

APOLLO SALES LTD 36 DEGREE X-BEAM RIDGE FRAME DESIGN CHECK CALCULATIONS

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NOV 2015

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CALCULATION SHEET	Project :	Apollo 36° Ridge Frame to Eurocode		
	Element :	Brief		
	Job Number :	V0181-02	By : anw	Date:Nov 15
	Document No :	001	Checked:mmr	Date:Nov 15



ALAN WHITE DESIGN

Brief The brief is to check the capacity of the Apollo 36 degree ridge frame unit when utilised with X-beams in a temporary roof.

The beams are manufactured from tube extrusions in aluminium alloy 6082 T6.

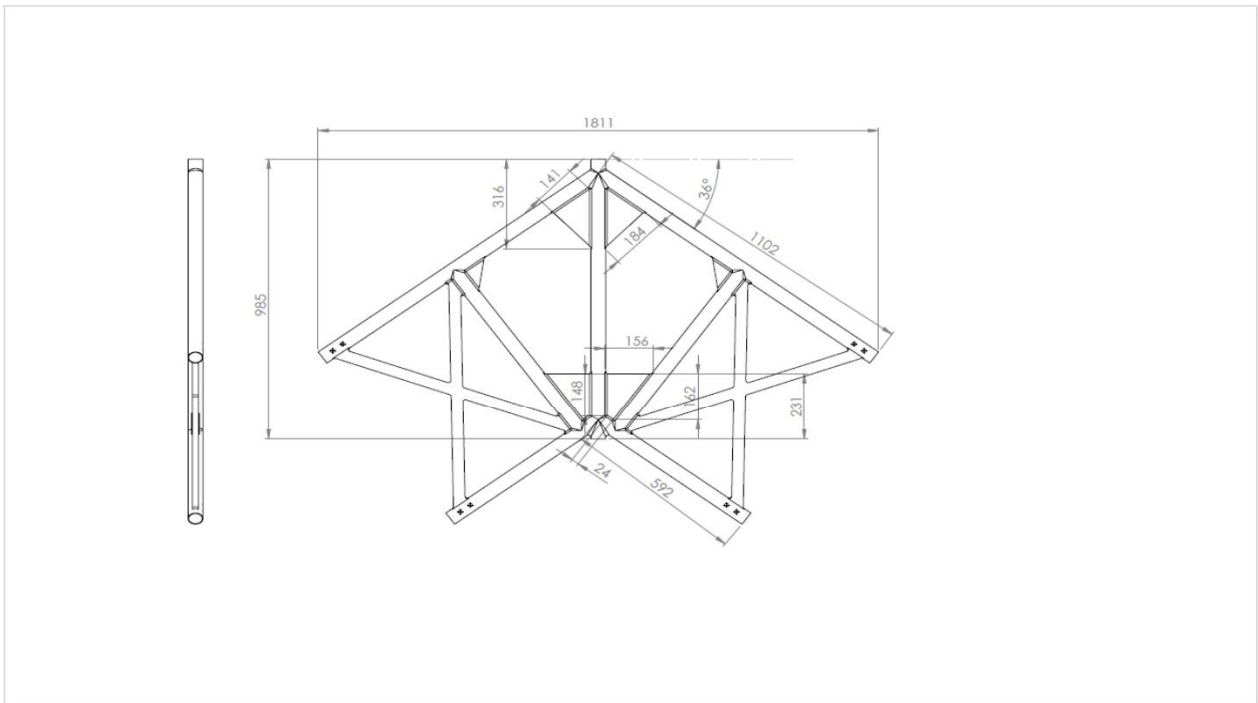
The ridge frame is to be designed to have the same capacities as an X-beam.

Alloy The alloy used is 6082 T6:

$f_o = 250 \text{ N/mm}^2$

$f_u = 290 \text{ N/mm}^2$

Layout The geometry of the beam is shown in the drawing below:



Notes	Drawn By	N. White	Date	04/03/15	DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETRES	Title
	Checked By						
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							Dwg No: 750mm X-Beam 36 degree ridge SCALE:1:10 SHEET 1 OF 1

Design Eurocode 9: Design of Aluminium structures EN 1999-1-1

X-beam Capacities From technical literature the capacities of an X-beam are:

