

INTERNATIONAL CONSULTANTS

Fareham Office  
Opus International Consultants (UK) Ltd.  
Modulus House  
Salterns Lane  
Fareham  
Hampshire  
PO16 0QS

Telephone: 01329 822021  
Facsimile: 01329 825274  
Website: [www.opusinternational.co.uk](http://www.opusinternational.co.uk)  
Email: [Fareham@opusinternational.co.uk](mailto:Fareham@opusinternational.co.uk)

**Project No: 9467**

**Structural Engineers Calculations**

**For**  
**Travelling Barn**

**Design Standards:**

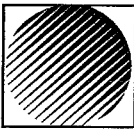
BS648      Weights

BS6399      Loads

BS5268      Timber

Designer's Guide To Wind Loading Of Building Structures

<u>Issue</u>	<u>Date</u>	<u>Documents</u>	<u>Issued</u>	<u>Reviewed</u>
Initial	27/01/2012	9467/1-11, Appendix A 1-7, Appendix B 1-4, Appendix C 1-6 & Appendix D 1-8	AWS	AJS

**OPUS**

Fareham Office  
Opus International Consultants (UK) Ltd  
Modulus House  
Salterns Lane  
Fareham  
Hampshire  
PO16 0QS

PROJECT NO: 9467 SHEET NO: 1

REV:

DESIGNED: AWS

REVIEWED:

DATE: JAN 12

Telephone: 01329 822021

Facsimile: 01329 825274

email: fareham@opusinternational.co.uk

PROJECT: TRAVELLING BARN

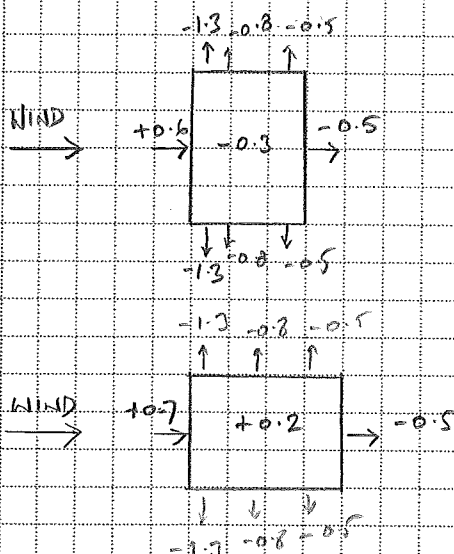
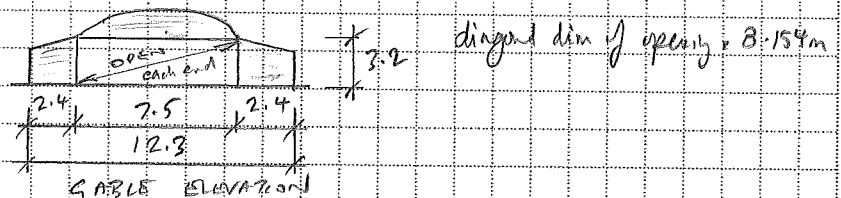
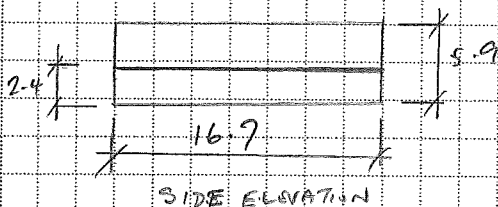
Brief

Structural assessment of timber framed demountable structure  
part canvas clad as indicated on Gabriel Langlands Company  
Drawings nos. 1, 2, 3 & 4.

Wind loading

Use recommendations of BS 6081 publication - Temporary Demountable Structures  
Third Edition - limit max wind gust to 25m/s @ 10m using Wind Action Plan  
Max height = 5.9m  $q = 0.323 \text{ kN/m}^2$  ( $V_e = 23.14 \text{ m/s}$ )  
 $q$  at side wall 2.4m high =  $0.244 \text{ kN/m}^2$  ( $V_e = 19.96 \text{ m/s}$ )

Structure dimensions:-

Plan -  $16.7\text{m} \times 12.3\text{m}$  Height - 2.4m side walls Gable 5.9m max

$$D/H = \frac{12.3}{2.4} = 5.125 \quad b = 2.4 \times 2 = 4.8 \quad 0.2b = 0.96\text{m}$$

$$\text{Zone A} = -1.3 \quad \text{Zone B} = -0.8 \quad \text{Zone C} = -0.5$$

$$q_{\text{internal}} = 10 \times \sqrt[3]{881.93} = 95.9\text{m} \quad C_{pe} = 0.817$$

$$p_i = 0.323 \times 0.3 \times 0.817 = -0.08 \text{ kN/m}^2 + 0.05 \text{ kN/m}^2$$

Beneficial effect only; ignore

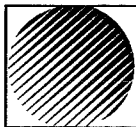
$$D/H = \frac{16.7}{5.9} = 2.83$$

Barrel-vault roof coefficients from BS 6399  
Handbook

$$R/W = \frac{1.9}{7.5} = 0.25 \quad H/W = \frac{3.7}{7.5} = 0.5$$

$$a = -0.3 \quad b = -0.55 \quad c = -0.95 \quad d = -0.78 \quad e = 0.55 \quad f = 0.55$$

$$A = -1.4 \quad B = -2 \quad C = -0.9 \quad D = -0.38 \quad E = -0.2 \quad F = +0.2$$

**OPUS**

Fareham Office  
Opus International Consultants (UK) Ltd  
Modulus House  
Salterns Lane  
Fareham  
Hampshire  
PO16 0QS

PROJECT NO: 9467 SHEET NO: 2

REV:

DESIGNED: AWS

REVIEWED:

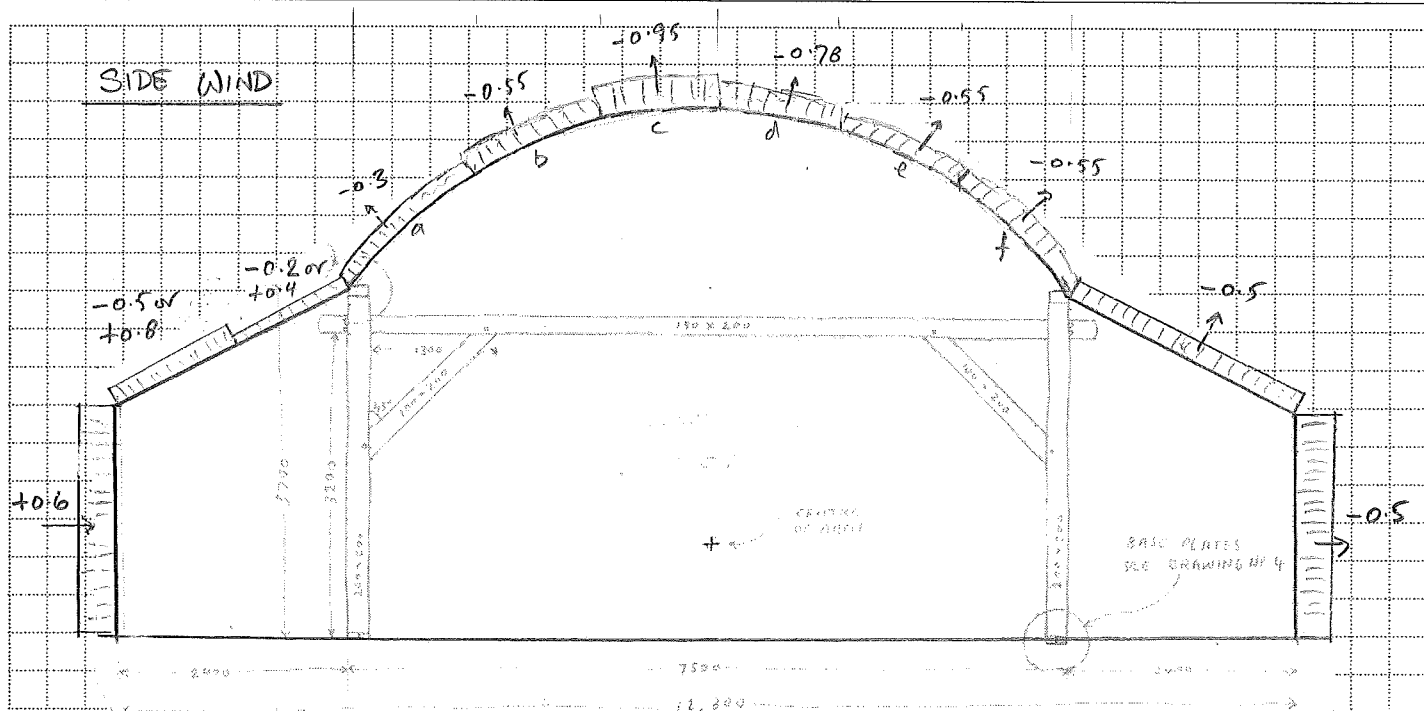
DATE: JAN12

Telephone: 01329 822021

Facsimile: 01329 825274

email: fareham@opusinternational.co.uk

PROJECT: TRAVELLING BARN

Take  $C_{pe}$  for external wind as 1.0

Overall wind loads at hoop: - (1.65m spacing) (Note: Hoop not loaded fabric acts in tension)

$$a = -0.162 \text{ Kt/m}$$

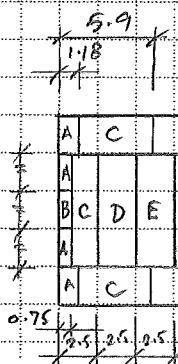
$$b = -0.298 \text{ Kt/m}$$

$$c = -0.514 \text{ Kt/m}$$

$$d = -0.422 \text{ Kt/m}$$

$$e = -0.298 \text{ Kt/m}$$

$$f = -0.298 \text{ Kt/m}$$



LEARN TO ROOF

BARRA VAULT ROOF - REFER TO WIND LOAD  
PLAN ON  
ROOF FOR  
END WIND  
BARRA VAULT ROOF

LEARN TO ROOF

End Wind

Max suction acts at 2nd hoop from end Zone A/B-C

$$A/C = -0.564 \text{ Kt/m}$$

$$B/C = -0.58 \text{ Kt/m}$$

Again hoop not loaded - fabric acts in tension

Consider Zone F  $\pm 0.2$ Wind load on hoop =  $\pm 0.108 \text{ Kt/m}$  hoop acts in compression with dead loadRefer to Appendix A for Analysis  
Max BM =  $0.008 \text{ Kt/m}$  Max Compression =  $0.66 \text{ Kt}$  Effective length for buckling =  $8715 \text{ mm}$ Try  $25 \times 200 \text{ C16}$  Compression capacity =  $0.13 \text{ Kt} < 0.66 \text{ Kt}$  OverstressedTry  $35 \times 200 \text{ C24 @ 1100chs}$  Compression =  $0.66 \times 1.1/1.65 = 0.44 \text{ Kt}$  - see sheet 3



Fareham Office

Opus International Consultants (UK) Ltd  
Modulus House  
Salterns Lane  
Fareham  
Hampshire  
PO16 0DS

PROJECT NO: 9467

SHEET NO: 3

REV:

DESIGNED: AWS

REVIEWED:

DATE: Jan 12

Telephone: 01329 822021

Facsimile: 01329 825274

email: fareham@opusinternational.co.uk

PROJECT: Travelling Barn

**Timber Hoop Design**

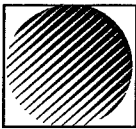
b (mm)	d (mm)	Stength class	Service class	No. of members	Span (mm)	BMx-x (kNm)	Compression (kN)	Tension (kN)	Hole area (mm <sup>2</sup> )
35	200	C24	2	1	8715	0	0.44	0	0

