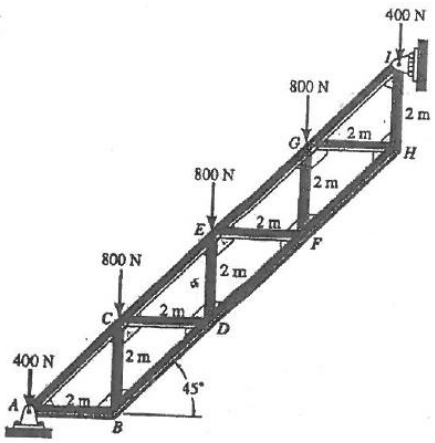
10/12/2020

ES 221 MECHANICS I (STATICS) RECITATION VIII

Q1)

The Warren truss is used to support a staircase. Determine the force in members *CE*, *ED* and *DF*, and indicate whether the members are in tension or compression. Assume that all joints are pinned.



Answer to Q1

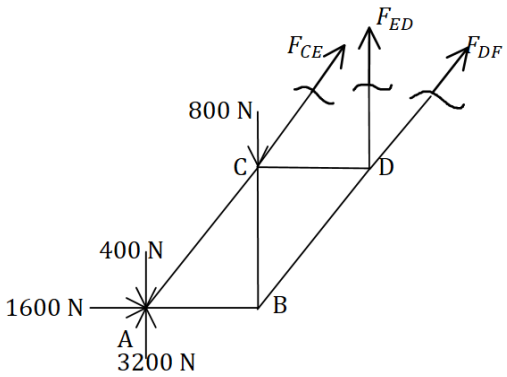
$$\circlearrowleft \sum M_A = 0$$

$$-800\ N \times 2\ m - 800\ N \times 4\ m - 800\ N \times 6\ m - 400\ N \times 8\ m + I_x \times 8\ m = 0$$

$$I_x = 1600\ N \leftarrow$$

$$A_x = 1600\ N \rightarrow$$

$$A_y = 3200\ N \uparrow$$



$$\circlearrowleft \sum M_D = 0$$

$$800\ N \times 2\ m + 1600\ N \times 2\ m - 2800\ N \times 4\ m - F_{CE} \times \frac{\sqrt{2}}{2} \times 2 = 0$$

$$F_{CE} \cong -4525\ N$$

$$F_{CE} \cong 4525\ N\ (C)$$

$$\circlearrowleft \sum M_E = 0$$

$$1600\ N \times 4\ m + 800\ N \times 2\ m - 2800\ N \times 4\ m + F_{DF} \times \frac{\sqrt{2}}{2} \times 2 = 0$$

$$F_{DF} = 2262\ N\ (T)$$

$$\uparrow \sum F_y = 0$$

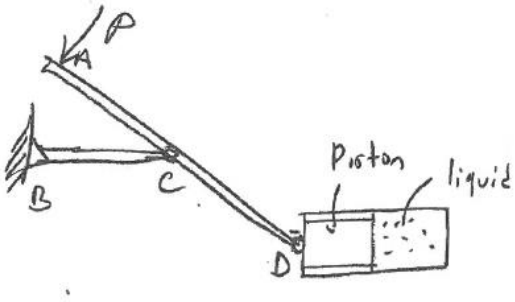
$$2800\ N - 800\ N - 4525 \times \frac{\sqrt{2}}{2} + 2262 \times \frac{\sqrt{2}}{2} + F_{ED} = 0$$

$$F_{ED} = -400\ N$$

$$F_{ED} = 400\ N\ (C)$$

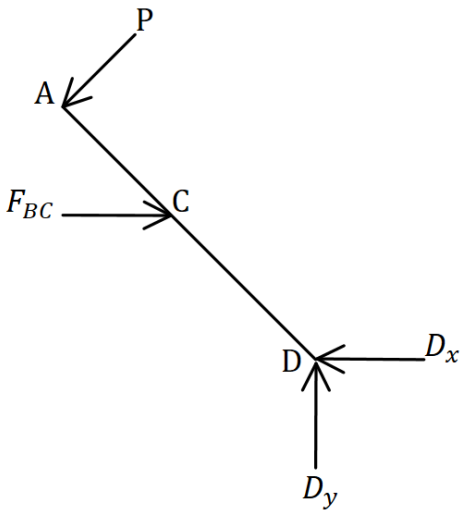
Q2)

Draw the FBD of the member *ACD* and the piston.

