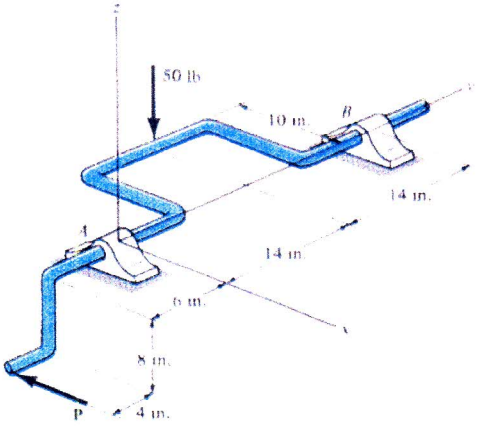
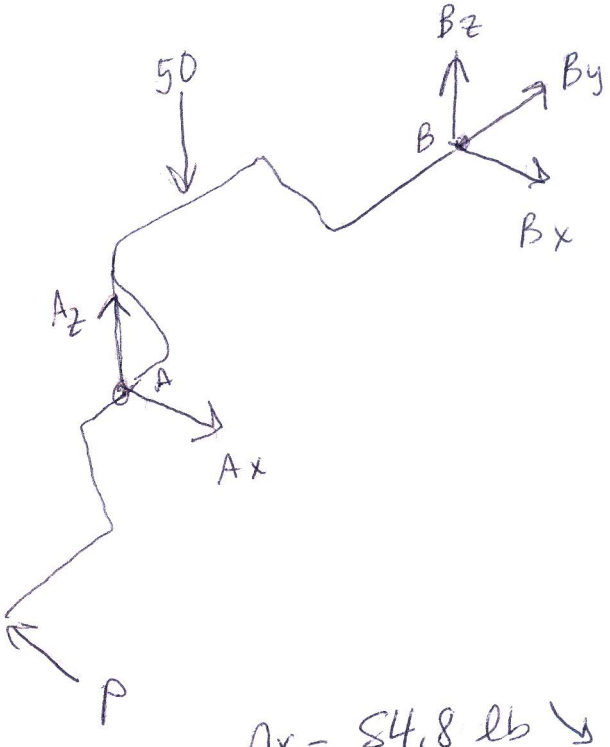
Practice Exam 2

1. A vertical force of 50 lb acts on the crankshaft. Determine the horizontal equilibrium force **P** that must be applied to the handle and the x, y, z components of reaction at the journal bearing A and thrust bearing B. The bearings are properly aligned and exert only force reactions on the shaft.