$\sigma_{m//}$ 7.50 N/mm <sup>2</sup>	$\sigma_{u//}$ 4.50 N/mm <sup>2</sup>	$\sigma_{c//}$ 7.90 N/mm <sup>2</sup>	
K <sub>2</sub> 1.00	K <sub>2</sub> 1.00	K <sub>2comp</sub> 1.00	
K <sub>3</sub> 1.75	K <sub>3</sub> 1.8	K <sub>2mod-elast</sub> 1.00	Bmy-y (kNm)
K <sub>7</sub> 1.0456	K <sub>8</sub> 1.0	K <sub>3</sub> 1.75	0.008
K <sub>8</sub> 1.0	$\sigma_{t adm//}$ 7.88 N/mm <sup>2</sup>	K <sub>8</sub> 1.0	
$\sigma_{m adm//}$ 13.72 N/mm <sup>2</sup>	A 7.00 x10E <sup>3</sup> mm <sup>2</sup>	K <sub>9</sub> or K <sub>28</sub> 1.00	$\sigma_{m//}$ 7.50 N/mm <sup>2</sup>
Z 233.3 x10 <sup>3</sup> mm <sup>3</sup>	A <sub>net</sub> 7.00 x10E <sup>3</sup> mm <sup>2</sup>	E <sub>mod</sub> 7,200 N/mm <sup>2</sup>	K <sub>2</sub> 1.00
$\sigma_{m all}$ 0.00 N/mm <sup>2</sup>	$\sigma_{t all}$ 0.00 N/mm <sup>2</sup>	E/ $\sigma_{c//}$ 520.80	K <sub>3</sub> 1.75
MR 3.202 kNm	PT 55.13 kN	I <sub>xx</sub> 2.333E+07 mm <sup>4</sup>	K <sub>7</sub> 1.1700
UF 0.000	UF 0.000	I <sub>yy</sub> 7.146E+05 mm <sup>4</sup>	K <sub>8</sub> 1.0
		r <sub>y</sub> 10.10 mm	$\sigma_{m adm//}$ 15.36 N/mm <sup>2</sup>
		$\lambda$ 862.56	Z 40.8 x10 <sup>3</sup> mm <sup>3</sup>
		K <sub>12</sub> 0.0046	$\sigma_{m all}$ 0.20 N/mm <sup>2</sup>
		$\sigma_{c adm//}$ 0.06 N/mm <sup>2</sup>	MR 0.627 kNm
		$\sigma_{c all}$ 0.06 N/mm <sup>2</sup>	UF 0.013
		PC 0.45 kN	
		$\sigma_e$ 0.10 N/mm <sup>2</sup>	
		UF 0.987	
Combined bending & tension	0.013		
Combined bending & compression	1.002		

OK Bm not reduced

Note: Loads are total for combined members (5+ assumed to be load per member)

~ Provide 35x200 C24 @ 1100max c/c

**OPUS**

Fareham Office  
Opus International Consultants (UK) Ltd  
Modulus House  
Salterns Lane  
Fareham  
Hampshire  
PO16 0QS

PROJECT NO: 9467 SHEET NO: 4

REV:

DESIGNED: ANS

REVIEWED:

DATE: JAN 12

Telephone: 01329 822021

Facsimile: 01329 825274

email: fareham@opusinternational.co.uk

PROJECT: TRAVELLING BARN

Frame Loads - SIDE WIND - Refer to Appendix C for analysis

Eaves point load:-

LHS

RHS

Barrel-vault roof - Vertical - 2.152 kN ↑      2.356 kN ↑  
Horizontal - 2.198 kN →      ← 1.918 kN

Aisle roof-

Vertical - 0.535 kN ↓      0.642 kN ↑  
Horizontal - 0.29 kN →      1.345 kN →

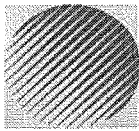
END WIND - Refer to Appendix D for analysisEaves point load -  $0.328 \times (0.7 + 0.5) \times 17.83/2 = 3.51 \text{ kN}$  (each side)

Wind suction from roof:-

Aisle roof Zone A -  $0.328 \times -1.2 \times 2.73/2 \times \cos 28.44^\circ = -0.472 \text{ kN/m}$   
Zone B -  $0.328 \times -0.6 \times 2.73/2 \times \cos 28.44^\circ = -0.236 \text{ kN/m}$   
Zone D -  $0.328 \times -0.5 \times 2.73/2 \times \cos 28.44^\circ = -0.197 \text{ kN/m}$

Barrel vault roof Zone A/B = -1.94 kN/m  
Zone C = -1.082 kN/m  
Zone D = -0.445 kN/m  
Zone E/F = -0.224 kN/m

} Refer to Appendix B  
for barrel vault loading

**OPUS**

Fareham Office

Opus International Consultants (UK) Ltd  
 Modulus House  
 Salters Lane  
 Fareham  
 Hampshire  
 PO16 0OS

PROJECT NO: 9467

SHEET NO: 5

REV:

DESIGNED: AWS

REVIEWED:

DATE: Jan 12

Telephone: 01329 822021

Facsimile: 01329 825274

email: fareham@opusinternational.co.uk

PROJECT: Travelling Barn

**Timber Post Design** (SIDEWIND WOLST CASE)

b (mm)	d (mm)	Stength class	Service class	No. of members	Span (mm)	BMx-x (kNm)	Compression (kN)	Tension (kN)	Hole area (mm <sup>2</sup> )
200	200	C16	2	1	2400	3.8	1.794	6.096	10000

$\sigma_{m//}$ 5.30 N/mm <sup>2</sup>	$\sigma_{t//}$ 3.20 N/mm <sup>2</sup>	$\sigma_{c//}$ 6.80 N/mm <sup>2</sup>	Bmy-y (kNm)
K <sub>2</sub> 1.00	K <sub>2</sub> 1.00	K <sub>2comp</sub> 1.00	
K <sub>3</sub> 1.75	K <sub>3</sub> 1.8	K <sub>2mod-elast</sub> 1.00	0
K <sub>7</sub> 1.0456	K <sub>8</sub> 1.0	K <sub>3</sub> 1.75	
K <sub>8</sub> 1.0	$\sigma_{t adm//}$ 5.60 N/mm <sup>2</sup>	K <sub>8</sub> 1.0	$\sigma_{m//}$ 5.30 N/mm <sup>2</sup>
$\sigma_{m adm//}$ 9.70 N/mm <sup>2</sup>	A 40.00 x10E <sup>3</sup> mm <sup>2</sup>	K <sub>9</sub> or K <sub>28</sub> 1.00	
Z 1333.3 x10 <sup>3</sup> mm <sup>3</sup>	A <sub>net</sub> 30.00 x10E <sup>3</sup> mm <sup>2</sup>	E <sub>mod</sub> 5,800 N/mm <sup>2</sup>	K <sub>2</sub> 1.00
$\sigma_{m all}$ 2.85 N/mm <sup>2</sup>	$\sigma_{t all}$ 0.20 N/mm <sup>2</sup>	E/ $\sigma_{c//}$ 487.39	K <sub>3</sub> 1.75
MR 12.931 kNm	PT 168.00 kN	I <sub>xx</sub> 1.333E+08 mm <sup>4</sup>	K <sub>7</sub> 1.0456
UF 0.294	UF 0.036	I <sub>yy</sub> 1.333E+08 mm <sup>4</sup>	K <sub>8</sub> 1.0
		r <sub>y</sub> 57.74 mm	$\sigma_{m adm//}$ 9.70 N/mm <sup>2</sup>
		$\lambda$ 41.57	Z 1333.3 x10 <sup>3</sup> mm <sup>3</sup>
		K <sub>12</sub> 0.9890	$\sigma_{m all}$ 0.00 N/mm <sup>2</sup>
		$\sigma_{c adm//}$ 11.77 N/mm <sup>2</sup>	MR 12.931 kNm
		$\sigma_{c all}$ 0.04 N/mm <sup>2</sup>	UF 0.000
		PC 470.76 kN	
		$\sigma_e$ 33.13 N/mm <sup>2</sup>	
		UF 0.004	

Combined bending & tension	0.330
Combined bending & compression	0.298

Note: Loads are total for combined members (5+ assumed to be load per member)

Provide 200x200 C16 POSTS



Fareham Office

Opus International Consultants (UK) Ltd  
Modulus House  
Salters Lane  
Fareham  
Hampshire  
PO16 0OS

PROJECT NO: 9467

SHEET NO: 6

REV:

DESIGNED: AWS

REVIEWED:

DATE: Jan 12

Telephone: 01329 822021

Facsimile: 01329 825274

email: fareham@opusinternational.co.uk

PROJECT: Travelling Barn

**Timber Horizontal Member Design** (SIDE WIND WORST CASE)

b (mm)	d (mm)	Stength class	Service class	No. of members	Span (mm)	BMx-x (kNm)	Compression (kN)	Tension (kN)	Hole area (mm <sup>2</sup> )
150	200	C16	2	1	7500	3.866	5.508	6.084	20000

$\sigma_{m//}$  5.30 N/mm<sup>2</sup>  
K<sub>2</sub> 1.00  
K<sub>3</sub> 1.75  
K<sub>7</sub> 1.0456  
K<sub>8</sub> 1.0  
 $\sigma_{m adm//}$  9.70 N/mm<sup>2</sup>  
Z 1000.0 x10<sup>3</sup> mm<sup>3</sup>  
 $\sigma_{m al/}$  3.87 N/mm<sup>2</sup>  
MR 9.698 kNm  
UF 0.399

$\sigma_{t//}$  3.20 N/mm<sup>2</sup>  
K<sub>2</sub> 1.00  
K<sub>3</sub> 1.8  
K<sub>8</sub> 1.0  
 $\sigma_{t adm//}$  5.60 N/mm<sup>2</sup>  
A 30.00 x10E<sup>3</sup>mm<sup>2</sup>  
A<sub>net</sub> 10.00 x10E<sup>3</sup>mm<sup>2</sup>  
 $\sigma_{t al/}$  0.61 N/mm<sup>2</sup>  
PT 56.00 kN  
UF 0.109

$\sigma_{c//}$  6.80 N/mm<sup>2</sup>  
K<sub>2comp</sub> 1.00  
K<sub>2mod-elast</sub> 1.00  
K<sub>3</sub> 1.75  
K<sub>8</sub> 1.0  
K<sub>9</sub> or K<sub>28</sub> 1.00  
E<sub>mod</sub> 5,800 N/mm<sup>2</sup>  
E/ $\sigma_{c//}$  487.39  
I<sub>xx</sub> 1.000E+08 mm<sup>4</sup>  
I<sub>yy</sub> 5.625E+07 mm<sup>4</sup>  
r<sub>y</sub> 43.30 mm  
 $\lambda$  173.21  
K<sub>12</sub> 0.1068  
 $\sigma_{c adm//}$  1.27 N/mm<sup>2</sup>  
 $\sigma_{c al/}$  0.18 N/mm<sup>2</sup>  
PC 38.14 kN  
 $\sigma_e$  1.91 N/mm<sup>2</sup>  
UF 0.144

Bmy-y (kNm)
0

$\sigma_{m//}$  5.30 N/mm<sup>2</sup>  
K<sub>2</sub> 1.00  
K<sub>3</sub> 1.75  
K<sub>7</sub> 1.0792  
K<sub>8</sub> 1.0  
 $\sigma_{m adm//}$  10.01 N/mm<sup>2</sup>  
Z 750.0 x10<sup>3</sup> mm<sup>3</sup>  
 $\sigma_{m al/}$  0.00 N/mm<sup>2</sup>  
MR 7.507 kNm  
UF 0.000

Combined bending & tension	0.507
Combined bending & compression	0.549

Note: Loads are total for combined members (5+ assumed to be load per member)

~ Provide 150 x 200 C16 HORIZONTAL



Fareham Office

Opus International Consultants (UK) Ltd  
Modulus House  
Sallerns Lane  
Fareham  
Hampshire  
PO16 0DS

PROJECT NO: 9467

SHEET NO: 7

REV:

DESIGNED: AWS

REVIEWED:

DATE: Jan 12

Telephone: 01329 822021

Facsimile: 01329 825274

email: fareham@opusinternational.co.uk

PROJECT: Travelling Barn

### Timber Brace Design

b (mm)	d (mm)	Stength class	Service class	No. of members	Span (mm)	BMx-x (kNm)	Compression (kN)	Tension (kN)	Hole area (mm <sup>2</sup> )
100	200	C16	2	1	1700	0	7.35	6.084	6666.7

