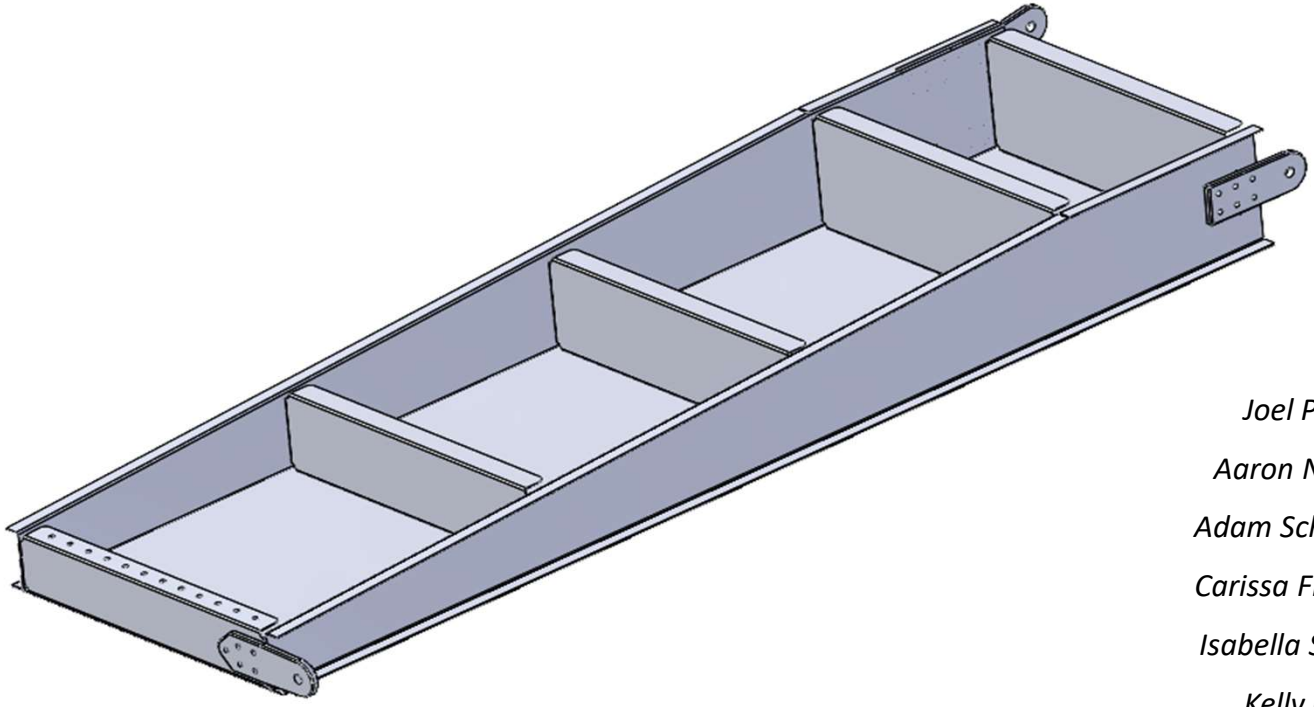
AERO3465:
Group 7 – Preliminary Design Review



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Interface Loads

x is positive aft;
y is positive right;
z is positive up;

LIMIT INTERFACE LOADS (N)												
Load Case	LUG P			LUG A			LUG B			LUG C		
Component	Px	Py	Pz	Ax	Ay	Az	Bx	By	Bz	Cx	Cy	Cz
1	0	0	-880	0	-11300	-66.0	0	11300	-66.0	0	0	1010
2	0	0	440	0	5650	33.0	0	-5350	33.0	0	0	-506
3	100	0	0	33.0	193	5.00	33.0	193	5.00	33	-385	-10.0
4	0	100	0	0	40.8	0	0	-25.8	0	0	-115	0

ULTIMATE INTERFACE LOADS (N)												
Load Case	LUG P			LUG A			LUG B			LUG C		
Component	Px	Py	Pz	Ax	Ay	Az	Bx	By	Bz	Cx	Cy	Cz
1	0	0	-1320	0	-16940	-99.0	0	16940	-99.0	0	0	1518
2	0	0	660	0	8470	49.5	0	-8470	49.5	0	0	-759
3	150	0	0	50	288	7.5	33.0	288	7.5	49.5	-577.5	-15
4	0	150	0	0	61.2	0	0	-38.7	0	0	-172.5	0