Allowable moment 42.90 kNm

Allowable shear 45.40 kN

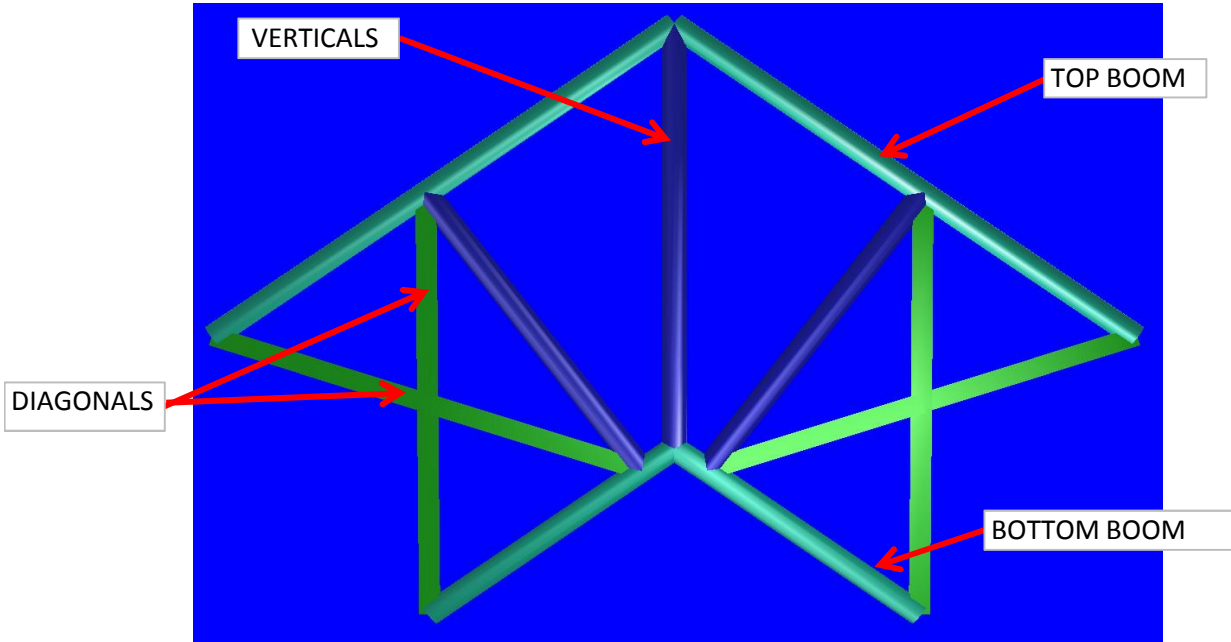
CALCULATION SHEET	Project :	Apollo 36° Ridge Frame to Eurocode		
	Element :	Analysis		
	Job Number :	V0181-02	By : anw	Date:Nov 15
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STRAP Model

The structure was analysed in STRAP structural analysis program.

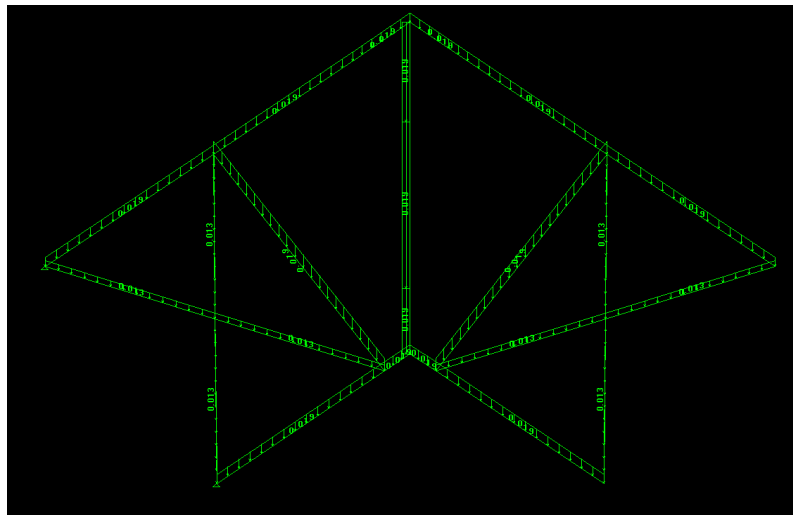


Load Cases

Load Case 1

Self Weight

Self weight of all members is factored by 1.15 to account for connections



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Load Case 2

Beam shear downforce

The max end shear from an X-beam is applied locally to the ridge frame

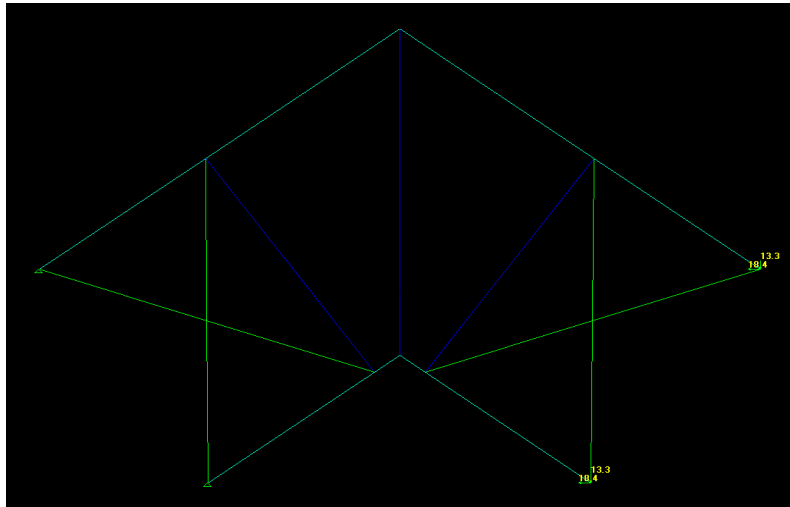
The X-beam max shear value of

$$Q = 45.40 \text{ kN}$$

is applied to the ends and resolved to 36 degrees

$$\begin{aligned} \text{Vertical component } Q_v &= 0.5Q \cdot \cos 36 \\ &= 0.5 \cdot 45.4 \cdot \cos(36 \cdot \pi / 180) \\ &= 18.36 \text{ kN} \end{aligned}$$

