ALANWHITEDESIGN
INSPIRED ENGINEERING

22126-04-001A
APOLLO SCAFFOLD SERVICES LTD
SCAFFOLD BEAMS
1.30M X-BEAM
DESIGN CALCULATIONS

OCT 2022

REGISTERED IN SCOTLAND
Company No. SC349820
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AWD016-05 Rev 5 by EMcG 17-01-2020

DOCUMENT REVISION HISTORY

REV.	DESCRIPTION	AUTHOR	DATE	CHECKED	APPROVED
A	Initial issue	PL	05-10-2022	MR	MR

TEMPORARY WORKS DESIGN CERTIFICATE

Project: Scaffold Beams

Client: Apollo Scaffold Services Ltd

Design Brief Issued: Yes

Design Brief Reference: Email

Does the design comply with the brief: Yes

Name	Paul Lynch
Title	Design Engineer
Signature	*Paul Lynch*
	To be signed by the Temporary Works Designer or other person authorised to sign on behalf of the organisation responsible for the Design of the Temporary Works.

Documents Produced
22126-04-001A

Notes:
Beam must be have chord restraints at 1.00m c/c.
Load must only be applied to node points.

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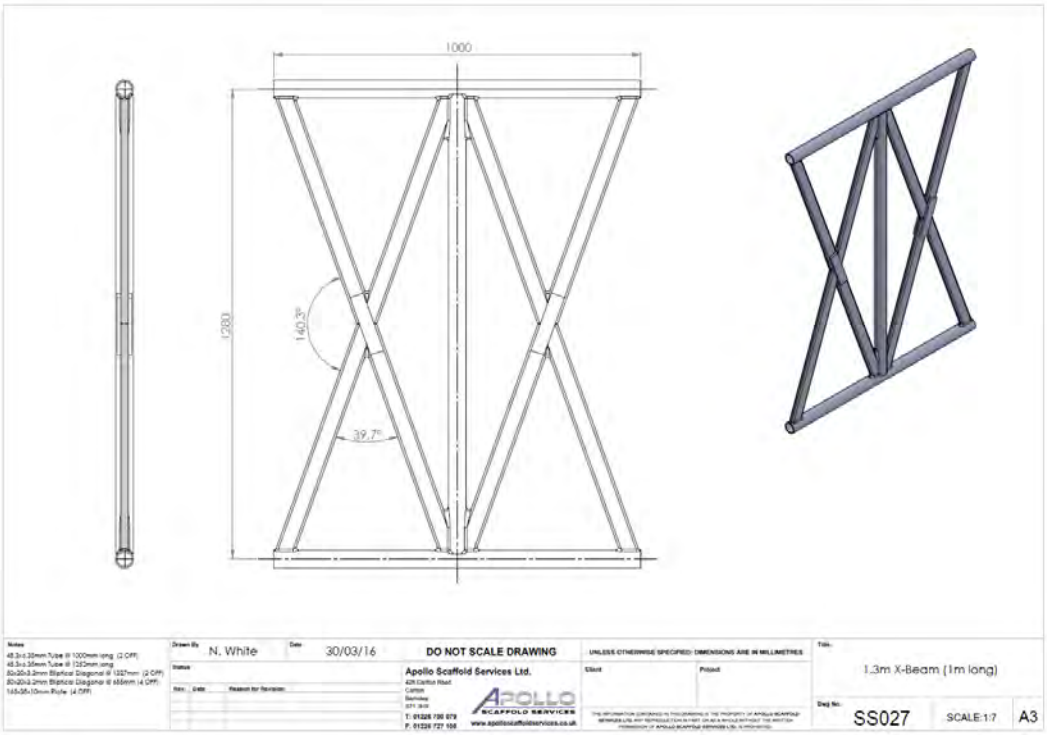
BRIEF

To prepare calculated values for the capacity of the Apollo 1.30m deep X-Beam with horizontal restraints every 1.00m to BS EN 1999-1-1+A2.

LAYOUT

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



DESIGN STANDARDS USED

BS EN 1999-1-1 Design of Aluminium Structures – General rules

NA to BS EN 1999-1-1 UK National Annex to Design of Aluminium Structures – General rules

INFORMATION RECEIVED

SS027 1.3m X-Beam 1m long.PDF

LOADING

The beam will be analysed for 5No load combinations:

- UDL - 10kN/m applied over full length of beam
- Central Point Load - 10kN applied to central point of top boom

- Two Point Loads - 2No 10kN applied at third points of top boom
- Three Point Loads - 3No 10kN applied at quarter points of top boom
- End Shear - 10kN applied 1.00m from end support

NOTE: LOAD MUST ONLY BE APPLIED AT NODE POINTS.

STABILITY

Beams to be simply supported at each end with horizontal restraints at 1.00m centres.

ASSUMPTIONS

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

fo = 250N/mm^2

fu = 290N/mm^2

Load must only be applied at node points.

Beam must be restrained at 1.00m centres.

EXCLUSIONS

Spigot connections are not covered in this report. For spigot design see AWD Ref. Y0149-01-001A.

SUMMARY

Maximum Allowable Moment and Maximum Allowable Shear can be found in the Results Summary section of this report.

RECOMMENDATIONS

N/A

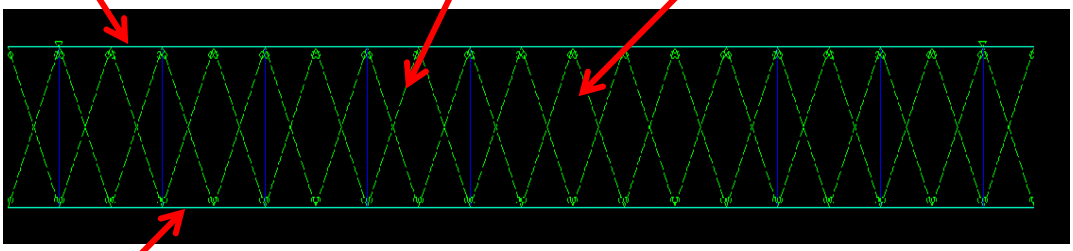
STRAP Loadings

The structure was analysed in STRAP structural analysis program.
(9m X-Beam shown below, larger spans are modules of below)

Top Boom Alu Scaffold Tube
ø48.3mm x 4.4mm

Diagonal RHS
50 x 19 x 3.5mm oval

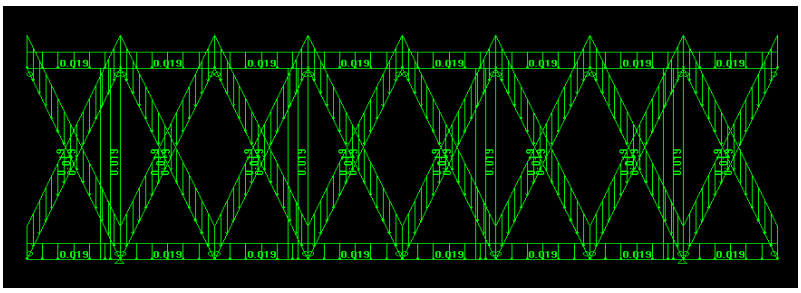
Vertical CHS
ø48.3mm x 4.4mm



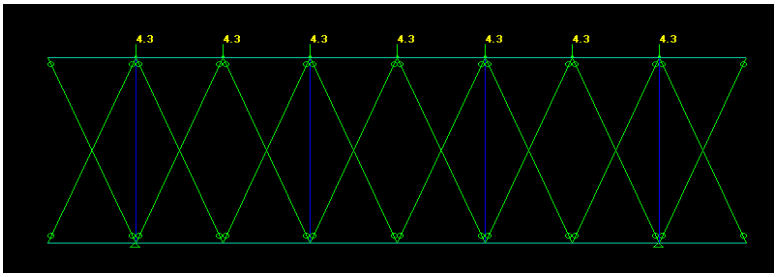
Bottom Boom Alu Scaffold Tube
ø48.3mm x 4.4mm

Load Cases **Images are shown of the 3m beam, loading for larger spans is applied using the same methodology.**

Load Case 1 **Self Weight**
Self weight of all members factored by 1.15 to account for all connections

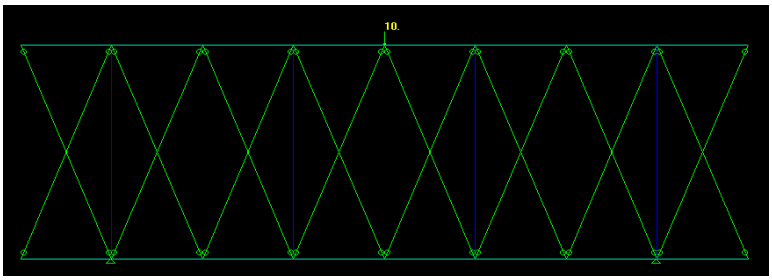


Load Case 2 **UDL**
10kN/m Load Applied to top boom over full length of the X-Beam at node points



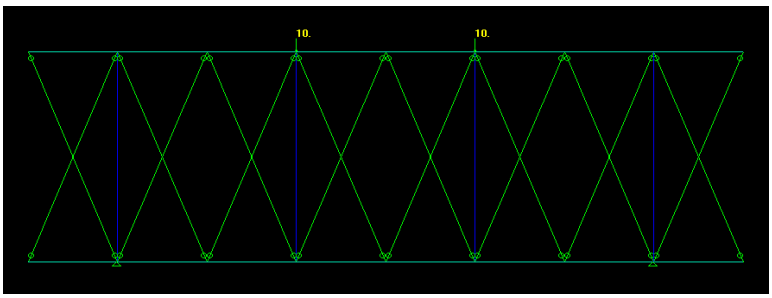
Load Case 3 **Central Point Load**

10kN Point Load Applied to Centre of Top Boom of the X-Beam



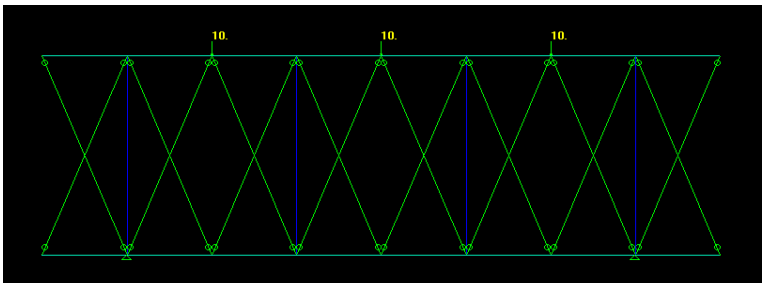
Load Case 4 **Two Point Loads**

2No 10kN point loads applied at third points along the top boom of the X-Beam.



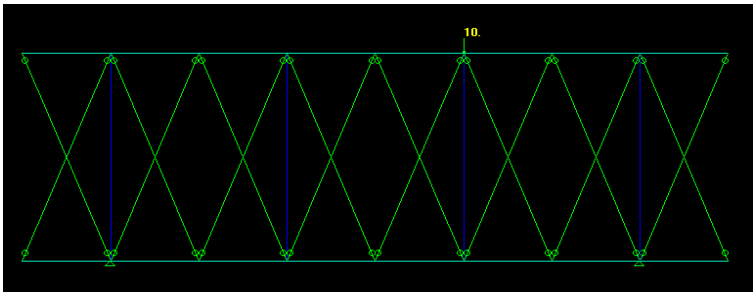
Load Case 5 **Three Point Loads**

3No 10kN Point Loads applied at quarter points along the X-Beam



Load Case 6 **End Shear**

10kN Point Load applied 1m from support



Load Combinations

Combination Number	Combination Description	Load Cases
1	UDL	1+2
2	Central Point Load	1+3
3	Two Point Loads	1+4
4	Three Point Loads	1+5
5	End Shear	1+6

Above Combinations were checked for the following design factors:

γ_D= 1.35

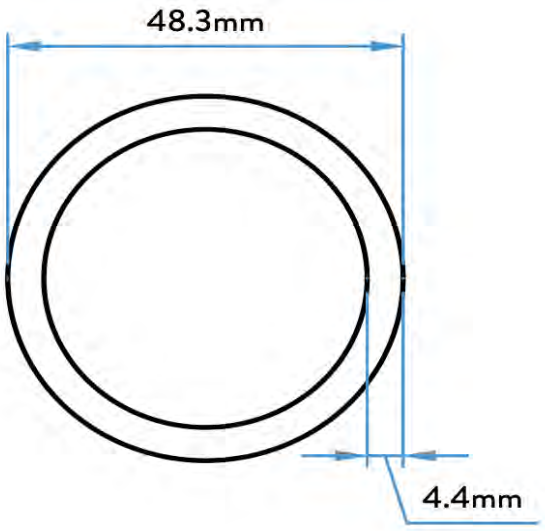
γ_L= 1.50

Main Boom Capacity

ø48.3mm x 4.4mm - 6082-T6

Alu. 6082-T6	$P_{o,haz}$ =	0.50	
	$P_{u,haz}$ =	0.64	
	f_o =	250	N/mm^2
	f_u =	290	N/mm^2

Class A Material



A=	607	mm^2
L =	1000	mm
k =	0.70	
L_{cr} =	700	mm
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	mm
	=	10.98	t =	4.4	mm
	ε=	sqrt(250/f_o)	f_o=	250	N/mm^2
	=	1.00			

Class A, without welds, Internal parts	β_1=	11ε
	=	11*1.00
	=	11.00
	>	10.98

Section is class 1

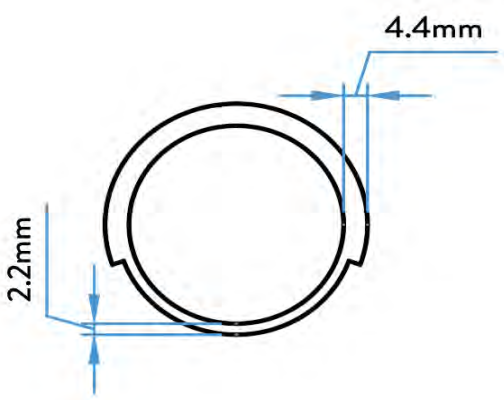
HAZ Length

Part perimeter weld at the joint, therefore part section is affected by HAZ.

As per BS EN 1999-1-1, for HAZ wall thickness factored by 0.50 (For $P_{o,haz}$)

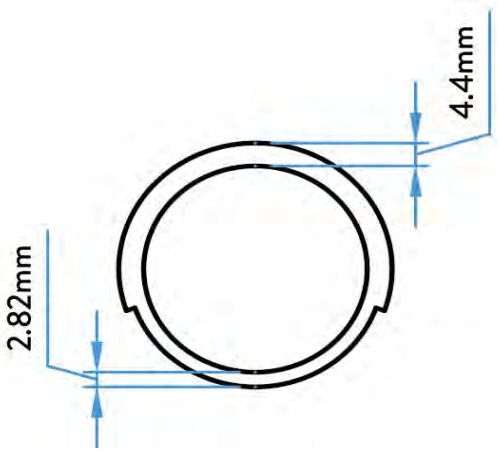
As per BS EN 1999-1-1, for HAZ wall thickness factored by 0.64 (For $P_{u,haz}$)

Po,haz HAZ Section Layout



A_{haz}=	482 mm^2
I=	95781 mm^4
W_{el}=	3966 mm^3
W_{pl}=	5354 mm^3

Pu,haz HAZ Section Layout



A_{haz}=	515 mm^2
I=	112275 mm^4
W_{el}=	4,649 mm^3
W_{pl}=	6,276 mm^3

Moment Capacity (6.2.5.1)

Non-HAZ

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

$\alpha = W_{pl}/W_{el}$ (Table 6.4)
$= 1.35$
$W_{el} = 6.11\ cm^3$
$f_o = 250\ N/mm^2$
$\gamma_{M1} = 1.1$ (6.1.3)

$= 1.35*6.11*250/1100$
$M_{c,Rd} = 1.88\ kNm$

HAZ

$M_{u,Rd} = W_{net} f_u / \gamma_{M2}$

$W_{net} = W_{u\ eff}$
$= 4.65\ cm^3$
$f_u = 290\ N/mm^2$
$\gamma_{M2} = 1.25$ (6.1.3)

$= 4.65*290/1250$
$M_{u,Rd} = 1.08\ kNm$

$M_{Rd,x} = 1.08\ kNm$ lesser value of $M_{c,Rd}$ / $M_{u,Rd}$

Shear Capacity (6.2.6)

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

$A_v = nA_e$
$n = 0.60$
$A_e = 482\ mm^2$
$A_v = 0.6*482$
$A_v = 289.20\ mm^2$
$f_o = 250\ N/mm^2$
$\gamma_{M1} = 1.1$

$= 289.20*250/(SQRT(3)*1100)$
$V_{Rd} = 37.95\ kN$

Vertical Axial Comp Capacity

Without Weld

$N_{b,Rd} = kX A_{eff} f_o / \gamma_{M1}$ (6.3.1.1 (6.49a))

$N_{cr} = \pi^2 EI / L_{cr}^2$ (Appendix I.3)