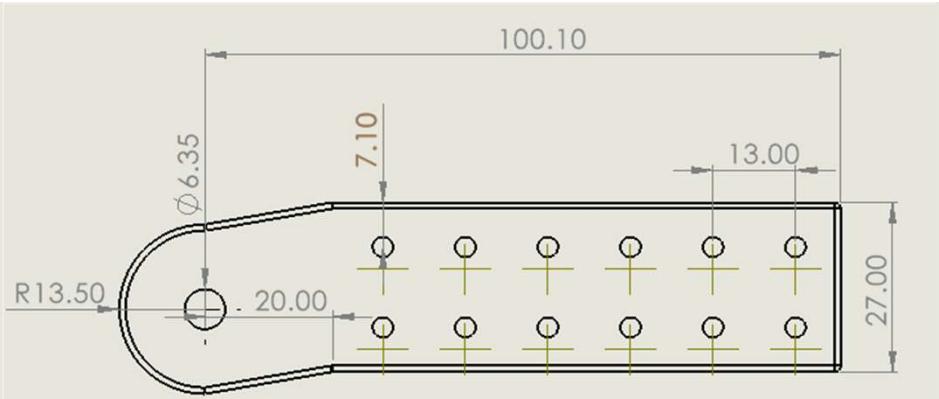
Determining Minimum Lug Dimensions

- ✓ Allowable loads for shear tear out, tension and transverse failure (Pbru, Ptu, Ptru) for respective efficiency (K) factors --> determine minimum a, width, A3 dimensions
- ✓ Margin of Safety Table Constructed – MoS > 0.05
- ✓ However, minimum rivet spacing requirements governed our preliminary design

Lug	Failure Mode	Load Case	Reactions C_x	C_y	C_z	MOS								
C	*Shear Bending Failure (axial (-F_Y) loads)*	Variable: k_br, determines 'a'. a:				0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4
		Allowable Load: P_bru				***2358.1***	***4847.2***	***7205.3***	***9170.3***	***11004.4***	***12576.5***	***14410.5***	***15982.6***	***17816.6***
		1	0	0	1012									
		2	0	0	-506									
		3	33	-385	-10	2.5506648	6.2985888	9.8492537	12.808141	15.569769	17.936879	20.698507	23.065617	25.827245
		4	0	-115	0	10.887008	23.434406	35.321414	45.227255	54.472706	62.397378	71.642829	79.567501	88.812952
	Tension Failure (axial (-F_Y) loads)	Variable: k_t, determines 'W'. Width:				6.985	7.62	7.9375	9.525	12.7	15.875	19.05	22.225	25.4
		Allowable Load: P_tu				***1310.0***	***2620.1***	***3209.6***	***6288.2***	***11790.4***	***16703.1***	***20960.8***	***28166.0***	***28690.0***
		1	0	0	1012									
		2	0	0	-506									
		3	33	-385	-10	0.9725916	2.9451832	3.8328494	8.4684396	16.753324	24.150543	30.561465	41.410719	42.199755
		4	0	-115	0	5.6038935	12.207787	15.179539	30.698689	58.435042	83.199643	104.6623	140.98371	143.62527
	Transverse Failure (Transverse loads, Fz)	Variable: k_tru, determines 'A3'. A_ave:				0.7661275	1.532255	2.2983825	3.06451	6.12902	9.19	12.26	15.32	18.39
		Allowable Load: P_tru				**524.0**	**917.0**	**1310.0**	**1572.1**	**3275.1**	**4585.2**	**6157.2**	**7336.3**	**8515.3**
		1	0	0	1012	-0.699823	-0.47469	-0.249558	-0.099469	0.8761061	1.6265486	2.5270795	3.2024777	3.8778759
		2	0	0	-506	-0.399646	0.0506194	0.5008849	0.8010619	2.7522122	4.2530971	6.054159	7.4049554	8.7557518
		3	33	-385	-10									
		4	0	-115	0									