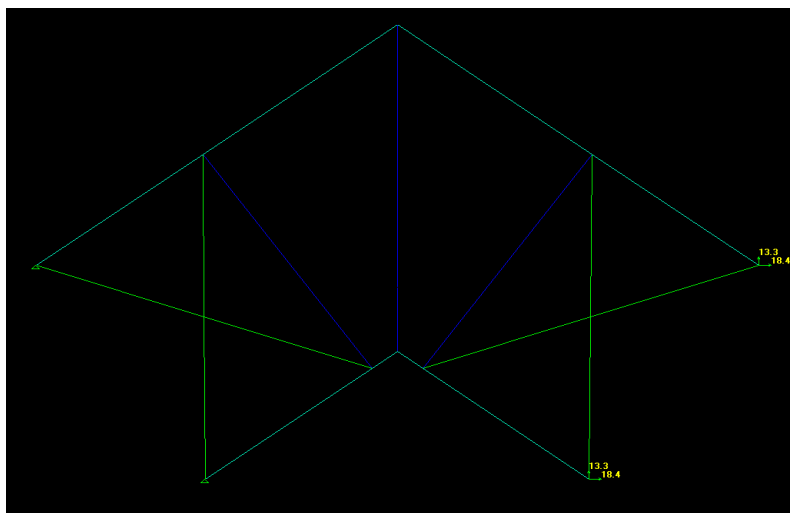
$$\begin{aligned} \text{Horizontal component } Q_h &= 0.5Q \cdot \sin 36 \\ &= 0.5 \cdot 45.4 \cdot \sin(36 \cdot \pi / 180) \\ &= 13.34 \text{ kN} \end{aligned}$$



Load Case 3

Beam shear uplift

The max end shear from an X-beam as above is applied locally to the ridge frame



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Load Case 4

Beam moment downforce

The push/pull loads from X-beam bending moment are applied to the ridge frame

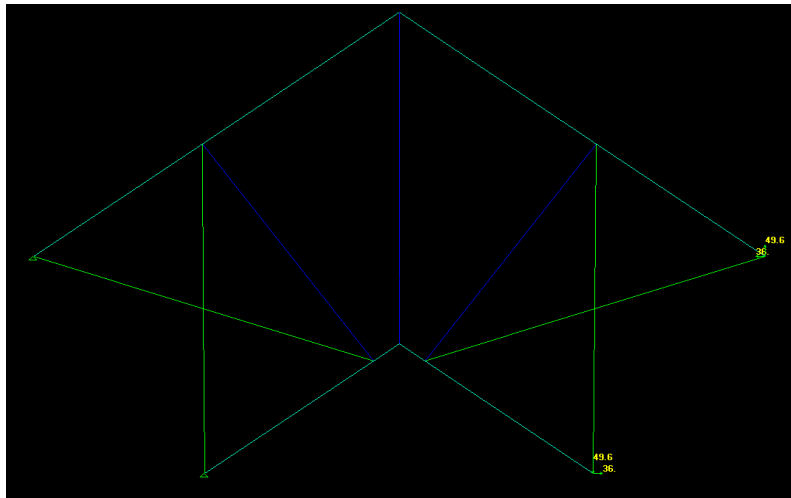
The X-beam max moment value of

$$M = 42.90 \text{ kN}$$

is converted to a push pull load, applied to the ends and resolved to 36 degrees

$$\begin{aligned} \text{Vertical component } F_v &= M/0.7 \cdot \sin 36 \\ &= 42.9/0.7 \cdot \sin(36 \cdot \text{PI}()/180) \\ &= 36.02 \text{ kN} \end{aligned}$$

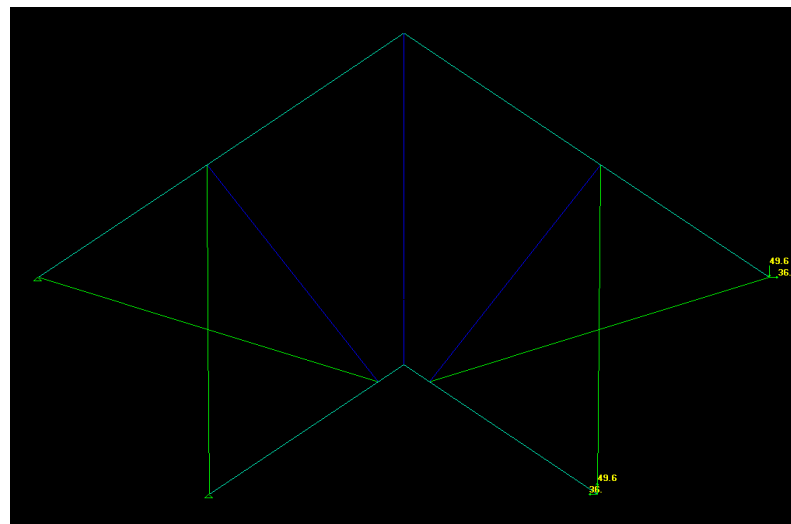
$$\begin{aligned} \text{Horizontal component } F_h &= M/0.7 \cdot \cos 36 \\ &= 42.9/0.7 \cdot \cos(36 \cdot \text{PI}()/180) \\ &= 49.58 \text{ kN} \end{aligned}$$



Load Case 5

Beam moment uplift

The push/pull loads from X-beam bending moment as above are applied to the ridge frame



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ALAN WHITE DESIGN


Load Combinations

Combination Number	Combination Description	Load Cases
1	SLS Downforce	1+2+4
2	ULS Downforce	1+2+4
3	SLS Uplift	1+3+5
4	ULS Uplift	1+3+5

Above Combinations were checked for the following design factors:

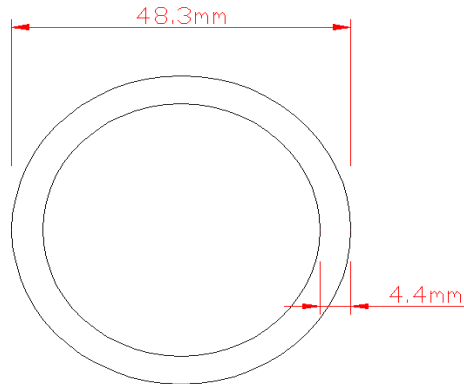
$$\begin{aligned} \gamma_D &= 1.35 \\ \gamma_{\text{Shear}} &= 0.25 \\ \gamma_{\text{Bending}} &= 1.50 \end{aligned}$$

Due to the nature of the loading on a roof, the maximum shear will be found at the support with a very low shear force found in the ridge itself.