$\sigma_{m//}$  5.30 N/mm<sup>2</sup>  
K<sub>2</sub> 1.00  
K<sub>3</sub> 1.75  
K<sub>7</sub> 1.0456  
K<sub>8</sub> 1.0  
 $\sigma_{m adm//}$  9.70 N/mm<sup>2</sup>  
Z 666.7 x10<sup>3</sup> mm<sup>3</sup>  
 $\sigma_{m all}$  0.00 N/mm<sup>2</sup>  
**MR 6.465 kNm**  
**UF 0.000**

$\sigma_{y//}$  3.20 N/mm<sup>2</sup>  
K<sub>2</sub> 1.00  
K<sub>3</sub> 1.8  
K<sub>8</sub> 1.0  
 $\sigma_{t adm//}$  5.60 N/mm<sup>2</sup>  
A 20.00 x10E<sup>3</sup>mm<sup>2</sup>  
A<sub>net</sub> 13.33 x10E<sup>3</sup>mm<sup>2</sup>  
 $\sigma_{t all}$  0.46 N/mm<sup>2</sup>  
**PT 74.67 kN**  
**UF 0.081**

$\sigma_{c//}$  6.80 N/mm<sup>2</sup>  
K<sub>2comp</sub> 1.00  
K<sub>2mod-elast</sub> 1.00  
K<sub>3</sub> 1.75  
K<sub>8</sub> 1.0  
K<sub>9</sub> or K<sub>28</sub> 1.00  
E<sub>mod</sub> 5,800 N/mm<sup>2</sup>  
E/ $\sigma_{c//}$  487.39  
I<sub>xx</sub> 6.667E+07 mm<sup>4</sup>  
I<sub>yy</sub> 1.667E+07 mm<sup>4</sup>  
r<sub>y</sub> 28.87 mm  
 $\lambda$  58.89  
K<sub>12</sub> 0.8870  
 $\sigma_{c adm//}$  10.56 N/mm<sup>2</sup>  
 $\sigma_{c all}$  0.37 N/mm<sup>2</sup>  
**PC 211.10 kN**  
 $\sigma_e$  16.51 N/mm<sup>2</sup>  
**UF 0.035**

Bmy-y (kNm)
0

$\sigma_{m//}$  5.30 N/mm<sup>2</sup>  
K<sub>2</sub> 1.00  
K<sub>3</sub> 1.75  
K<sub>7</sub> 1.1285  
K<sub>8</sub> 1.0  
 $\sigma_{m adm//}$  10.47 N/mm<sup>2</sup>  
Z 333.3 x10<sup>3</sup> mm<sup>3</sup>  
 $\sigma_{m all}$  0.00 N/mm<sup>2</sup>  
**MR 3.489 kNm**  
**UF 0.000**

Combined bending & tension	0.081
Combined bending & compression	0.035

**Note: Loads are total for combined members (5+ assumed to be load per member)**

*Provide 100x200 DIAGONALS*





Fareham Office

Onus International Consultants (UK) Ltd  
 Modulus House  
 Salterns Lane  
 Fareham  
 Hampshire  
 PO16 0OS

PROJECT NO: 9467

SHEET NO: 8

REV:

DESIGNED: AWS

REVIEWED:

DATE: Jan 12

Telephone: 01329 822021

Facsimile: 01329 825274

email: fareham@onusinternational.co.uk

PROJECT: Travelling Barn

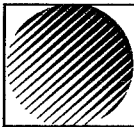
**Timber Wall Plate Design** (END WIND WORST CASE)

b (mm)	d (mm)	Stength class	Service class	No. of members	Span (mm)	BMx-x (kNm)	Compression (kN)	Tension (kN)	Hole area (mm <sup>2</sup> )
200	100	C16	2	1	1200	0.419	1.204		0

 $\sigma_{m//}$  5.30 N/mm<sup>2</sup> $K_2$  1.00 $K_3$  1.75 $K_7$  1.1285 $K_8$  1.0 $\sigma_{m adm//}$  10.47 N/mm<sup>2</sup> $Z$  333.3 x10<sup>3</sup> mm<sup>3</sup> $\sigma_{m all}$  1.26 N/mm<sup>2</sup>**MR 3.489 kNm****UF 0.120** $\sigma_{v//}$  3.20 N/mm<sup>2</sup> $K_2$  1.00 $K_3$  1.8 $K_8$  1.0 $\sigma_{t adm//}$  5.60 N/mm<sup>2</sup> $A$  20.00 x10E<sup>3</sup>mm<sup>2</sup> $A_{net}$  20.00 x10E<sup>3</sup>mm<sup>2</sup> $\sigma_{t all}$  0.00 N/mm<sup>2</sup>**PT 112.00 kN****UF 0.000** $\sigma_{c//}$  6.80 N/mm<sup>2</sup> $K_{2comp}$  1.00 $K_{2mod-elast}$  1.00 $K_3$  1.75 $K_8$  1.0 $K_9$  or  $K_{28}$  1.00 $E_{mod}$  5,800 N/mm<sup>2</sup> $E/\sigma_{c//}$  487.39 $I_{xx}$  1.667E+07 mm<sup>4</sup> $I_{yy}$  6.667E+07 mm<sup>4</sup> $r_y$  57.74 mm $\lambda$  20.78 $K_{12}$  0.9940 $\sigma_{c adm//}$  11.83 N/mm<sup>2</sup> $\sigma_{c all}$  0.06 N/mm<sup>2</sup>**PC 236.58 kN** $\sigma_e$  132.51 N/mm<sup>2</sup>**UF 0.005****Bmy-y (kNm)** $\sigma_{m//}$  5.30 N/mm<sup>2</sup> $K_2$  1.00 $K_3$  1.75 $K_7$  1.0456 $K_8$  1.0 $\sigma_{m adm//}$  9.70 N/mm<sup>2</sup> $Z$  666.7 x10<sup>3</sup> mm<sup>3</sup> $\sigma_{m all}$  0.00 N/mm<sup>2</sup>**MR 6.465 kNm****UF 0.000**

Combined bending & tension	0.120
Combined bending & compression	0.125

**Note: Loads are total for combined members (5+ assumed to be load per member)**Provide 100x200 C16 WALL PLATE

**OPUS**

Fareham Office  
Opus International Consultants (UK) Ltd  
Modulus House  
Salterns Lane  
Fareham  
Hampshire  
PO16 0QS

PROJECT NO: 9467

SHEET NO: 9

REV:

DESIGNED: AWS

REVIEWED:

DATE: JAN 12

Telephone: 01329 822021

Facsimile: 01329 825274

email: fareham@opusinternational.co.uk

PROJECT: TRAVELLING BARN

POST FOUNDATIONS

Max compression = 1.058 kN

Max horizontal = 0.179 kN (Dead load)

Max uplift from wind = 2.11 kN

Max horizontal = 1.809 kN (with wind)

Beating pressure under raft =  $\frac{1.058}{0.4 \times 0.4} = 6.6 \text{ kN/m}^2 \leq dk$ Minimum kentledge req'd for uplift =  $2.11 \times 1.5 = 3.1665 \text{ kN}$  $\therefore$  Provide 325 kg of kentledge to each post



Fareham Office  
Opus International Consultants (UK) Ltd  
Modulus House  
Salterns Lane  
Fareham  
Hampshire  
PO16 0QS

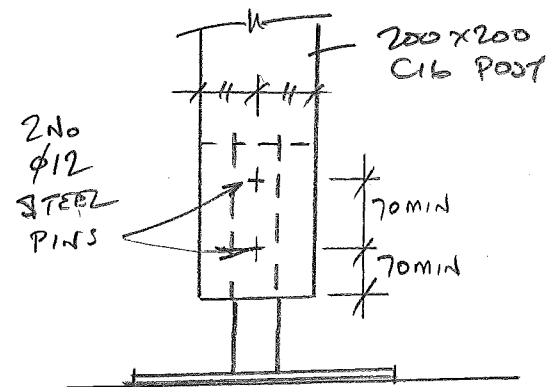
PROJECT NO: 9467 SHEET NO: 10 REV:  
DESIGNED: AWS REVIEWED: DATE: JAN 12  
Telephone: 01329 822021 Facsimile: 01329 825274 email: fareham@opusinternational.co.uk

PROJECT: Travelling Barn

### Post Base Pin Connection

#### Basic shear loads from BS5268 Appendix G

	Basic Shear	Basic Shear ⊥
Bolt diameter	M12	M12
t <sub>1</sub>	95mm	38mm
t <sub>2</sub>	95mm	63mm
Load duration	Short term	Short term
Bolt grade	4.6	4.6
Timber grade	C16	C16
Spacing parallel to grain	70mm	70mm
No of bolts in line	2	2
K <sub>2b</sub>	1.33	1.33
K <sub>90</sub>	1.53	1.53
M <sub>yd</sub>	82944	82944
Angle to grain	0°	90°
α <sub>II</sub>	70mm	70mm
K <sub>a</sub>	0.913	1.208
p <sub>k</sub>	310	310
f <sub>h0d</sub>	14.195	18.778
f <sub>had</sub>	14.195	12.273
β	1	1
F <sub>d</sub>	1400	1400
K <sub>d</sub>	1.00	1.00
2 Member Joint		
Equation G.1	16182.05	5522.92
Equation G.2	16182.05	9278.50
Equation G.3	8914.75	4299.35
Equation G.4	6857.82	3984.24
Equation G.5	6857.82	4722.28
Equation G.6	5847.30	5437.12
Min	5847.30	3984.24
F	4.18	2.85
3 Member Joint		
Equation G.7	16182.05	5522.92
Equation G.8	8091.02	4639.25
Equation G.9	6857.82	3984.24
Equation G.10	5847.30	5437.12
Min	5847.30	3984.24
F	4.18	2.85
K <sub>46</sub> (Steel to timber)	1.25	1
K <sub>56</sub>	1	1
K <sub>57</sub> = 1-3x(2-1)/100 =	0.97	0.97
Shear capacity per bolt	5.06	2.76



NOTE 325Kg of kentledge to be applied to each post!

$$5.06 \times 2 = 10.12 > 3.17 \text{ kN}$$

**Therefore provide 2 no. 12mm diameter pins to baseplate/post connection**



Fareham Office  
Opus International Consultants (UK) Ltd  
Modulus House  
Salterns Lane  
Fareham  
Hampshire  
PO16 0QS

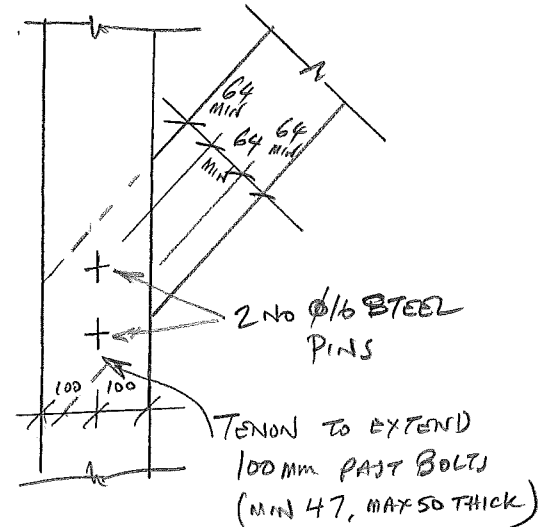
PROJECT NO: 9467 SHEET NO: 11 REV:  
DESIGNED: AWS REVIEWED: DATE: JAN 12  
Telephone: 01329 822021 Facsimile: 01329 825274 email: fareham@opusinternational.co.uk