$E = 70{,}000$ N/mm^2
$I = 147{,}654$ mm^4
$L_{cr} = 700.00$ mm

$N_{cr} = (((PI()^2)*70000*147654))/((700^2))$
$= 208{,}183.80$ N

$\lambda = \sqrt{A_{eff} f_o / N_{cr}}$ (6.3.1.2)
$= 0.85$ $A_{eff} = 607$ mm^2

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

$\Phi = 0.5(1+\acute{\alpha}(\lambda-\lambda_o)+\lambda^2)$
$\acute{\alpha} = 0.20$ Table 6.6
$\lambda_o = 0.10$ Table 6.6
$\Phi = 0.94$

$X = 0.75$

$k = 1.00$ (no welds)

$N_{b,Rd} = 1.00*0.75*607*250/1100$
$= 103.49$ kN

Localised Weld

$N_{b,Rd} = X_{haz}\omega_{x,haz} A_{u,eff} f_u / \gamma_{M2}$ (6.3.1.1 (6.49b))

$N_{cr} = \pi^2 EI / L_{cr}^2$ (Appendix I.3)

$E =$ 70,000 N/mm^2

$I =$ 147,654 mm^4

$L_{cr} =$ 700.00 mm

$N_{cr} = (((PI()^2)*70000*147654))/((700^2))$

$=$ 208,183.80 N

$\lambda_{haz} = \sqrt{A_{u,eff} f_u / N_{cr}}$ (6.3.1.2)

$=$ 0.74

$A_{u,eff} =$ 515 mm^2

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

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

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

$\lambda_o =$ 0.10 Table 6.6

$\Phi =$ 0.84

$X_{haz} =$ 0.81

$\omega_{x,haz} = 1/X_{haz}+(1-X_{haz})\sin(PI()x_{s,haz}/L_{cr})$

For end results

$x_{s,haz} =$ 100 mm

$=$ 1.12

$N_{b,Rd} = 0.81*1.12*515*290/1250$

$=$ 108.68 kN

Lesser Value= 103.49 kN

Axial Tension Capacity (6.2.3)

1. General yielding

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

$f_o =$ 250 N/mm^2

$A_g =$ A

$=$ 607 mm^2

$\gamma_{M1} =$ 1.1

$= 607*250/1100$

$=$ 137.92 kN

2. Local failure

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

$f_u =$ 290 N/mm^2

$A_{u,eff} =$ 482 mm^2

$\gamma_{M1} =$ 1.25

$= 482*290/1250$

$=$ 111.82 kN

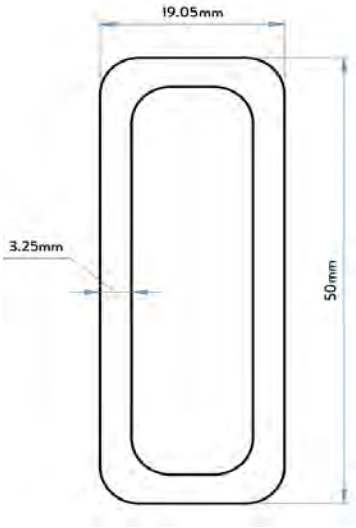
Lesser Value= 111.82 kN

Diagonal Member Capacity

50mm x 19.0mm x 3.25mm - 6082-T6

Alu. 6082-T6	$P_{o,haz}$ =	0.50	
	$P_{u,haz}$ =	0.64	
	f_o =	250	N/mm^2
	f_u =	290	N/mm^2

Class A Material



A=	406	mm^2
L =	1310	mm
k =	0.70	
L_{cr} =	917	mm
I=	110245	mm^4
r_y=	7.2	mm

for slenderness

β=	b/t	b=	43.5	mm
=	13.38	t =	3.25	mm
ε=	sqrt(250/f_o)	f_o=	250	N/mm^2
=	1.00			

Class A, without welds, Internal parts	β_1=	11ε
	=	11*1.00
	=	11.00
	<	13.38
Class A, without welds, Internal parts	β_1=	16ε
	=	16*1.00
	=	16.00
	>	13.38

Section is class 2

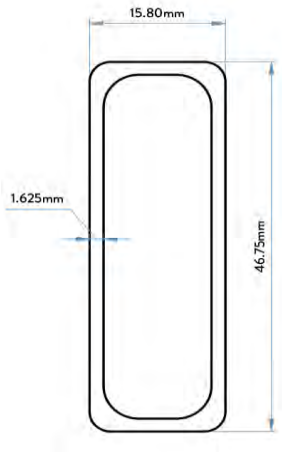
HAZ Length

Full perimeter weld at the joint, therefore the entire section is affected by HAZ.

As per BS EN 1999-1-1, for HAZ wall thickness factored by 0.50 (For $P_{o,haz}$)

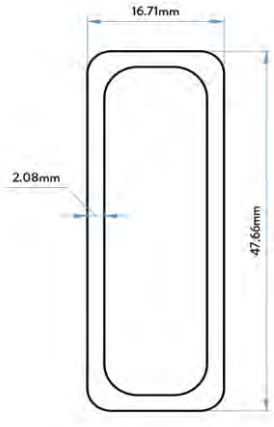
As per BS EN 1999-1-1, for HAZ wall thickness factored by 0.64 (For $P_{u,haz}$)

Po,haz HAZ Section Layout



A_{haz}= 202 mm^2
I= 51977 mm^4
I_z= 8339 mm^4

Pu,haz HAZ Section Layout



A_{haz}= 257 mm^2
I= 66976 mm^4
I_z= 11349 mm^4

Axial Comp Capacity

Without Weld

$N_{b,Rd} = kX A_{eff} f_o / \gamma_{M1}$ (6.3.1.1 (6.49a))

$N_{cr} = \pi^2 EI / L_{cr}^2$ (Appendix I.3)

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

$I = 110{,}245$ mm^4

$L_{cr} = 917.00$ mm

$N_{cr} = (((PI()^2)*70000*105532))/((917^2))$

$= 90{,}577.02$ N

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

$= 1.06$ $A_{eff} = 406$ mm^2

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

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

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

$\lambda_o = 0.10$ Table 6.6

$\Phi = 1.16$

$X = 0.62$

$k = 1.00$ (no welds)

$N_{b,Rd} = 0.61*1.00*396*250/1100$

$= 56.92$ kN

Localised Weld

$N_{b,Rd} = X_{haz}\omega_{x,haz} A_{u,eff} f_u / \gamma_{M2}$ (6.3.1.1 (6.49b))

$N_{cr} = \pi^2 EI / L_{cr}^2$ (Appendix I.3)

$E =$ 70,000 N/mm^2
$I =$ 110,245 mm^4
$L_{cr} =$ 917.00 mm

$N_{cr} =$ (((PI()^2)*70000*105532))/((917^2))
$=$ 90,577.02 N

$\lambda_{haz} = \sqrt{A_{u,eff} f_u / N_{cr}}$ (6.3.1.2)
$=$ 0.85

$A_{u,eff} =$ 257 mm^2

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

$\Phi = 0.5(1+\acute{\alpha}(\lambda-\lambda_o)+\lambda^2)$
$\acute{\alpha} =$ 0.20 Table 6.6
$\lambda_o =$ 0.10 Table 6.6
$\Phi =$ 0.94
$X_{haz} =$ 0.75

$\omega_{x,haz} = 1/X_{haz}+(1-X_{haz})\sin(PI()x_{s,haz}/lcr)$

for end results
$x_{s,haz} =$ 0.00 mm
$=$ 1.00 Axial force only

$N_{b,Rd} =$ 0.75*1.00*257*290/1250
$=$ 44.84 kN

Lesser Value= 44.84 kN

Axial Tension Capacity (6.2.3)

1. General yielding

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

$f_o =$ 250 N/mm^2

$A_g =$ A

$=$ 406 mm^2

$\gamma_{M1} =$ 1.1

$= 406*250/1100$

$= 92.27$ kN

2. Local failure

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

$f_u =$ 290 N/mm^2

$A_{u,eff} =$ 257 mm^2

$\gamma_{M1} =$ 1.25

$= 257*290/1250$

$= 59.62$ kN

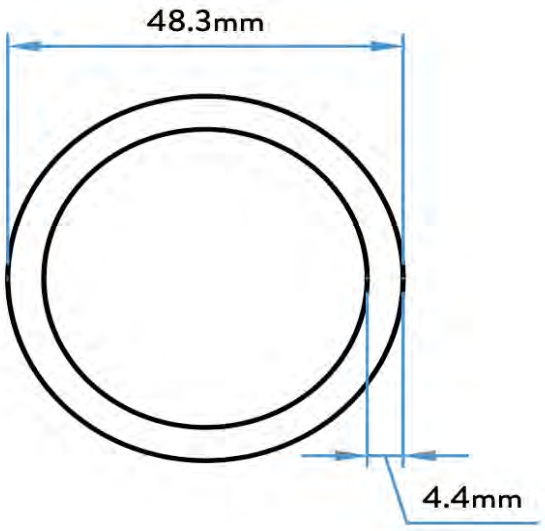
Lesser Value= 59.62 kN

Vertical Boom Capacity

ø48.3mm x 4.4mm - 6082-T6

Alu. 6082-T6	$P_{o,haz}$ =	0.50	
	$P_{u,haz}$ =	0.64	
	f_o =	250	N/mm^2
	f_u =	290	N/mm^2

Class A Material



A=	607	mm^2
L =	1300	mm
k =	0.70	
L_{cr} =	910	mm
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 mm
	=	10.98	t =	4.4 mm
	ε=	sqrt(250/f_o)	f_o=	250 N/mm^2
	=	1.00		
Class A, without welds, Internal parts	β_1=	11ε		
	=	11*1.00		
	=	11.00		
	>	10.98		

Section is class 1

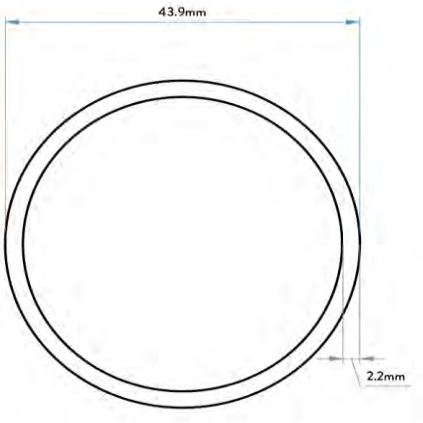
HAZ Length

Full perimeter weld at the joint, therefore full section is affected by HAZ.

As per BS EN 1999-1-1, for HAZ wall thickness factored by 0.50 (For $P_{o,haz}$)

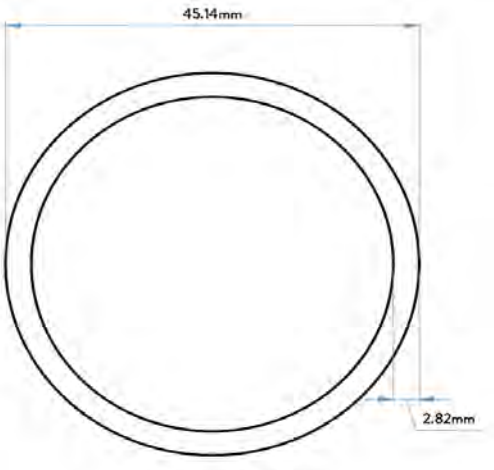
As per BS EN 1999-1-1, for HAZ wall thickness factored by 0.64 (For $P_{u,haz}$)

Po,haz HAZ Section Layout



A_{haz}=	288 mm^2
I=	62820 mm^4
W_{el}=	2862 mm^3
W_{pl}=	3864 mm^3

Pu,haz HAZ Section Layout



A_{haz}=	375 mm^2
I=	84308 mm^4
W_{el}=	3,735 mm^3
W_{pl}=	5,043 mm^3

Moment Capacity (6.2.5.1)

Non-HAZ

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

$\alpha = W_{pl}/W_{el}$ (Table 6.4)
$= 1.35$
$W_{el} = 6.11\ cm^3$
$f_o = 250\ N/mm^2$
$\gamma_{M1} = 1.1$ (6.1.3)

$= 1.35*6.11*250/1100$
$M_{c,Rd} = 1.88\ kNm$

HAZ

$M_{u,Rd} = W_{net} f_u / \gamma_{M2}$

$W_{net} = W_{u\ eff}$
$= 3.74\ cm^3$
$f_u = 290\ N/mm^2$
$\gamma_{M2} = 1.25$ (6.1.3)

$= 3.74*290/1250$
$M_{u,Rd} = 0.87\ kNm$

$M_{Rd,x} = 0.87\ kNm$ lesser value of $M_{c,Rd}$ / $M_{u,Rd}$

Shear Capacity (6.2.6)

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

$A_v = nA_e$
$n = 0.60$
$A_e = 288\ mm^2$
$A_v = 0.6*288$
$A_v = 172.80\ mm^2$
$f_o = 250\ N/mm^2$
$\gamma_{M1} = 1.1$

$= 172.80*250/(SQRT(3)*1100)$
$V_{Rd} = 22.67\ kN$

Vertical Axial Comp Capacity

Without Weld

$N_{b,Rd} = kX A_{eff} f_o / \gamma_{M1}$ (6.3.1.1 (6.49a))

$N_{cr} = \pi^2 EI / L_{cr}^2$ (Appendix I.3)

$E = 70{,}000$ N/mm^2
$I = 147{,}654$ mm^4
$L_{cr} = 910.00$ mm

$N_{cr} = (((PI()^2)*70000*147654))/((910^2))$
$= 123{,}185.68$ N

$\lambda = \sqrt{A_{eff} f_o / N_{cr}}$ (6.3.1.2)
$= 1.11$ $A_{eff} = 607$ mm^2

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

$\Phi = 0.5(1+\acute{\alpha}(\lambda-\lambda_o)+\lambda^2)$
$\acute{\alpha} = 0.20$ Table 6.6
$\lambda_o = 0.10$ Table 6.6
$\Phi = 1.22$

$X = 0.58$

$k = 1.00$ (no welds)

$N_{b,Rd} = 1.00*0.58*607*250/1100$
$= 80.39$ kN

Localised Weld

$N_{b,Rd} = X_{haz}\omega_{x,haz} A_{u,eff} f_u / \gamma_{M2}$ (6.3.1.1 (6.49b))

$N_{cr} = \pi^2 EI / L_{cr}^2$ (Appendix I.3)

$E =$ 70,000 N/mm^2
$I =$ 147,654 mm^4
$L_{cr} =$ 910.00 mm

$N_{cr} =$ (((PI()^2)*70000*147654))/((910^2))
$=$ 123,185.68 N

$\lambda_{haz} = \sqrt{A_{u,eff} f_u / N_{cr}}$ (6.3.1.2)
$=$ 0.88

$A_{u,eff} =$ 375 mm^2

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

$\Phi = 0.5(1+\acute{\alpha}(\lambda-\lambda_o)+\lambda^2)$
$\acute{\alpha} =$ 0.20 Table 6.6
$\lambda_o =$ 0.10 Table 6.6
$\Phi =$ 0.97

$X_{haz} =$ 0.73

$\omega_{x,haz} = 1/X_{haz}+(1-X_{haz})\sin(PI()x_{s,haz}/lcr)$

For end results
$x_{s,haz} =$ 0
$=$ 1.36

$N_{b,Rd} =$ 0.73*1.36*375*290/1250
$=$ 87.00 kN

Lesser Value= 80.39 kN

Axial Tension Capacity (6.2.3)

1. General yielding

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

$f_o =$ 250 N/mm^2

$A_g =$ A

$=$ 607 mm^2

$\gamma_{M1} =$ 1.1

$= 607*250/1100$

$= 137.92$ kN

2. Local failure

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

$f_u =$ 290 N/mm^2

$A_{u,eff} =$ 375 mm^2

$\gamma_{M1} =$ 1.25

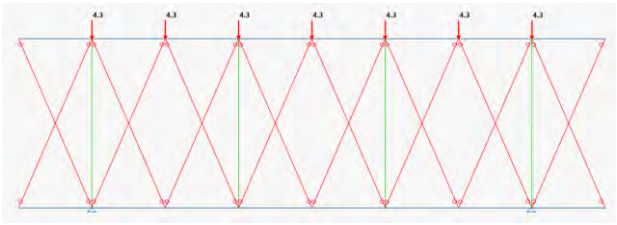
$= 375*290/1250$

$= 87.00$ kN

Lesser Value= 87.00 kN

3m - Load Comb.1 UDL load 10kN/m applied along beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.02	63.45
	Shear	V_{Rd}	37.95	0.23	163.57
	Tension	$N_{o,Rd}$	111.82	3.44	32.48
	Compression	$N_{b,Rd}$	103.49	10.40	9.95
	Deflection	d	30.00	0.55	54.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.90
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.00	468.97
	Shear	V_{Rd}	37.95	0.06	677.64
	Tension	$N_{o,Rd}$	111.82	0.02	5885.47
	Compression	$N_{b,Rd}$	103.49	10.40	9.95
	Deflection	d	30.00	0.55	54.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	9.81
Vertical	Moment	$M_{c,Rd}$	0.87	0.01	72.22
	Shear	V_{Rd}	22.67	0.02	1133.71
	Tension	$N_{o,Rd}$	87.00	0.10	870.00
	Compression	$N_{b,Rd}$	80.39	10.86	7.40
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.88
Diagonal	Tension	$N_{o,Rd}$	59.62	5.34	11.16
	Compression	$N_{b,Rd}$	44.84	12.45	3.60
				Factor	**3.60**