CALCULATION SHEET	Project :	Apollo 36° Ridge Frame to Eurocode			 ALAN WHITE DESIGN
	Element :	Main Boom Capacity			
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CHS Boom Layout

Boom 48.3 x 4.4 CHS



Section Properties

A=	607 mm ²
I=	147654 mm ⁴
W _{el} =	6114 mm ³
W _{pl} =	8254 mm ³
r _y =	15.6 mm

for slenderness

β =	b/t	b= 48.3
=	10.98	t = 4.4

ϵ =	sqrt(250/f _o)	f _o = 250N/mm ²
=	1.00	

Class A, without welds, Internal parts

β_1 =	11 ϵ
=	11*1.0
=	11.00
>	10.98

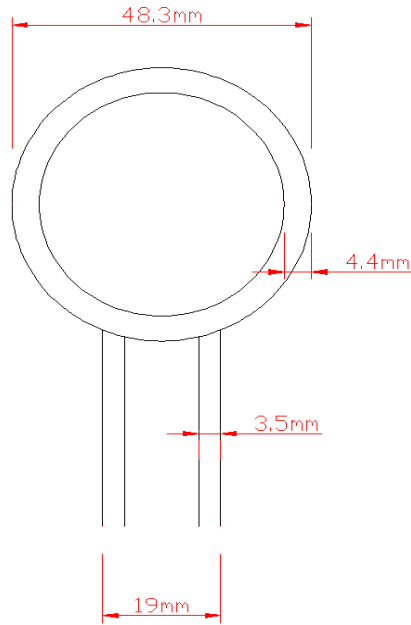
Section is class 1

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Boom 48.3 x 4.4 CHS HAZ

There is a HAZ at welded joint to the diagonal brace



$$t_{boom} = 4.40\text{mm}$$


$$t_{diagonal} = 3.5\text{mm}$$

$$t_{average} = 3.95\text{mm}$$

All welds are TIG.
As per EN 1999-1-1 6.1.6.3

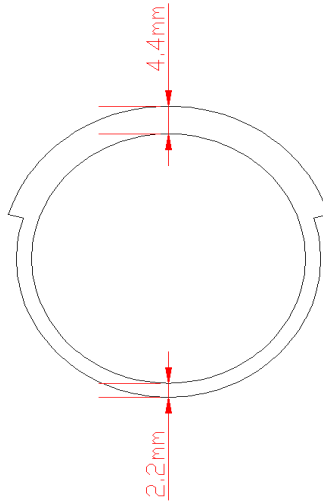
$$b_{haz} = 30\text{mm}$$

Therefore HAZ extends 30mm from intersection of welded materials

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	Element :	Main Boom Capacity			
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HAZ Section Layout

Take section shown as non-HAZ.



Revised Section Properties

A=	418 mm ²
I=	92785 mm ⁴
W _{el} =	3398 mm ³
W _{pl} =	4587 mm ³
r _y =	14.7 mm

Truss Boom Moment Capacity

(6.2.5.1)

$$M_{c,Rd} = \alpha W_{el} f_o / \gamma_{M1}$$

$\alpha =$	W _{pl} /W _{el} (Table 6.4)
$=$	1.35
W _{el} =	3.40 cm ³
f _o =	250 N/mm ²
$\gamma_{M1} =$	1.1 (6.1.3)

$$= 1.35 \cdot 3.40 \cdot 250 / 1100$$

$$M_{c,Rd} = 1.04 \text{ kNm}$$

Truss Boom Shear Capacity


(6.2.6)

$$V_{Rd} = A_v f_o / \sqrt{3} \gamma_{M1}$$

A _v =	0.6A
A _v =	0.6 * 607
A _v =	364.20 mm ²
$\gamma_{M1} =$	1.1
f _o =	250 N/mm ²

$$= 364.20 \cdot 250 / (\text{SQRT}(3) \cdot 1100)$$

$$V_{Rd} = 47.79 \text{ kN}$$

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	Element :	Main Boom Capacity			
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Truss Top Boom Axial Comp Capacity @ 450mm (effective length of beam between restraints)

$$N_{b,Rd} = k \times A_{eff} f_o / \gamma_{M1} \quad (6.3.1.1)$$

$$N_{cr} = \pi^2 EI / k^2 L^2 \quad (\text{Appendix I.3})$$

$$E = 70,000 \text{ N/mm}^2$$

$$I = 147,654 \text{ mm}^4$$

$$k = 0.50 \text{ (Table I.2)}$$

$$L = 450 \text{ mm}$$

$$N_{cr} = ((\pi)^2 * 70000 * 147654) / ((0.5^2) * (450^2))$$

$$= 2,015,013.53 \text{ N}$$

$$\lambda = \sqrt{A_{eff} f_o / N_{cr}} \quad (6.3.1.2)$$

$$= 0.27 \quad A_{eff} = 607 \text{ mm}^2$$

$$X = 1 / \Phi + \sqrt{\Phi^2 - \lambda^2}$$

$$\Phi = 0.5(1 + \alpha(\lambda - \lambda_o) + \lambda^2)$$

$$\alpha = 0.20 \text{ Table 6.6}$$

$$\lambda_o = 0.10 \text{ Table 6.6}$$

$$\Phi = 0.56$$

$$X = 0.964$$

$$k = 1 - (1 - (A_1/A) 10^{-\lambda} - (0.005 + 0.1(A_1/A)) \lambda^{1.3(1-\lambda)})$$