PROJECT: Travelling Barn

### Diagonal Brace Pin Connection

#### Basic shear loads from BS5268 Appendix G

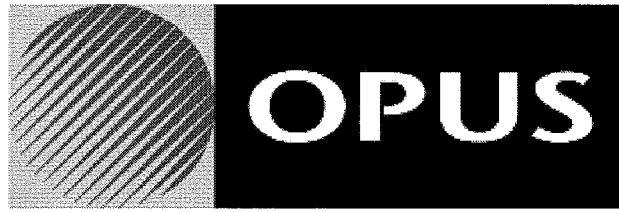
	Basic Shear	Basic Shear ⊥
Bolt diameter	M16	M16
$t_1$	47mm	47mm
$t_2$	47mm	47mm
Load duration	Short term	Short term
Bolt grade	4.6	4.6
Timber grade	C16	C16
Spacing parallel to grain	100mm	100mm
No of bolts in line	1	1
$K_{2b}$	1.33	1.33
$K_{90}$	1.59	1.59
$M_{yd}$	196608	196608
Angle to grain	45°	45°
$\alpha_{//}$	100mm	100mm
$K_a$	1.010	1.010
$p_k$	310	310
$f_{h0d}$	14.998	14.998
$f_{had}$	11.581	11.581
$\beta$	1	1
$F_d$	1400	1400
$K_d$	1.00	1.00
2 Member Joint		
Equation G.1	8709.26	8709.26
Equation G.2	8709.26	8709.26
Equation G.3	4797.97	4797.97
Equation G.4	6785.00	6785.00
Equation G.5	6785.00	6785.00
Equation G.6	9389.66	9389.66
Min	4797.97	4797.97
<b>F</b>	<b>3.43</b>	<b>3.43</b>
3 Member Joint		
Equation G.7	8709.26	8709.26
Equation G.8	4354.63	4354.63
Equation G.9	6785.00	6785.00
Equation G.10	9389.66	9389.66
Min	4354.63	4354.63
<b>F</b>	<b>3.11</b>	<b>3.11</b>
$K_{46}$ (Steel to timber)	1.25	1
$K_{56}$	1	1
$K_{57} = 1-3x(2-1)/100 =$	1	1
Shear capacity per bolt	3.89	3.11



$$3.11 \times 2 = 6.22 \text{ kN} > 6.08 \text{ kN}$$

**Therefore provide 2 no. 16mm diameter pins to each end of diagonal brace**

NOTE HORIZONTAL TIE CONNECTION SIMILAR (max tension = 3.93 kN)



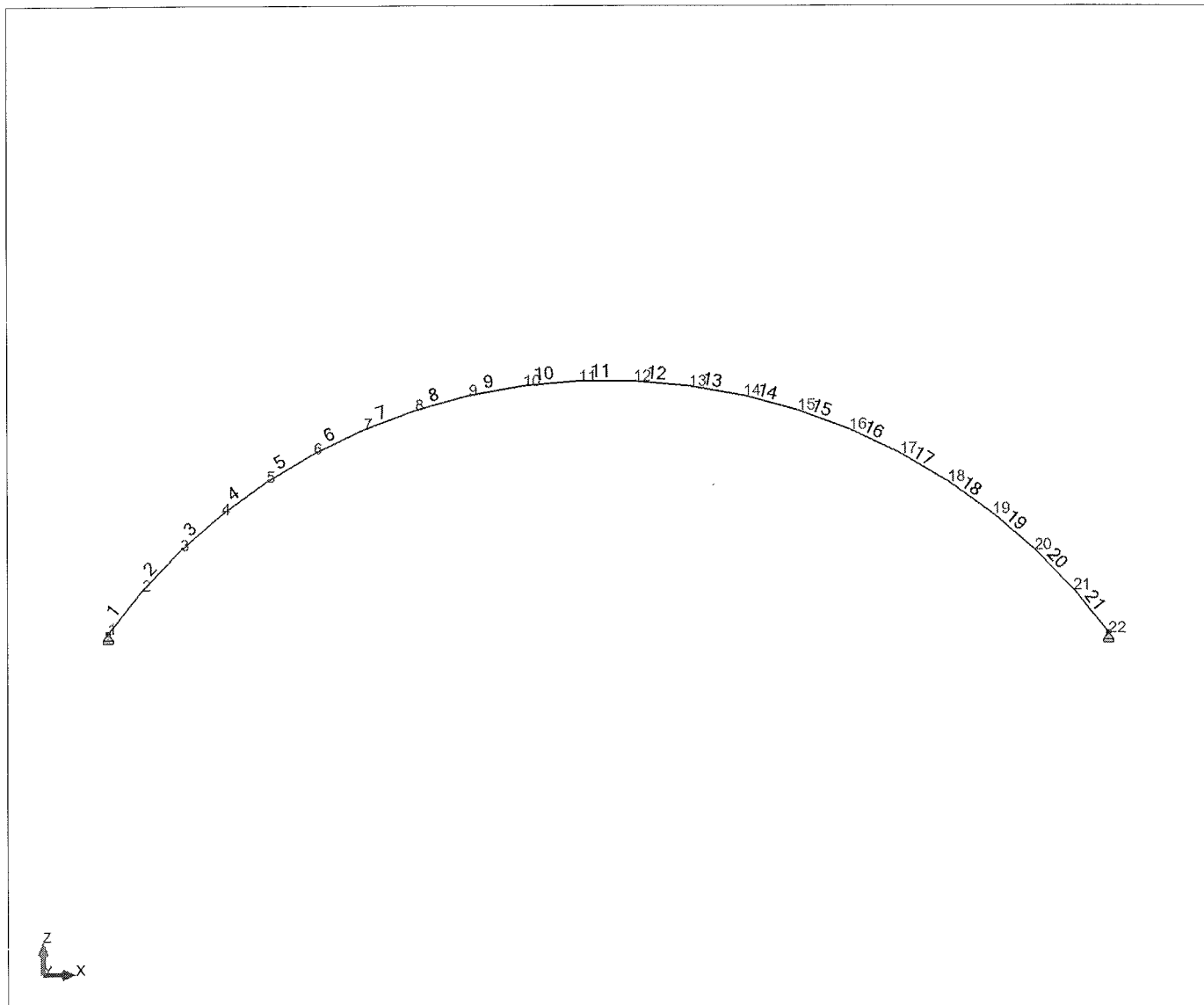
## TITLE PAGE

**Project: 9467 Travelling Barn - Hoop**

APPENDIX A

**Author : AWS**

**View - Cases: 7 (D+W3)**



**Nodes: Values: 1**

Node	X (m)	Z (m)	Support code	Support
1	0.0	0.0	xxf	Pinned
2	0.260	0.324		
3	0.548	0.623		
4	0.862	0.895		
5	1.199	1.138		
6	1.556	1.350		
7	1.931	1.529		
8	2.320	1.675		
9	2.720	1.785		

Node	X (m)	Z (m)	Support code	Support
10	3.129	1.858		
11	3.542	1.895		
12	3.958	1.895		
13	4.371	1.858		
14	4.780	1.785		
15	5.180	1.675		
16	5.569	1.529		
17	5.944	1.350		
18	6.301	1.138		
19	6.638	0.895		
20	6.952	0.623		
21	7.240	0.324		
22	7.500	0.0	xxf	Pinned

**Bars: Values: 1**

Bar	Node 1	Node 2	Section	Material	Length (m)	Gamma (Deg)
1	1	2	RECT_181	TIMBER-C16	0.415	0.0
2	2	3	RECT_181	TIMBER-C16	0.415	0.0
3	3	4	RECT_181	TIMBER-C16	0.415	0.0
4	4	5	RECT_181	TIMBER-C16	0.415	0.0
5	5	6	RECT_181	TIMBER-C16	0.415	0.0
6	6	7	RECT_181	TIMBER-C16	0.415	0.0
7	7	8	RECT_181	TIMBER-C16	0.415	0.0
8	8	9	RECT_181	TIMBER-C16	0.415	0.0
9	9	10	RECT_181	TIMBER-C16	0.415	0.0
10	10	11	RECT_181	TIMBER-C16	0.415	0.0
11	11	12	RECT_181	TIMBER-C16	0.415	0.0
12	12	13	RECT_181	TIMBER-C16	0.415	0.0
13	13	14	RECT_181	TIMBER-C16	0.415	0.0
14	14	15	RECT_181	TIMBER-C16	0.415	0.0
15	15	16	RECT_181	TIMBER-C16	0.415	0.0
16	16	17	RECT_181	TIMBER-C16	0.415	0.0
17	17	18	RECT_181	TIMBER-C16	0.415	0.0
18	18	19	RECT_181	TIMBER-C16	0.415	0.0
19	19	20	RECT_181	TIMBER-C16	0.415	0.0
20	20	21	RECT_181	TIMBER-C16	0.415	0.0
21	21	22	RECT_181	TIMBER-C16	0.415	0.0

**Properties: Bars: 1**

Section name	Bar list	AX (cm2)	AY (cm2)	AZ (cm2)	IX (cm4)	IY (cm4)
RECT_181	1to21	50.0	41.7	41.7	96.0	26.0

Section name	IZ (cm4)	HY (mm)	HZ (mm)	VY (mm)	VZ (mm)	VPY (mm)	VPZ (mm)
RECT_181	1666.7	200.0	25.0	100.0	12.5	100.0	12.5

### Loads - Cases: 1to4 : Values: 1

Case	Load type	List
1	self-weight	1to21
1	uniform load	1to21
2	uniform load	1to4
2	uniform load	5to7 15to21
2	trapezoidal load (2p)	8
2	trapezoidal load (2p)	8
2	uniform load	9 10
2	trapezoidal load (2p)	11
2	trapezoidal load (2p)	11
2	uniform load	12 13
2	trapezoidal load (2p)	14
2	trapezoidal load (2p)	14
3	uniform load	1to7 15to21
3	uniform load	9to13
3	trapezoidal load (2p)	8
3	trapezoidal load (2p)	14
3	trapezoidal load (2p)	8
3	trapezoidal load (2p)	14
4	uniform load	1to21

Case	Load values	Label
1	PZ Negative Factor=1.000	DL1
1	PZ=-0.009(kN/m)	DL1
2	PZ=0.162(kN/m) local	WIND1
2	PZ=0.298(kN/m) local	WIND1
2	PZ2=0.298(kN/m) PZ1=0.298(kN/m) X2=0.500 X1=0.0 local not project. relative	WIND1
2	PZ2=0.514(kN/m) PZ1=0.514(kN/m) X2=1.000 X1=0.500 local not project. relative	WIND1
2	PZ=0.514(kN/m) local	WIND1
2	PZ2=0.514(kN/m) PZ1=0.514(kN/m) X2=0.500 X1=0.0 local not project. relative	WIND1
2	PZ2=0.422(kN/m) PZ1=0.422(kN/m) X2=1.000 X1=0.500 local not project. relative	WIND1
2	PZ=0.422(kN/m) local	WIND1
2	PZ2=0.422(kN/m) PZ1=0.422(kN/m) X2=0.500 X1=0.0 local not project. relative	WIND1
2	PZ2=0.298(kN/m) PZ1=0.298(kN/m) X2=1.000 X1=0.500 local not project. relative	WIND1
3	PZ=0.564(kN/m) local	WIND2
3	PZ=0.580(kN/m) local	WIND2
3	PZ2=0.564(kN/m) PZ1=0.564(kN/m) X2=0.500 X1=0.0 local not project. relative	WIND2
3	PZ2=0.564(kN/m) PZ1=0.564(kN/m) X2=1.000 X1=0.500 local not project. relative	WIND2
3	PZ2=0.580(kN/m) PZ1=0.580(kN/m) X2=1.000 X1=0.500 local not project. relative	WIND2
3	PZ2=0.580(kN/m) PZ1=0.580(kN/m) X2=0.500 X1=0.0 local not project. relative	WIND2
4	PZ=-0.108(kN/m) local	WIND3

### Load Combination - Cases: 5to7 : Values: 1

Combinations	Name	Analysis type	Combination type	Definition
--------------	------	---------------	------------------	------------



Combinations	Name	Analysis type	Combination type	Definition
5 (C)	D+W1	Linear Combination	SLS	(1+2)*1.000
6 (C)	D+W2	Linear Combination	SLS	(1+3)*1.000
7 (C)	D+W3	Linear Combination	SLS	(1+4)*1.000