Max Moment= $ML^2/8$

so for ultimate condition

W= 1.50*10.00
15.00 kN

apply factor from above

Wf= 15.00*3.60
= 54.02 kN

so maximum moment is as above

Ultimate Mu= Wf*3^2/8
= (54.02*3^2)/8
= 60.77 kNm

and for allowable value

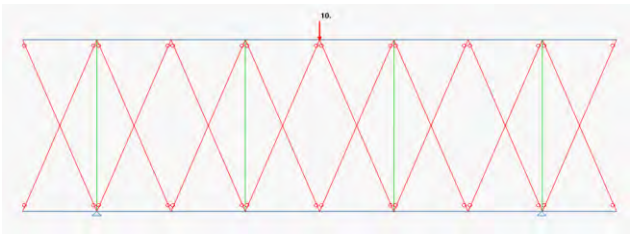
allowable max moment= 60.77/1.50

= 40.51 kNm

Moment values	**Ultimate**	**60.77 kNm**
	Allowable	**40.51 kNm**

3m - Load Comb. 2 Point load 10kN load applied at midspan of beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.08	13.48
	Shear	V_{Rd}	37.95	0.20	190.69
	Tension	$N_{o,Rd}$	111.82	4.00	27.98
	Compression	$N_{b,Rd}$	103.49	6.17	16.78
	Deflection	d	30.00	0.45	67.26
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.23
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.08	23.45
	Shear	V_{Rd}	37.95	0.27	139.00
	Tension	$N_{o,Rd}$	111.82	0.01	18637.33
	Compression	$N_{b,Rd}$	103.49	6.17	16.76
	Deflection	d	30.00	0.55	54.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	10.64
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	50.98
	Shear	V_{Rd}	22.67	0.02	1133.71
	Tension	$N_{o,Rd}$	87.00	2.46	35.41
	Compression	$N_{b,Rd}$	80.39	2.88	27.96
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	19.48
Diagonal	Tension	$N_{o,Rd}$	59.62	5.22	11.43
	Compression	$N_{b,Rd}$	44.84	7.89	5.68
				Factor	**5.68**



Max Moment= ML/4

so for ultimate condition

W= 1.50*10
= 15.00 kN

apply factor from above

Wf= 15.00*5.68
= 85.20 kN

so maximum moment is as above

Ultimate Mu= Wf*3/4
= 85.20*3/4
= 63.90 kNm

and for allowable value

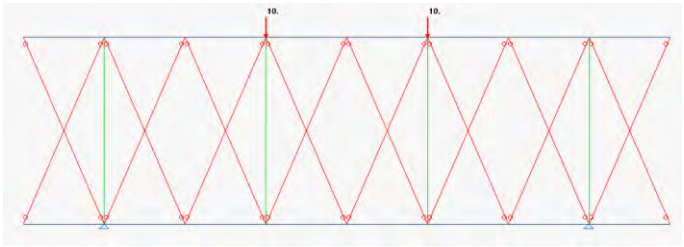
allowable max moment= 63.90/1.50

= 42.60 kNm

Moment values	**Ultimate**	**63.90 kNm**
	Allowable	**42.60 kNm**

3m - Load Comb. 3 PL at third points 10kN load applied at each of the two third points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.05	20.74
	Shear	V_{Rd}	37.95	0.25	154.89
	Tension	$N_{o,Rd}$	111.82	4.03	27.73
	Compression	$N_{b,Rd}$	103.49	12.03	8.61
	Deflection	d	30.00	0.60	50.17
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.50
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.07	27.59
	Shear	V_{Rd}	37.95	0.27	138.50
	Tension	$N_{o,Rd}$	111.82	0.02	5324.95
	Compression	$N_{b,Rd}$	103.49	12.02	8.61
	Deflection	d	30.00	0.55	54.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.94
Vertical	Moment	$M_{c,Rd}$	0.87	0.01	66.66
	Shear	V_{Rd}	22.67	0.02	1417.13
	Tension	$N_{o,Rd}$	87.00	0.10	870.00
	Compression	$N_{b,Rd}$	80.39	7.11	11.30
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	10.02
Diagonal	Tension	$N_{o,Rd}$	59.62	7.96	7.49
	Compression	$N_{b,Rd}$	44.84	8.40	5.34
				Factor	**5.34**



Max Moment= ML/3

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*5.34
= 80.09 kN

so maximum moment is as above

Ultimate Mu= Wf*3/3
= 80.09*3/3
= 80.09 kNm

and for allowable value

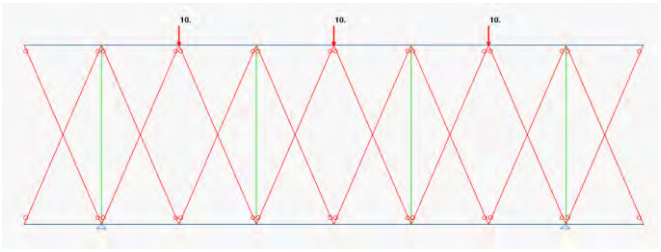
allowable max moment= 80.09/1.50

= 53.39 kNm

Moment values	**Ultimate**	**80.09 kNm**
	Allowable	**53.39 kNm**

3m - Load Comb. 4 10kN load applied at each of the three quarter points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.10	10.47
	Shear	V_{Rd}	37.95	0.29	130.85
	Tension	$N_{o,Rd}$	111.82	4.00	27.95
	Compression	$N_{b,Rd}$	103.49	12.19	8.49
	Deflection	d	30.00	0.71	42.43
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	39.43
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.08	24.05
	Shear	V_{Rd}	37.95	0.39	96.81
	Tension	$N_{o,Rd}$	111.82	4.00	27.96
	Compression	$N_{b,Rd}$	103.49	12.20	8.48
	Deflection	d	30.00	0.55	54.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.66
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	37.68
	Shear	V_{Rd}	22.67	0.30	75.58
	Tension	$N_{o,Rd}$	87.00	4.88	17.84
	Compression	$N_{b,Rd}$	80.39	5.76	13.95
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	10.83
Diagonal	Tension	$N_{o,Rd}$	59.62	5.95	10.02
	Compression	$N_{b,Rd}$	44.84	18.19	2.46
				Factor	**2.46**



Max Moment= ML/2

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*2.46
= 36.97 kN

so maximum moment is as above

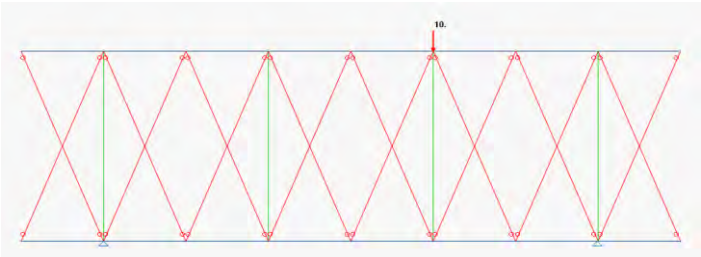
Ultimate Mu= Wf*L/2
= 36.97*3/2
= 55.46 kNm

allowable max moment= 55.46/1.50
= 36.97 kNm

Moment values	Ultimate	55.46 kNm
	Allowable	36.97 kNm

3m - Load Comb. 5 End Shear 10kN load applied at a 1.0m distance from the support

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	31.72
	Shear	V_{Rd}	37.95	0.16	232.81
	Tension	$N_{o,Rd}$	111.82	3.41	32.82
	Compression	$N_{b,Rd}$	103.49	5.95	17.38
	Deflection	d	30.00	0.37	80.65
	Combined Axial	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	12.11
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.06	32.91
	Shear	V_{Rd}	37.95	0.21	179.85
	Tension	$N_{o,Rd}$	111.82	0.02	6212.44
	Compression	$N_{b,Rd}$	103.49	6.78	15.26
	Deflection	d	30.00	0.55	54.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	11.18
Vertical	Moment	$M_{c,Rd}$	0.87	0.01	96.29
	Shear	V_{Rd}	22.67	0.01	2267.41
	Tension	$N_{o,Rd}$	87.00	0.10	870.00
	Compression	$N_{b,Rd}$	80.39	5.91	13.61
	Combined Axial	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	12.31
Diagonal	Tension	$N_{o,Rd}$	59.62	5.51	10.82
	Compression	$N_{b,Rd}$	44.84	5.75	7.80
				Factor	**7.80**



Max Shear Rb= W*2/3

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*7.80
= 117.07 kN

so maximum shear is as above

Ultimate Qu= Wf*2/3
= 117.07*2/3
= 78.05 kN

and for allowable value

allowable max shear= 78.05/1.50

= 52.03 kN

Shear values	**Ultimate**	**78.05 kN**
	Allowable	**52.03 kN**

3m Span Results

1.30m X-BEAM			
Loadcase No.		Ultimate Moment	Allowable Moment
1	UDL	60.77	40.51
2	Point	63.90	42.60
3	Third	80.09	53.39
4	Quarter	55.46	36.97

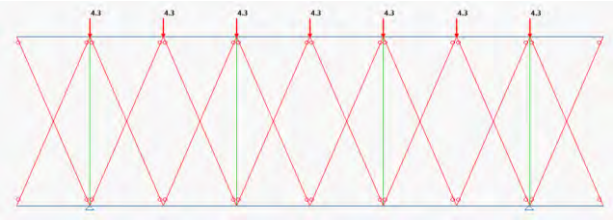
Loadcase No.		Ultimate Shear	Allowable Shear
5	End Shear	78.05	52.03

Max Allowable Moment = 36 kNm

Max Allowable Shear = 52 kN

6m - Load Comb.1 UDL load 10kN/m applied along beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	34.79
	Shear	V_{Rd}	37.95	0.26	144.84
	Tension	$N_{o,Rd}$	111.82	17.66	6.33
	Compression	$N_{b,Rd}$	103.49	53.14	1.95
	Deflection	d	60.00	4.27	14.05
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.87
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.02	117.24
	Shear	V_{Rd}	37.95	0.27	140.03
	Tension	$N_{o,Rd}$	111.82	17.65	6.33
	Compression	$N_{b,Rd}$	103.49	53.15	1.95
	Deflection	d	60.00	4.27	14.05
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.92
Vertical	Moment	$M_{c,Rd}$	0.87	0.04	20.15
	Shear	V_{Rd}	22.67	0.06	377.90
	Tension	$N_{o,Rd}$	87.00	0.02	3625.00
	Compression	$N_{b,Rd}$	80.39	21.98	3.66
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	3.22
Diagonal	Tension	$N_{o,Rd}$	59.62	20.10	2.97
	Compression	$N_{b,Rd}$	44.84	28.67	1.56
				Factor	**1.56**



Max Moment= $ML^2/8$

so for ultimate condition

W= 1.50*10.00
15.00 kN

apply factor from above

Wf= 15.00*1.56
= 23.46 kN

so maximum moment is as above

Ultimate Mu= Wf*6^2/8
= (23.46*6^2)/8
= 105.55 kNm

and for allowable value

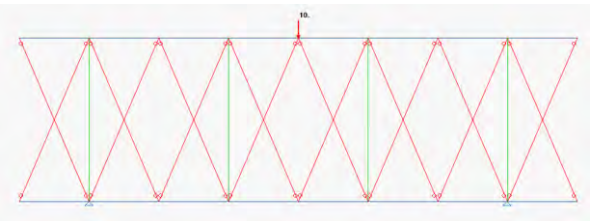
allowable max moment= 105.55/1.50

= 70.37 kNm

Moment values	Ultimate	105.55 kNm
	Allowable	70.37 kNm

6m - Load Comb. 2 Point load 10kN load applied at midspan of beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.02	51.36
	Shear	V_{Rd}	37.95	0.16	244.82
	Tension	$N_{o,Rd}$	111.82	8.10	13.80
	Compression	$N_{b,Rd}$	103.49	16.82	6.15
	Deflection	d	60.00	1.35	44.54
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	5.65
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.02	89.33
	Shear	V_{Rd}	37.95	0.16	243.25
	Tension	$N_{o,Rd}$	111.82	8.10	13.81
	Compression	$N_{b,Rd}$	103.49	16.82	6.15
	Deflection	d	60.00	1.35	44.54
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	5.86
Vertical	Moment	$M_{c,Rd}$	0.87	0.01	78.78
	Shear	V_{Rd}	22.67	0.02	1417.13
	Tension	$N_{o,Rd}$	87.00	0.10	870.00
	Compression	$N_{b,Rd}$	80.39	5.33	15.09
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	13.18
Diagonal	Tension	$N_{o,Rd}$	59.62	5.01	11.91
	Compression	$N_{b,Rd}$	44.84	5.11	8.78
				Factor	**5.65**



Max Moment= ML/4

so for ultimate condition

W= 1.50*10
= 15.00 kN

apply factor from above

Wf= 15.00*5.65
= 84.73 kN

so maximum moment is as above

Ultimate Mu= Wf*6/4
= 84.73*6/4
= 127.10 kNm

and for allowable value

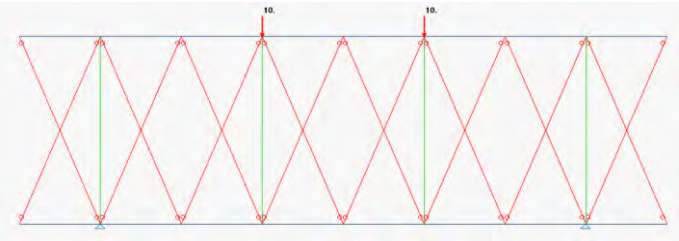
allowable max moment= 127.10/1.50

= 84.73 kNm

Moment values	**Ultimate**	**127.10**	**kNm**
	Allowable	**84.73**	**kNm**

6m - Load Comb. 3 PL at third points 10kN load applied at each of the two third points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	39.95
	Shear	V_{Rd}	37.95	0.22	176.50
	Tension	$N_{o,Rd}$	111.82	2.24	49.94
	Compression	$N_{b,Rd}$	103.49	12.98	7.98
	Deflection	d	60.00	1.08	55.56
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.93
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.02	98.73
	Shear	V_{Rd}	37.95	0.23	164.99
	Tension	$N_{o,Rd}$	111.82	2.40	46.61
	Compression	$N_{b,Rd}$	103.49	12.98	7.98
	Deflection	d	60.00	1.08	55.56
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	7.53
Vertical	Moment	$M_{c,Rd}$	0.87	0.01	66.66
	Shear	V_{Rd}	22.67	0.02	1333.77
	Tension	$N_{o,Rd}$	87.00	0.10	870.00
	Compression	$N_{b,Rd}$	80.39	7.21	11.15
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	9.90
Diagonal	Tension	$N_{o,Rd}$	59.62	8.36	7.14
	Compression	$N_{b,Rd}$	44.84	8.77	5.11
				Factor	**5.11**



Max Moment= ML/3

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*5.11
= 76.66 kN

so maximum moment is as above

Ultimate Mu= Wf*6/3
= 76.66*6/3
= 153.31 kNm

and for allowable value

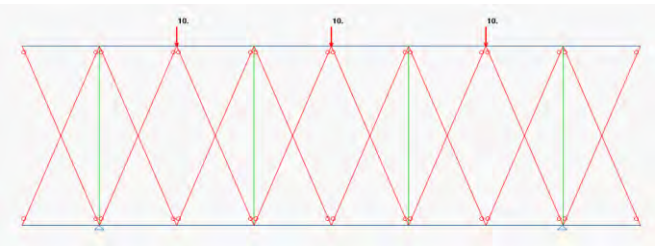
allowable max moment= 153.31/1.50

= 102.21 kNm

Moment values	**Ultimate**	**153.31 kNm**
	Allowable	**102.21 kNm**

6m - Load Comb. 4 10kN load applied at each of the three quarter points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.01	134.82
	Shear	V_{Rd}	37.95	0.65	58.11
	Tension	$N_{o,Rd}$	111.82	12.25	9.13
	Compression	$N_{b,Rd}$	103.49	34.63	2.99
	Deflection	d	60.00	2.80	21.45
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	21.35
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.01	234.49
	Shear	V_{Rd}	37.95	0.23	167.91
	Tension	$N_{o,Rd}$	111.82	12.25	9.13
	Compression	$N_{b,Rd}$	103.49	34.63	2.99
	Deflection	d	60.00	2.80	21.45
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	2.96
Vertical	Moment	$M_{c,Rd}$	0.87	0.04	23.42
	Shear	V_{Rd}	22.67	0.05	453.48
	Tension	$N_{o,Rd}$	87.00	2.31	37.63
	Compression	$N_{b,Rd}$	80.39	9.18	8.76
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.78
Diagonal	Tension	$N_{o,Rd}$	59.62	14.53	4.10
	Compression	$N_{b,Rd}$	44.84	16.31	2.75
				Factor	**2.75**