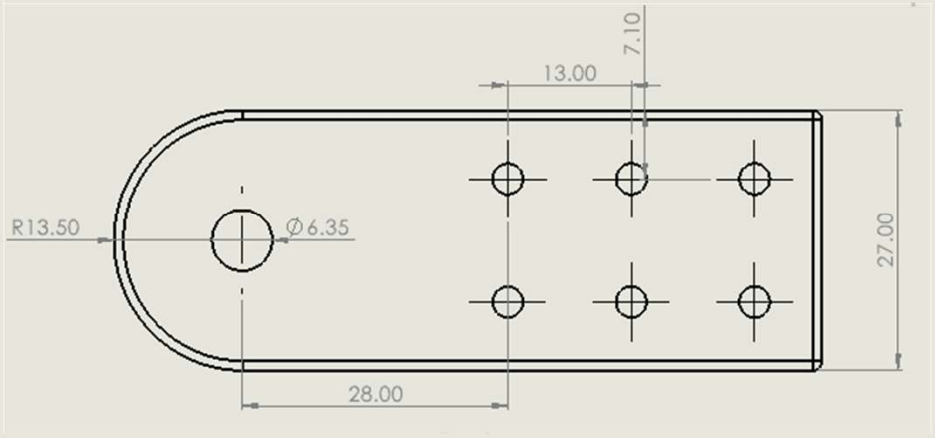
A & B Lug Design

- 12 Rivets
- 4.83mm thick
- MOS: 0.06 based on axial direct load



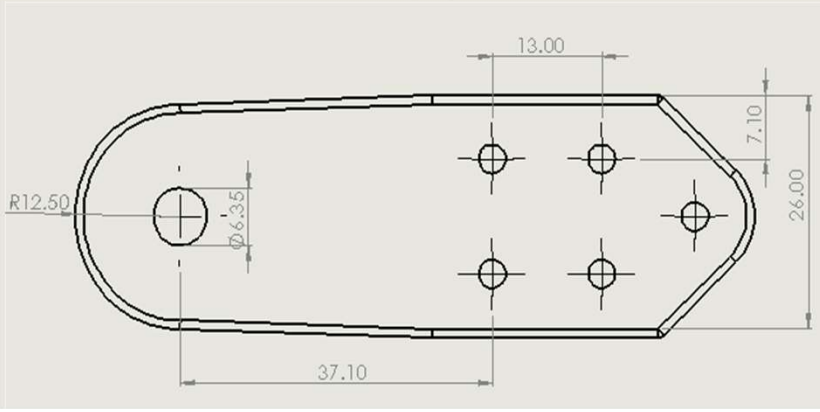
C Lug Design

-6 Rivets
- 4.83mm thick
- MOS: 0.8 based on fastener group analysis

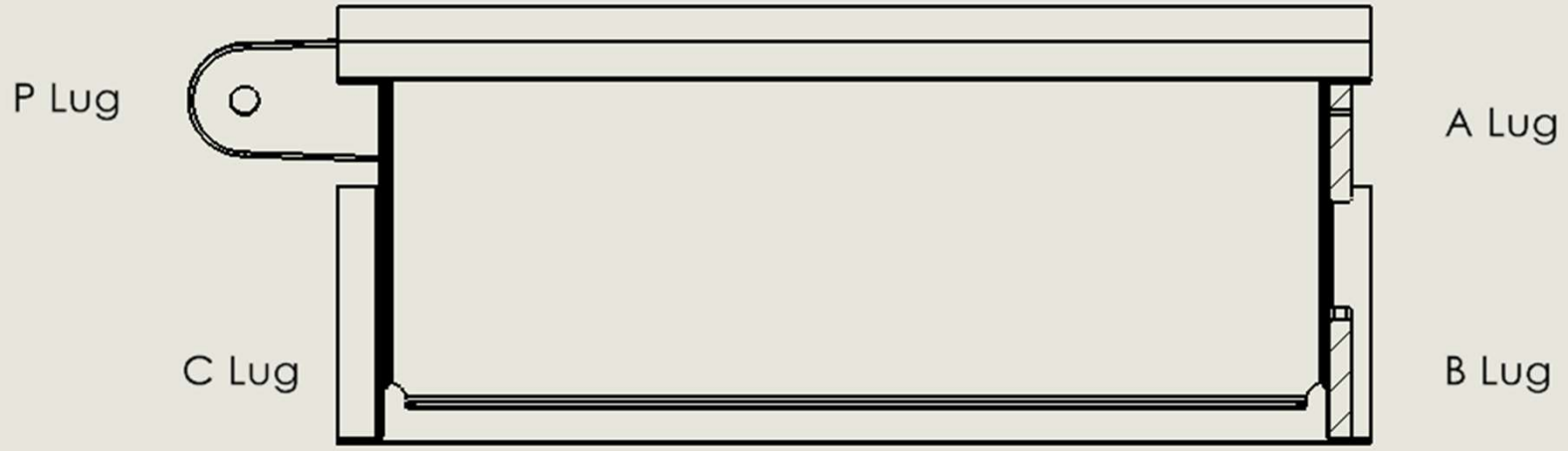


P Lug Design

- 5 Rivets
- 4.83mm thick
- MOS: 13.9 based on fastener group analysis