### Reactions in the coordinate system: global - Cases: 1to7 : Values: 1

Node/Case	FX (kN)	FZ (kN)	MY (kNm)
1/ 1	0.105	0.118	-0.000
1/ 2	-1.204	-1.194	-0.000
1/ 3	-1.584	-2.135	0.000
1/ 4	0.298	0.405	0.000
1/ 5 (C)	-1.099	-1.076	-0.000
1/ 6 (C)	-1.479	-2.016	-0.000
1/ 7 (C)	0.403	0.523	-0.000
22/ 1	-0.105	0.118	-0.000
22/ 2	1.064	-1.296	-0.000
22/ 3	1.584	-2.135	-0.000
22/ 4	-0.298	0.405	-0.000
22/ 5 (C)	0.959	-1.178	-0.000
22/ 6 (C)	1.479	-2.016	-0.000
22/ 7 (C)	-0.403	0.523	-0.000
Case 1	DL1		
Sum of val.	-0.000	0.237	-0.000
Sum of reac.	-0.000	0.237	-0.888
Sum of forc.	0.000	-0.237	0.888
Check val.	-0.000	-0.000	-0.000
Precision	3.75110e-013	2.43641e-025	
Case 2	WIND1		
Sum of val.	-0.139	-2.490	-0.000
Sum of reac.	-0.139	-2.490	9.722
Sum of forc.	0.139	2.490	-9.722
Check val.	0.000	-0.000	0.000
Precision	1.18908e-012	1.10183e-024	
Case 3	WIND2		
Sum of val.	0.000	-4.269	-0.000
Sum of reac.	0.000	-4.269	16.010
Sum of forc.	-0.000	4.269	-16.010
Check val.	0.000	0.000	0.000
Precision	2.34331e-014	5.75001e-028	
Case 4	WIND3		
Sum of val.	0.000	0.810	0.000
Sum of reac.	0.000	0.810	-3.037

Node/Case	FX (kN)	FZ (kN)	MY (kNm)
Sum of forc.	0.000	-0.810	3.038
Check val.	0.000	0.000	0.000
Precision	1.90882e-014	2.07537e-028	
Case 5 (C)	D+W1		
Sum of val.	-0.139	-2.253	-0.000
Sum of reac.	-0.139	-2.253	8.834
Sum of forc.	0.139	2.253	-8.834
Check val.	0.000	-0.000	0.000
Precision	1.56419e-012	1.34547e-024	
Case 6 (C)	D+W2		
Sum of val.	-0.000	-4.033	-0.000
Sum of reac.	-0.000	-4.033	15.122
Sum of forc.	-0.000	4.033	-15.122
Check val.	-0.000	-0.000	-0.000
Precision	3.98543e-013	2.44216e-025	
Case 7 (C)	D+W3		
Sum of val.	-0.000	1.047	-0.000
Sum of reac.	-0.000	1.047	-3.925
Sum of forc.	0.000	-1.047	3.925
Check val.	-0.000	-0.000	-0.000
Precision	3.94198e-013	2.43849e-025	

**Forces - Case: 7 (D+W3): Values: 1**

Bar/Node/Case	Fx compression (kN)	Fx tension (kN)	FZ (kN)	MY (kNm)
1/ 1/ 7 (C)	0.660		0.014	-0.000
1/ 2/ 7 (C)	0.652		-0.038	-0.005
2/ 2/ 7 (C)	0.652		0.020	-0.005
2/ 3/ 7 (C)	0.644		-0.032	-0.007
3/ 3/ 7 (C)	0.645		0.025	-0.007
3/ 4/ 7 (C)	0.637		-0.028	-0.008
4/ 4/ 7 (C)	0.637		0.029	-0.008
4/ 5/ 7 (C)	0.631		-0.025	-0.007
5/ 5/ 7 (C)	0.630		0.031	-0.007
5/ 6/ 7 (C)	0.625		-0.023	-0.005
6/ 6/ 7 (C)	0.624		0.033	-0.005
6/ 7/ 7 (C)	0.619		-0.022	-0.003
7/ 7/ 7 (C)	0.619		0.033	-0.003
7/ 8/ 7 (C)	0.615		-0.023	-0.001
8/ 8/ 7 (C)	0.614		0.032	-0.001
8/ 9/ 7 (C)	0.611		-0.023	0.001
9/ 9/ 7 (C)	0.611		0.031	0.001
9/ 10/ 7 (C)	0.609		-0.025	0.002

Bar/Node/Case	Fx compression (kN)	Fx tension (kN)	FZ (kN)	MY (kNm)
10/ 10/ 7 (C)	0.609		0.030	0.002
10/ 11/ 7 (C)	0.608		-0.026	0.003
11/ 11/ 7 (C)	0.608		0.028	0.003
11/ 12/ 7 (C)	0.608		-0.028	0.003
12/ 12/ 7 (C)	0.608		0.026	0.003
12/ 13/ 7 (C)	0.609		-0.030	0.002
13/ 13/ 7 (C)	0.609		0.025	0.002
13/ 14/ 7 (C)	0.611		-0.031	0.001
14/ 14/ 7 (C)	0.611		0.023	0.001
14/ 15/ 7 (C)	0.614		-0.032	-0.001
15/ 15/ 7 (C)	0.615		0.023	-0.001
15/ 16/ 7 (C)	0.619		-0.033	-0.003
16/ 16/ 7 (C)	0.619		0.022	-0.003
16/ 17/ 7 (C)	0.624		-0.033	-0.005
17/ 17/ 7 (C)	0.625		0.023	-0.005
17/ 18/ 7 (C)	0.630		-0.031	-0.007
18/ 18/ 7 (C)	0.631		0.025	-0.007
18/ 19/ 7 (C)	0.637		-0.029	-0.008
19/ 19/ 7 (C)	0.637		0.028	-0.008
19/ 20/ 7 (C)	0.645		-0.025	-0.007
20/ 20/ 7 (C)	0.644		0.032	-0.007
20/ 21/ 7 (C)	0.652		-0.020	-0.005
21/ 21/ 7 (C)	0.652		0.038	-0.005
21/ 22/ 7 (C)	0.660		-0.014	0.000



## **TITLE PAGE**

**Project: 9467 Travelling Barn - Hoop-1**

APPENDIX B

BARREL VAULT ROOF LOADING

**Author : AWS**

**Nodes: Values: 1**

Node	X (m)	Z (m)	Support code	Support
1	0.0	0.0	xxf	Pinned
2	0.260	0.324		
3	0.548	0.623		
4	0.862	0.895		
5	1.199	1.138		
6	1.556	1.350		
7	1.931	1.529		
8	2.320	1.675		
9	2.720	1.785		
10	3.129	1.858		
11	3.542	1.895		
12	3.958	1.895		
13	4.371	1.858		
14	4.780	1.785		
15	5.180	1.675		
16	5.569	1.529		
17	5.944	1.350		
18	6.301	1.138		
19	6.638	0.895		
20	6.952	0.623		
21	7.240	0.324		
22	7.500	0.0	xxf	Pinned

**Bars: Values: 1**

Bar	Node 1	Node 2	Section	Material	Length (m)	Gamma (Deg)
1	1	2	RECT_181	TIMBER-C16	0.415	0.0
2	2	3	RECT_181	TIMBER-C16	0.415	0.0
3	3	4	RECT_181	TIMBER-C16	0.415	0.0
4	4	5	RECT_181	TIMBER-C16	0.415	0.0
5	5	6	RECT_181	TIMBER-C16	0.415	0.0
6	6	7	RECT_181	TIMBER-C16	0.415	0.0
7	7	8	RECT_181	TIMBER-C16	0.415	0.0
8	8	9	RECT_181	TIMBER-C16	0.415	0.0
9	9	10	RECT_181	TIMBER-C16	0.415	0.0
10	10	11	RECT_181	TIMBER-C16	0.415	0.0
11	11	12	RECT_181	TIMBER-C16	0.415	0.0
12	12	13	RECT_181	TIMBER-C16	0.415	0.0
13	13	14	RECT_181	TIMBER-C16	0.415	0.0
14	14	15	RECT_181	TIMBER-C16	0.415	0.0
15	15	16	RECT_181	TIMBER-C16	0.415	0.0
16	16	17	RECT_181	TIMBER-C16	0.415	0.0
17	17	18	RECT_181	TIMBER-C16	0.415	0.0
18	18	19	RECT_181	TIMBER-C16	0.415	0.0

Bar	Node 1	Node 2	Section	Material	Length (m)	Gamma (Deg)
19	19	20	RECT_181	TIMBER-C16	0.415	0.0
20	20	21	RECT_181	TIMBER-C16	0.415	0.0
21	21	22	RECT_181	TIMBER-C16	0.415	0.0

**Properties: Bars: 1**

Section name	Bar list	AX (cm <sup>2</sup> )	AY (cm <sup>2</sup> )	AZ (cm <sup>2</sup> )	IX (cm <sup>4</sup> )	IY (cm <sup>4</sup> )
RECT_181	1to21	50.0	41.7	41.7	96.0	26.0

Section name	IZ (cm <sup>4</sup> )	HY (mm)	HZ (mm)	VY (mm)	VZ (mm)	VPY (mm)	VPZ (mm)
RECT_181	1666.7	200.0	25.0	100.0	12.5	100.0	12.5

**Loads - Cases: 1to4 : Values: 1**

Case	Load type	List	Load values	Label
1	uniform load	1to21	PZ=-0.005(kN/m)	DL1
2	uniform load	1to7 15to21	PZ=0.459(kN/m) local	WIND1
2	uniform load	9to13	PZ=0.656(kN/m) local	WIND1
2	trapezoidal load (2p)	8	PZ2=0.459(kN/m) PZ1=0.459(kN/m) X2=0.500 X1=0.- 0 local not project. relative	WIND1
2	trapezoidal load (2p)	8	PZ2=0.656(kN/m) PZ1=0.656(kN/m) X2=1.000 X1=0.- 500 local not project. relative	WIND1
2	trapezoidal load (2p)	14	PZ2=0.656(kN/m) PZ1=0.656(kN/m) X2=0.500 X1=0.- 0 local not project. relative	WIND1
2	trapezoidal load (2p)	14	PZ2=0.459(kN/m) PZ1=0.459(kN/m) X2=1.000 X1=0.- 500 local not project. relative	WIND1
3	uniform load	1to21	PZ=0.295(kN/m) local	WIND2
4	uniform load	1to21	PZ=0.125(kN/m) local	WIND3

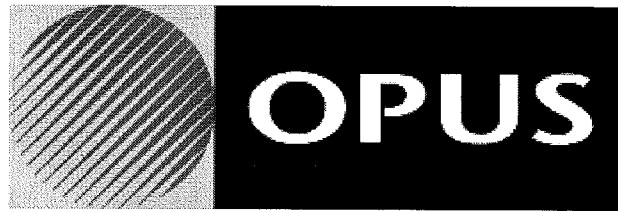
**Load Combination - Cases: 5to7 : Values: 1**

Combinations	Name	Analysis type	Combination type	Definition
9 (C)	Wind A-B	Linear Combination	SLS	(1+2)*1.000
10 (C)	Wind C	Linear Combination	SLS	(1+3)*1.000
11 (C)	Wind D	Linear Combination	SLS	(1+4)*1.000
12 (C)	Wind E-F	Linear Combination	SLS	(1+5)*1.000

**Reactions in the coordinate system: global - Cases: 9to12 : Values: 1**

Node/Case	FX (kN)	FZ (kN)	MY (kNm)	Case name
1/ 9 (C)	-1.586	-1.940	0.000	Wind A-B
1/ 10 (C)	-0.793	-1.082	-0.000	Wind C
1/ 11 (C)	-0.324	-0.445	-0.000	Wind D
1/ 12 (C)	-0.161	-0.224	0.000	Wind E-F
22/ 9 (C)	1.586	-1.940	0.000	Wind A-B