Max Moment= ML/2

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*2.75
= 41.25 kN

so maximum moment is as above

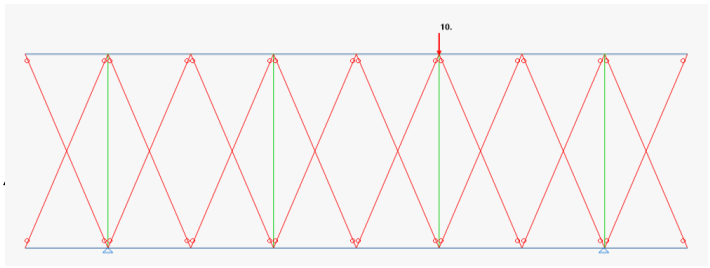
Ultimate Mu= Wf*L/2
= 41.25*6/2
= 123.75 kNm

allowable max moment= 123.75/1.50
= 82.50 kNm

Moment values	**Ultimate**	**123.75 kNm**
	Allowable	**82.50 kNm**

6m - Load Comb. 5 End Shear 10kN load applied at a 1.0m distance from the support

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	41.48
	Shear	V_{Rd}	37.95	0.21	185.11
	Tension	$N_{o,Rd}$	111.82	4.90	22.82
	Compression	$N_{b,Rd}$	103.49	9.52	10.87
	Deflection	d	60.00	0.66	91.46
	Combined Axial	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	9.05
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.05	37.52
	Shear	V_{Rd}	37.95	0.21	185.11
	Tension	$N_{o,Rd}$	111.82	4.90	22.83
	Compression	$N_{b,Rd}$	103.49	9.52	10.87
	Deflection	d	60.00	0.66	91.46
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.88
Vertical	Moment	$M_{c,Rd}$	0.87	0.01	78.78
	Shear	V_{Rd}	22.67	0.01	1744.16
	Tension	$N_{o,Rd}$	87.00	0.04	2416.67
	Compression	$N_{b,Rd}$	80.39	6.20	12.97
	Combined Axial	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	11.54
Diagonal	Tension	$N_{o,Rd}$	59.62	6.85	8.71
	Compression	$N_{b,Rd}$	44.84	7.22	6.21
				Factor	**6.21**



Max Shear Rb= W*5/6

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*6.21
= 93.10 kN

so maximum shear is as above

Ultimate Qu= Wf*5/6
= 93.10*5/6
= 77.59 kN

and for allowable value

allowable max shear= 77.59/1.50

= 51.72 kN

Shear values	**Ultimate**	**77.59 kN**
	Allowable	**51.72 kN**

6m Span Results

1.30m X-BEAM			
Loadcase No.		Ultimate Moment	Allowable Moment
1	UDL	105.55	70.37
2	Point	127.10	84.73
3	Third	153.31	102.21
4	Quarter	123.75	82.50

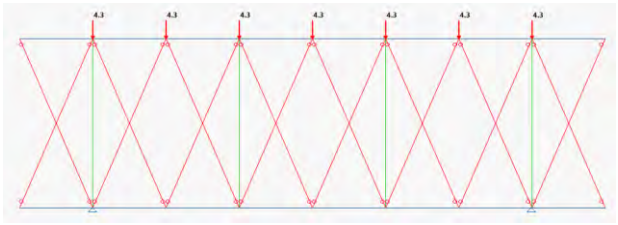
Loadcase No.		Ultimate Shear	Allowable Shear
5	End Shear	77.59	51.72

Max Allowable Moment = 70 kNm

Max Allowable Shear = 51 kN

9m - Load Comb.1 UDL load 10kN/m applied along beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	39.95
	Shear	V_{Rd}	37.95	2.21	17.16
	Tension	$N_{o,Rd}$	111.82	39.53	2.83
	Compression	$N_{b,Rd}$	103.49	118.71	0.87
	Deflection	d	90.00	18.29	4.92
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.86
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.03	75.04
	Shear	V_{Rd}	37.95	0.89	42.69
	Tension	$N_{o,Rd}$	111.82	39.53	2.83
	Compression	$N_{b,Rd}$	103.49	115.73	0.89
	Deflection	d	90.00	18.29	4.92
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.89
Vertical	Moment	$M_{c,Rd}$	0.87	0.10	8.33
	Shear	V_{Rd}	22.67	0.16	146.28
	Tension	$N_{o,Rd}$	87.00	1.44	60.42
	Compression	$N_{b,Rd}$	80.39	33.99	2.37
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.94
Diagonal	Tension	$N_{o,Rd}$	59.62	31.65	1.88
	Compression	$N_{b,Rd}$	44.84	40.23	1.11
				Factor	**0.86**



Max Moment= $ML^2/8$

so for ultimate condition

W= 1.50*10.00
15.00 kN

apply factor from above

Wf= 15.00*0.86
= 12.88 kN

so maximum moment is as above

Ultimate Mu= Wf*9^2/8
= (12.88*9^2)/8
= 130.37 kNm

and for allowable value

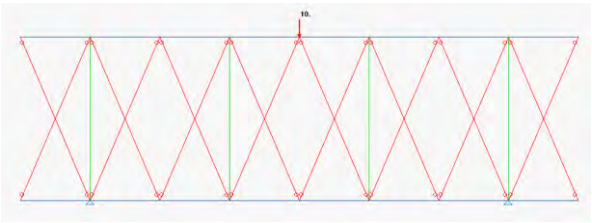
allowable max moment= 130.37/1.50

= 86.91 kNm

Moment values	**Ultimate**	**130.37 kNm**
	Allowable	**86.91 kNm**

9m - Load Comb. 2 Point load 10kN load applied at midspan of beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.09	12.26
	Shear	V_{Rd}	37.95	0.53	71.06
	Tension	$N_{o,Rd}$	111.82	13.69	8.17
	Compression	$N_{b,Rd}$	103.49	25.40	4.07
	Deflection	d	90.00	3.92	22.96
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	3.24
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.08	22.33
	Shear	V_{Rd}	37.95	0.27	140.03
	Tension	$N_{o,Rd}$	111.82	13.69	8.17
	Compression	$N_{b,Rd}$	103.49	25.40	4.07
	Deflection	d	90.00	3.92	22.96
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	3.58
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	36.11
	Shear	V_{Rd}	22.67	0.03	755.80
	Tension	$N_{o,Rd}$	87.00	2.99	29.10
	Compression	$N_{b,Rd}$	80.39	3.56	22.56
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	15.04
Diagonal	Tension	$N_{o,Rd}$	59.62	4.79	12.45
	Compression	$N_{b,Rd}$	44.84	7.82	5.73
				Factor	**3.24**



Max Moment= ML/4

so for ultimate condition

W= 1.50*10
= 15.00 kN

apply factor from above

Wf= 15.00*3.24
= 48.61 kN

so maximum moment is as above

Ultimate Mu= Wf*9/4
= 48.61*9/4
= 109.38 kNm

and for allowable value

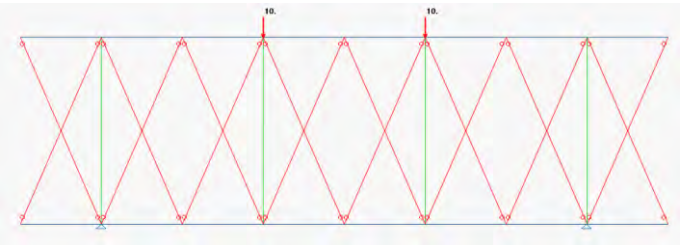
allowable max moment= 109.38/1.50

= 72.92 kNm

Moment values	**Ultimate**	**109.38 kNm**
	Allowable	**72.92 kNm**

9m - Load Comb. 3 PL at third points 10kN load applied at each of the two third points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	43.14
	Shear	V_{Rd}	37.95	0.65	58.74
	Tension	$N_{o,Rd}$	111.82	12.60	8.87
	Compression	$N_{b,Rd}$	103.49	37.51	2.76
	Deflection	d	90.00	5.87	15.33
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	2.64
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.06	30.26
	Shear	V_{Rd}	37.95	0.23	166.44
	Tension	$N_{o,Rd}$	111.82	12.60	8.87
	Compression	$N_{b,Rd}$	103.49	36.89	2.81
	Deflection	d	90.00	5.87	15.33
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	2.63
Vertical	Moment	$M_{c,Rd}$	0.87	0.03	27.96
	Shear	V_{Rd}	22.67	0.05	482.43
	Tension	$N_{o,Rd}$	87.00	0.10	870.00
	Compression	$N_{b,Rd}$	80.39	6.75	11.90
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.93
Diagonal	Tension	$N_{o,Rd}$	59.62	9.17	6.50
	Compression	$N_{b,Rd}$	44.84	9.41	4.76
				Factor	**2.63**



Max Moment= ML/3

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*2.63
= 39.38 kN

so maximum moment is as above

Ultimate Mu= Wf*9/3
= 39.38*9/3
= 118.15 kNm

and for allowable value

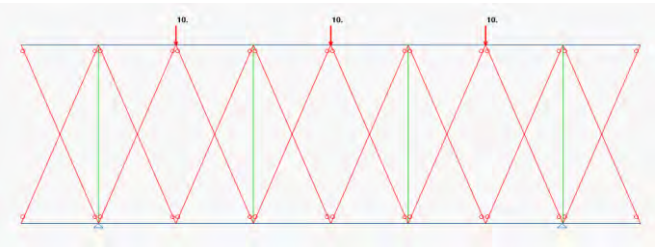
allowable max moment= 118.15/1.50

= 78.77 kNm

Moment values	Ultimate	118.15 kNm
	Allowable	78.77 kNm

9m - Load Comb. 4 10kN load applied at each of the three quarter points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.08	12.84
	Shear	V_{Rd}	37.95	0.96	39.49
	Tension	$N_{o,Rd}$	111.82	18.99	5.89
	Compression	$N_{b,Rd}$	103.49	49.33	2.10
	Deflection	d	90.00	7.79	11.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.87
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.01	234.49
	Shear	V_{Rd}	37.95	0.33	115.69
	Tension	$N_{o,Rd}$	111.82	18.99	5.89
	Compression	$N_{b,Rd}$	103.49	47.92	2.16
	Deflection	d	90.00	7.79	11.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	2.15
Vertical	Moment	$M_{c,Rd}$	0.87	0.04	19.70
	Shear	V_{Rd}	22.67	0.07	333.44
	Tension	$N_{o,Rd}$	87.00	3.12	27.92
	Compression	$N_{b,Rd}$	80.39	9.98	8.06
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.10
Diagonal	Tension	$N_{o,Rd}$	59.62	13.48	4.42
	Compression	$N_{b,Rd}$	44.84	13.84	3.24
				Factor	**1.87**



Max Moment= ML/2

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*1.87
= 28.02 kN

so maximum moment is as above

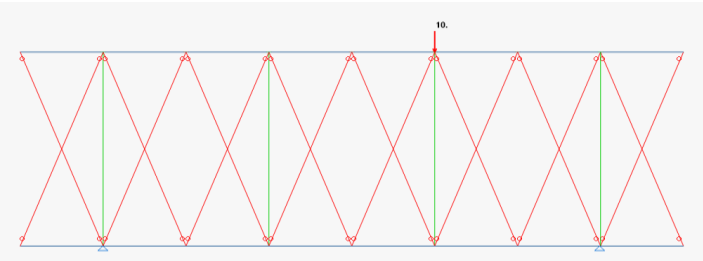
Ultimate Mu= Wf*L/2
= 28.02*9/2
= 126.10 kNm

allowable max moment= 126.10/1.50
= 84.06 kNm

Moment values	**Ultimate**	**126.10 kNm**
	Allowable	**84.06 kNm**

9m - Load Comb. 5 End Shear 10kN load applied at a 1.0m distance from the support

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	41.48
	Shear	V_{Rd}	37.95	0.23	166.44
	Tension	$N_{o,Rd}$	111.82	7.86	14.23
	Compression	$N_{b,Rd}$	103.49	10.61	9.76
	Deflection	d	90.00	1.32	68.18
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.27
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.04	49.37
	Shear	V_{Rd}	37.95	0.23	166.44
	Tension	$N_{o,Rd}$	111.82	5.06	22.12
	Compression	$N_{b,Rd}$	103.49	8.16	12.68
	Deflection	d	90.00	1.32	68.18
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	10.60
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	54.16
	Shear	V_{Rd}	22.67	0.02	1030.64
	Tension	$N_{o,Rd}$	87.00	0.07	1318.18
	Compression	$N_{b,Rd}$	80.39	6.63	12.12
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	10.35
Diagonal	Tension	$N_{o,Rd}$	59.62	7.35	8.11
	Compression	$N_{b,Rd}$	44.84	7.74	5.80
				Factor	**5.80**



Max Shear Rb= W*8/9

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*5.80
= 86.94 kN

so maximum shear is as above

Ultimate Qu= Wf*8/9
= 86.94*8/9
= 77.28 kN

and for allowable value

allowable max shear= 77.28/1.50
= 51.52 kN

Shear values	**Ultimate**	**77.28 kN**
	Allowable	**51.52 kN**

9m Span Results

1.30m X-BEAM			
Loadcase No.		Ultimate Moment	Allowable Moment
1	UDL	130.37	86.91
2	Point	109.38	72.92
3	Third	118.15	78.77
4	Quarter	126.10	84.06

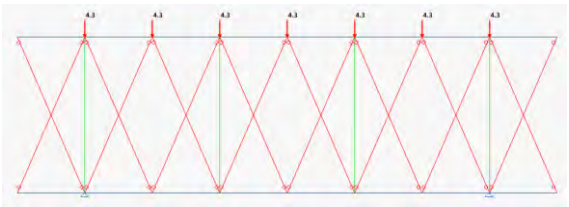
Loadcase No.		Ultimate Shear	Allowable Shear
5	End Shear	77.28	51.52

Max Allowable Moment = 72 kNm

Max Allowable Shear = 51 kN

12m - Load Comb.1 UDL Load - 10kN/m applied along beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.02	53.93
	Shear	V_{Rd}	37.95	3.34	11.38
	Tension	$N_{o,Rd}$	111.82	70.56	1.58
	Compression	$N_{b,Rd}$	103.49	211.81	0.49
	Deflection	d	120.00	50.75	2.36
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.49
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.02	81.56
	Shear	V_{Rd}	37.95	1.20	31.68
	Tension	$N_{o,Rd}$	111.82	70.56	1.58
	Compression	$N_{b,Rd}$	103.49	211.81	0.49
	Deflection	d	120.00	50.75	2.36
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.49
Vertical	Moment	$M_{c,Rd}$	0.87	0.15	5.82
	Shear	V_{Rd}	22.67	0.22	102.60
	Tension	$N_{o,Rd}$	87.00	0.84	103.33
	Compression	$N_{b,Rd}$	80.39	41.27	1.95
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.55
Diagonal	Tension	$N_{o,Rd}$	59.62	44.65	1.34
	Compression	$N_{b,Rd}$	44.84	53.61	0.84
				Factor	**0.49**



Max Moment= $ML^2/8$

so for ultimate condition

W= 1.50*10.00
15.00 kN

apply factor from above

Wf= 15.00*0.49
= 7.28 kN

so maximum moment is as above

Ultimate Mu= Wf*12^2/8
= (7.28*12^2)/8
= 131.09 kNm

and for allowable value

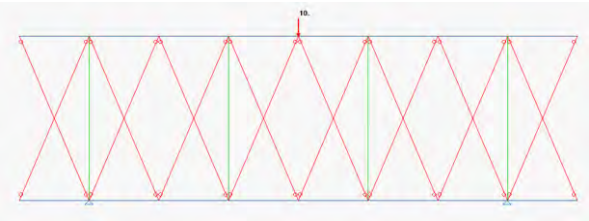
allowable max moment= 131.09/1.50

= 87.40 kNm

Moment values	**Ultimate**	**131.09 kNm**
	Allowable	**87.40 kNm**

12m - Load Comb. 2 -Point load 10kN load applied at midspan of beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.02	44.94
	Shear	V_{Rd}	37.95	0.41	91.66
	Tension	$N_{o,Rd}$	111.82	17.45	6.41
	Compression	$N_{b,Rd}$	103.49	36.21	2.86
	Deflection	d	120.00	8.05	14.91
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	2.73
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.07	27.19
	Shear	V_{Rd}	37.95	0.20	192.63
	Tension	$N_{o,Rd}$	111.82	17.45	6.41
	Compression	$N_{b,Rd}$	103.49	36.21	2.86
	Deflection	d	120.00	8.05	14.91
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	2.65
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	50.98
	Shear	V_{Rd}	22.67	0.03	906.96
	Tension	$N_{o,Rd}$	87.00	0.17	517.86
	Compression	$N_{b,Rd}$	80.39	5.67	14.19
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	11.69
Diagonal	Tension	$N_{o,Rd}$	59.62	4.94	12.08
	Compression	$N_{b,Rd}$	44.84	5.11	8.78
				Factor	**2.65**