$$A_1 = A - A_{HAZ}(1 - p_{o,HAZ})$$

$$= 607 - 189 * (1 - 0.5)$$

$$= 512.50 \text{ mm}^2$$

$$k = 0.878$$

$$N_{b,Rd} = k \times A_{eff} f_o / \gamma_{M1}$$

$$N_{b,Rd} = 0.878 * 0.964 * 607 * 250 / 1100$$

$$= 116.76 \text{ kN}$$

Truss Bottom Boom Axial Comp Capacity @ 1000mm

$$N_{b,Rd} = k \times A_{eff} f_o / \gamma_{M1} \quad (6.3.1.1)$$

$$N_{cr} = \pi^2 EI / k^2 L^2 \quad (\text{Appendix I.3})$$

$$E = 70,000 \text{ N/mm}^2$$

$$I = 147,654 \text{ mm}^4$$

$$k = 0.50 \text{ (Table I.2)}$$


$$L = 540 \text{ mm}$$

$$N_{cr} = ((\pi)^2 * 70000 * 147654) / ((0.5^2) * (540^2))$$

$$= 1,399,314.95 \text{ N}$$

$$\lambda = \sqrt{A_{eff} f_o / N_{cr}} \quad (6.3.1.2)$$

$$= 0.33 \quad A_{eff} = 607 \text{ mm}^2$$

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	Element :	Main Boom Capacity			
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$$X = 1 / \Phi + \sqrt{\Phi^2 - \lambda^2}$$

$$\Phi = 0.5(1 + \alpha(\lambda - \lambda_0) + \lambda^2)$$

$$\alpha = 0.20 \text{ Table 6.6}$$

$$\lambda_0 = 0.10 \text{ Table 6.6}$$

$$\Phi = 0.58$$

$$X = 0.951$$

$$k = 1 - (1 - (A_1/A)10^{-\lambda} - (0.005 + 0.1(A_1/A)))\lambda^{1.3(1-\lambda)}$$

$$\begin{aligned} A_1 &= A - A_{HAZ}(1 - p_{o,HAZ}) \\ &= 607 - 189(1 - 0.5) \\ &= 512.50 \text{ mm}^2 \end{aligned}$$

$$k = 0.876$$

$$N_{b,Rd} = k \times A_{eff} f_o / \gamma_{M1}$$

$$\begin{aligned} N_{b,Rd} &= 0.876 \times 0.951 \times 607 \times 250 / 1100 \\ &= 114.93 \text{ kN} \end{aligned}$$

Truss Boom Axial Tension Capacity

(6.2.3)

1. General yielding

$$N_{o,Rd} = A_g f_o / \gamma_{M1}$$

$$f_o = 250 \text{ N/mm}^2$$

$$A_g = 607 \text{ mm}^2$$

$$\gamma_{M1} = 1.1$$

$$= 607 \times 250 / 1100$$

$$= 137.95 \text{ kN}$$

2. Local failure

$$N_{u,Rd} = A_{net} f_u / \gamma_{M2}$$


$$f_u = 290 \text{ N/mm}^2$$

$$A_{net} = 418 \text{ mm}^2$$

$$\gamma_{M1} = 1.25$$

$$= 418 \times 290 / 1250$$

$$= 96.98 \text{ kN}$$

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	Element :	Main Boom Capacity			
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Gusset plate


A 80mm x 12.7mm thick gusset plate is added to strengthen the top and bottom boom
Assume section fully heat affected

$$\begin{aligned}
A &= 80 \times 12.7 \\
&= 1,016.00 \text{ mm}^2 \\
W_{el} &= 12.7 \times 80^2 / 6000 \\
&= 13.55 \text{ cm}^3 \\
M_{u,Rd} &= W_{net} f_u / \gamma_{M2} \\
W_{net} &= W_{el} * \rho_{u, haz} \\
&= 13.55 * 0.64 \\
&= 8.67 \text{ cm}^3 \\
f_u &= 290 \text{ N/mm}^2 \\
\gamma_{M2} &= 1.25 \text{ (6.1.3)} \\
&= 8.67 * 290 / 1250 \\
M_{u,Rd} &= 2.01 \text{ kNm}
\end{aligned}$$

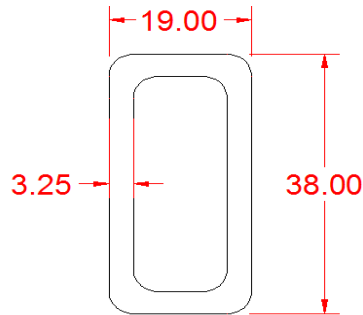
Gusset Plate Shear Capacity

(6.2.6)

$$\begin{aligned}
V_{Rd} &= A_v f_o / \sqrt{3} \gamma_{M1} \\
A_v &= A \\
A_v &= 1,016 \text{ mm}^2 \\
\gamma_{M1} &= 1.1 \\
f_o &= 250 \text{ N/mm}^2 \\
&= 1016 * 250 / (\text{SQRT}(3) * 1100) \\
V_{Rd} &= 133.32 \text{ kN}
\end{aligned}$$