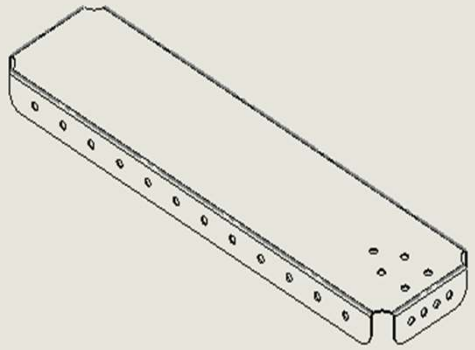
Cross section BL120

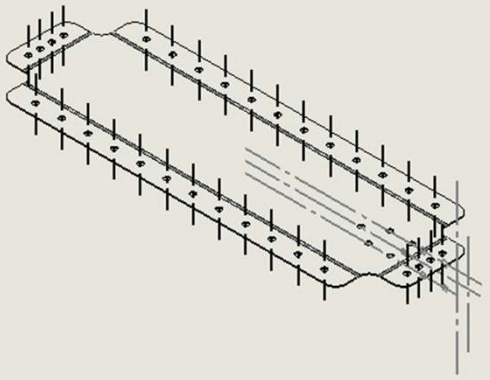


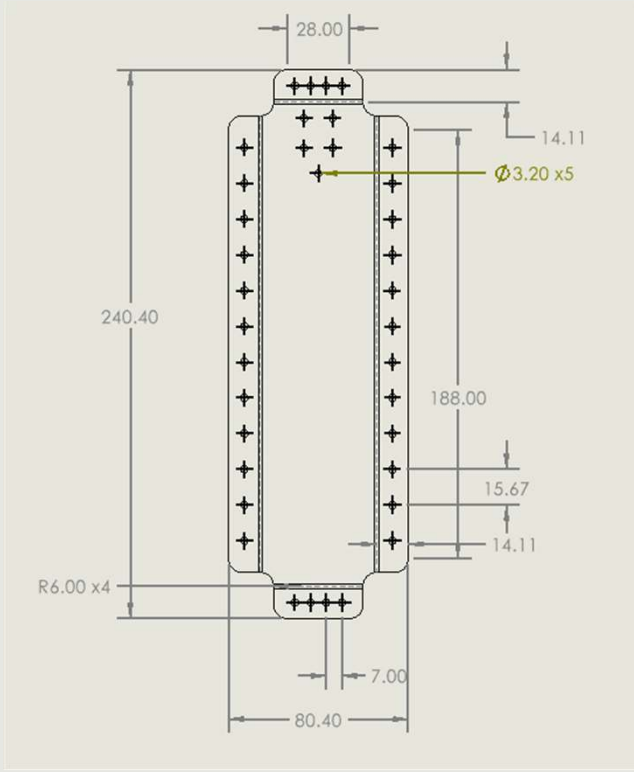
SECTION F-F

Layout of tip rib

- Thickness = 0.635mm
- Bend Radii = 1.905 mm
- Bend Allowance = 0.0388 mm
- Fastener Centre lines = 7.055mm
- Flange Width = 14.11 mm
- Number of rivets = 32