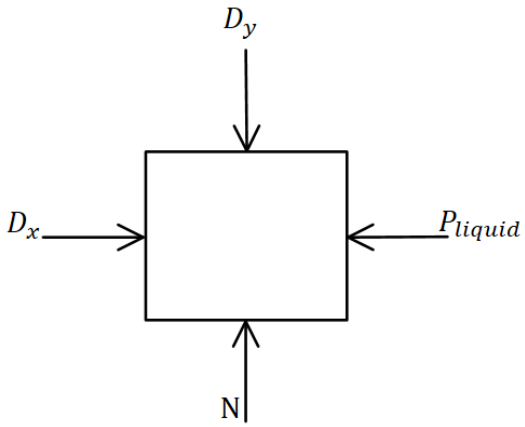


Answer to Q2

Free Body Diagram of the member ACD:

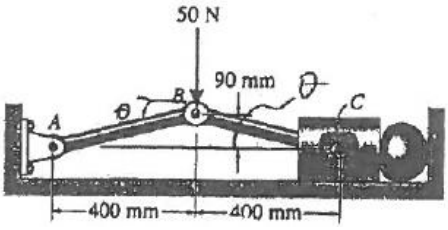


Free-Body Diagram of the Piston:

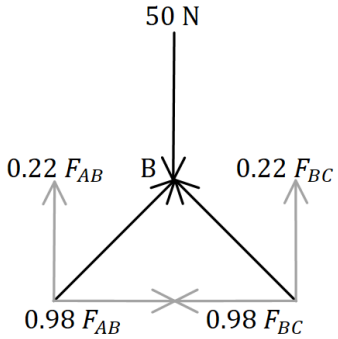


Q3)

Determine the compressive force exerted on the specimen by a vertical load of 50 N applied to the toggle press.



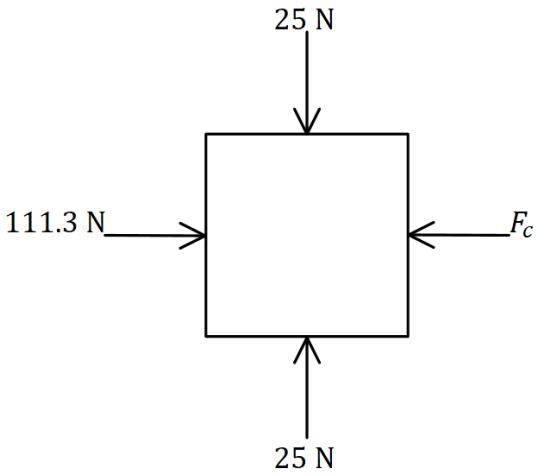
Answer to Q3



$$\uparrow \sum F_y = 0$$

$$0.22 \times (F_{AB} + F_{BC}) = 50\ N$$

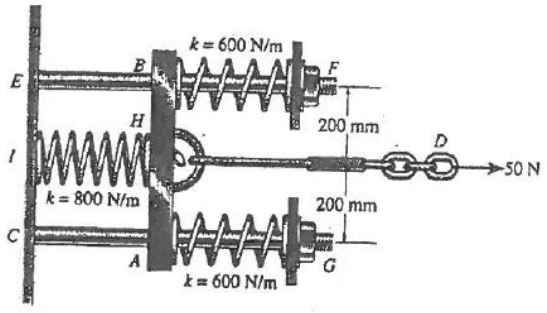
$$|F_{AB}| = |F_{BC}| \cong 113.6\ N$$



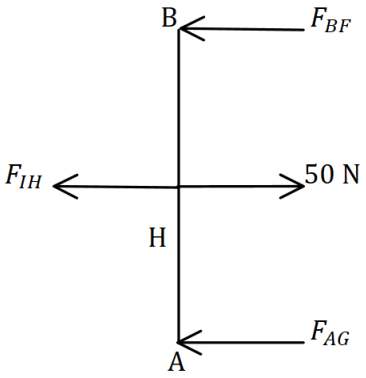
$F_c \cong 111.3\ N$

Q4)

The spring mechanism is used as a shock absorber for a load applied to the rigid drawbar *AB*. Determine the equilibrium length of each spring when the 50-N force is applied. Each spring has an unloaded length of 200 mm, and the drawbar slides along the smooth guide posts *CG* and *EF*. The ends of all springs are attached to their respective members.



Answer to Q4



$F = kx;$

$|F_{BF}| = |F_{AG}| = 600x,$

$|F_{IH}| = 800x$

$\rightarrow \sum F_x = 0$

$50\ N - 1200x - 800x = 0$

$x = 0.025\ m = 25\ mm$

$l_{AG} = l_{BF} = 175\ mm$

$l_{IH} = 225\ mm$