$\Sigma F_x = A_x + B_x - P = 0$

$\Sigma F_y = B_y = 0$

$\Sigma F_z = A_z - 50 + B_z = 0$

$\Sigma M_{A_x} = -50(14) + B_z(28) = 0$

$B_z = +\frac{50(14)}{28} = 25 \text{ lb} \uparrow$

$\Sigma M_{A_y} = -50(10) + P(8) = 0$

$P = \frac{50(10)}{8} = 62.5 \text{ lb} \leftarrow$

$\Sigma M_{A_z} = -P(10) - B_x(28) = 0$

$-B_x = \frac{P(10)}{28} = -22.3 \leftarrow$

$\Sigma F_x = A_x + B_x - P = 0$

$A_x = P - B_x = 62.5 - (-22.3) = 84.8 \text{ lb} \searrow$

$\Sigma F_z \Rightarrow A_z = 50 - B_z = 50 - 25 = 25 \text{ lb} \uparrow$

$A_x = 84.8 \text{ lb} \searrow$

$A_z = 25 \text{ lb} \uparrow$

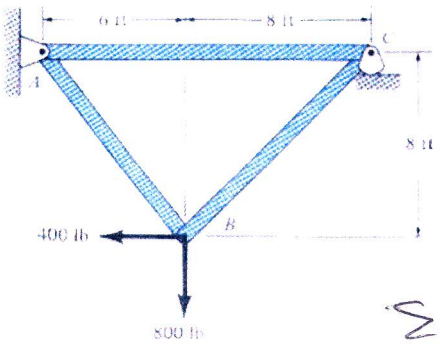
$B_x = -22.3 \leftarrow \text{lb}$

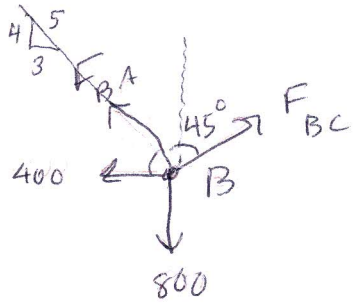
$B_y = 0$

$B_z = 25 \text{ lb} \uparrow$

$P = 62.5 \text{ lb} \leftarrow$

2. Determine the force in each member of the truss and state if the members are in tension or compression.





$$\Sigma F_x = -400 - \frac{3}{5}F_{BA} + F_{BC}\sin 45^\circ = 0$$

$$\Sigma F_y = -800 + \frac{4}{5}F_{BA} + F_{BC}\cos 45 = 0$$

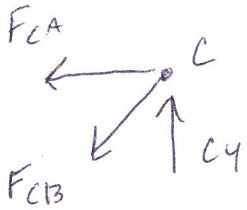
$$F_{BA} = \frac{800 - F_{BC}\cos 45}{\frac{4}{5}}$$

$$\Sigma F_x = -400 - \frac{3}{5}\left[\frac{-800 - F_{BC}\cos 45}{4/5}\right] + F_{BC}\sin 45 = 0$$

$F_{BC} = 808$ lb (T)

$F_{BC} = \frac{808}{808}$ lb (T)

$F_{AB} = \frac{286}{286}$ lb (T)



$$\Sigma F_x = -F_{CA} - F_{CB}\cos 45^\circ = 0$$

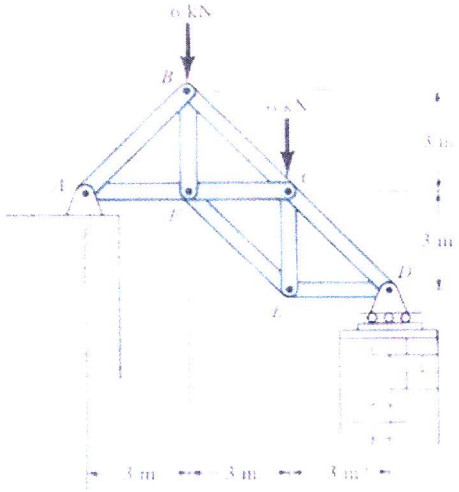
$$F_{CA} = -F_{CB}\cos 45 = -571 \text{ lb (C)}$$

$F_{BC} = 800$ lb (T)

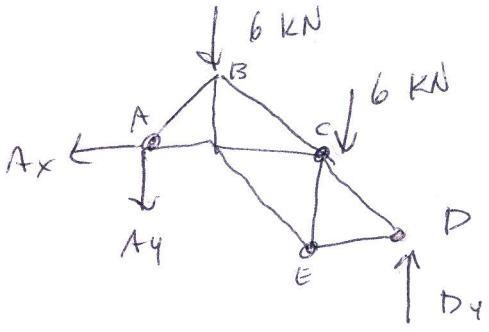
$F_{AB} = 286$ (T)

$F_{AC} = 571$ (C)

3. Determine the force in members BC, FC, and FE. State if the members are in tension or compression.



Whole body FBD to find D_y



$\Sigma F_x = A_x = 0$

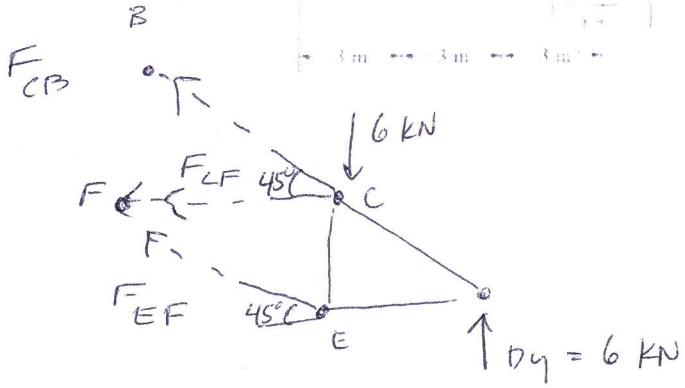
$\Sigma F_y = -A_y - 6 - 6 + D_y = 0$

$\Sigma M_A = -3(6) - 6(6) + D_y(9) = 0$

$-18 - 36 + 9D_y = 0$

$D_y = 6\ kN \uparrow$

$A_y = -6\ kN$ ✱ $\uparrow$



$\Sigma M_C = D_y(3) - \cos 45\, F_{EF} = 0$

$F_{EF} = 8.49\ kN\ (T)$

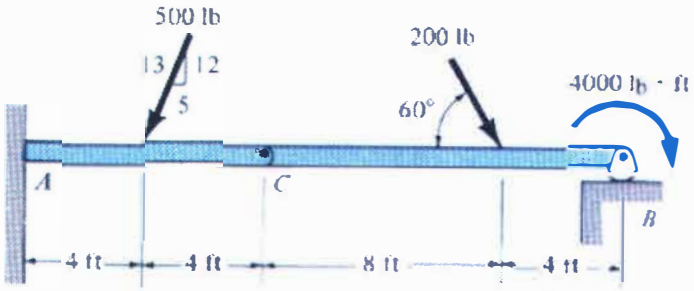
$\Sigma M_F = D_y(6) - 6\ kN(3) + F_{BC}\cos 45\,(3) = 0$