Node/Case	FX (kN)	FZ (kN)	MY (kNm)	Case name
22/ 10 (C)	0.793	-1.082	0.000	Wind C
22/ 11 (C)	0.324	-0.445	-0.000	Wind D
22/ 12 (C)	0.161	-0.224	0.000	Wind E-F
Case 9 (C)	Wind A-B			
Sum of val.	0.000	-3.879	0.000	
Sum of reac.	0.000	-3.879	14.547	
Sum of forc.	0.000	3.879	-14.547	
Check val.	0.000	0.000	0.000	
Precision	1.03744e-012	4.67075e-025		
Case 10 (C)	Wind C			
Sum of val.	-0.000	-2.165	0.000	
Sum of reac.	-0.000	-2.165	8.117	
Sum of forc.	-0.000	2.165	-8.117	
Check val.	-0.000	-0.000	-0.000	
Precision	4.78595e-013	2.22596e-025		
Case 11 (C)	Wind D			
Sum of val.	-0.000	-0.890	-0.000	
Sum of reac.	-0.000	-0.890	3.336	
Sum of forc.	0.000	0.890	-3.336	
Check val.	-0.000	-0.000	-0.000	
Precision	4.80773e-013	2.22650e-025		
Case 12 (C)	Wind E-F			
Sum of val.	-0.000	-0.447	0.000	
Sum of reac.	-0.000	-0.447	1.676	
Sum of forc.	0.000	0.447	-1.676	
Check val.	-0.000	-0.000	-0.000	
Precision	4.76773e-013	2.22552e-025		



## **TITLE PAGE**

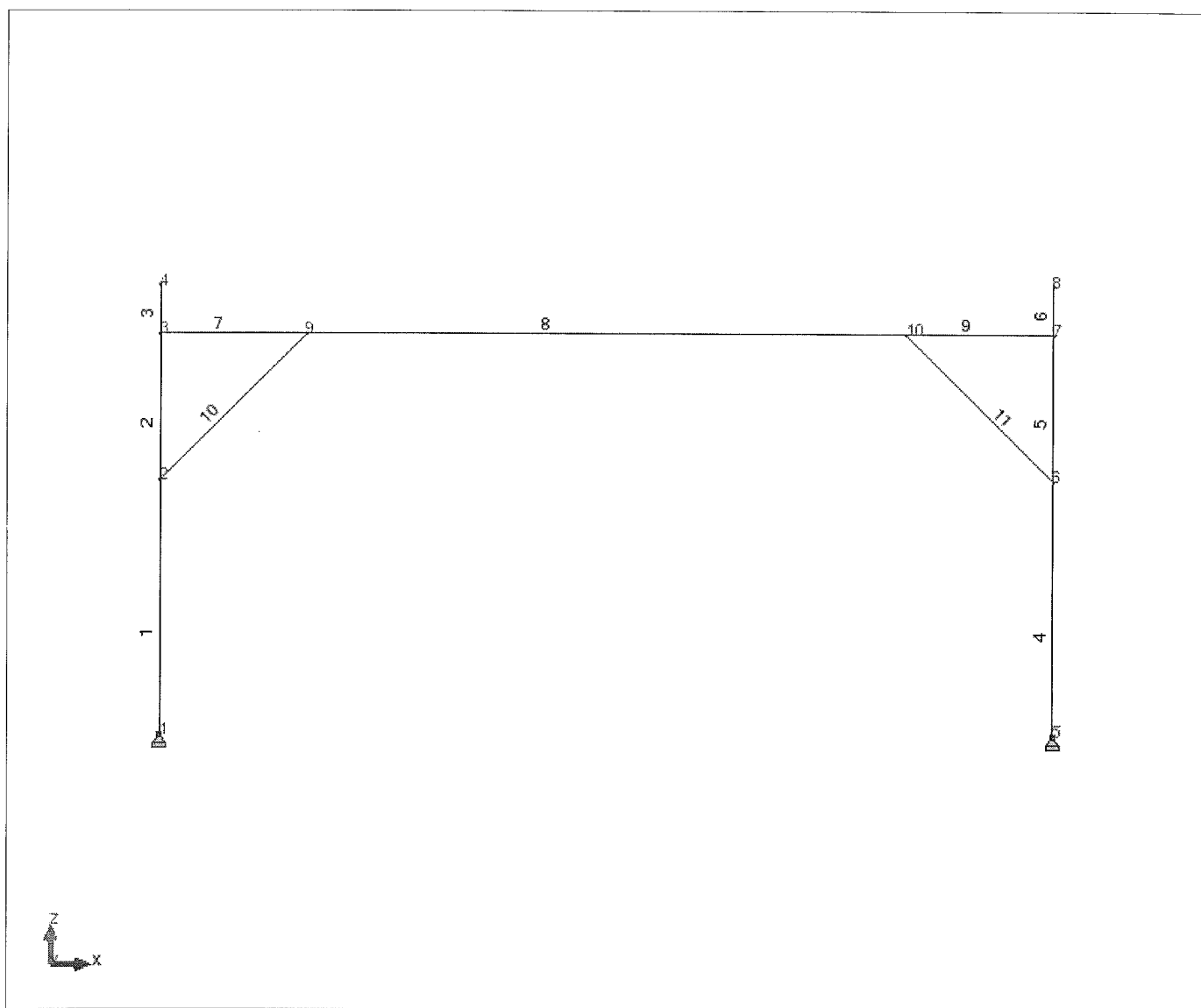
**Project: 9467 Travelling Barn - Timber Frame**

APPENDIX C

BARN FRAMEWORK SIDE WIND

**Author : AWS**



**View****Nodes: Values: 1**

Node	X (m)	Z (m)	Support code	Support
1	0.0	0.0	xxf	Pinned
2	0.0	2.100		
3	0.0	3.300		
4	0.0	3.700		
5	7.300	0.0	xxf	Pinned
6	7.300	2.100		
7	7.300	3.300		
8	7.300	3.700		
9	1.200	3.300		

10 6.100 3.300

### Bars: Values: 1

Bar	Node 1	Node 2	Section	Material	Length (m)	Gamma (Deg)
1	1	2	RECT_200x200	TIMBER-C16	2.100	0.0
2	2	3	RECT_200x200	TIMBER-C16	1.200	0.0
3	3	4	RECT_200x200	TIMBER-C16	0.400	0.0
4	5	6	RECT_200x200	TIMBER-C16	2.100	0.0
5	6	7	RECT_200x200	TIMBER-C16	1.200	0.0
6	7	8	RECT_200x200	TIMBER-C16	0.400	0.0
7	3	9	RECT_150x200	TIMBER-C16	1.200	0.0
8	9	10	RECT_150x200	TIMBER-C16	4.900	0.0
9	10	7	RECT_150x200	TIMBER-C16	1.200	0.0
10	2	9	RECT_100x200	TIMBER-C16	1.697	0.0
11	6	10	RECT_100x200	TIMBER-C16	1.697	0.0

### Properties: Bars: 1

Section name	Bar list	AX (cm2)	AY (cm2)	AZ (cm2)	IX (cm4)	IY (cm4)
RECT_100x200	10 11	200.0	166.7	166.7	4573.7	6666.7
RECT_150x200	7to9	300.0	250.0	250.0	12181.2	10000.0
RECT_200x200	1to6	400.0	333.3	333.3	22493.3	13333.3

Section name	IZ (cm4)	HY (mm)	HZ (mm)	VY (mm)	VZ (mm)	VPY (mm)	VPZ (mm)
RECT_100x200	1666.7	100.0	200.0	50.0	100.0	50.0	100.0
RECT_150x200	5625.0	150.0	200.0	75.0	100.0	75.0	100.0
RECT_200x200	13333.3	200.0	200.0	100.0	100.0	100.0	100.0

### Loads - Cases: 1 2 : Values: 1

Case	Load type	List	Load values	Label
1	self-w eight	1to11	PZ Negative Factor=1.000	DL1
2	nodal force	4	FX=2.488(kN) FZ=1.617(kN)	WIND1
2	nodal force	8	FX=0.573(kN) FZ=2.998(kN)	WIND1

### Load Combination - Case: 3 (COMB1): Values: 1

Combinations	Name	Analysis type	Combination type	Definition
3 (C)	COMB1	Linear Combination	SLS	(1+2)*1.000

### Reactions in the coordinate system: global - Cases: 1to3 : Values: 1

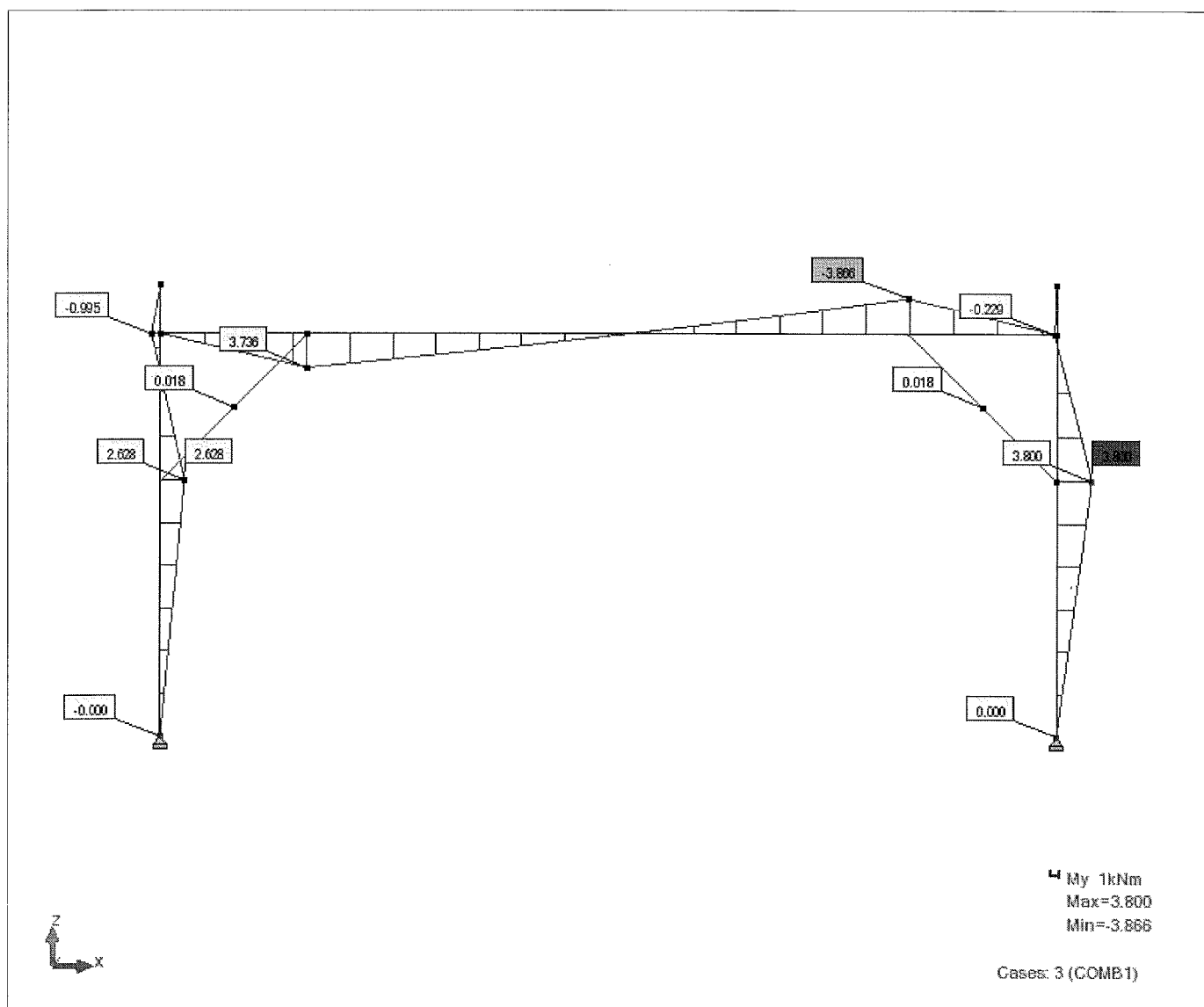
Node/Case	FX (kN)	FZ (kN)	MY (kNm)
1/ 1	0.179	1.058	0.000

