3	Imposed	Variable		0.00
4	Wind (0)	Variable	Wind	0.00
5	Wind (90)	Variable	Wind	1.00

Member Effects for Combination 1

Analysis Type : Linear elastic

Interval no	Interval pos. (m)	Axial force (kN)	Shear force (kN)		Moment effects (kNm)		
			Normal	Lateral	Torsion	Normal	Lateral
Member 1							
0	0.000	30.133	-3.938	0.000	0.000	17.722	0.000
1	1.125	30.133	-3.938	0.000	0.000	13.291	0.000
2	2.250	30.133	-3.938	0.000	0.000	8.861	0.000
3	3.375	30.133	-3.938	0.000	0.000	4.430	0.000
4	4.500	30.133	-3.938	0.000	0.000	0.000	0.000
Member 2							
0	0.000	36.437	3.938	0.000	0.000	11.907	0.000
1	1.131	36.437	3.938	0.000	0.000	16.359	0.000
2	2.261	36.437	3.938	0.000	0.000	20.811	0.000
3	3.392	36.437	3.938	0.000	0.000	25.263	0.000
4	4.522	36.437	3.938	0.000	0.000	29.715	0.000
Member 3							
0	0.000	0.486	-36.951	0.000	0.000	29.561	0.000
1	0.200	0.486	-36.951	0.000	0.000	22.171	0.000
2	0.400	0.486	-36.951	0.000	0.000	14.780	0.000
3	0.600	0.486	-36.951	0.000	0.000	7.390	0.000
4	0.800	0.486	-36.951	0.000	0.000	0.000	0.000
Member 4							
0	0.000	6.551	29.675	0.000	0.000	0.000	0.000
1	2.150	5.228	14.565	0.000	0.000	47.557	0.000
2	4.300	3.905	-0.545	0.000	0.000	62.628	0.000
3	6.450	2.583	-15.655	0.000	0.000	45.213	0.000
4	8.600	1.260	-30.765	0.000	0.000	-4.687	0.000
Member 5							
0	0.000	-36.347	8.575	0.000	0.000	-4.713	0.000
1	0.209	-36.474	7.106	0.000	0.000	-3.074	0.000
2	0.418	-36.601	5.636	0.000	0.000	-1.742	0.000
3	0.627	-36.728	4.167	0.000	0.000	-0.717	0.000
4	0.836	-36.855	2.698	0.000	0.000	0.000	0.000
Member 6							
0	0.000	54.446	-0.163	0.000	0.000	0.026	0.000
1	0.277	54.446	-0.163	0.000	0.000	-0.020	0.000
2	0.553	54.446	-0.163	0.000	0.000	-0.065	0.000
3	0.830	54.446	-0.163	0.000	0.000	-0.110	0.000
4	1.106	54.446	-0.163	0.000	0.000	-0.155	0.000



Member Effects for Combination 2

Analysis Type : Linear elastic

Interval no	Interval pos. (m)	Axial force (kN)	Shear force (kN)		Moment effects (kNm)		
			Normal	Lateral	Torsion	Normal	Lateral
Member 1							
0	0.000	-36.489	12.643	0.000	0.000	-29.392	0.000
1	1.125	-36.489	9.587	0.000	0.000	-16.888	0.000
2	2.250	-36.489	6.532	0.000	0.000	-7.821	0.000
3	3.375	-36.489	3.476	0.000	0.000	-2.192	0.000
4	4.500	-36.489	0.421	0.000	0.000	0.000	0.000
Member 2							
0	0.000	-41.813	8.444	0.000	0.000	-23.049	0.000
1	1.131	-41.813	4.329	0.000	0.000	-15.828	0.000
2	2.261	-41.813	0.214	0.000	0.000	-13.260	0.000
3	3.392	-41.813	-3.901	0.000	0.000	-15.344	0.000
4	4.522	-41.813	-8.016	0.000	0.000	-22.080	0.000
Member 3							
0	0.000	-10.588	27.420	0.000	0.000	-21.936	0.000
1	0.200	-10.588	27.420	0.000	0.000	-16.452	0.000
2	0.400	-10.588	27.420	0.000	0.000	-10.968	0.000
3	0.600	-10.588	27.420	0.000	0.000	-5.484	0.000
4	0.800	-10.588	27.420	0.000	0.000	0.000	0.000
Member 4							
0	0.000	-3.601	-36.313	0.000	0.000	0.000	0.000
1	2.150	-3.771	-18.389	0.000	0.000	-58.803	0.000
2	4.300	-3.941	-0.465	0.000	0.000	-79.071	0.000
3	6.450	-4.111	17.459	0.000	0.000	-60.804	0.000
4	8.600	-4.281	35.383	0.000	0.000	-4.001	0.000
Member 5							
0	0.000	28.295	1.217	0.000	0.000	-3.932	0.000
1	0.209	28.279	2.960	0.000	0.000	-3.495	0.000
2	0.418	28.262	4.703	0.000	0.000	-2.694	0.000
3	0.627	28.246	6.445	0.000	0.000	-1.529	0.000
4	0.836	28.230	8.188	0.000	0.000	0.000	0.000
Member 6							
0	0.000	-47.230	0.193	0.000	0.000	-0.069	0.000
1	0.277	-47.230	0.193	0.000	0.000	-0.016	0.000
2	0.553	-47.230	0.193	0.000	0.000	0.038	0.000
3	0.830	-47.230	0.193	0.000	0.000	0.091	0.000
4	1.106	-47.230	0.193	0.000	0.000	0.144	0.000