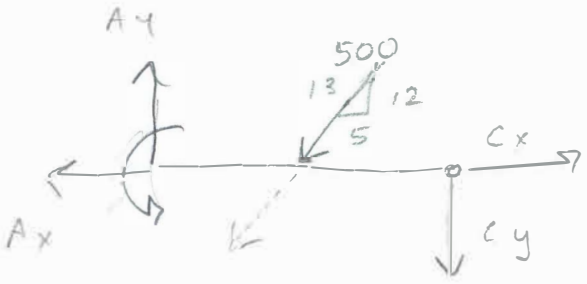
$F_{BC} = -8.49\ kN\ (C)$

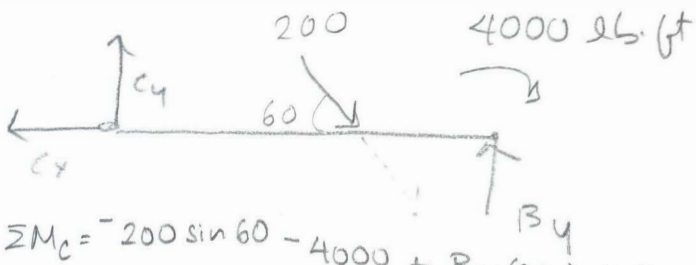
$\Sigma F_x = -F_{FC} - \sin\cos 45\, F_{CB} - \cos 45\, F_{EF} = 0$

$F_{FC} = 0$

4. The compound beam is supported by a rocker at B and is fixed to the wall at A. If it is hinged (pinned) together at C, determine the reactions at the supports.







$\Sigma M_C = -200 \sin 60 - 4000 + B_y(20) = 0$

$B_y = \frac{200 \sin 60 + 4000}{20} = 208.7 \text{ lb}$

$\Sigma M_A = -500 \frac{12}{13}(4 \text{ ft}) - C_y(8 \text{ ft}) + M_A = 0$

$\Sigma F_y = A_y - 500 \frac{12}{13} - C_y = 0$

$\Sigma F_x = -C_x + 200 \cos 60 = 0$

$C_x = 100 \text{ lb}$

$\Rightarrow -C_x = A_x = -92 \text{ lb}$

$\Sigma F_x = -A_x + C_x - 500 \, 5/13 = 0$

$\Sigma F_y = C_y - 200 \sin 60 + B_y = 0$

$C_y = 200 \sin 60 - 208.7$

$C_y = -35.5 \text{ lb}$

$\Sigma F_y = A_y - 500 \frac{12}{13} - (-35.5) = 0$

$A_y = 500 \frac{12}{13} - 35.5$

$A_y = 426 \text{ lb} \uparrow$

$\Sigma M_A = -500 \frac{12}{13}(4 \text{ ft}) - (-35.5)\, 8 \text{ ft} + M_A = 0$