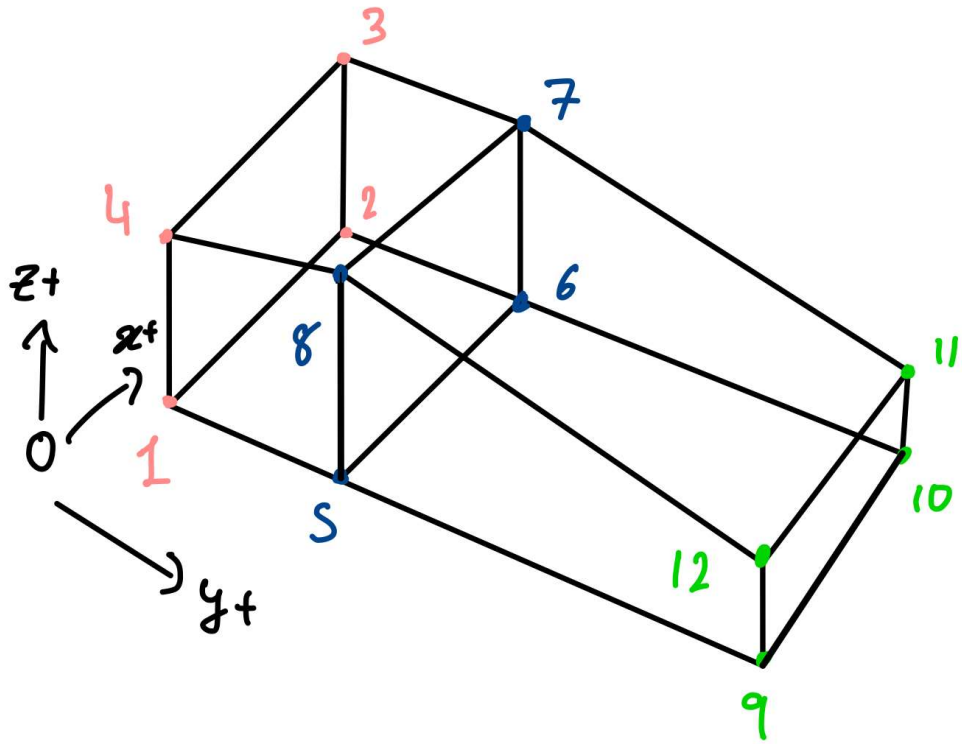




Structural Idealisation

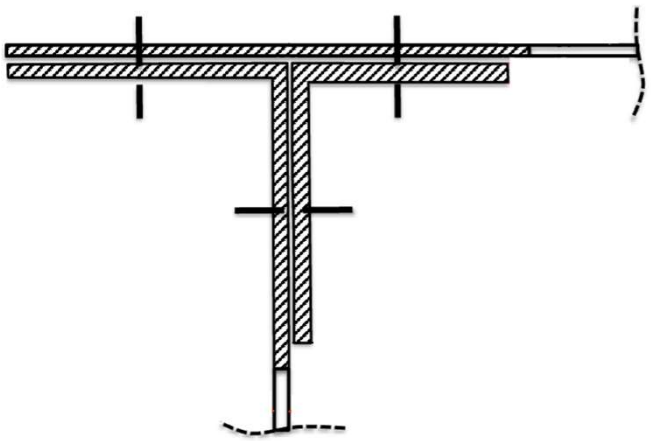
- Nodes 1, 2, 3, 4 make up the Inboard Rib.
- Nodes 5, 6, 7, 8 make up the Mid Rib.
- Nodes 9, 10, 11, 12 make up the Outboard Rib.

- Nodes 1, 5, 9, 4, 8, 12 make up the Forward Spar.
- Nodes 2, 6, 10, 11, 7, 3 make up the Rear Spar.