Max Moment= ML/4

so for ultimate condition

W= 1.50*10
= 15.00 kN

apply factor from above

Wf= 15.00*2.65
= 39.75 kN

so maximum moment is as above

Ultimate Mu= Wf*12/4
= 39.75*12/4
= 119.26 kNm

and for allowable value

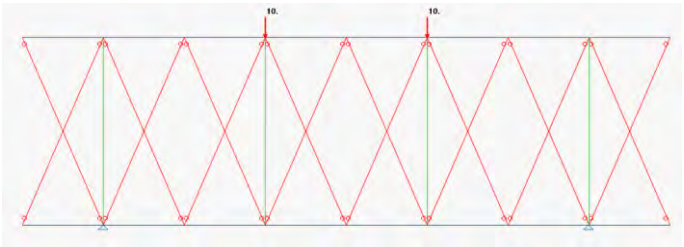
allowable max moment= 119.26/1.50

= 79.50 kNm

Moment values	**Ultimate**	**119.26**	**kNm**
	Allowable	**79.50**	**kNm**

12m - Load Comb. 3 -PL at third points 10kN load applied at each of the two third points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	43.14
	Shear	V_{Rd}	37.95	0.73	52.34
	Tension	$N_{o,Rd}$	111.82	16.86	6.63
	Compression	$N_{b,Rd}$	103.49	50.16	2.06
	Deflection	d	120.00	12.38	9.69
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.99
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.04	49.37
	Shear	V_{Rd}	37.95	0.24	155.52
	Tension	$N_{o,Rd}$	111.82	16.77	6.67
	Compression	$N_{b,Rd}$	103.49	50.16	2.06
	Deflection	d	120.00	12.38	9.69
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	2.00
Vertical	Moment	$M_{c,Rd}$	0.87	0.03	27.96
	Shear	V_{Rd}	22.67	0.05	472.38
	Tension	$N_{o,Rd}$	87.00	0.22	395.45
	Compression	$N_{b,Rd}$	80.39	6.83	11.77
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.85
Diagonal	Tension	$N_{o,Rd}$	59.62	9.32	6.40
	Compression	$N_{b,Rd}$	44.84	9.59	4.68
				Factor	**1.99**



Max Moment= ML/3

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*1.99
= 29.91 kN

so maximum moment is as above

Ultimate Mu= Wf*12/3
= 29.91*12/3
= 119.64 kNm

and for allowable value

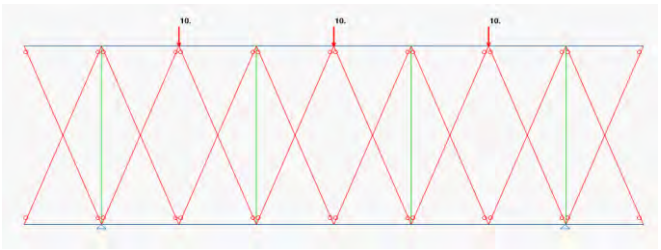
allowable max moment= 119.64/1.50

= 79.76 kNm

Moment values	**Ultimate**	**119.64 kNm**
	Allowable	**79.76 kNm**

12m - Load Comb. 4 10kN load applied at each of the three quarter points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	38.52
	Shear	V_{Rd}	37.95	1.01	37.76
	Tension	$N_{o,Rd}$	111.82	26.41	4.23
	Compression	$N_{b,Rd}$	103.49	72.12	1.44
	Deflection	d	120.00	17.18	6.98
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.40
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.09	20.84
	Shear	V_{Rd}	37.95	0.33	116.40
	Tension	$N_{o,Rd}$	111.82	26.41	4.23
	Compression	$N_{b,Rd}$	103.49	72.12	1.44
	Deflection	d	120.00	17.18	6.98
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.37
Vertical	Moment	$M_{c,Rd}$	0.87	0.05	18.84
	Shear	V_{Rd}	22.67	0.07	323.92
	Tension	$N_{o,Rd}$	87.00	0.10	870.00
	Compression	$N_{b,Rd}$	80.39	9.94	8.09
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.05
Diagonal	Tension	$N_{o,Rd}$	59.62	13.69	4.35
	Compression	$N_{b,Rd}$	44.84	14.07	3.19
				Factor	**1.37**



Max Moment= ML/2

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*1.37
= 20.49 kN

so maximum moment is as above

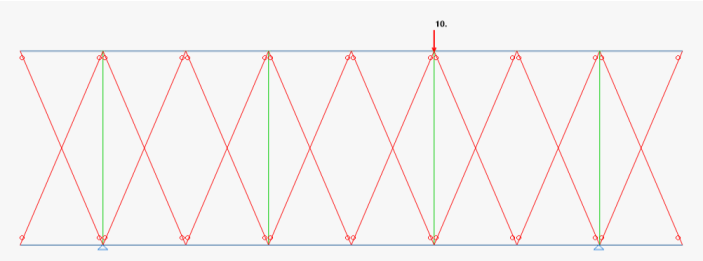
Ultimate Mu= Wf*L/2
= 20.49*12/2
= 122.92 kNm

allowable max moment= 122.92/1.50
= 81.95 kNm

Moment values	**Ultimate**	**122.92 kNm**
	Allowable	**81.95 kNm**

12m - Load Comb. 5 End Shear 10kN load applied at a 1.0m distance from the support

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	38.52
	Shear	V_{Rd}	37.95	0.24	159.44
	Tension	$N_{o,Rd}$	111.82	4.92	22.71
	Compression	$N_{b,Rd}$	103.49	11.54	8.97
	Deflection	d	120.00	2.30	52.17
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	7.61
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.00	468.97
	Shear	V_{Rd}	37.95	0.24	159.44
	Tension	$N_{o,Rd}$	111.82	4.92	22.71
	Compression	$N_{b,Rd}$	103.49	10.98	9.42
	Deflection	d	120.00	2.30	52.17
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	9.29
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	50.98
	Shear	V_{Rd}	22.67	0.02	985.83
	Tension	$N_{o,Rd}$	87.00	0.07	1208.33
	Compression	$N_{b,Rd}$	80.39	6.92	11.61
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	9.89
Diagonal	Tension	$N_{o,Rd}$	59.62	7.75	7.69
	Compression	$N_{b,Rd}$	44.84	8.14	5.51
				Factor	**5.51**



so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*5.51
= 82.63 kN

so maximum shear is as above

Ultimate Qu= Wf*11/12
= 82.63*11/12
= 75.74 kN

and for allowable value

allowable max shear= 75.74/1.50
= 50.49 kN

Shear values	**Ultimate**	**75.74 kN**
	Allowable	**50.49 kN**

12m Span Results

1.30m X-BEAM			
Loadcase No.		Ultimate Moment	Allowable Moment
1	UDL	131.09	87.40
2	Point	119.26	79.50
3	Third	119.64	79.76
4	Quarter	122.92	81.95

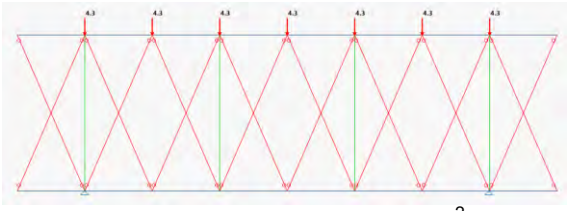
Loadcase No.		Ultimate Shear	Allowable Shear
5	End Shear	75.74	50.49

Max Allowable Moment = 79 kNm

Max Allowable Shear = 50 kN

15m - Load Comb.1 UDL Load - 10kN/m applied along beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.02	59.92
	Shear	V_{Rd}	37.95	5.59	6.79
	Tension	$N_{o,Rd}$	111.82	109.54	1.02
	Compression	$N_{b,Rd}$	103.49	328.76	0.31
	Deflection	d	150.00	115.01	1.30
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.31
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.16	11.44
	Shear	V_{Rd}	37.95	1.54	24.59
	Tension	$N_{o,Rd}$	111.82	109.54	1.02
	Compression	$N_{b,Rd}$	103.49	328.76	0.31
	Deflection	d	150.00	115.01	1.30
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.31
Vertical	Moment	$M_{c,Rd}$	0.87	0.19	4.54
	Shear	V_{Rd}	22.67	0.29	79.56
	Tension	$N_{o,Rd}$	87.00	1.46	59.71
	Compression	$N_{b,Rd}$	80.39	50.01	1.61
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.26
Diagonal	Tension	$N_{o,Rd}$	59.62	57.01	1.05
	Compression	$N_{b,Rd}$	44.84	66.30	0.68
				Factor	**0.31**



Max Moment= $ML^2/8$

so for ultimate condition

W= 1.50*10.00
15.00 kN

apply factor from above

Wf= 15.00*0.31
= 4.63 kN

so maximum moment is as above

Ultimate Mu= Wf*15^2/8
= (4.63*15^2)/8
= 130.24 kNm

and for allowable value

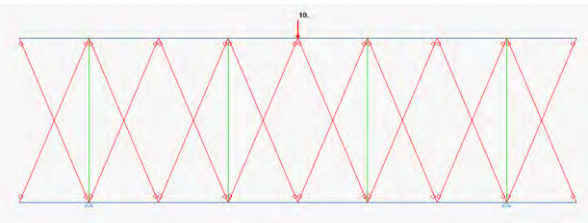
allowable max moment= 130.24/1.50

= 86.83 kNm

Moment values	**Ultimate**	**130.24 kNm**
	Allowable	**86.83 kNm**

15m - Load Comb. 2 Point load 10kN load applied at midspan of beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.09	12.12
	Shear	V_{Rd}	37.95	0.61	62.52
	Tension	$N_{o,Rd}$	111.82	23.57	4.74
	Compression	$N_{b,Rd}$	103.49	45.86	2.26
	Deflection	d	150.00	14.91	10.06
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.98
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.03	62.53
	Shear	V_{Rd}	37.95	0.25	151.19
	Tension	$N_{o,Rd}$	111.82	23.57	4.74
	Compression	$N_{b,Rd}$	103.49	45.86	2.26
	Deflection	d	150.00	14.91	10.06
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	2.20
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	36.11
	Shear	V_{Rd}	22.67	0.03	755.80
	Tension	$N_{o,Rd}$	87.00	3.06	28.43
	Compression	$N_{b,Rd}$	80.39	3.75	21.46
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	14.55
Diagonal	Tension	$N_{o,Rd}$	59.62	5.08	11.73
	Compression	$N_{b,Rd}$	44.84	7.84	5.72
				Factor	**1.98**



Max Moment= ML/4

so for ultimate condition

W= 1.50*10
= 15.00 kN

apply factor from above

Wf= 15.00*1.98
= 29.66 kN

so maximum moment is as above

Ultimate Mu= Wf*15/4
= 29.66*15/4
= 111.22 kNm

and for allowable value

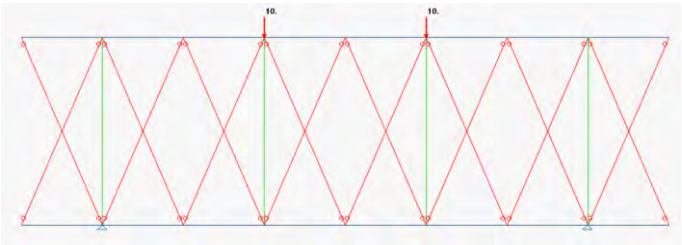
allowable max moment= 111.22/1.50

= 74.15 kNm

Moment values	**Ultimate**	**111.22 kNm**
	Allowable	**74.15 kNm**

15m - Load Comb. 3 PL at third points 10kN load applied at each of the two third points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	41.48
	Shear	V_{Rd}	37.95	1.04	36.49
	Tension	$N_{o,Rd}$	111.82	21.24	5.27
	Compression	$N_{b,Rd}$	103.49	63.78	1.62
	Deflection	d	150.00	23.08	6.50
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.58
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.08	24.36
	Shear	V_{Rd}	37.95	0.26	146.52
	Tension	$N_{o,Rd}$	111.82	21.24	5.27
	Compression	$N_{b,Rd}$	103.49	63.08	1.64
	Deflection	d	150.00	23.08	6.50
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.56
Vertical	Moment	$M_{c,Rd}$	0.87	0.03	27.08
	Shear	V_{Rd}	22.67	0.05	462.74
	Tension	$N_{o,Rd}$	87.00	0.32	271.88
	Compression	$N_{b,Rd}$	80.39	6.91	11.64
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.70
Diagonal	Tension	$N_{o,Rd}$	59.62	9.46	6.30
	Compression	$N_{b,Rd}$	44.84	9.76	4.59
				Factor	**1.56**



Max Moment= ML/3

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*1.56
= 23.44 kN

so maximum moment is as above

Ultimate Mu= Wf*15/3
= 23.44*15/3
= 117.18 kNm

and for allowable value

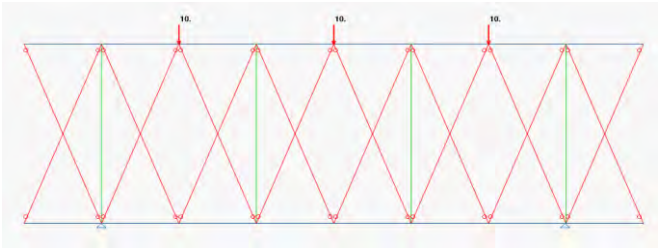
allowable max moment= 117.18/1.50

= 78.12 kNm

Moment values	**Ultimate**	**117.18 kNm**
	Allowable	**78.12 kNm**

15m - Load Comb. 4 10kN load applied at each of the three quarter points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.08	12.84
	Shear	V_{Rd}	37.95	1.48	25.64
	Tension	$N_{o,Rd}$	111.82	36.32	3.08
	Compression	$N_{b,Rd}$	103.49	93.73	1.10
	Deflection	d	150.00	32.67	4.59
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.04
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.00	937.94
	Shear	V_{Rd}	37.95	0.35	107.50
	Tension	$N_{o,Rd}$	111.82	36.32	3.08
	Compression	$N_{b,Rd}$	103.49	93.73	1.10
	Deflection	d	150.00	32.67	4.59
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.10
Vertical	Moment	$M_{c,Rd}$	0.87	0.05	18.44
	Shear	V_{Rd}	22.67	0.07	319.35
	Tension	$N_{o,Rd}$	87.00	3.33	26.15
	Compression	$N_{b,Rd}$	80.39	10.06	7.99
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	5.96
Diagonal	Tension	$N_{o,Rd}$	59.62	13.83	4.31
	Compression	$N_{b,Rd}$	44.84	14.25	3.15
				Factor	**1.04**



Max Moment= ML/2

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*1.04
= 15.57 kN

so maximum moment is as above

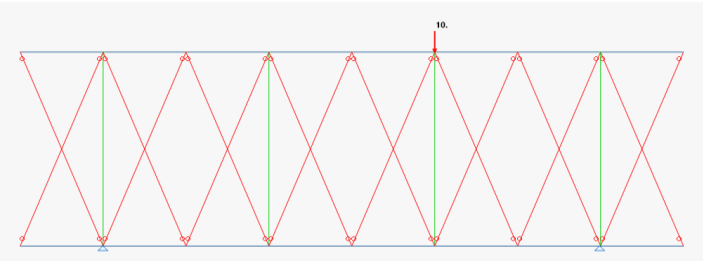
Ultimate Mu= Wf*L/2
= 15.57*15/2
= 116.75 kNm

allowable max moment= 116.75/1.50
= 77.84 kNm

Moment values	**Ultimate**	**116.75 kNm**
	Allowable	**77.84 kNm**

15m - Load Comb. 5 End Shear 10kN load applied at a 1.0m distance from the support

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	38.52
	Shear	V_{Rd}	37.95	0.24	155.52
	Tension	$N_{o,Rd}$	111.82	4.29	26.07
	Compression	$N_{b,Rd}$	103.49	12.44	8.32
	Deflection	d	150.00	3.85	38.96
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	7.15
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.03	69.48
	Shear	V_{Rd}	37.95	0.24	155.52
	Tension	$N_{o,Rd}$	111.82	4.29	26.07
	Compression	$N_{b,Rd}$	103.49	12.44	8.32
	Deflection	d	150.00	3.85	38.96
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	7.64
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	48.15
	Shear	V_{Rd}	22.67	0.02	944.75
	Tension	$N_{o,Rd}$	87.00	0.08	1087.50
	Compression	$N_{b,Rd}$	80.39	7.14	11.26
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	9.56
Diagonal	Tension	$N_{o,Rd}$	59.62	8.05	7.41
	Compression	$N_{b,Rd}$	44.84	8.45	5.31
				Factor	**5.31**



Max Shear Rb= W*14/15

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*5.31
= 79.62 kN

so maximum shear is as above

Ultimate Qu= Wf*14/15
= 79.62*14/15
= 74.32 kN

and for allowable value

allowable max shear= 74.32/1.50
= 49.54 kN

Shear values	**Ultimate**	**74.32 kN**
	Allowable	**49.54 kN**

15m Span Results

1.30m X-BEAM			
Loadcase No.		Ultimate Moment	Allowable Moment
1	UDL	130.24	86.83
2	Point	111.22	74.15
3	Third	117.18	78.12
4	Quarter	116.75	77.84

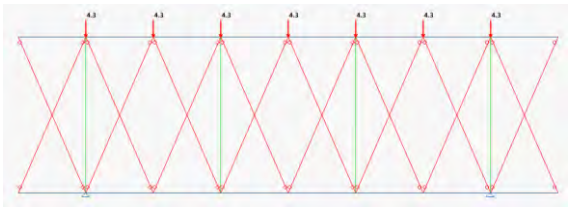
Loadcase No.		Ultimate Shear	Allowable Shear
5	End Shear	74.32	49.54

