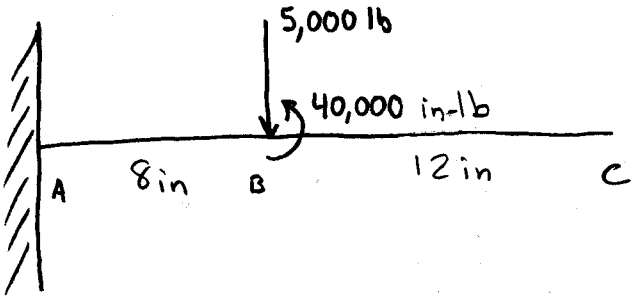
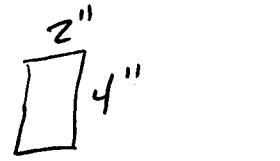
ME 340
1/4/98

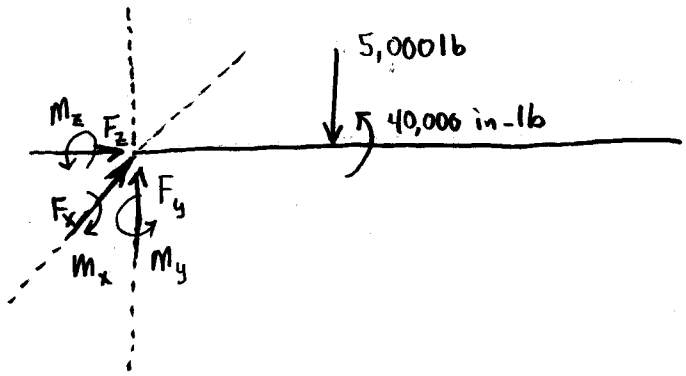
STATICS/SOLIDS REVIEW PROBLEM





CROSS-SECTION

FBD:



STATICS: (FIND RXNS @ A)

$\Sigma F_x = 0;\ F_x = 0$

$\Sigma F_y = 0;\ F_y = 5{,}000\text{lb}$

$\Sigma F_z = 0;\ F_z = 0$

$\Sigma M_x = 0;\ M_x - 40{,}000\ \text{in-lb} + 5{,}000\text{lb}(8\text{in})$

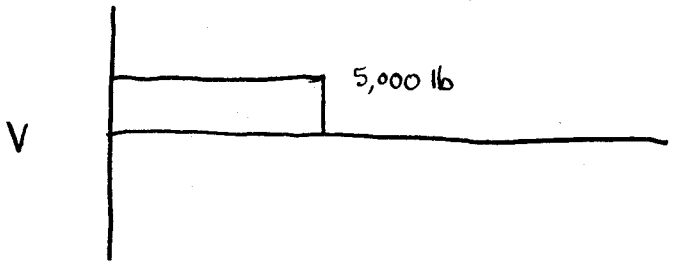
$M_x = 40{,}000\ \text{in-lb} - 5{,}000\text{lb}(8\text{in})$

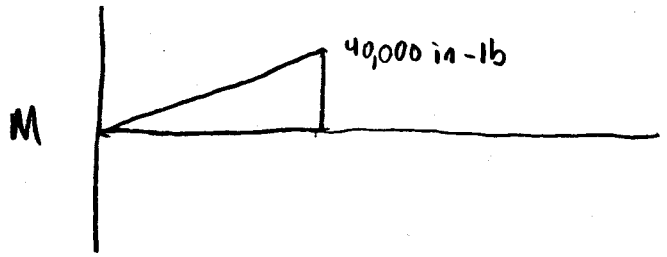
$M_x = 0$

$\Sigma M_y = 0;\ M_y = 0$

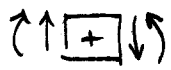
$\Sigma M_z = 0;\ M_z = 0$

SHEAR AND MOMENT DIAGRAMS:





SIGN CONVENTION



REMEMBER:

$$\frac{dM}{dx} = V$$

MAX BENDING STRESS:

$$\sigma = \frac{Mc}{I} = \frac{12Mc}{bh^3} = \frac{12(40{,}000\text{in-lb})\,2\text{in}}{2\text{in}(4\text{in})^3} = 7{,}500\ \text{psi}$$

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FIND DEFLECTION AT C:

(SUPERPOSITION OF CANTILEVER BEAM WITH APPLIED MOMENT AND CANTILEVER BEAM WITH CONCENTRATED LOAD)

$$y_c = \frac{M_A l^2}{2EI} + \frac{Fa^2}{6EI}(a - 3l)$$

WHERE:

M_A = APPLIED MOMENT = 40,000 in-lb

l = TOTAL LENGTH OF BEAM = 20 in

E = ELASTIC CONSTANT = UNKNOWN

I = BENDING MOMENT OF INERTIA $\frac{bh^3}{12} = \frac{2(4^3)}{12} = 10.67\ in^4$

F = CONCENTRATED FORCE = 5,000 lb

a = DISTANCE TO APPLIED FORCE = 8 in

$$y_c = \frac{1}{E}\left(\frac{40{,}000\ in\text{-}lb\,(20\ in)^2}{2(10.67\ in^4)} + \frac{5{,}000\ lb\,(8\ in)^2}{6(10.67\ in^4)}(8\ in - 3(20\ in))\right)$$

$$= \frac{1}{E}\left(4.90 \times 10^5\right)$$

IF WE ASSUME A STEEL BEAM, $E = 30 \times 10^6$ psi

$$y_c = \frac{4.90 \times 10^5\ lb/in}{30 \times 10^6\ lb/in^2} = 0.016\ in$$