Boom Area Calculated Results

Nodes	Z-axis		Y-axis		X-axis	
	Area (mm^2)	Diameter (mm)	Area (mm^2)	Diameter (mm)	Area (mm^2)	Diameter (mmm)
1,2,3,4	1420	42.521	133.2105	13.023	3000	61.804
5,6	1420	42.521	133.2105	13.023	15000	138.20
7,8	1420	42.521	133.2105	13.023	12000	123.61
9,10	1420	42.521	133.2105	13.023	6000	87.403
11,12	1420	42.521	133.2105	13.023	9000	107.0474



Y-Axis Booms

$$A_{boom} \approx t_{Skin} * w_{effSkin} + t_{cap} * (w_{cap} + h_{cap}) + t_{spar} * (w_{flange} + w_{effWeb})$$

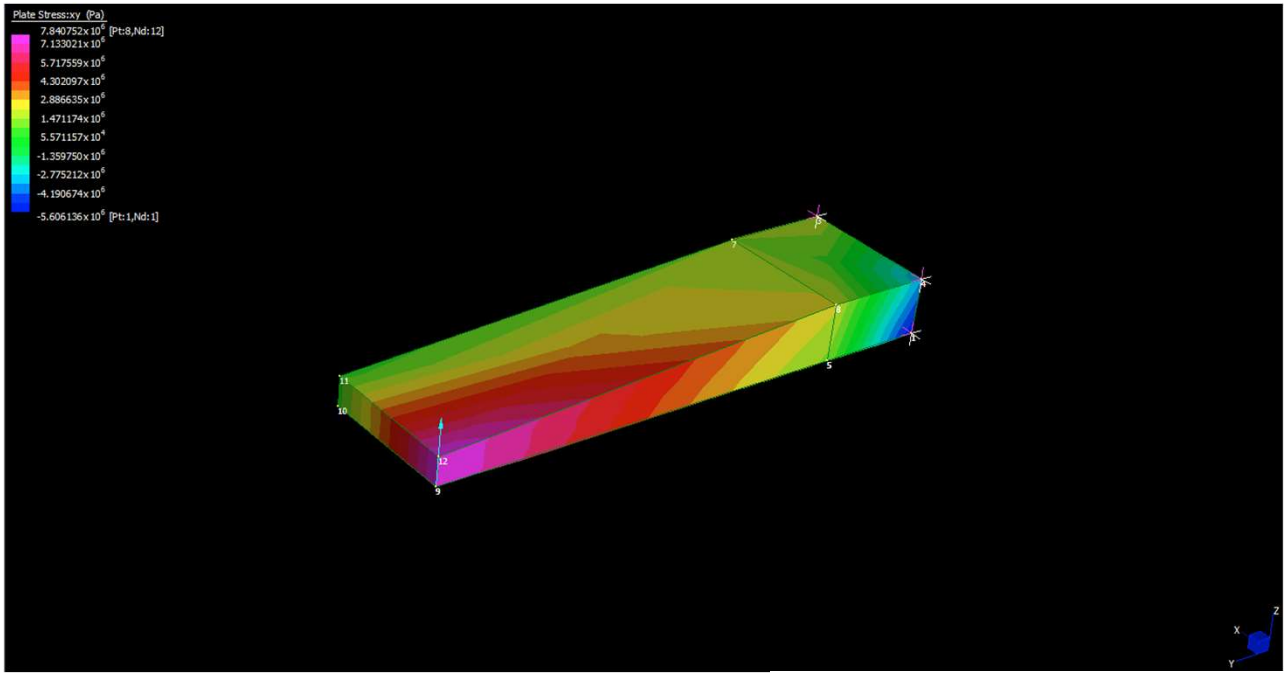
X-Axis Booms

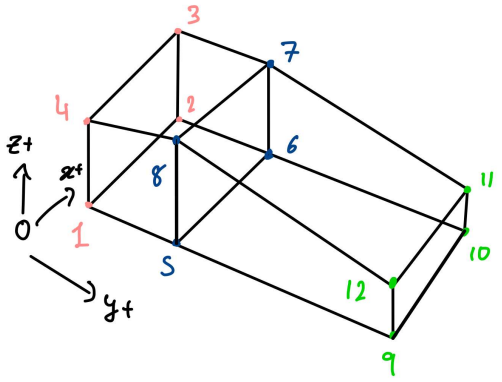
$$A_{boom} \approx (w_{spar} * h_{spar})$$