Max Allowable Moment = 74 kNm

Max Allowable Shear = 49 kN

18m - Load Comb.1 UDL load 10kN/m applied along beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.01	89.88
	Shear	V_{Rd}	37.95	7.83	4.85
	Tension	$N_{o,Rd}$	111.82	158.43	0.71
	Compression	$N_{b,Rd}$	103.49	475.36	0.22
	Deflection	d	180.00	230.55	0.78
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.22
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.25	7.41
	Shear	V_{Rd}	37.95	5.84	6.50
	Tension	$N_{o,Rd}$	111.82	158.43	0.71
	Compression	$N_{b,Rd}$	103.49	475.36	0.22
	Deflection	d	180.00	230.55	0.78
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.21
Vertical	Moment	$M_{c,Rd}$	0.87	0.17	5.16
	Shear	V_{Rd}	22.67	0.35	64.42
	Tension	$N_{o,Rd}$	87.00	2.21	39.37
	Compression	$N_{b,Rd}$	80.39	59.28	1.36
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.13
Diagonal	Tension	$N_{o,Rd}$	59.62	70.01	0.85
	Compression	$N_{b,Rd}$	44.84	79.84	0.56
				Factor	**0.21**



Max Moment= $ML^2/8$

so for ultimate condition

W= 1.50*10.00
15.00 kN

apply factor from above

Wf= 15.00*0.21
= 3.20 kN

so maximum moment is as above

Ultimate Mu= Wf*18^2/8
= (3.20*18^2)/8
= 129.49 kNm

and for allowable value

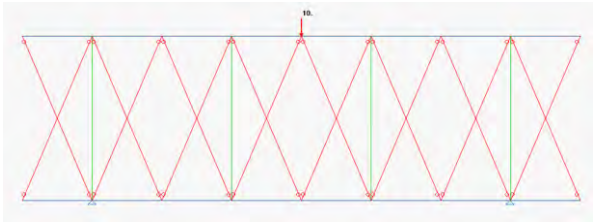
allowable max moment= 129.49/1.50

= 86.32 kNm

Moment values	Ultimate	129.49 kNm
	Allowable	86.32 kNm

18m - Load Comb. 2 Point load 10kN load applied at midspan of beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.02	46.90
	Shear	V_{Rd}	37.95	0.73	52.34
	Tension	$N_{o,Rd}$	111.82	27.60	4.05
	Compression	$N_{b,Rd}$	103.49	57.67	1.79
	Deflection	d	180.00	25.12	7.17
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.75
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.02	93.79
	Shear	V_{Rd}	37.95	0.22	174.07
	Tension	$N_{o,Rd}$	111.82	27.60	4.05
	Compression	$N_{b,Rd}$	103.49	57.67	1.79
	Deflection	d	180.00	25.12	7.17
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.77
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	48.15
	Shear	V_{Rd}	22.67	0.03	839.78
	Tension	$N_{o,Rd}$	87.00	0.26	338.52
	Compression	$N_{b,Rd}$	80.39	5.58	14.40
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	11.70
Diagonal	Tension	$N_{o,Rd}$	59.62	5.23	11.40
	Compression	$N_{b,Rd}$	44.84	5.44	8.24
				Factor	**1.75**



Max Moment= ML/4

so for ultimate condition

W= 1.50*10
= 15.00 kN

apply factor from above

Wf= 15.00*1.75
= 26.19 kN

so maximum moment is as above

Ultimate Mu= Wf*18/4
= 26.19*18/4
= 117.87 kNm

and for allowable value

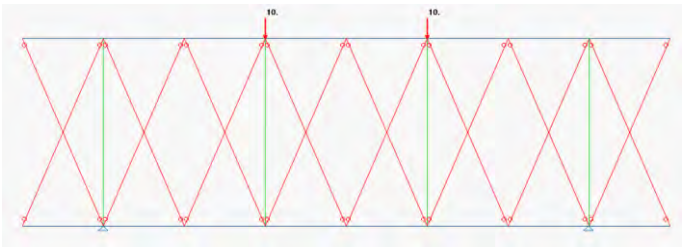
allowable max moment= 117.87/1.50

= 78.58 kNm

Moment values	**Ultimate**	**117.87 kNm**
	Allowable	**78.58 kNm**

18m - Load Comb. 3 PL at third points 10kN load applied at each of the two third points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	41.48
	Shear	V_{Rd}	37.95	1.23	30.80
	Tension	$N_{o,Rd}$	111.82	25.81	4.33
	Compression	$N_{b,Rd}$	103.49	77.34	1.34
	Deflection	d	180.00	38.92	4.62
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.31
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.09	22.07
	Shear	V_{Rd}	37.95	0.28	137.49
	Tension	$N_{o,Rd}$	111.82	25.81	4.33
	Compression	$N_{b,Rd}$	103.49	76.60	1.35
	Deflection	d	180.00	38.92	4.62
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.29
Vertical	Moment	$M_{c,Rd}$	0.87	0.03	27.08
	Shear	V_{Rd}	22.67	0.05	462.74
	Tension	$N_{o,Rd}$	87.00	0.41	210.14
	Compression	$N_{b,Rd}$	80.39	6.98	11.51
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.64
Diagonal	Tension	$N_{o,Rd}$	59.62	9.60	6.21
	Compression	$N_{b,Rd}$	44.84	9.94	4.51
				Factor	**1.29**



Max Moment= ML/3

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*1.29
= 19.40 kN

so maximum moment is as above

Ultimate Mu= Wf*18/3
= 19.40*18/3
= 116.41 kNm

and for allowable value

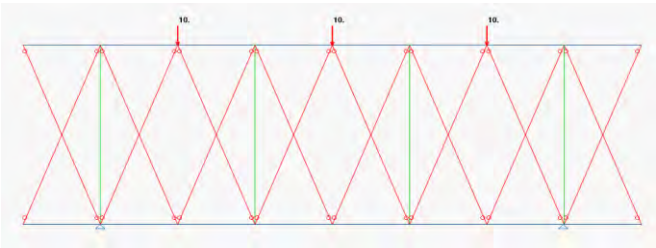
allowable max moment= 116.41/1.50

= 77.61 kNm

Moment values	**Ultimate**	**116.41 kNm**
	Allowable	**77.61 kNm**

18m - Load Comb. 4 10kN load applied at each of the three quarter points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	37.19
	Shear	V_{Rd}	37.95	1.71	22.19
	Tension	$N_{o,Rd}$	111.82	40.91	2.73
	Compression	$N_{b,Rd}$	103.49	111.53	0.93
	Deflection	d	180.00	53.09	3.39
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.91
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.03	75.04
	Shear	V_{Rd}	37.95	0.39	97.55
	Tension	$N_{o,Rd}$	111.82	40.91	2.73
	Compression	$N_{b,Rd}$	103.49	111.53	0.93
	Deflection	d	180.00	53.09	3.39
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.92
Vertical	Moment	$M_{c,Rd}$	0.87	0.05	16.05
	Shear	V_{Rd}	22.67	0.08	290.69
	Tension	$N_{o,Rd}$	87.00	3.44	25.33
	Compression	$N_{b,Rd}$	80.39	10.13	7.93
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	5.71
Diagonal	Tension	$N_{o,Rd}$	59.62	13.97	4.27
	Compression	$N_{b,Rd}$	44.84	16.40	2.73
				Factor	**0.91**



Max Moment= ML/2

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*0.91
= 13.68 kN

so maximum moment is as above

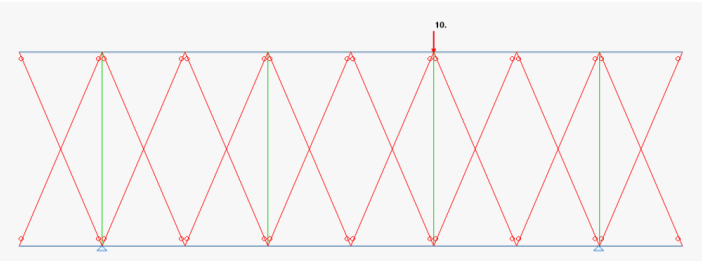
Ultimate Mu= Wf*L/2
= 13.68*18/2
= 123.08 kNm

allowable max moment= 123.08/1.50
= 82.05 kNm

Moment values	**Ultimate**	**123.08 kNm**
	Allowable	**82.05 kNm**

18m - Load Comb. 5 End Shear 10kN load applied at a 1.0m distance from the support

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	37.19
	Shear	V_{Rd}	37.95	0.25	152.40
	Tension	$N_{o,Rd}$	111.82	3.79	29.47
	Compression	$N_{b,Rd}$	103.49	13.04	7.94
	Deflection	d	180.00	6.22	28.94
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.83
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.02	98.73
	Shear	V_{Rd}	37.95	0.25	152.40
	Tension	$N_{o,Rd}$	111.82	3.79	29.47
	Compression	$N_{b,Rd}$	103.49	13.04	7.94
	Deflection	d	180.00	6.22	28.94
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	7.49
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	48.15
	Shear	V_{Rd}	22.67	0.03	906.96
	Tension	$N_{o,Rd}$	87.00	0.09	977.53
	Compression	$N_{b,Rd}$	80.39	7.32	10.98
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	9.36
Diagonal	Tension	$N_{o,Rd}$	59.62	8.30	7.18
	Compression	$N_{b,Rd}$	44.84	8.70	5.15
				Factor	**5.15**



Max Shear Rb= W*17/18

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*5.15
= 77.27 kN

so maximum shear is as above

Ultimate Qu= Wf*17/18
= 77.27*17/18
= 72.98 kN

and for allowable value

allowable max shear= 72.98/1.50
= 48.65 kN

Shear values	**Ultimate**	**72.98 kN**
	Allowable	**48.65 kN**

18m Span Results

1.30m X-BEAM			
Loadcase No.		Ultimate Moment	Allowable Moment
1	UDL	129.49	86.32
2	Point	117.87	78.58
3	Third	116.41	77.61
4	Quarter	123.08	82.05

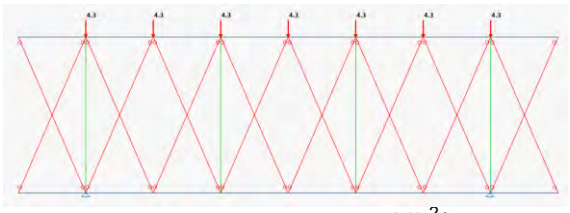
Loadcase No.		Ultimate Shear	Allowable Shear
5	End Shear	72.98	48.65

Max Allowable Moment = 77 kNm

Max Allowable Shear = 48 kN

24m - Load Comb.1 UDL load 10kN/m applied along beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.00	539.29
	Shear	V_{Rd}	37.95	7.57	5.02
	Tension	$N_{o,Rd}$	111.82	284.34	0.39
	Compression	$N_{b,Rd}$	103.49	853.10	0.12
	Deflection	d	240.00	707.90	0.34
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.12
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.46	4.04
	Shear	V_{Rd}	37.95	2.74	13.84
	Tension	$N_{o,Rd}$	111.82	284.34	0.39
	Compression	$N_{b,Rd}$	103.49	853.10	0.12
	Deflection	d	240.00	707.90	0.34
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.12
Vertical	Moment	$M_{c,Rd}$	0.87	0.33	2.67
	Shear	V_{Rd}	22.67	0.49	46.37
	Tension	$N_{o,Rd}$	87.00	4.02	21.63
	Compression	$N_{b,Rd}$	80.39	77.97	1.03
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.79
Diagonal	Tension	$N_{o,Rd}$	59.62	96.41	0.62
	Compression	$N_{b,Rd}$	44.84	107.54	0.42
				Factor	**0.12**



Max Moment= $ML^2/8$

so for ultimate condition

W= 1.50*10.00
15.00 kN

apply factor from above

Wf= 15.00*0.12
= 1.78 kN

so maximum moment is as above

Ultimate Mu= Wf*24^2/8
= (1.78*24^2)/8
= 128.25 kNm

and for allowable value

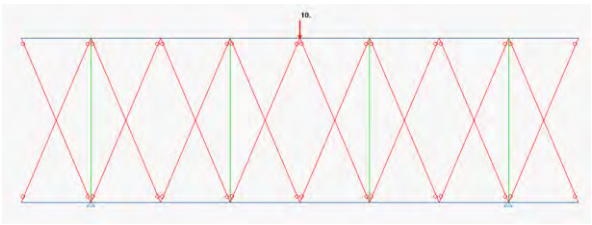
allowable max moment= 128.25/1.50

= 85.50 kNm

Moment values	**Ultimate**	**128.25 kNm**
	Allowable	**85.50 kNm**

24m - Load Comb. 2 Point load 10kN load applied at midspan of beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.02	56.77
	Shear	V_{Rd}	37.95	0.44	86.84
	Tension	$N_{o,Rd}$	111.82	38.04	2.94
	Compression	$N_{b,Rd}$	103.49	80.02	1.29
	Deflection	d	240.00	59.28	4.05
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.27
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.09	20.39
	Shear	V_{Rd}	37.95	0.24	157.46
	Tension	$N_{o,Rd}$	111.82	38.04	2.94
	Compression	$N_{b,Rd}$	103.49	80.02	1.29
	Deflection	d	240.00	59.28	4.05
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	1.24
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	45.61
	Shear	V_{Rd}	22.67	0.03	809.79
	Tension	$N_{o,Rd}$	87.00	0.34	255.88
	Compression	$N_{b,Rd}$	80.39	5.49	14.64
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	11.73
Diagonal	Tension	$N_{o,Rd}$	59.62	5.52	10.80
	Compression	$N_{b,Rd}$	44.84	5.78	7.76
				Factor	**1.24**



Max Moment= ML/4

so for ultimate condition

W= 1.50*10
= 15.00 kN

apply factor from above

Wf= 15.00*1.24
= 18.55 kN

so maximum moment is as above

Ultimate Mu= Wf*24/4
= 18.55*24/4
= 111.31 kNm

and for allowable value

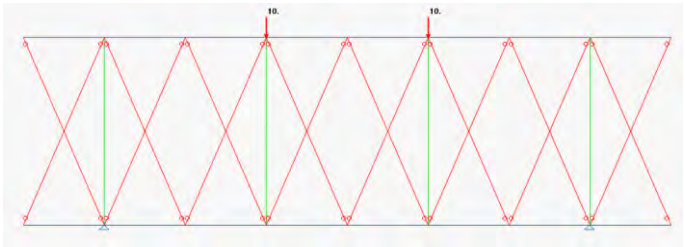
allowable max moment= 111.31/1.50

= 74.21 kNm

Moment values	**Ultimate**	**111.31 kNm**
	Allowable	**74.21 kNm**

24m - Load Comb. 3 PL at third points 10kN load applied at each of the two third points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	38.52
	Shear	V_{Rd}	37.95	0.81	46.96
	Tension	$N_{o,Rd}$	111.82	35.25	3.17
	Compression	$N_{b,Rd}$	103.49	105.28	0.98
	Deflection	d	240.00	91.29	2.63
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.97
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.10	18.76
	Shear	V_{Rd}	37.95	0.31	121.63
	Tension	$N_{o,Rd}$	111.82	35.25	3.17
	Compression	$N_{b,Rd}$	103.49	104.47	0.99
	Deflection	d	240.00	91.29	2.63
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.95
Vertical	Moment	$M_{c,Rd}$	0.87	0.03	26.26
	Shear	V_{Rd}	22.67	0.05	444.59
	Tension	$N_{o,Rd}$	87.00	0.55	157.32
	Compression	$N_{b,Rd}$	80.39	7.13	11.27
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.44
Diagonal	Tension	$N_{o,Rd}$	59.62	9.88	6.03
	Compression	$N_{b,Rd}$	44.84	10.29	4.36
				Factor	**0.95**



Max Moment= ML/3

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*0.95
= 14.31 kN

so maximum moment is as above

Ultimate Mu= Wf*24/3
= 14.31*24/3
= 114.49 kNm

and for allowable value

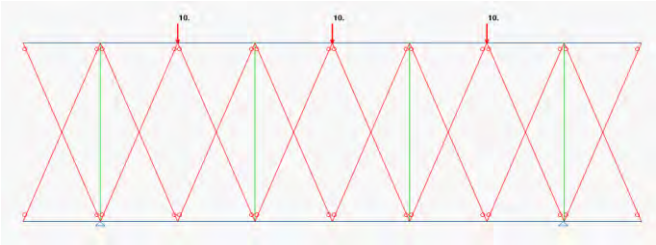
allowable max moment= 114.49/1.50

= 76.32 kNm

Moment values	**Ultimate**	**114.49 kNm**
	Allowable	**76.32 kNm**

24m - Load Comb. 4 10kN load applied at each of the three quarter points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	43.14
	Shear	V_{Rd}	37.95	1.18	32.16
	Tension	$N_{o,Rd}$	111.82	55.99	2.00
	Compression	$N_{b,Rd}$	103.49	151.83	0.68
	Deflection	d	240.00	123.46	1.94
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.67
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.13	14.10
	Shear	V_{Rd}	37.95	0.41	93.70
	Tension	$N_{o,Rd}$	111.82	55.99	2.00
	Compression	$N_{b,Rd}$	103.49	151.83	0.68
	Deflection	d	240.00	123.46	1.94
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.66
Vertical	Moment	$M_{c,Rd}$	0.87	0.05	18.05
	Shear	V_{Rd}	22.67	0.07	306.41
	Tension	$N_{o,Rd}$	87.00	0.75	116.15
	Compression	$N_{b,Rd}$	80.39	10.26	7.84
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	5.85
Diagonal	Tension	$N_{o,Rd}$	59.62	14.24	4.19
	Compression	$N_{b,Rd}$	44.84	14.80	3.03
				Factor	**0.66**