$M_A = 500 \frac{12}{13}(4 \text{ ft}) - 35.5 \text{ lb}(8 \text{ ft})$

$1846.2 \text{ lb·ft} \circlearrowleft$

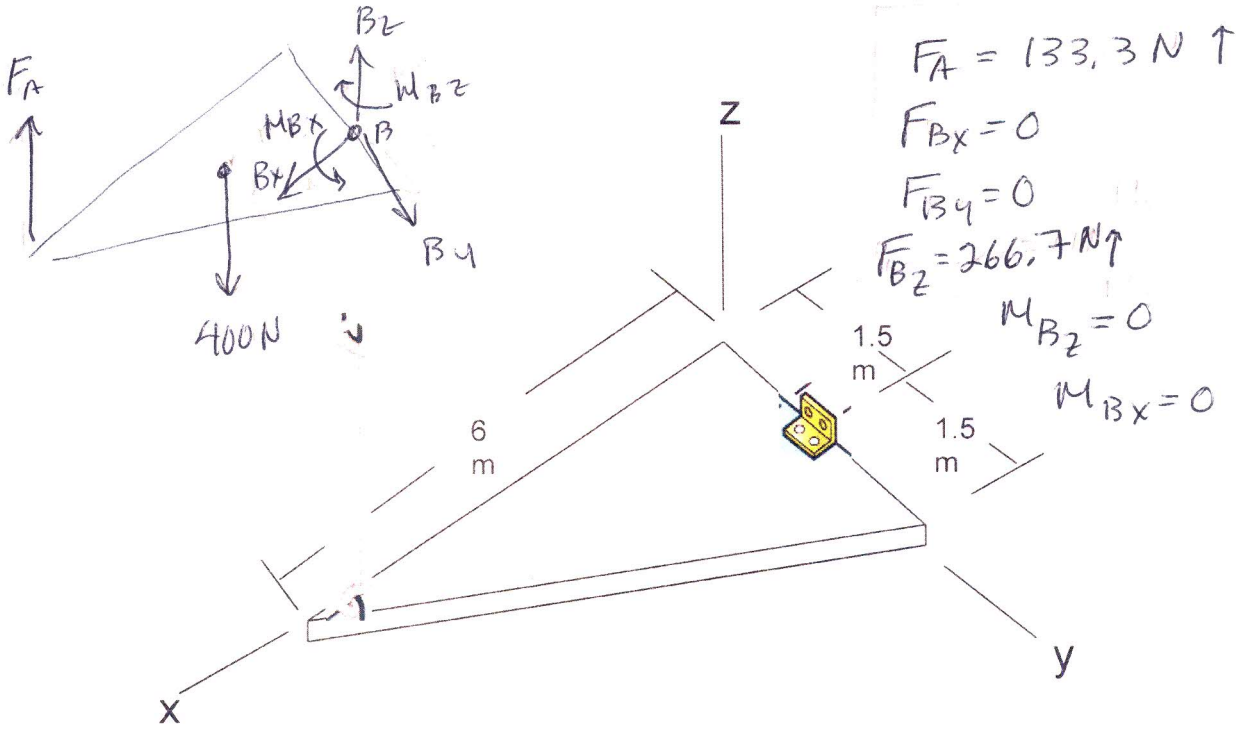
$A_x = 92 \text{ lb} \leftarrow$

$A_y = 426 \text{ lb} \uparrow$

$M_A = 1846.2 \text{ lb·ft} \circlearrowleft$

$B_y = 208.7 \text{ lb} \uparrow$

5. A triangular plate is supported by a cable at A and a hinge at B. Its weight is 400 N and the material is homogeneous. Determine the tension in the cable and the loads acting on the plate at the hinge.



$F_A = 133.3\ N \uparrow$

$F_{Bx} = 0$

$F_{By} = 0$

$F_{Bz} = 266.7\ N \uparrow$

$M_{Bz} = 0$

$M_{Bx} = 0$

$\Sigma F_x = B_x = 0 \qquad F_{Bx} = 0$

$\Sigma F_y = B_y = 0 \qquad F_{By} = 0$

$\Sigma F_z = F_A - 400 + B_z = 0$

$F_A \downarrow$

$133 - 400 + B_z = 0$

$B_z = 400 - 133 = 266.7\ N \uparrow$

$\Sigma M_x = -1(400) + M_{Bx} + (1.5)B_z = 0$

$\Sigma M_y = -6(F_A) + 2(400) = 0 \rightsquigarrow F_A = \frac{2(400)}{6} = 133.3\ N \uparrow$

$\Sigma M_z = 1.5(F_{By}) + M_{Bz} = 0$

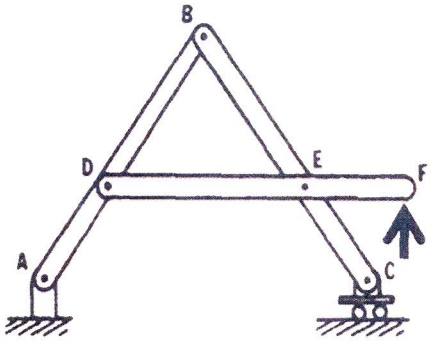
F_{By}: zero

$M_{Bz} = 0$

$\Sigma M_x = -400 + M_{Bx} + 1.5(266.7) = 0$

$M_{Bx} = 400 - 400 = 0$

6. The structure is pin connected at A and has a roller at C. Is the structure statically determinate? What would this structure be considered – a truss, frame, or machine?



Not statically determinate because the way it is loaded it will move – so it's a dynamics problem.

This would likely be considered a frame because the parts ~~stay~~ don't move like a machine would