Floor Attachment Analysis

The apparatus will be attached to the plane with six 2" 5000 lb. rated NASA-provided straps connected at six points of the apparatus as in the figure below. Each strap will connect to a cargo ring, which is rated to 2000 lb (the limiting factor), screwed into the 20x20" grid in the floor of the aircraft.

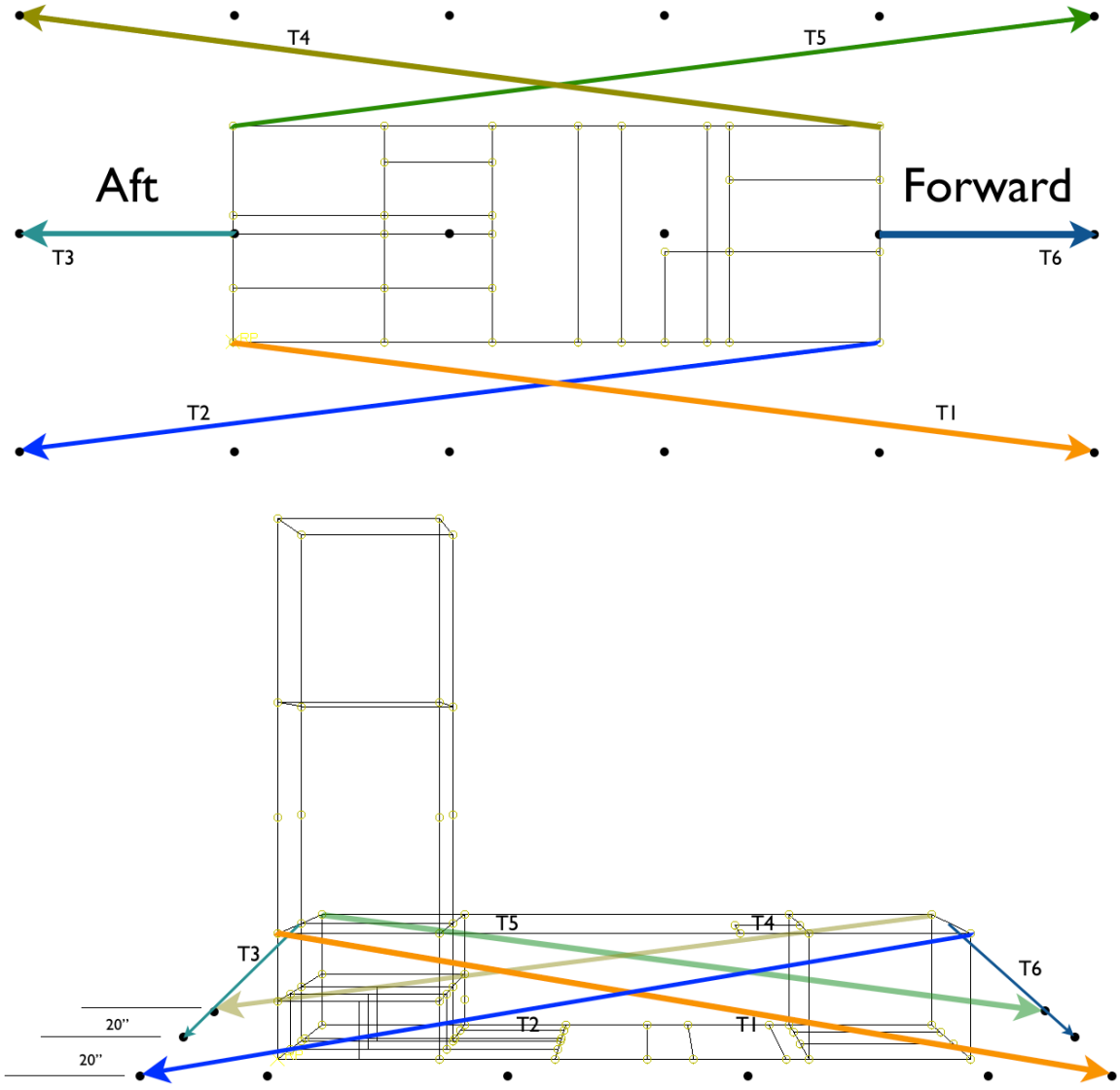

Figure XXX. Cargo strap attachment points

T1, T2, T4 and T5 are 82" long, T3 and T6 are 16" long, and all will be tensioned to 100 lb. while attaching apparatus to the floor. Friction was ignored and the center of gravity is as shown in figure 5.12. Note that T1=T2 and T4=T5 because the CG is approximately half-way into the apparatus. All angles were solved with simple geometry and are used in the equations to follow. A counterclockwise positive moment was chosen.

