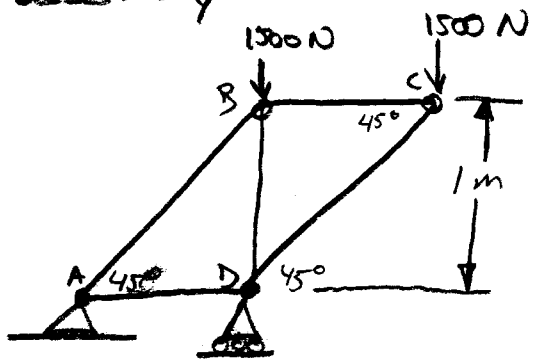
ME111 Solutions to PS #1

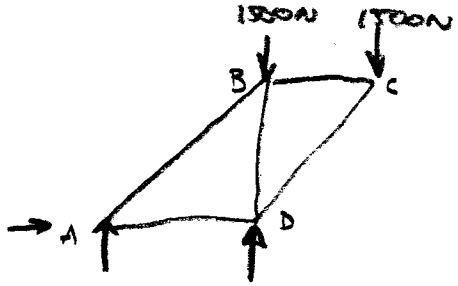
2.5

FIND: magnitude of forces acting on each member of assembly

GIVEN:



SOLUTION: ① FIND EXTERNAL FORCES



$\Sigma F_x = 0$

$0 = F_{Ax}$

$\Sigma M_A = 0$

$0 = (-1500\,N)(1\,m) - (1500\,N)(2\,m) + (F_{Dy})(1\,m)$

$F_{Dy} = 4500\,N\cdot m$

$\Sigma F_y = 0$

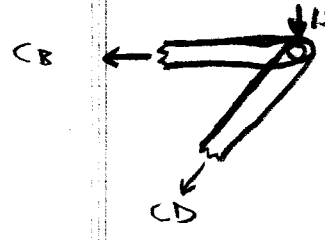
$0 = F_{Ay} + F_{Dy} - 1500\,N - 1500\,N$

$F_{Ay} = 3000\,N - F_{Dy} = 3000\,N - 4500\,N$

$F_{Ay} = -1500\,N$

NOTE: tension = positive

② FIND FORCES AT PIN C:



$\Sigma F_x = 0$

$0 = -F_{CB} - F_{CD}\cos 45°$

$F_{CB} = -\frac{1}{\sqrt{2}} F_{CD}$

$\Sigma F_y = 0$

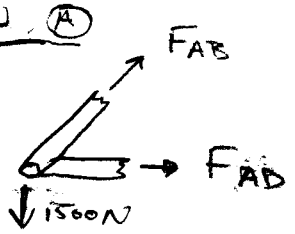
$0 = -1500\,N - F_{CD}\sin 45°$

$F_{CD} = -2121\,N$ (compression)

$F_{CB} = 1500\,N$ (tension)

2.5 (cont.)

PIN (A)



$\Sigma F_x = 0$

① $0 = F_{AD} + \frac{1}{\sqrt{2}} F_{AB}$

$\Sigma F_y = 0$

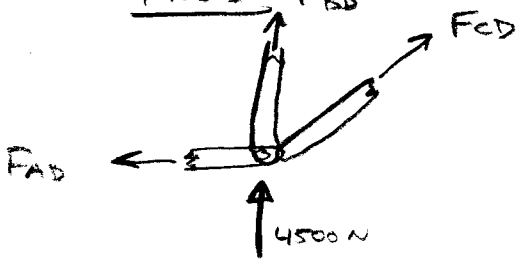
$0 = -1500\,N + \frac{1}{\sqrt{2}} F_{AB}$

② $F_{AB} = 2121\,N$ (tension)

from ①: $0 = F_{AD} + \frac{1}{\sqrt{2}} F_{AB}$

$F_{AD} = 1500\,N$ (compression)

PIN D



$\Sigma F_y = 0$

$0 = 4500\,N + F_{CD} \sin 45° + F_{BD}$

$0 = 4500\,N + -\frac{2121\,N}{\sqrt{2}} + F_{BD}$

$F_{BD} = -3000\,N$

$F_{BD} = 3000\,N$ (compression)

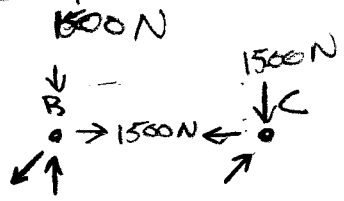
$F_{AB} = 2121\,N$ tens.

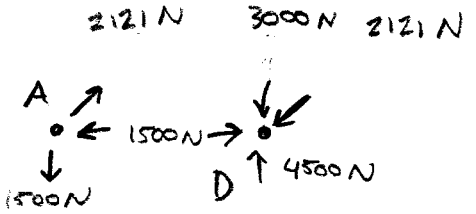
$F_{AD} = 1500\,N$ comp.