Max Moment= ML/2

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*0.66
= 9.88 kN

so maximum moment is as above

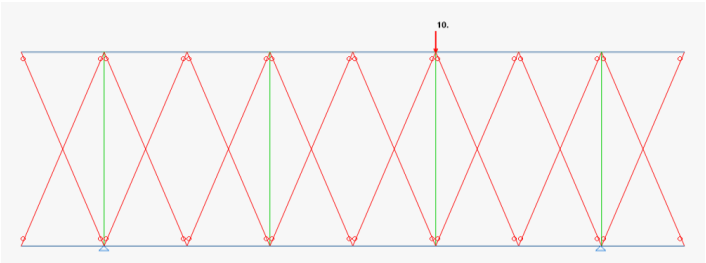
Ultimate Mu= Wf*L/2
= 9.88*24/2
= 118.57 kNm

allowable max moment= 118.57/1.50
= 79.05 kNm

Moment values	**Ultimate**	**118.57 kNm**
	Allowable	**79.05 kNm**

24m - Load Comb. 5 End Shear 10kN load applied at a 1.0m distance from the support

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	37.19
	Shear	V_{Rd}	37.95	0.26	146.52
	Tension	$N_{o,Rd}$	111.82	4.48	24.96
	Compression	$N_{b,Rd}$	103.49	14.06	7.36
	Deflection	d	240.00	14.54	16.51
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.40
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.01	208.43
	Shear	V_{Rd}	37.95	0.26	147.08
	Tension	$N_{o,Rd}$	111.82	4.48	24.96
	Compression	$N_{b,Rd}$	103.49	16.86	6.14
	Deflection	d	240.00	14.54	16.51
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	6.01
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	45.61
	Shear	V_{Rd}	22.67	0.03	872.08
	Tension	$N_{o,Rd}$	87.00	0.11	783.78
	Compression	$N_{b,Rd}$	80.39	7.62	10.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.97
Diagonal	Tension	$N_{o,Rd}$	59.62	8.73	6.83
	Compression	$N_{b,Rd}$	44.84	9.15	4.90
				Factor	**4.90**



Max Shear Rb= W*23/24

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*4.90
= 73.55 kN

so maximum shear is as above

Ultimate Qu= Wf*23/24
= 73.55*23/24
= 70.48 kN

and for allowable value

allowable max shear= 70.48/1.50

= 46.99 kN

Shear values	**Ultimate**	**70.48 kN**
	Allowable	**46.99 kN**

24m Span Results

1.30m X-BEAM			
Loadcase No.		Ultimate Moment	Allowable Moment
1	UDL	128.25	85.50
2	Point	111.31	74.21
3	Third	114.49	76.32
4	Quarter	118.57	79.05

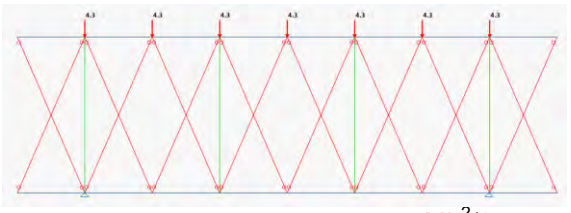
Loadcase No.		Ultimate Shear	Allowable Shear
5	End Shear	70.48	46.99

Max Allowable Moment = 74 kNm

Max Allowable Shear = 46 kN

30m - Load Comb.1 UDL load 10kN/m applied along beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.04	24.51
	Shear	V_{Rd}	37.95	9.48	4.01
	Tension	$N_{o,Rd}$	111.82	444.58	0.25
	Compression	$N_{b,Rd}$	103.49	1,333.79	0.08
	Deflection	d	300.00	1,698.40	0.18
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.08
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.71	2.65
	Shear	V_{Rd}	37.95	3.63	10.44
	Tension	$N_{o,Rd}$	111.82	444.58	0.25
	Compression	$N_{b,Rd}$	103.49	1,333.79	0.08
	Deflection	d	300.00	1,698.40	0.18
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.08
Vertical	Moment	$M_{c,Rd}$	0.87	0.41	2.09
	Shear	V_{Rd}	22.67	0.62	36.40
	Tension	$N_{o,Rd}$	87.00	6.46	13.46
	Compression	$N_{b,Rd}$	80.39	95.88	0.84
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.64
Diagonal	Tension	$N_{o,Rd}$	59.62	122.14	0.49
	Compression	$N_{b,Rd}$	44.84	134.76	0.33
				Factor	**0.08**



Max Moment= $ML^2/8$

so for ultimate condition

W= 1.50*10.00
15.00 kN

apply factor from above

Wf= 15.00*0.08
= 1.14 kN

so maximum moment is as above

Ultimate Mu= Wf*30^2/8
= (1.14*30^2)/8
= 128.25 kNm

and for allowable value

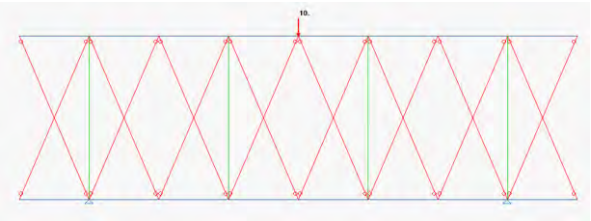
allowable max moment= 128.25/1.50

= 85.50 kNm

Moment values	**Ultimate**	**128.25 kNm**
	Allowable	**85.50 kNm**

30m - Load Comb. 2 Point load 10kN load applied at midspan of beam

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.02	49.03
	Shear	V_{Rd}	37.95	0.44	85.85
	Tension	$N_{o,Rd}$	111.82	48.90	2.29
	Compression	$N_{b,Rd}$	103.49	103.62	1.00
	Deflection	d	300.00	117.84	2.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.99
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.10	18.76
	Shear	V_{Rd}	37.95	0.27	143.20
	Tension	$N_{o,Rd}$	111.82	48.90	2.29
	Compression	$N_{b,Rd}$	103.49	103.62	1.00
	Deflection	d	300.00	117.84	2.55
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.96
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	43.33
	Shear	V_{Rd}	22.67	0.03	755.80
	Tension	$N_{o,Rd}$	87.00	0.44	198.63
	Compression	$N_{b,Rd}$	80.39	5.39	14.90
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	11.76
Diagonal	Tension	$N_{o,Rd}$	59.62	5.81	10.26
	Compression	$N_{b,Rd}$	44.84	6.12	7.33
				Factor	**0.96**



Max Moment= ML/4

so for ultimate condition

W= 1.50*10
= 15.00 kN

apply factor from above

Wf= 15.00*0.96
= 14.43 kN

so maximum moment is as above

Ultimate Mu= Wf*30/4
= 14.43*30/4
= 108.19 kNm

and for allowable value

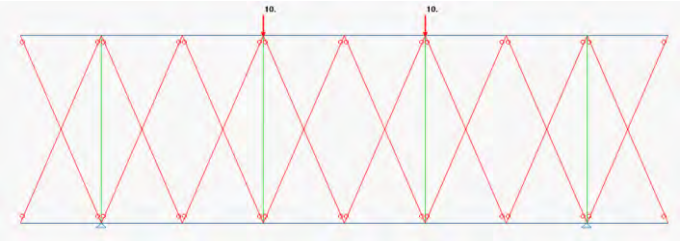
allowable max moment= 108.19/1.50

= 72.13 kNm

Moment values	**Ultimate**	**108.19 kNm**
	Allowable	**72.13 kNm**

30m - Load Comb. 3 PL at third points 10kN load applied at each of the two third points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	32.68
	Shear	V_{Rd}	37.95	0.80	47.49
	Tension	$N_{o,Rd}$	111.82	45.12	2.48
	Compression	$N_{b,Rd}$	103.49	134.34	0.77
	Deflection	d	300.00	179.71	1.67
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.76
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.07	25.70
	Shear	V_{Rd}	37.95	0.35	108.42
	Tension	$N_{o,Rd}$	111.82	45.12	2.48
	Compression	$N_{b,Rd}$	103.49	135.35	0.76
	Deflection	d	300.00	179.71	1.67
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.75
Vertical	Moment	$M_{c,Rd}$	0.87	0.04	24.76
	Shear	V_{Rd}	22.67	0.05	427.81
	Tension	$N_{o,Rd}$	87.00	0.71	122.88
	Compression	$N_{b,Rd}$	80.39	7.28	11.05
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.18
Diagonal	Tension	$N_{o,Rd}$	59.62	10.16	5.87
	Compression	$N_{b,Rd}$	44.84	10.65	4.21
				Factor	**0.75**



Max Moment= ML/3

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*0.75
= 11.23 kN

so maximum moment is as above

Ultimate Mu= Wf*30/3
= 11.23*30/3
= 112.29 kNm

and for allowable value

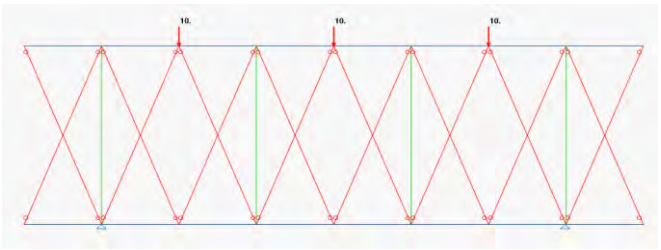
allowable max moment= 112.29/1.50

= 74.86 kNm

Moment values	**Ultimate**	**112.29 kNm**
	Allowable	**74.86 kNm**

30m - Load Comb. 4 10kN load applied at each of the three quarter points

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.03	33.71
	Shear	V_{Rd}	37.95	1.16	32.69
	Tension	$N_{o,Rd}$	111.82	71.25	1.57
	Compression	$N_{b,Rd}$	103.49	193.38	0.54
	Deflection	d	300.00	241.04	1.24
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.53
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.15	12.42
	Shear	V_{Rd}	37.95	0.44	85.85
	Tension	$N_{o,Rd}$	111.82	71.25	1.57
	Compression	$N_{b,Rd}$	103.49	193.38	0.54
	Deflection	d	300.00	241.04	1.24
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	0.52
Vertical	Moment	$M_{c,Rd}$	0.87	0.06	15.76
	Shear	V_{Rd}	22.67	0.08	287.01
	Tension	$N_{o,Rd}$	87.00	3.80	22.88
	Compression	$N_{b,Rd}$	80.39	10.37	7.75
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	5.58
Diagonal	Tension	$N_{o,Rd}$	59.62	14.51	4.11
	Compression	$N_{b,Rd}$	44.84	16.79	2.67
				Factor	**0.52**



Max Moment= ML/2

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*0.52
= 7.79 kN

so maximum moment is as above

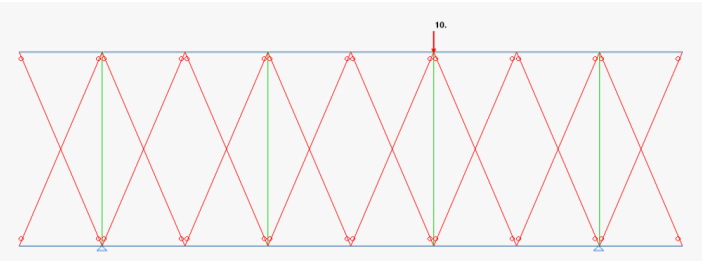
Ultimate Mu= Wf*L/2
= 7.79*30/2
= 116.82 kNm

allowable max moment= 116.82/1.50
= 77.88 kNm

Moment values	**Ultimate**	**116.82 kNm**
	Allowable	**77.88 kNm**

30m - Load Comb. 5 End Shear 10kN load applied at a 1.0m distance from the support

Element	Action	Formula	Ultimate	Calculated	Factor
HAZ Boom	Moment	$M_{c,Rd}$	1.08	0.00	359.53
	Shear	V_{Rd}	37.95	0.27	141.07
	Tension	$N_{o,Rd}$	111.82	5.99	18.66
	Compression	$N_{b,Rd}$	103.49	22.21	4.66
	Deflection	d	300.00	30.16	9.95
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	4.61
Non-HAZ Boom	Moment	$M_{c,Rd}$	1.88	0.01	156.32
	Shear	V_{Rd}	37.95	0.27	141.07
	Tension	$N_{o,Rd}$	111.82	5.99	18.66
	Compression	$N_{b,Rd}$	103.49	22.21	4.66
	Deflection	d	300.00	30.16	9.95
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	4.56
Vertical	Moment	$M_{c,Rd}$	0.87	0.02	43.33
	Shear	V_{Rd}	22.67	0.03	809.79
	Tension	$N_{o,Rd}$	87.00	0.14	621.43
	Compression	$N_{b,Rd}$	80.39	7.89	10.19
	Combined	$(N_{ed}/N_{Rd})^{1.3} + [(M_{ed,x}/M_{rd,x})^{1.7}]^{0.6} < 1.0$		1.00	8.64
Diagonal	Tension	$N_{o,Rd}$	59.62	9.10	6.55
	Compression	$N_{b,Rd}$	44.84	9.54	4.70
				Factor	**4.56**



Max Shear Rb= W*29/30

so for ultimate condition

W= 1.50*10
15.00 kN

apply factor from above

Wf= 15.00*4.56
= 68.40 kN

so maximum shear is as above

Ultimate Qu= Wf*29/30
= 68.40*29/30
= 66.12 kN

and for allowable value

allowable max shear= 66.12/1.50

= 44.08 kN

Shear values	**Ultimate**	**66.12 kN**
	Allowable	**44.08 kN**

30m Span Results

1.30m X-BEAM			
Loadcase No.		Ultimate Moment	Allowable Moment
1	UDL	128.25	85.50
2	Point	108.19	72.13
3	Third	112.29	74.86
4	Quarter	116.82	77.88

Loadcase No.		Ultimate Shear	Allowable Shear
5	End Shear	66.12	44.08

Max Allowable Moment = 72 kNm

Max Allowable Shear = 44 kN

Load case 1 : UDL

1.3m X-BEAM		
Loadcase 1 Length (m)	Ultimate Moment	Allowable Moment
3	60.77	40.51
6	105.55	70.37
9	130.37	86.91
12	131.09	87.40
15	130.24	86.83
18	129.49	86.32
24	128.25	85.50
30	128.25	85.50
Average (kNm)	118.00	78.67
Minimum (kNm)	60.77	40.51

Load case 2 : Central Point Load

1.3m X-BEAM		
Loadcase 2 Length (m)	Ultimate Moment	Allowable Moment
3	63.90	42.60
6	127.10	84.73
9	109.38	72.92
12	119.26	79.50
15	111.22	74.15
18	117.87	78.58
24	111.31	74.21
30	108.19	72.13
Average (kNm)	108.53	72.35
Minimum (kNm)	63.90	42.60

Load case 3 : Two Point Loads at Third Points

1.3m X-BEAM		
Loadcase 3 Length (m)	**Ultimate Moment**	**Allowable Moment**
3	80.09	53.39
6	153.31	102.21
9	118.15	78.77
12	119.64	79.76
15	117.18	78.12
18	116.41	77.61
24	114.49	76.32
30	112.29	74.86
Average (kNm)	116.44	77.63
Minimum (kNm)	80.09	53.39

Load case 4 : Three Point Loads at Quarter Points

1.3m X-BEAM		
Loadcase 4 Length (m)	**Ultimate Moment**	**Allowable Moment**
3	55.46	36.97
6	123.75	82.50
9	126.10	84.06
12	122.92	81.95
15	116.75	77.84
18	123.08	82.05
24	118.57	79.05
30	116.82	77.88
Average (kNm)	112.93	75.29
Minimum (kNm)	55.46	36.97

Load case 5 : Shear

1.3m X-BEAM		
Loadcase 5 Length (m)	**Ultimate Shear**	**Allowable Shear**
3	78.05	52.03
6	77.59	51.72
9	77.28	51.52
12	75.74	50.49
15	74.32	49.54
18	72.98	48.65
24	70.48	46.99
30	66.12	44.08

Average (kNm)	74.07	49.38	kN
Minimum (kNm)	66.12	44.08	kN

Client:	Apollo Scaff old Services Ltd		
Project:	Scaff old Beams 1.30m X-Beam		
Element:	Overall Results		
Job No:	22126-04	By: pl	
Doc No:	001A	Checked: mr	Date: Oct-22

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Test Results

	Span (m)							
	3	6	9	12	15	18	24	30
Allowable Moment	36	70	72	79	74	77	74	72
Allowable Shear (Load on Vertical)	52	51	51	50	49	48	46	44