9G Forward

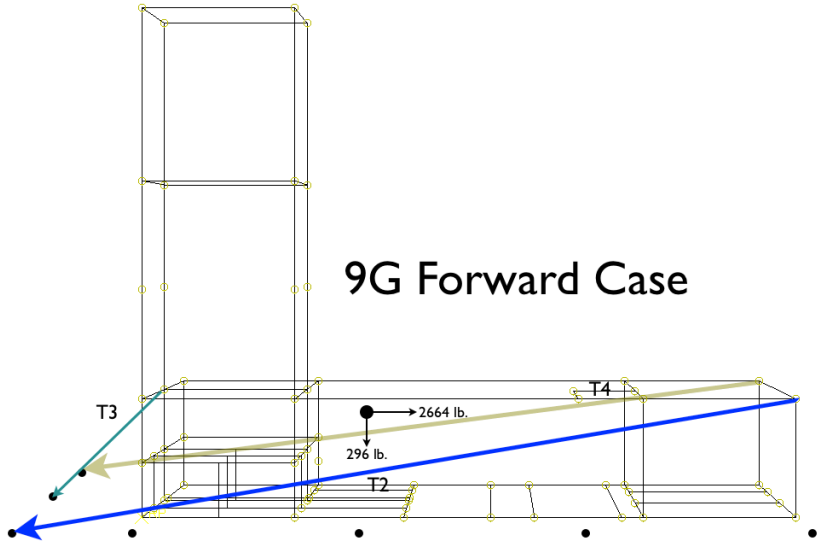

Figure XXX.

$\Sigma F_x = 0 = 9W - (T_2 + T_4)\cos(10°) - T_3\cos(35°)$
$\Sigma M_{CG} = 0$
$= (T_2 + T_4)(3" \cdot \cos(10°) - 39" \cdot \sin(10°)) + T_3(3" \cdot \cos(35°) + 21" \cdot \sin(35°))$

Solving yields T2=T4=1110 lb. and T3=584lb.

3G Aft

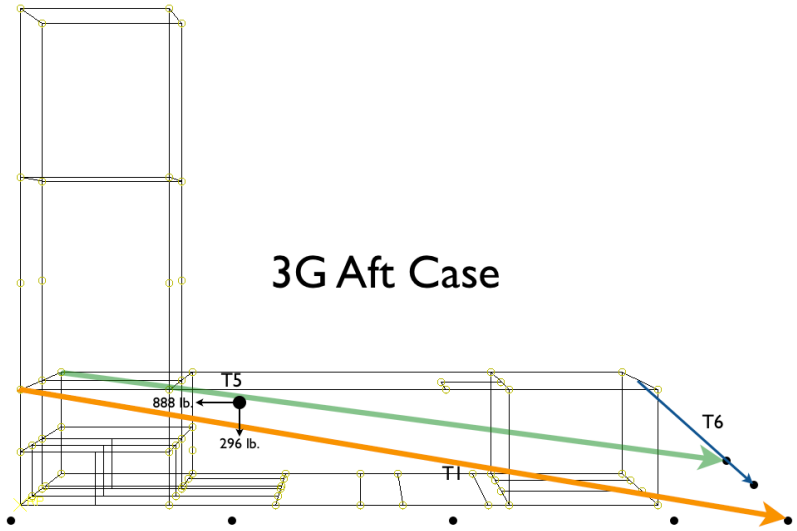

Figure XXX.

$\Sigma F_x = 0 = -3W + 2T_1\cos(10°) + T_6\cos(35°)$
$\Sigma M_{CG} = 0$
$= 2T_1(21" \cdot \sin(10°) - 3" \cdot \cos(10°)) - T_6(3" \cdot \cos(35°) + 39" \cdot \sin(35°))$

Solving yields T1=T5=441 lb. and T6=24.5 lb.

2G Lateral

This analysis neglects the aid of T3 and T6, which would only increase the MS.

$$\Sigma F_x = 0 = 2W - 2T_1 \cdot \cos(60°)$$

Solving yields T1=T2=592 lb.

2G Up

The up calculation introduces 4 equations and 4 unknowns. When approximating the load as distributed across all straps evenly, a MS of 4.8 is found. Because of this very large MS, the time-intensive process of the proper method was not done. Such an analysis assumes T1=T2=T4=T5 and T3=T6.

$$\frac{2W}{6} = T_1 \sin(10°) = T_3 \sin(35°)$$

Results

Table XXX. Margins of safety for floor attachment

	Forward			Aft			Lateral			Up		
	Load	Strap	Ring	Load	Strap	Ring	Load	Strap	Ring	Load	Strap	Ring
T1				441	4.67	1.27	592	3.22	0.69	570	3.39	0.75
T2	1110	1.25	-0.10				592	3.22	0.69	570	3.39	0.75
T3	584	3.28	0.71							173	13.45	4.78
T4	1110	1.25	-0.10							570	3.39	0.75
T5				441	4.67	1.27				570	3.39	0.75
T6				24.5	101.04	39.82				173	13.45	4.78