$F_{BC} = 1500\,N$ tens.

$F_{CD} = 2121\,N$ comp.

$F_{BD} = 3000\,N$ Comp.

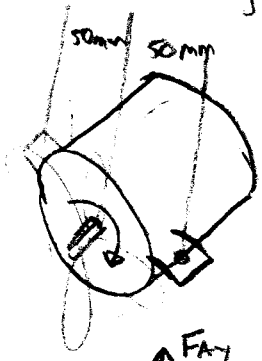




2.7

FIND: All loads acting on fan

GIVEN:

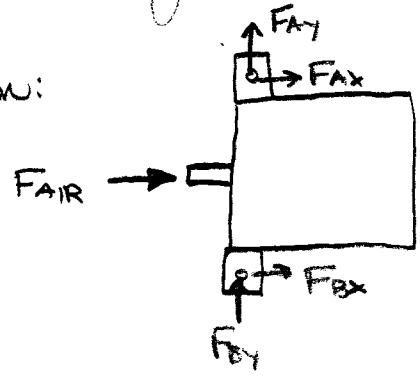


ASSUME: no gravity, no friction

$F_{AIR} = 20\ N$

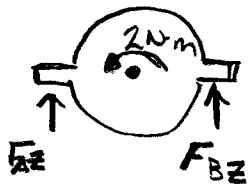
$T = 2\ N\cdot m$

SOLUTION:



Top View

FRONT VIEW



$\Sigma F_x = 0$

$0 = F_{AIR} + F_{Ax} + F_{Bx}$

$-20\ N = F_{Ax} + F_{Bx}$

$\boxed{F_{Ax} = F_{Bx} = -10\ N}$

$\Sigma M^{+}) = 0$

① $0 = 2\ N\cdot m - (F_{Az})(.05\ m) + (F_{Bz})(.05\ m)$

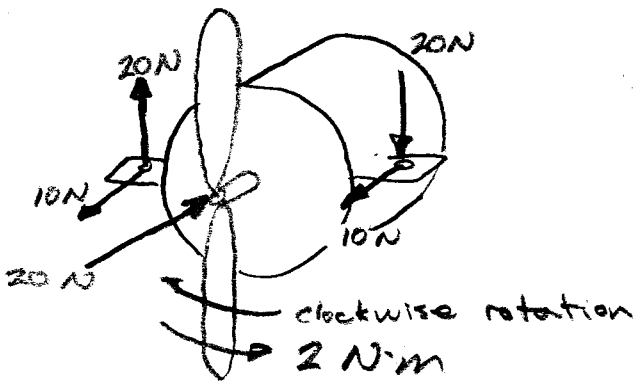
② $F_{Az} = -F_{Bz}$

from ① + ②: $0 = 2\ N\cdot m + (2F_{Bz})(.05\ m)$

$-2\ N\cdot m = .1\ F_{Bz}$

$\boxed{F_{Bz} = -20\ Nm}$

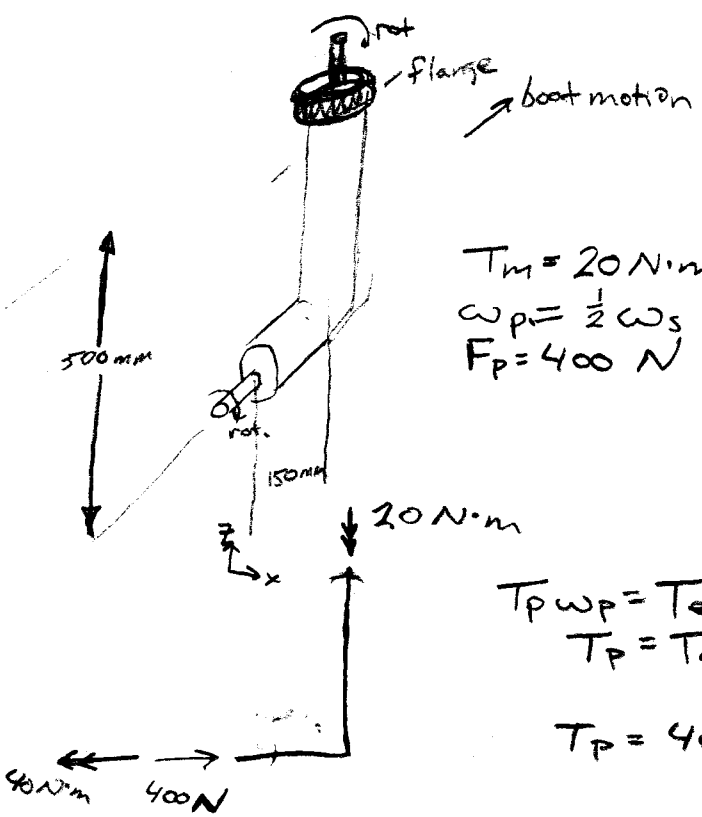
$\boxed{F_{Az} = 20\ Nm}$

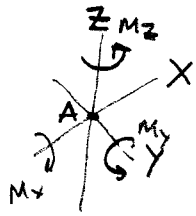


2.10

FIND: External loads acting on assembly

GIVEN:





$T_M = 20\ N\cdot m$

$\omega_p = \frac{1}{2}\omega_s$

$F_p = 400\ N$

ASSUME: no gravity, no friction

SOLUTION:

$T_p \omega_p = T_e \omega_e$

$T_p = T_e \frac{\omega_e}{\omega_p} = 2T_e = (2)(20\ N\cdot m)$

$T_p = 40\ N\cdot m$

$\Sigma F_x = 0$

$0 = 400\ N + F_{Ax}$

$F_{Ax} = -400\ N$

$\Sigma F_y = 0$

$F_{Ay} = 0$

$\Sigma F_z = 0$

$F_{Az} = 0$

$\Sigma M_x = 0$

$0 = -40\ N\cdot m + M_{Ax}$

$M_{Ax} = 40\ N\cdot m$

$\Sigma M_y = 0$

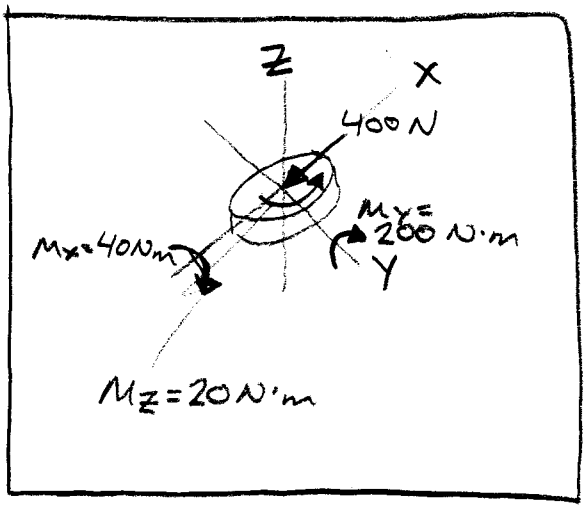
$0 = (400\ N)(.5\ m) + M_{Ay}$

$M_{Ay} = -200\ N\cdot m$

$\Sigma M_z = 0$

$0 = -20\ N\cdot m + M_{Az}$

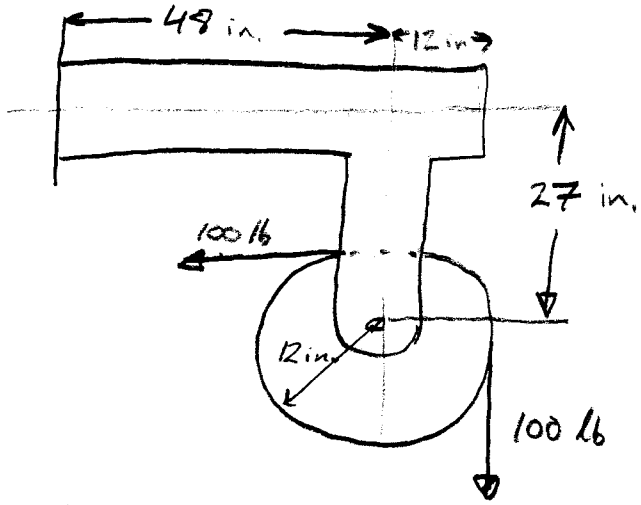
$M_{Az} = 20\ N\cdot m$



2.19

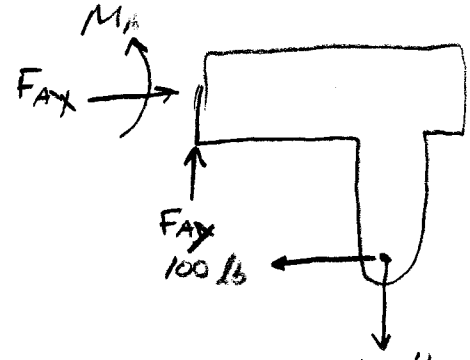
FIND: a. FBD of structure
b. shear and bending moment diagrams for vert. and horiz. portion of structure

GIVEN:



SOLUTION:

a.