Node/Case	FX (kN)	FZ (kN)	MY (kNm)
1/ 2	-1.431	-3.168	-0.000
1/ 3 (C)	-1.252	-2.111	-0.000
5/ 1	-0.179	1.058	0.000
5/ 2	-1.630	-1.447	0.000
5/ 3 (C)	-1.809	-0.389	0.000
Case 1	DL1		
Sum of val.	0.000	2.116	0.000
Sum of reac.	0.000	2.116	-7.723
Sum of forc.	-0.000	-2.116	7.723
Check val.	0.000	-0.000	0.000
Precision	4.52890e-011	1.39975e-021	
Case 2	WIND1		
Sum of val.	-3.061	-4.615	0.000
Sum of reac.	-3.061	-4.615	10.560
Sum of forc.	3.061	4.615	-10.560
Check val.	0.000	-0.000	0.000
Precision	1.44690e-009	1.55110e-017	
Case 3 (C)	COMB1		
Sum of val.	-3.061	-2.499	0.000
Sum of reac.	-3.061	-2.499	2.837
Sum of forc.	3.061	2.499	-2.837
Check val.	0.000	-0.000	0.000
Precision	1.49219e-009	1.55124e-017	

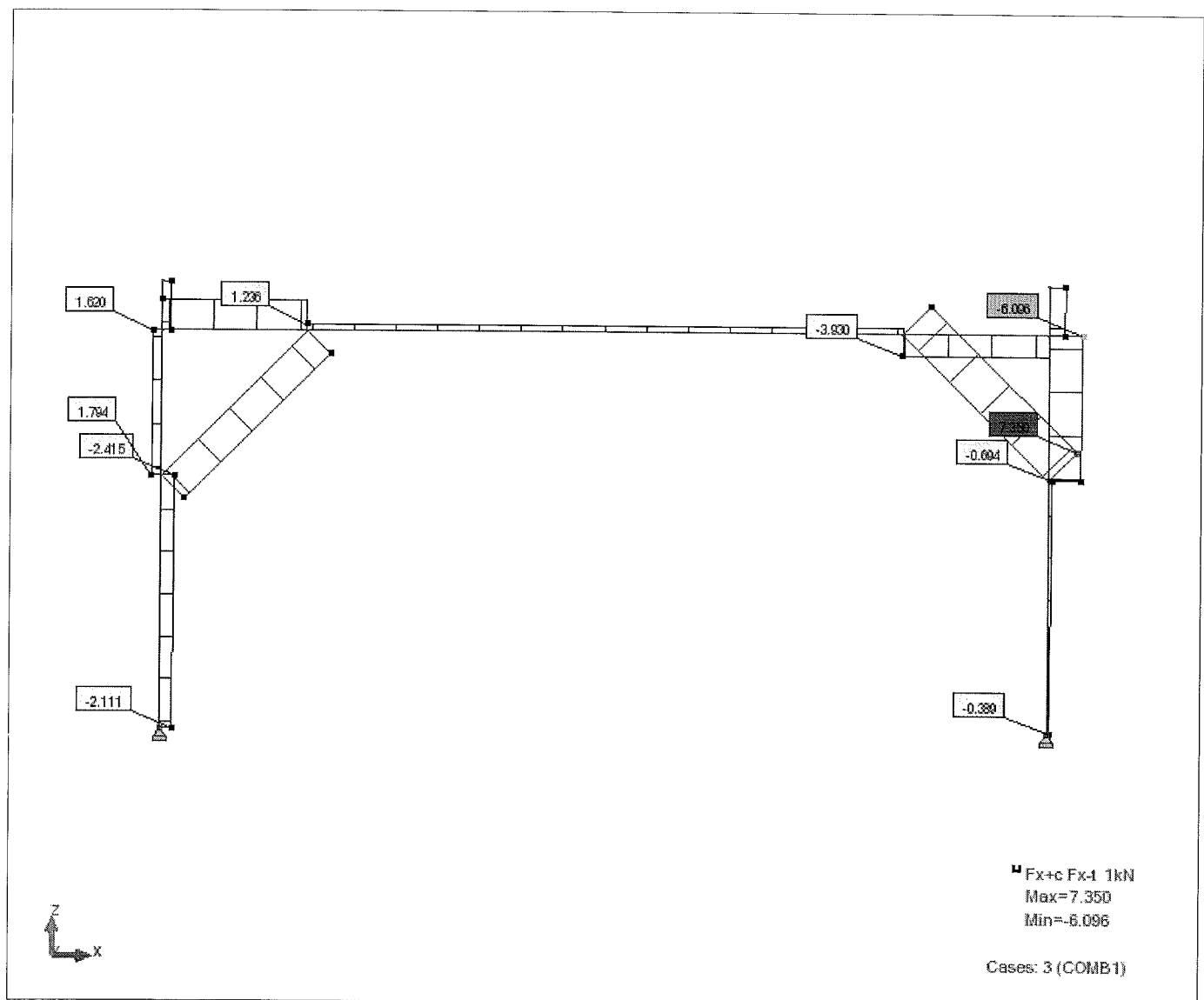
**Forces - Case: 3 (COMB1): Values: 1**

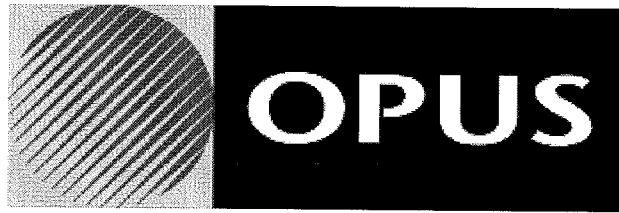
Bar/Point (m)/Case	Fx compression (kN)	Fx tension (kN)	FZ (kN)	MY (kNm)
1/ origin (1)/ 3 (C)		-2.111	1.252	-0.000
1/ end (2)/ 3 (C)		-2.415	1.252	2.628
2/ origin (2)/ 3 (C)	1.794		-3.020	2.628
2/ end (3)/ 3 (C)	1.620		-3.020	-0.995
3/ origin (3)/ 3 (C)		-1.559	2.488	-0.995
3/ end (4)/ 3 (C)		-1.617	2.488	0.000
4/ origin (5)/ 3 (C)		-0.389	1.809	0.000
4/ end (6)/ 3 (C)		-0.694	1.809	3.800
5/ origin (6)/ 3 (C)		-5.922	-3.357	3.800
5/ end (7)/ 3 (C)		-6.096	-3.357	-0.229
6/ origin (7)/ 3 (C)		-2.940	0.573	-0.229
6/ end (8)/ 3 (C)		-2.998	0.573	-0.000
7/ origin (3)/ 3 (C)	5.508		3.179	0.000
7/ end (9)/ 3 (C)	5.508		3.048	3.736
8/ origin (9)/ 3 (C)	1.236		-1.285	3.736
8/ end (10)/ 3 (C)	1.236		-1.818	-3.866

Bar/Point (m)/Case	Fx compression (kN)	Fx tension (kN)	FZ (kN)	MY (kNm)
9/ origin (10)/ 3 (C)		-3.930	3.287	-3.866
9/ end (7)/ 3 (C)		-3.930	3.156	-0.000
10/ origin (2)/ 3 (C)		-5.997	0.044	0.000
10/ end (9)/ 3 (C)		-6.084	-0.044	-0.000
11/ origin (6)/ 3 (C)	7.350		0.044	-0.000
11/ end (10)/ 3 (C)	7.263		-0.044	0.000

**View - MY, Cases: 3 (COMB1)**

**View - FX, Cases: 3 (COMB1)**





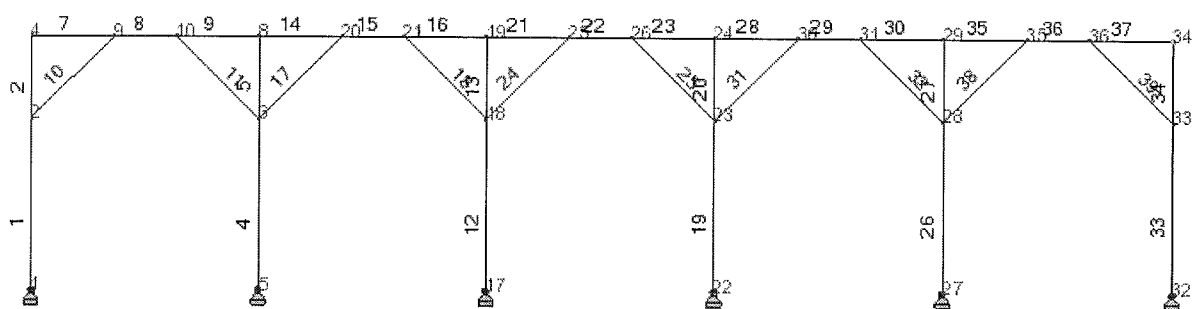
## **TITLE PAGE**

**Project: 9467 Travelling Barn - Timber Frame-1**

APPENDIX D

BARN FRAMEWORK END WIND

**Author : AWS**

**View****Nodes: Values: 1**

Node	X (m)	Z (m)	Support code	Support
1	0.0	0.0	xxf	Pinned
2	0.0	2.500		
4	0.0	3.700		
5	3.300	0.0	xxf	Pinned
6	3.300	2.500		
8	3.300	3.700		
9	1.200	3.700		
10	2.100	3.700		
17	6.600	0.0	xxf	Pinned

Node	X (m)	Z (m)	Support code	Support
18	6.600	2.500		
19	6.600	3.700		
20	4.500	3.700		
21	5.400	3.700		
22	9.900	0.0	xxf	Pinned
23	9.900	2.500		
24	9.900	3.700		
25	7.800	3.700		
26	8.700	3.700		
27	13.200	0.0	xxf	Pinned
28	13.200	2.500		
29	13.200	3.700		
30	11.100	3.700		
31	12.000	3.700		
32	16.500	0.0	xxf	Pinned
33	16.500	2.500		
34	16.500	3.700		
35	14.400	3.700		
36	15.300	3.700		

**Bars: Values: 1**

Bar	Node 1	Node 2	Section	Material	Length (m)	Gamma (Deg)
1	1	2	RECT_200x200	TIMBER-C16	2.500	0.0
2	2	4	RECT_200x200	TIMBER-C16	1.200	0.0
4	5	6	RECT_200x200	TIMBER-C16	2.500	0.0
5	6	8	RECT_200x200	TIMBER-C16	1.200	0.0
7	4	9	RECT_100x200	TIMBER-C16	1.200	90.0
8	9	10	RECT_100x200	TIMBER-C16	0.900	90.0
9	10	8	RECT_100x200	TIMBER-C16	1.200	90.0
10	2	9	RECT_100x200	TIMBER-C16	1.697	0.0
11	6	10	RECT_100x200	TIMBER-C16	1.697	0.0
12	17	18	RECT_200x200	TIMBER-C16	2.500	0.0
13	18	19	RECT_200x200	TIMBER-C16	1.200	0.0
14	8	20	RECT_100x200	TIMBER-C16	1.200	90.0
15	20	21	RECT_100x200	TIMBER-C16	0.900	90.0
16	21	19	RECT_100x200	TIMBER-C16	1.200	90.0
17	6	20	RECT_100x200	TIMBER-C16	1.697	0.0
18	18	21	RECT_100x200	TIMBER-C16	1.697	0.0
19	22	23	RECT_200x200	TIMBER-C16	2.500	0.0
20	23	24	RECT_200x200	TIMBER-C16	1.200	0.0
21	19	25	RECT_100x200	TIMBER-C16	1.200	90.0
22	25	26	RECT_100x200	TIMBER-C16	0.900	90.0
23	26	24	RECT_100x200	TIMBER-C16	1.200	90.0
24	18	25	RECT_100x200	TIMBER-C16	1.697	0.0
25	23	26	RECT_100x200	TIMBER-C16	1.697	0.0



Bar	Node 1	Node 2	Section	Material	Length (m)	Gamma (Deg)
26	27	28	RECT_200x200	TIMBER-C16	2.500	0.0
27	28	29	RECT_200x200	TIMBER-C16	1.200	0.0
28	24	30	RECT_100x200	TIMBER-C16	1.200	90.0
29	30	31	RECT_100x200	TIMBER-C16	0.900	90.0
30	31	29	RECT_100x200	TIMBER-C16	1.200	90.0
31	23	30	RECT_100x200	TIMBER-C16	1.697	0.0
32	28	31	RECT_100x200	TIMBER-C16	1.697	0.0
33	32	33	RECT_200x200	TIMBER-C16	2.500	0.0
34	33	34	RECT_200x200	TIMBER-C16	1.200	0.0
35	29	35	RECT_100x200	TIMBER-C16	1.200	90.0
36	35	36	RECT_100x200	TIMBER-C16	0.900	90.0
37	36	34	RECT_100x200	TIMBER-C16	1.200	90.0
38	28	35	RECT_100x200	TIMBER-C16	1.697	0.0
39	33	36	RECT_100x200	TIMBER-C16	1.697	0.0