CALCULATION SHEET	Project : Apollo 36° Ridge Frame to Eurocode			 ALAN WHITE DESIGN
	Element : Diagonal Member Capacity			
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RHS-Oval Diagonal Member
Diagonal 38 x 19 x 3.25mm Oval



Section Properties

A=	328 mm ²
I=	53341 mm ⁴
W _{el} =	2807 mm ³
W _{pl} =	3729 mm ³
r _y =	7.0 mm

for slenderness

β=	b/t	b= 38-2*3.25
=	9.69	= 31.50
		t = 3.25

ε=	sqrt(250/f _o)	f _o = 250N/mm ²
=	1.00	

Class A, without welds, Internal parts

β ₁ =	11ε
=	11*1.0
=	11.00
>	9.69

Section is class 1

Diagonal Axial Comp Capacity @ 400mm (effective length of beam)

$$N_{b,Rd} = k \times A_{eff} f_o / \gamma_{M1} \quad (6.3.1.1)$$

$$N_{cr} = \pi^2 EI / k^2 L^2 \quad (\text{Appendix I.3})$$


E =	70,000 N/mm ²
I =	53,341 mm ⁴
k =	0.50
L =	400 mm

$$N_{cr} = ((\pi)^2 * 70000 * 53341) / ((0.5^2) * (400^2))$$

$$= 921,295.49 \text{ N}$$

$$\lambda = \sqrt{A_{eff} f_o / N_{cr}} \quad (6.3.1.2)$$

$$= 0.30 \quad A_{eff} = 328 \text{ mm}^2$$

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$$X = 1 / \Phi + \sqrt{\Phi^2 - \lambda^2}$$

$$\Phi = 0.5(1 + \alpha(\lambda - \lambda_0) + \lambda^2)$$

$$\alpha = 0.20 \text{ Table 6.6}$$

$$\lambda_0 = 0.10 \text{ Table 6.6}$$

$$\Phi = 0.56$$

$$X = 0.89$$

$$\begin{aligned} A_1 &= A - A_{HAZ}(1 - p_{o,HAZ}) \\ &= 328 - 164 * (1 - 0.5) \\ &= 246.00 \text{ mm}^2 \end{aligned}$$

$$k = 0.833$$

$$\begin{aligned} N_{b,Rd} &= 0.833 * 0.89 * 328 * 250 / 1100 \\ &= 55.27 \text{ kN} \end{aligned}$$

Diagonal Axial Tension Capacity

(6.2.3)

1. General yielding

$$\begin{aligned} N_{o,Rd} &= A_g f_o / \gamma_{M1} \\ &= 328 * 250 / 1100 \\ &= 79.55 \text{ kN} \end{aligned}$$

$$f_o = 250 \text{ N/mm}^2$$

$$A_g = 328 \text{ mm}^2$$

$$\gamma_{M1} = 1.1$$

2. Local failure

$$\begin{aligned} N_{u,Rd} &= A_{net} f_u / \gamma_{M2} \\ &= 209.9 * 290 / 1250 \\ &= 48.70 \text{ kN} \end{aligned}$$


$$f_u = 290 \text{ N/mm}^2$$

$$A_{net} = \rho_{u,haz} * A$$

$$= 0.64 * 328 \text{ mm}^2$$

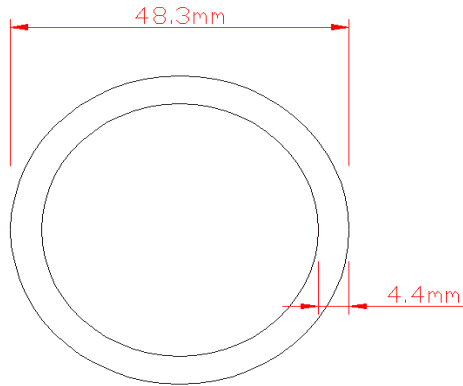
$$= 209.9 \text{ mm}^2$$

$$\gamma_{M2} = 1.25$$

CALCULATION SHEET	Project :	Apollo 36° Ridge Frame to Eurocode			 ALAN WHITE DESIGN
	Element :	Vertical capacity			
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Vertical 48.3 x 4.4mm CHS

Vertical CHS Layout



Section Properties

$$\begin{aligned}
A &= 607 \text{ mm}^2 \\
I &= 147654 \text{ mm}^4 \\
W_{el} &= 6114 \text{ mm}^3 \\
W_{pl} &= 8254 \text{ mm}^3 \\
r_y &= 15.6 \text{ mm}
\end{aligned}$$

for slenderness


$$\begin{aligned}
\beta &= b/t & b &= 48.3 \\
&= 10.98 & t &= 4.4
\end{aligned}$$

$$\begin{aligned}
\varepsilon &= \text{sqrt}(250/f_o) & f_o &= 250\text{N/mm}^2 \\
&= 1.00
\end{aligned}$$

Class A, without welds, Internal parts

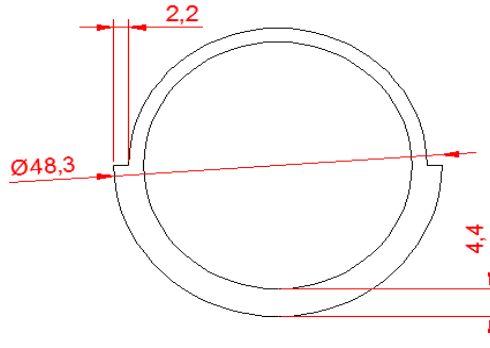
$$\begin{aligned}
\beta_1 &= 11\varepsilon \\
&= 11*1.0 \\
&= 11.00 \\
&> 10.98
\end{aligned}$$