$\Sigma F_x = 0 = -100\ lb + F_{AY}$

$F_{AY} = 100\ lb$

$F_{AX} = 100\ lb$

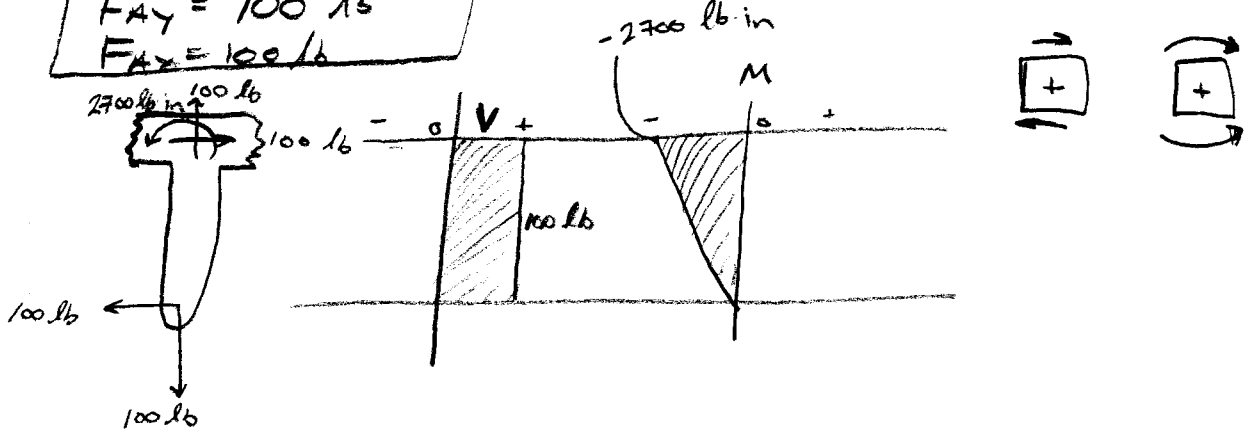
$\Sigma M_A = 0$

$0 = M - (100\ lb)(27\ in.) - (100\ lb)(48\ in.)$

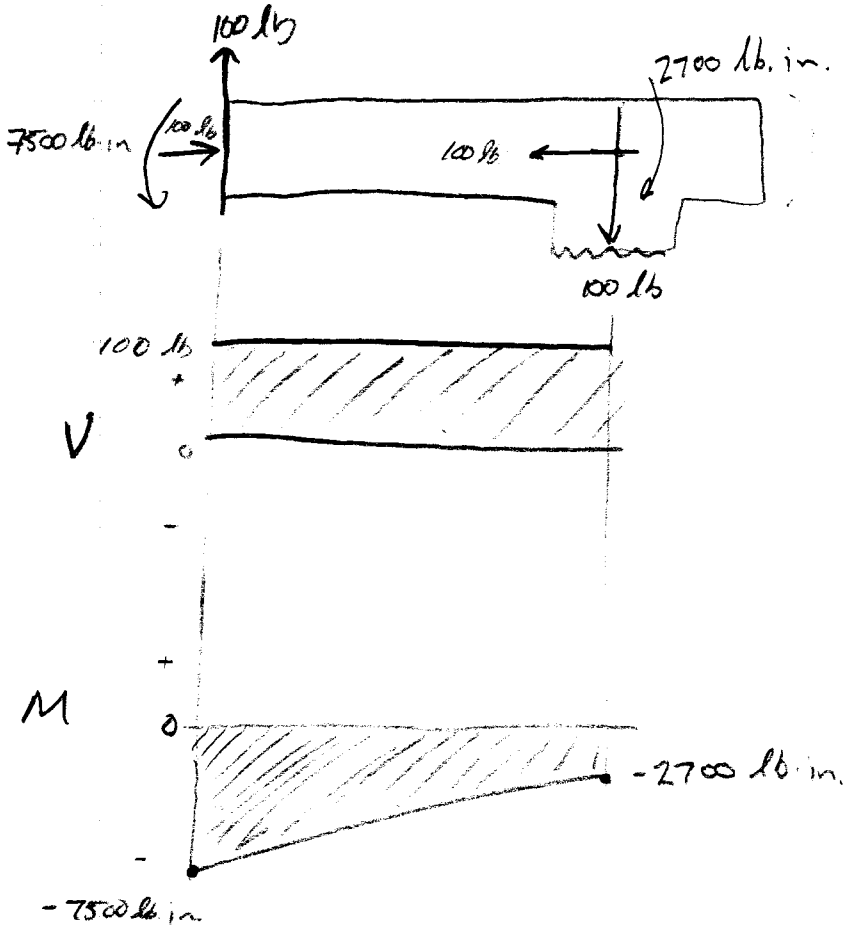
$M = 7500\ lb \cdot in.$

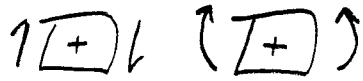
$M = 7500\ lb \cdot in.$
$F_{AY} = 100\ lb$
$F_{AX} = 100\ lb$

b.



2.19 (cont.)


100 lb
2700 lb. in.
7500 lb. in
100 lb
100 lb
100 lb
V
+
0
-
M
+
0
-2700 lb. in.
-
-7500 lb. in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