Z-Axis Booms

$$A_{boom} \approx (w_{rib} * l_{rib})$$

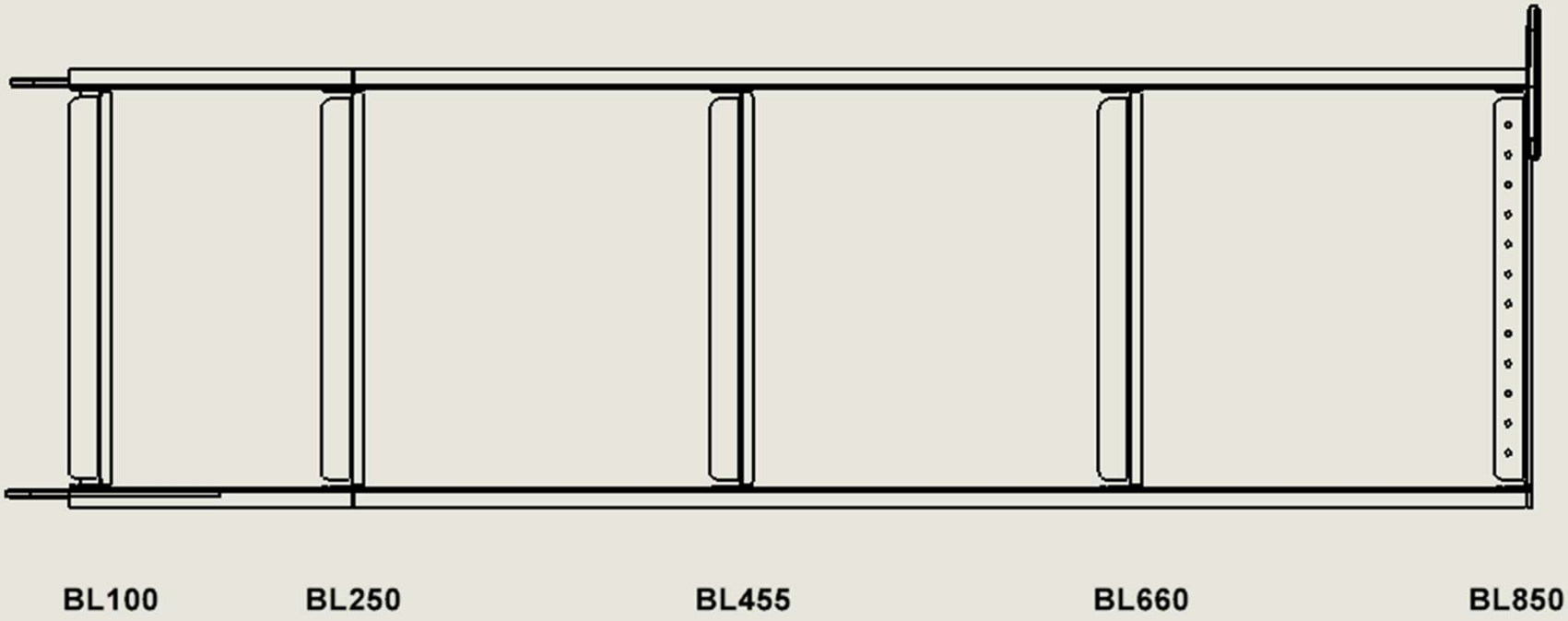
Shear Stress on Skin Panels – Load Case 1





Face	Nodes	Shear Stress (MPa)
1	1, 2, 3, 4	0.000
2	5, 6, 7, 8	0.218
3	9,10,11,12	-0.755
4	1, 5, 8, 4	3.163
5	2, 3, 6, 7	-13.660
6	5, 8, 12, 9	-1.645
7	6, 7, 10, 11	20.363
8	5, 6, 9, 10	3.914
9	1, 2, 6, 5	-3.158
10	3, 4, 8, 7	3.158
11	7, 8, 12, 11	3.914

Rib placement



Estimated Weight of 1122.95g using Al 2024-T3 Aluminum Sheeting
2.09% over the target limit without rivets, etc...