Section is class 1

CALCULATION SHEET	Project :	Apollo 36° Ridge Frame to Eurocode			 ALAN WHITE DESIGN
	Element :	Vertical capacity			
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Vertical HAZ at Gusset Plate

Vertical CHS Layout



Section Properties

A=	447 mm ²
I=	105237 mm ⁴
W _{el} =	4358 mm ³
W _{pl} =	5883 mm ³
r _y =	15.3 mm

Vertical CHS Moment Capacity

(6.2.5.1)

$$M_{c,Rd} = \alpha W_{el} f_o / \gamma_{M1} \quad (\text{Table 6.4})$$

$\alpha =$	1.35
$W_{el} =$	4.36 cm ³
$f_o =$	250 N/mm ²
$\gamma_{M1} =$	1.1 (6.1.3)

$$= 1.35 * 4.36 * 250 / 1100$$

$$M_{c,Rd} = 1.34 \text{ kNm}$$

Vertical CHS Shear Capacity


(6.2.6)

$$V_{Rd} = A_v f_o / \sqrt{3} \gamma_{M1}$$

$A_v =$	0.6A
$A_v =$	0.6 * 607
$A_v =$	364.20 mm ²
$\gamma_{M1} =$	1.1
$f_o =$	250 N/mm ²

$$= 364.20 * 250 / (\text{SQRT}(3) * 1100)$$

$$V_{Rd} = 47.79 \text{ kN}$$

CALCULATION SHEET	Project :	Apollo 36° Ridge Frame to Eurocode			 ALAN WHITE DESIGN
	Element :	Vertical capacity			
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Vertical CHS Axial Comp Capacity @ 500mm (effective length of beam)

$$N_{b,Rd} = k \times A_{eff} f_o / \gamma_{M1} \quad (6.3.1.1)$$

$$N_{cr} = \pi^2 EI / k^2 L^2 \quad (\text{Appendix I.3})$$

$$E = 70,000 \text{ N/mm}^2$$

$$I = 105,237 \text{ mm}^4$$

$$k = 0.50$$

$$L = 308 \text{ mm}$$

$$N_{cr} = ((\pi)^2 * 70000 * 105237) / ((0.5^2) * (308^2))$$

$$= 3,065,665.76 \text{ N}$$

$$\lambda = \sqrt{A_{eff} f_o / N_{cr}} \quad (6.3.1.2)$$

$$= 0.22 \quad A_{eff} = 607 \text{ mm}^2$$

$$X = 1 / (\Phi + \sqrt{\Phi^2 - \lambda^2}) \quad \Phi = 0.5(1 + \alpha(\lambda - \lambda_o) + \lambda^2)$$

$$\alpha = 0.20 \text{ Table 6.6}$$

$$\lambda_o = 0.10 \text{ Table 6.6}$$

$$\Phi = 0.54$$

$$X = 0.94$$

$$k = 1 - (1 - (A_1/A) 10^{-\lambda} - (0.005 + 0.1(A_1/A)) \lambda^{1.3(1-\lambda)})$$

$$A_1 = A - A_{HAZ}(1 - p_{o,HAZ})$$

$$= 607 - 160 * (1 - 0.5)$$

$$= 527.00 \text{ mm}^2$$

$$k = 0.750$$

$$N_{b,Rd} = 0.75 * 0.94 * 607 * 250 / 1100$$

$$= 97.26 \text{ kN}$$

Vertical CHS Axial Tension Capacity (6.2.3)

1. General yielding

$$N_{o,Rd} = A_g f_o / \gamma_{M1}$$

$$f_o = 250 \text{ N/mm}^2$$

$$A_g = 607 \text{ mm}^2$$

$$\gamma_{M1} = 1.1$$

$$= 607 * 250 / 1100$$

$$= 137.95 \text{ kN}$$

2. Local failure

$$N_{u,Rd} = A_{net} f_u / \gamma_{M2}$$


$$f_u = 290 \text{ N/mm}^2$$

$$A_{net} = 447 \text{ mm}^2$$

$$\gamma_{M2} = 1.25$$

$$= 447 * 290 / 1250$$

$$= 103.70 \text{ kN}$$

CALCULATION SHEET	Project : Apollo 36° Ridge Frame to Eurocode			 ALAN WHITE DESIGN
	Element : Results- 36 Degree ridge Downforce			
	Job Number : V0181-02	By : anw	Date:Nov 15	
	Document No : 001	Checked:mmmr	Date:Nov 15	

Results	Action	Formula	Ultimate	Calculated	Factor
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Arrangement: 36 Degree ridge
Load orientation: Downforce

Top Boom Capacity

Moment	$M_{Rd,x}$		1.04	0.18	0.17
Shear	V_{Rd}		47.79	10.91	0.23
Tension	$N_{u,Rd}$		96.98	0.00	0.00
Compression	$N_{b,Rd}$		116.76	87.58	0.75
Combined	< 1.0		1.00	0.74	0.74

Bottom Boom Capacity


Moment	$M_{Rd,x}$		1.04	0.21	0.20
Shear	V_{Rd}		181.10	4.17	0.02
Tension	$N_{u,Rd}$		96.98	71.23	0.73
Compression	$N_{b,Rd}$		114.93	0.00	0.00
Combined	< 1.0		1.00	0.74	0.74