**Properties: Bars: 1**

Section name	Bar list	AX (cm2)	AY (cm2)	AZ (cm2)
RECT_100x200	7to11 14to18 21to25 28to32 35to39	200.0	166.7	166.7
RECT_200x200	1 2 4 5to33By7 13to34By7	400.0	333.3	333.3

Section name	IX (cm4)	IY (cm4)	IZ (cm4)	HY (mm)
RECT_100x200	4573.7	6666.7	1666.7	100.0
RECT_200x200	22493.3	13333.3	13333.3	200.0

Section name	HZ (mm)	VY (mm)	VZ (mm)	VPY (mm)	VPZ (mm)
RECT_100x200	200.0	50.0	100.0	50.0	100.0
RECT_200x200	200.0	100.0	100.0	100.0	100.0

**Loads - Cases: 1to4 : Values: 1**

Case	Load type	List
1	self-weight	1 2 4 5 7to39
2	trapezoidal load (2p)	7
2	trapezoidal load (2p)	7
2	uniform load	8
2	trapezoidal load (2p)	9
2	trapezoidal load (2p)	9
2	uniform load	14
2	trapezoidal load (2p)	15
2	trapezoidal load (2p)	15
2	uniform load	16 21to23 28to30 35to37
4	uniform load	7
4	uniform load	8 9 14 15
4	trapezoidal load (2p)	16
4	trapezoidal load (2p)	16

4	uniform load	21to23 28to30 35to37
Case	Load values	
1	PZ Negative Factor=1.000	
2	PZ2=1.940(kN/m) PZ1=1.940(kN/m) X2=0.750(m) X1=0.0(m) global not project. absolute	
2	PZ2=1.082(kN/m) PZ1=1.082(kN/m) X2=1.200(m) X1=0.750(m) global not project. absolute	
2	PZ=1.082(kN/m)	
2	PZ2=1.082(kN/m) PZ1=1.082(kN/m) X2=0.400(m) X1=0.0(m) global not project. absolute	
2	PZ2=0.445(kN/m) PZ1=0.445(kN/m) X2=1.200(m) X1=0.400(m) global not project. absolute	
2	PZ=0.445(kN/m)	
2	PZ2=0.445(kN/m) PZ1=0.445(kN/m) X2=0.500(m) X1=0.0(m) global not project. absolute	
2	PZ2=0.224(kN/m) PZ1=0.224(kN/m) X2=0.900(m) X1=0.500(m) global not project. absolute	
2	PZ=0.224(kN/m)	
4	PZ=0.472(kN/m)	
4	PZ=0.236(kN/m)	
4	PZ2=0.236(kN/m) PZ1=0.236(kN/m) X2=0.500(m) X1=0.0(m) global not project. absolute	
4	PZ2=0.197(kN/m) PZ1=0.197(kN/m) X2=1.200(m) X1=0.500(m) global not project. absolute	
4	PZ=0.197(kN/m)	

**Load Combination - Case: 3 (COMB1): Values: 1**

Combinations	Name	Analysis type	Combination type	Definition
3 (C)	COMB1	Linear Combination	SLS	(1+2+4)*1.000

**Reactions in the coordinate system: global - Cases: 1to3 : Values: 1**

Node/Case	FX (kN)	FZ (kN)	MY (kNm)
1/ 1	0.030	0.745	0.0
1/ 2	-0.329	-2.163	-0.000
1/ 3 (C)	-0.385	-1.989	-0.000
1/ 4	-0.087	-0.572	-0.000
5/ 1	-0.009	1.068	0.000
5/ 2	0.197	-2.444	-0.000
5/ 3 (C)	0.218	-2.285	-0.000
5/ 4	0.029	-0.909	-0.000
17/ 1	0.004	1.013	-0.000
17/ 2	-0.016	-0.489	-0.000
17/ 3 (C)	-0.010	-0.129	-0.000
17/ 4	0.002	-0.652	-0.000
22/ 1	-0.004	1.013	0.000
22/ 2	0.053	-0.797	-0.000
22/ 3 (C)	0.061	-0.417	-0.000
22/ 4	0.011	-0.633	-0.000
27/ 1	0.009	1.068	0.000
27/ 2	0.017	-0.781	0.000
27/ 3 (C)	0.019	-0.431	0.000
27/ 4	-0.007	-0.718	-0.000

Node/Case	FX (kN)	FZ (kN)	MY (kNm)
32/ 1	-0.030	0.745	0.0
32/ 2	0.078	-0.363	0.000
32/ 3 (C)	0.099	0.103	0.000
32/ 4	0.051	-0.280	0.000
Case 1	DL1		
Sum of val.	0.000	5.653	0.000
Sum of reac.	0.000	5.653	-46.641
Sum of forc.	0.0	-5.653	46.641
Check val.	0.000	-0.000	0.000
Precision	1.06786e-011	4.55215e-024	
Case 2	WIND1		
Sum of val.	0.000	-7.037	-0.000
Sum of reac.	0.000	-7.037	35.486
Sum of forc.	0.0	7.037	-35.486
Check val.	0.000	0.000	-0.000
Precision	5.90383e-011	7.19239e-021	
Case 3 (C)	COMB1		
Sum of val.	0.000	-5.147	-0.000
Sum of reac.	0.000	-5.147	16.511
Sum of forc.	0.0	5.147	-16.511
Check val.	0.000	0.000	-0.000
Precision	1.30495e-010	7.70086e-021	
Case 4	WIND2		
Sum of val.	0.000	-3.764	-0.000
Sum of reac.	0.000	-3.764	27.665
Sum of forc.	0.0	3.764	-27.665
Check val.	0.000	0.000	-0.000
Precision	6.07779e-011	5.03916e-022	

**Forces - Case: 3 (COMB1): Values: 1**

Bar/Point (m)/Case	Fx compression (kN)	Fx tension (kN)	FZ (kN)	MY (kNm)
1/ origin (1)/ 3 (C)		-1.989	0.385	-0.000
1/ end (2)/ 3 (C)		-2.352	0.385	0.963
2/ origin (2)/ 3 (C)		-1.225	-0.803	0.963
2/ end (4)/ 3 (C)		-1.399	-0.803	-0.000
4/ origin (5)/ 3 (C)		-2.285	-0.218	-0.000
4/ end (6)/ 3 (C)		-2.648	-0.218	-0.544
5/ origin (6)/ 3 (C)		-0.262	0.453	-0.544
5/ end (8)/ 3 (C)		-0.437	0.453	0.000
7/ origin (4)/ 3 (C)	0.803		-1.399	0.000
7/ end (9)/ 3 (C)	0.803		1.022	-0.082

Bar/Point (m)/Case	Fx compression (kN)	Fx tension (kN)	FZ (kN)	MY (kNm)
8/ origin (9)/ 3 (C)		-0.385	-0.228	-0.082
8/ end (10)/ 3 (C)		-0.385	0.893	0.217
9/ origin (10)/ 3 (C)	1.204		-0.758	0.217
9/ end (8)/ 3 (C)	1.204		0.226	0.000
10/ origin (2)/ 3 (C)		-1.637	0.044	0.000
10/ end (9)/ 3 (C)		-1.724	-0.044	0.000
11/ origin (6)/ 3 (C)		-2.205	0.044	-0.000
11/ end (10)/ 3 (C)		-2.292	-0.044	0.000
12/ origin (17)/ 3 (C)		-0.129	0.010	-0.000
12/ end (18)/ 3 (C)		-0.492	0.010	0.026
13/ origin (18)/ 3 (C)		-0.260	-0.022	0.026
13/ end (19)/ 3 (C)		-0.434	-0.022	-0.000
14/ origin (8)/ 3 (C)	0.751		-0.210	-0.000
14/ end (20)/ 3 (C)	0.751		0.520	0.186
15/ origin (20)/ 3 (C)		-0.168	-0.461	0.186
15/ end (21)/ 3 (C)		-0.168	-0.001	0.000
16/ origin (21)/ 3 (C)		-0.006	-0.225	0.000
16/ end (19)/ 3 (C)		-0.006	0.213	0.000
17/ origin (6)/ 3 (C)		-1.256	0.044	-0.000
17/ end (20)/ 3 (C)		-1.343	-0.044	0.000
18/ origin (18)/ 3 (C)		-0.185	0.044	-0.000
18/ end (21)/ 3 (C)		-0.272	-0.044	0.000
19/ origin (22)/ 3 (C)		-0.417	-0.061	-0.000
19/ end (23)/ 3 (C)		-0.780	-0.061	-0.152
20/ origin (23)/ 3 (C)		-0.160	0.127	-0.152
20/ end (24)/ 3 (C)		-0.334	0.127	-0.000
21/ origin (19)/ 3 (C)	0.015		-0.221	0.000
21/ end (25)/ 3 (C)	0.015		0.197	-0.014
22/ origin (25)/ 3 (C)		-0.178	-0.058	-0.014
22/ end (26)/ 3 (C)		-0.178	0.255	0.075
23/ origin (26)/ 3 (C)	0.287		-0.271	0.075
23/ end (24)/ 3 (C)	0.287		0.147	0.000
24/ origin (18)/ 3 (C)		-0.230	0.044	0.000
24/ end (25)/ 3 (C)		-0.318	-0.044	0.0
25/ origin (23)/ 3 (C)		-0.614	0.044	-0.000
25/ end (26)/ 3 (C)		-0.701	-0.044	-0.000
26/ origin (27)/ 3 (C)		-0.431	-0.019	0.000
26/ end (28)/ 3 (C)		-0.794	-0.019	-0.047
27/ origin (28)/ 3 (C)		-0.156	0.039	-0.047
27/ end (29)/ 3 (C)		-0.330	0.039	-0.000
28/ origin (24)/ 3 (C)	0.160		-0.188	-0.000
28/ end (30)/ 3 (C)	0.160		0.231	0.026
29/ origin (30)/ 3 (C)		-0.118	-0.109	0.026
29/ end (31)/ 3 (C)		-0.118	0.205	0.069
30/ origin (31)/ 3 (C)	0.292		-0.267	0.069
30/ end (29)/ 3 (C)	0.292		0.152	-0.000
31/ origin (23)/ 3 (C)		-0.349	0.044	-0.000

Bar/Point (m)/Case	Fx compression (kN)	Fx tension (kN)	FZ (kN)	MY (kNm)
31/ end (30)/ 3 (C)		-0.436	-0.044	0.000
32/ origin (28)/ 3 (C)		-0.536	0.044	-0.000
32/ end (31)/ 3 (C)		-0.623	-0.044	-0.000
33/ origin (32)/ 3 (C)	0.103		-0.099	0.000
33/ end (33)/ 3 (C)		-0.260	-0.099	-0.247
34/ origin (33)/ 3 (C)		-0.017	0.206	-0.247
34/ end (34)/ 3 (C)		-0.192	0.206	0.000
35/ origin (29)/ 3 (C)	0.253		-0.179	-0.000
35/ end (35)/ 3 (C)	0.253		0.239	0.036
36/ origin (35)/ 3 (C)		-0.099	-0.174	0.036
36/ end (36)/ 3 (C)		-0.099	0.140	0.021
37/ origin (36)/ 3 (C)	0.206		-0.227	0.021
37/ end (34)/ 3 (C)	0.206		0.192	-0.000
38/ origin (28)/ 3 (C)		-0.454	0.044	-0.000
38/ end (35)/ 3 (C)		-0.541	-0.044	-0.000
39/ origin (33)/ 3 (C)		-0.387	0.044	0.000
39/ end (36)/ 3 (C)		-0.474	-0.044	0.000