Allowable loads for load distributions from results

Type of Load	Clear span (m)								
		3	6	9	12	15	18	24	30
Uniformly Distributed load	kN/m	32.0	15.6	7.1	4.4	2.6	1.9	1.0	0.6
Total UDL	kN	96.0	93.3	64.0	52.7	39.5	34.2	24.7	19.2
Single point load (mid Point)	kN	48.0	46.7	32.0	26.3	19.7	17.1	12.3	9.6
Two point loads (third points)	Each kN	36.0	35.0	24.0	19.8	14.8	12.8	9.3	7.2
Three pint loads (quarter points)	Each kN	24.0	23.3	16.0	13.2	9.9	8.6	6.2	4.8

		3	6	9	12	15	18	24	30
Uniformly Distributed load	kN/m	*34.7*	*17.0*	*11.3*	*8.3*	*6.5*	*5.3*	*3.8*	*2.9*
Total UDL	kN	*104*	*102*	*102*	*100*	*98*	*96*	*92*	*88*
Single point load (mid Point)	kN	*104*	*102*	*102*	*100*	*98*	*96*	*92*	*88*
Two point loads (third points)	Each kN	*52*	*51*	*51*	*50*	*49*	*48*	*46*	*44*
Three pint loads (quarter points)	Each kN	*34.7*	*34*	*34*	*33.3*	*32.7*	*32*	*30.7*	*29.3*

Type of Load		Clear span (m)							
		3	6	9	12	15	18	24	30
Uniformly Distributed load	kN/m	32.0	15.6	7.1	4.4	2.6	1.9	1.0	0.6
Total UDL	kN	96.0	93.3	64.0	52.7	39.5	34.2	24.7	19.2
Single point load (mid Point)	kN	48.0	46.7	32.0	26.3	19.7	17.1	12.3	9.6
Two point loads (third points)	Each kN	36.0	35.0	24.0	19.8	14.8	12.8	9.3	7.2
Three point loads (quarter points)	Each kN	24.0	23.3	16.0	13.2	9.9	8.6	6.2	4.8

Client:	Apollo Scaff old Services Ltd
Project:	Scaff old Beams 1.30m X-Beam
Element:	Overall Results
Job No:	22126-04
By:	pl
Doc No:	001A
Checked:	mr
Date:	Oct-22

Extrapolated Allowable loads for load distributions

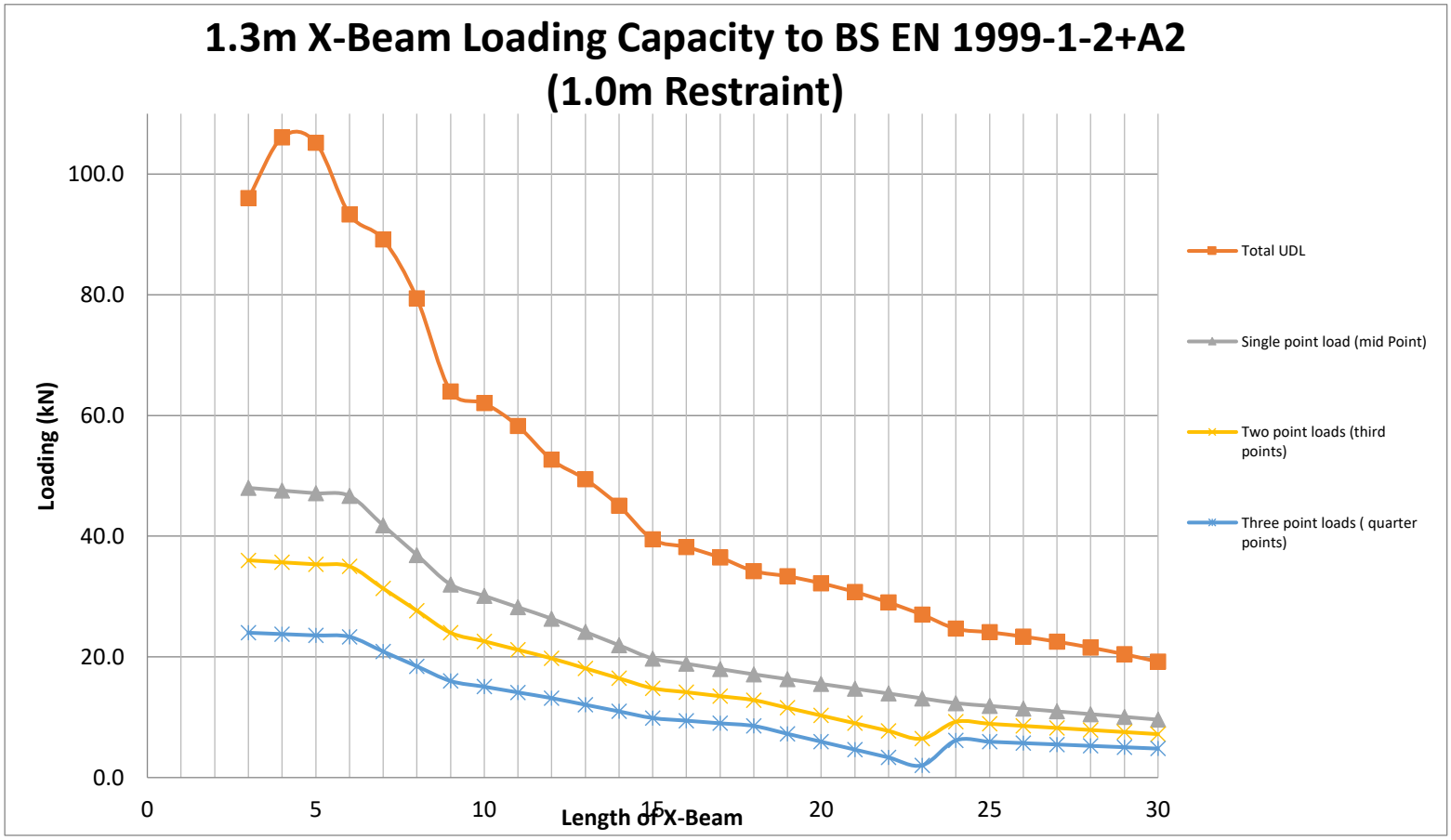
Type of Load		Clear span (m)															
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Uniformly Distributed load	kN/m	32.0	26.5	21.0	15.6	12.7	9.9	7.1	6.2	5.3	4.4	3.8	3.2	2.6	2.4	2.1	1.9
Total UDL	kN	96.0	106.1	105.2	93.3	89.2	79.4	64.0	62.0	58.3	52.7	49.4	45.0	39.5	38.2	36.5	34.2
Single point load (mid Point)	kN	48.0	47.6	47.1	46.7	41.8	36.9	32.0	30.1	28.2	26.3	24.1	21.9	19.7	18.9	18.0	17.1
Two point loads (third points)	Each kN	36.0	35.7	35.3	35.0	31.3	27.7	24.0	22.6	21.2	19.8	18.1	16.5	14.8	14.1	13.5	12.8
Three point loads (quarter points)	Each kN	24.0	23.8	23.6	23.3	20.9	18.4	16.0	15.1	14.1	13.2	12.1	11.0	9.9	9.4	9.0	8.6

		Clear Span (m)											
		19	20	21	22	23	24	25	26	27	28	29	30
Uniformly Distributed load	kN/m	1.8	1.6	1.5	1.3	1.2	1.0	1.0	0.9	0.8	0.8	0.7	0.6
Total UDL	kN	33.4	32.2	30.8	29.0	27.0	24.7	24.1	23.4	22.5	21.5	20.4	19.2
Single point load (mid Point)	kN	16.3	15.5	14.7	13.9	13.1	12.3	11.9	11.4	11.0	10.5	10.1	9.6
Two point loads (third points)	Each kN	11.6	10.3	9.0	7.7	6.5	9.3	8.9	8.6	8.2	7.9	7.5	7.2
Three point loads (quarter points)	Each kN	7.3	5.9	4.6	3.3	2.0	6.2	5.9	5.7	5.5	5.3	5.0	4.8

Notes:

1. Above allowable loads may be increased by 1.11 for **wind loading only**
2. This table is provided as a guide only and assume all loads are applied at nodes. All scaffolds and structures should be checked by a qualified structural engineer.
3. Maximum capacity of a point load mid way between nodes is 15kN but overall buckling of the top chord should be checked if loads are placed other than at restrained loads. Compression chord restraint required at 1.0m c/c
4. Factor of Safety = 1.65
5. Calculations as per BS EN 1999-1-2-A2
6. All allowable loads below take the self weight of the beam into account.

Graph Summary of Allowable Working Loads for a 1.3m X-Beam to BS EN 1999-1-2+A2



Client:	Apollo Scaff old Services Ltd
Project:	Scaff old Beams 1.30m X-Beam
Element:	Results Summary
Job No:	22126-04 By: pl
Doc No:	001A Checked: mr Date: Oct-22

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Results Summary

Type of Load		Clear span (m)															
		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Uniformly Distributed load	kN/m	32.0	26.5	21.0	15.6	12.7	9.9	7.1	6.2	5.3	4.4	3.8	3.2	2.6	2.4	2.1	1.9
Total UDL	kN	96.0	106.1	105.2	93.3	89.2	79.4	64.0	62.0	58.3	52.7	49.4	45.0	39.5	38.2	36.5	34.2
Single point load (mid Point)	kN	48.0	47.6	47.1	46.7	41.8	36.9	32.0	30.1	28.2	26.3	24.1	21.9	19.7	18.9	18.0	17.1
Two point loads (third points)	Each kN	36.0	35.7	35.3	35.0	31.3	27.7	24.0	22.6	21.2	19.8	18.1	16.5	14.8	14.1	13.5	12.8
Three point loads (quarter points)	Each kN	24.0	23.8	23.6	23.3	20.9	18.4	16.0	15.1	14.1	13.2	12.1	11.0	9.9	9.4	9.0	8.6

		Clear Span (m)											
		19	20	21	22	23	24	25	26	27	28	29	30
Uniformly Distributed load	kN/m	1.8	1.6	1.5	1.3	1.2	1.0	1.0	0.9	0.8	0.8	0.7	0.6
Total UDL	kN	33.4	32.2	30.8	29.0	27.0	24.7	24.1	23.4	22.5	21.5	20.4	19.2
Single point load (mid Point)	kN	16.3	15.5	14.7	13.9	13.1	12.3	11.9	11.4	11.0	10.5	10.1	9.6
Two point loads (third points)	Each kN	11.6	10.3	9.0	7.7	6.5	9.3	8.9	8.6	8.2	7.9	7.5	7.2
Three point loads (quarter points)	Each kN	7.3	5.9	4.6	3.3	2.0	6.2	5.9	5.7	5.5	5.3	5.0	4.8

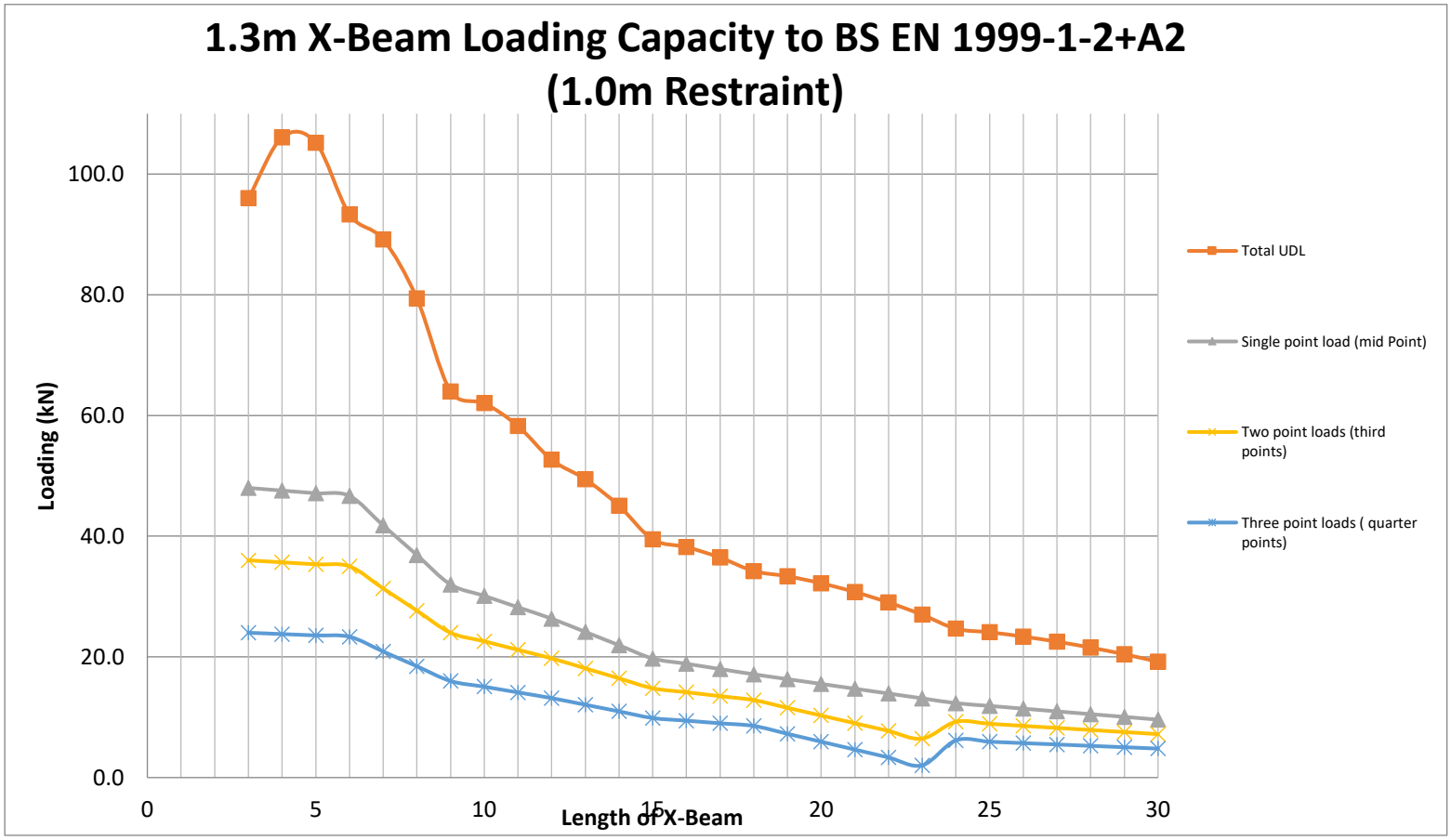
	Span (m)							
	3	6	9	12	15	18	24	30
Allowable Moment	36	70	72	79	74	77	74	72
Allowable Shear (Load on Vertical)	52	51	51	50	49	48	46	44

Notes:

1. Above allowable loads may be increased by 1.11 for **wind loading only**
2. This table is provided as a guide only and assume all loads are applied at nodes. All scaffolds and structures should be checked by a qualified structural engineer.
3. Maximum capacity of a point load mid way between nodes is 15kN but overall buckling of the top chord should be checked if loads are placed other than at restrained loads. Compression chord restraint required at 1.0m c/c
4. Factor of Safety = 1.65
5. Calculations as per BS EN 1999-1-2-A2
6. All allowable loads below take the self weight of the beam into account.

Client:	Apollo Scaff old Services Ltd			
Project:	Scaff old Beams 1.30m X-Beam			
Element:	Results Summary			
Job No:	22126-04	By:	pl	
Doc No:	001A	Checked:	mr	Date: Oct-22

Graph Summary of Allowable Working Loads for a 1.3m X-Beam to BS EN 1999-1-2+A2



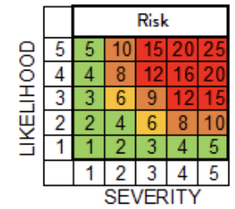
Client: Apollo Scaffold Services Ltd

Project: Scaffold Beams **Job No:** 22126-04 **By:** pl

Element: Designers Risk Assessment **Doc No:** 001A **Checked:** mr **Date:** Wednesday Oct 05, 2022

Impact:	Probability:
1: Nil or slight injury / illness, property damage or environmental issue.	1 - Highly Unlikely
2: Minor injury / illness, property damage or environmental issue.	2 - Unlikely
3: Moderate injury or illness, property damage or environmental issue.	3 - Possible
4: Major injury or illness, property damage or environmental issue.	4 - Likely
5: Fatal or long term disabling injury or illness, property damage or environmental issue.	5 - Highly Likely

Risk type:	
Design	D
Construction	C
Operational	O
Decomissioning	D
-	-

Risk Rating	
Risk Rating System:	
Where the rating is 5 or less, no further action is required.	
Where the rating is 6 or more, the risk is unacceptable and control measures are required.	

Ref No	Risk Type	Activity / Element	Potential Hazard	Population at Risk	Prob	Imp	Risk Rating	Action at Design Stage	Prob	Imp	Risk Rating	Residual Risk	Residual Risk Description	Notes
1	D	Member Failure	Failure of beam due to insufficient member capacity.	operative_contractors	3	5	15	All member capacities have been calculated as per the requirements detailed in BS EN 1999-1-1.	1	5	5	N		
2	D	Beam Failure	Failure of beam due to incorrect horizontal restraint locations.	operative_contractors	3	5	15	Beam has been checked with 1.00m chord restraints.	3	5	15	Y	Client to ensure beam is horizontally restrained at 1.00m centres prior to loadings.	

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