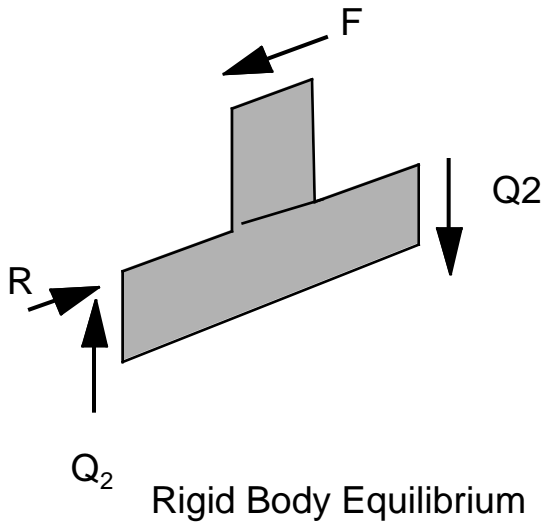


ME599
Automotive Body Structures
Solution for Homework #4

A

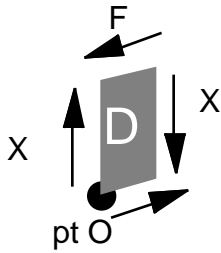


$$M_o = aF - LQ_2 = 0$$

$$Q_2 = (a/L) F$$

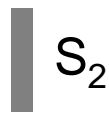
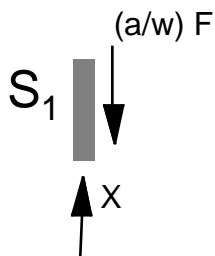
$$F = -F + R = 0$$

$$R = F$$



$$M_o = aF - wX = 0$$

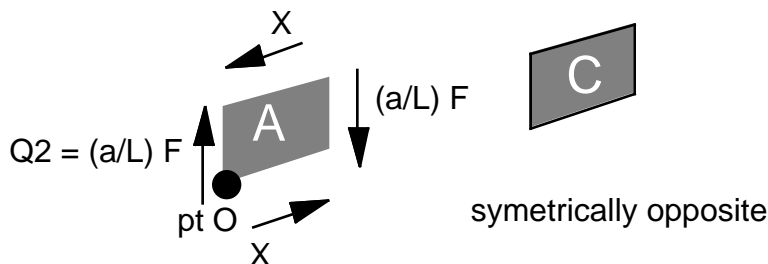
$$X = (a/w) F$$



symmetrically opposite

$$F = (a/w) F - X = 0$$

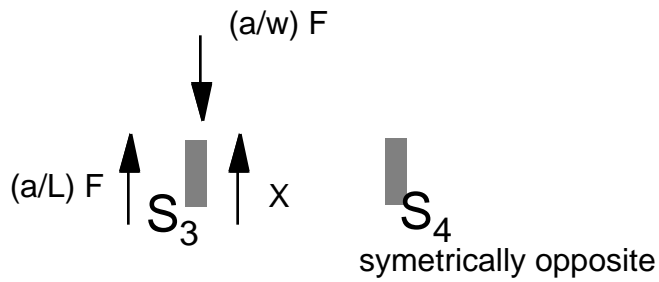
$$X = (a/w) F$$



$$M_o = \frac{(L-w)}{2} \frac{a F}{L} - hX = 0$$

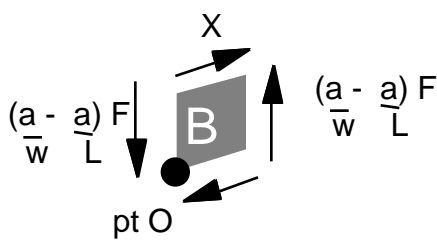
$$X = \frac{(L-w)a F}{2h L}$$

A CONTINUED



$$F = (a/w) F - (a/L) F - X = 0$$

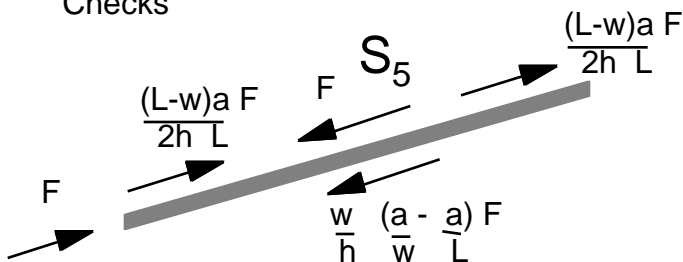
$$X = \left(\frac{a}{w} - \frac{a}{L} \right) F$$



$$M_o = w \left(\frac{a}{w} - \frac{a}{L} \right) F - hX$$

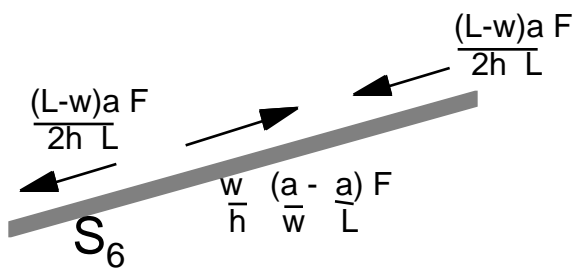
$$X = \frac{w}{h} \left(\frac{a}{w} - \frac{a}{L} \right) F$$

Checks



$$F = 0$$

OK



$$F = 0$$

OK

B

$$P_{CRIT} = K \frac{2E}{12 \left(1 - \nu^2\right) \frac{w}{t^3}}$$

Note: w in this equation is the narrow dimension of the plate

=.29, other values as given

Panel	w (in above Eqn) (in)	t (in)	cr (psi)	Shear Area (in ²)	Edge Force (lb)	Edge Force in terms of F	Force, F, at top when buckling occurs (lb)
A	4	0.035	10313	h*t= 0.14	1444	=0.4F	3609
B	4	0.035	10313	w*t= 0.14	1444	=1.6F	902
C	4	0.035	10313	h*t= 0.14	1444	= .4F	3609
D	4	0.042	14850	w*t= 0.168	2495	= F	2495

C

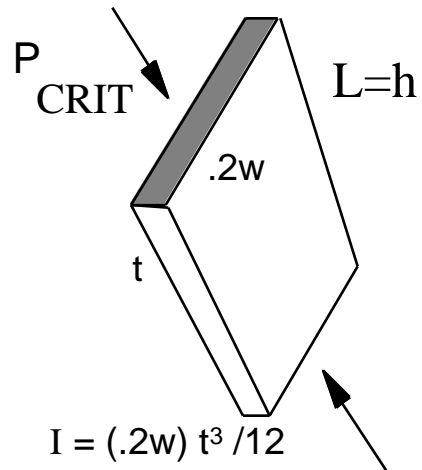
Euler Beam Buckling
simply supported ends

$$P_{CRIT} = \frac{\pi^2 EI}{L^2}$$

$$P_{CRIT} = 52.9 \text{ Lb}$$

$$(a/w)F = P_{crit}$$

$$F = 26.45 \text{ Lb}$$



To improve Buckling load 1) add rib along spar 3, 2) add bulkhead to stabilize this area, 3) increase thickness, 4) use material with higher modulus of elasticity, 5) add foam to section to stabilize