Diagonal Capacity

Tension	$N_{u,Rd}$		48.70	7.77	0.16
Compression	$N_{b,Rd}$		55.27	2.72	0.05

Vertical Capacity

Moment	$M_{Rd,x}$		1.34	0.12	0.09
Shear	V_{Rd}		47.79	0.54	0.01
Tension	$N_{u,Rd}$		103.70	94.72	0.91
Compression	$N_{b,Rd}$		97.26	4.80	0.05
Combined	< 1.0		1.00	0.91	0.91

CALCULATION SHEET	Project : Apollo 36° Ridge Frame to Eurocode			 ALAN WHITE DESIGN
	Element : Results-36 Degree ridge Uplift			
	Job Number : V0181-02	By : anw	Date:Nov 15	
	Document No : 001	Checked:mmmr	Date:Nov 15	

Results	Action	Formula	Ultimate	Calculated	Factor
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Arrangement: 36 Degree ridge
Load orientation: Uplift

Top Boom Capacity

Moment	$M_{Rd,x}$		1.04	0.19	0.18
Shear	V_{Rd}		47.79	10.78	0.23
Tension	$N_{u,Rd}$		96.98	87.60	0.90
Compression	$N_{b,Rd}$		116.76	0.00	0.00
Combined	< 1.0		1.00	0.93	0.93

Bottom Boom Capacity

Moment	$M_{Rd,x}$		1.04	0.21	0.20
Shear	V_{Rd}		181.10	3.97	0.02
Tension	$N_{u,Rd}$		96.98	0.00	0.00
Compression	$N_{b,Rd}$		114.93	71.48	0.62
Combined	< 1.0		1.00	0.99	0.99

Diagonal Capacity

Tension	$N_{u,Rd}$		48.70	7.29	0.15
Compression	$N_{b,Rd}$		55.27	7.93	0.14

Vertical Capacity

Moment	$M_{Rd,x}$		1.34	0.17	0.13
Shear	V_{Rd}		47.79	0.95	0.02
Tension	$N_{u,Rd}$		103.70	4.69	0.05
Compression	$N_{b,Rd}$		97.26	94.89	0.98
Combined	< 1.0		1.00	0.99	0.99

CALCULATION SHEET

Project : Apollo 36° Ridge Frame to Eurocode	
Element : Summary	
Job Number : V0181-02	By : anw
Document No : 001	Checked:mmr
Date:Nov 15	
Date:Nov 15	



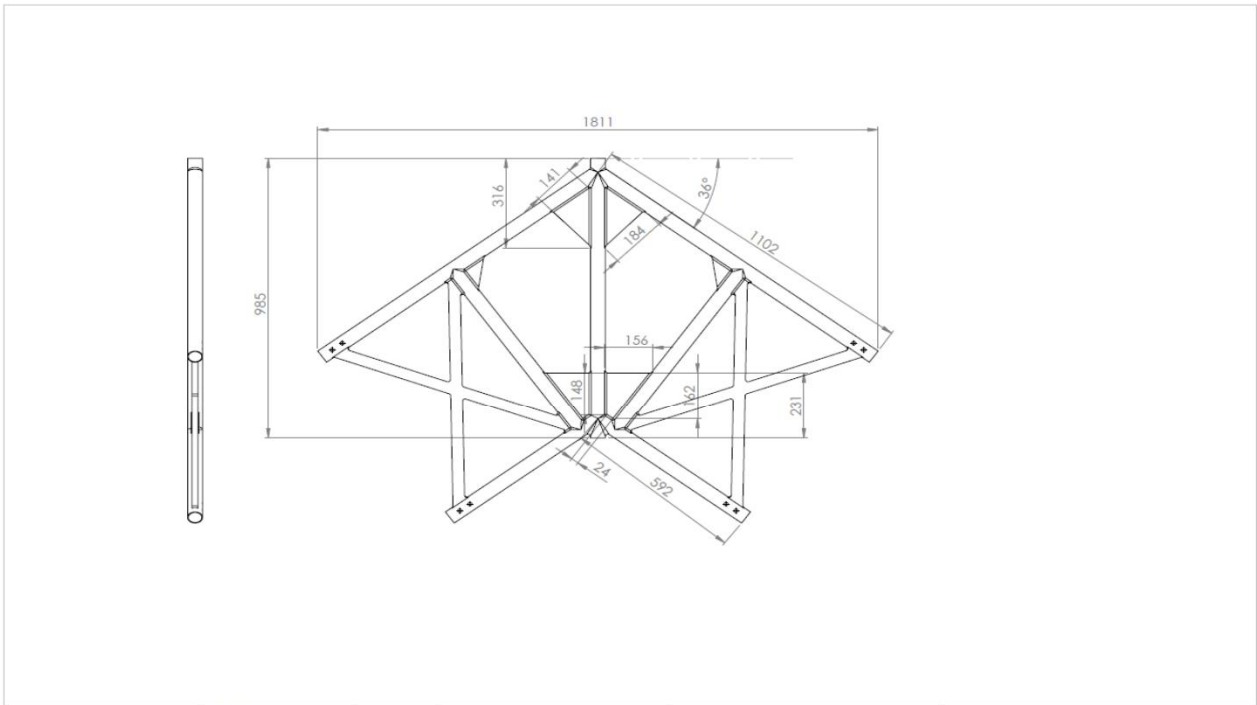
Summary

All structural members have passed design checks for specified loading

The ridge member has been checked and found to be stronger than the x-beams to which it will be connected.

The ridge can be used as part of an x-beam roof which is properly laced and braced without additional calculation.

Stiffener plates must be utilised as shown in drawing below



Notes	Drawn By	N. White	Date	04/03/15	DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETRES		Title
	Checked By					Client	Project	
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