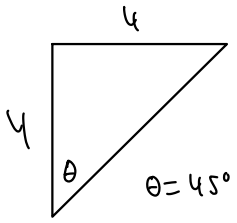
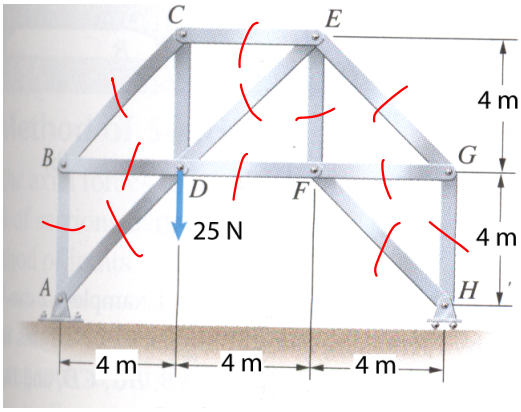
BOSTON UNIVERSITY
College of Engineering
EK 301 Engineering Mechanics I

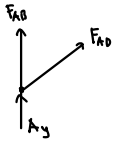
Truss project computational method validation problem

Determine the loads in each of the members and whether they are in tension or compression. Analyze the loads yourselves using standard equilibrium analysis, and MATLAB (results should match!).





Pin A:



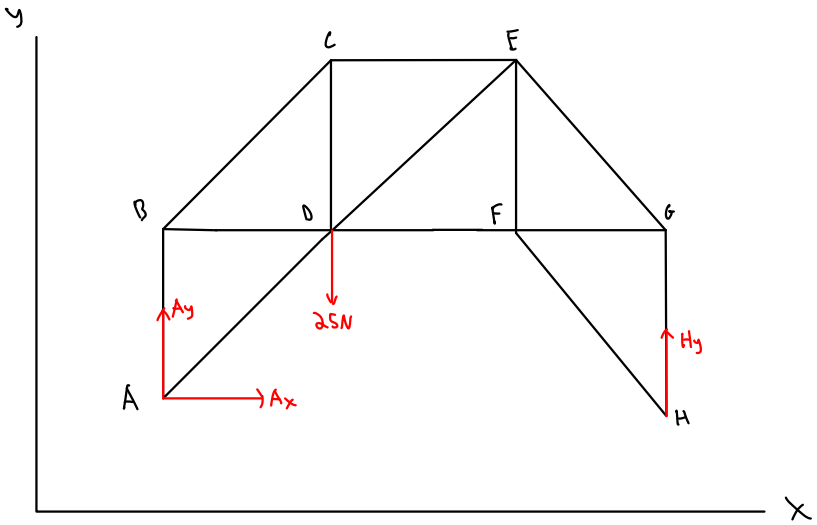
$\rightarrow \Sigma F_x = 0 = F_{AD} \cos 45$

$\boxed{F_{AD} = 0\ N}$

$+\uparrow \Sigma F_y = 0 = F_{AB} + 16.7\ N$

$F_{AB} = -16.7\ N$

$\boxed{F_{AB} = 16.7\ N\ (c)}$



$\rightarrow \Sigma F_x = 0 = A_x \quad A_x = 0$

$+\uparrow \Sigma F_y = 0 = A_y + H_y - 25N$

$A_y = 25 - H_y$

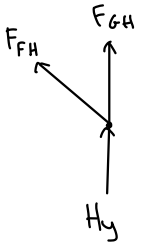
$A_y = 16.7\ N$

$\circlearrowleft + \Sigma M_A = 0 = -25N(4m) + H_y(12m)$

$H_y(12m) = 100N\text{-}m$

$H_y = 8.33\ N$

Pin H:



$\rightarrow \Sigma F_x = 0 = F_{FH} \cos 45$

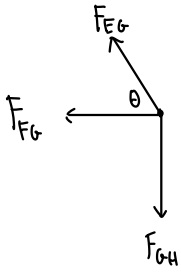
$\boxed{F_{FH} = 0\ N}$

$+\uparrow \Sigma F_y = 0 = F_{GH} + H_y$

$F_{GH} = -H_y = -8.33$

$\boxed{F_{GH} = 8.33\ N\ (c)}$

Pin G:



$\rightarrow \Sigma F_x = 0 = -F_{FG} - F_{EG} \cos\theta$

$F_{FG} = -F_{EG} \cos 45$

$F_{FG} = -(-11.8N) \cos 45$

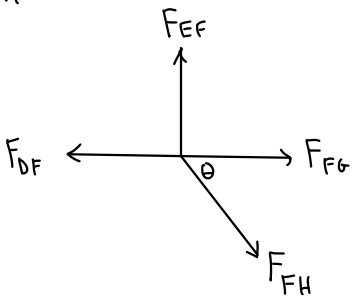
$\boxed{F_{FG} = 8.33\ N\ (t)}$

$+\uparrow \Sigma F_y = 0 = F_{EG} \sin 45 - F_{GH}$

$F_{EG} = \frac{-8.33N}{\sin 45} = -11.8$

$\boxed{F_{EG} = 11.8\ N\ (c)}$

Pin F:



$$\xrightarrow{+} \sum F_x = 0 = F_{FG} + F_{FH}\cos 45 - F_{DF}$$

$$F_{DF} = F_{FG} + F_{FH}\cos 45$$

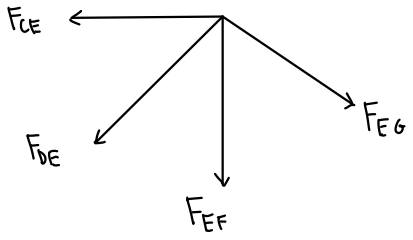
$$F_{DF} = 8.33N + (0)\cos 45$$

$$\boxed{F_{DF} = 8.33\,N\,(t)}$$

$$+\uparrow \sum F_y = 0 = F_{EF} - F_{FH}\sin 45$$

$$F_{EF} = (0)\sin 45 \qquad \boxed{F_{EF} = 0\,N}$$

Pin E:



$$\xrightarrow{+} \sum F_x = 0 = F_{EG}\cos 45 - F_{DE}\cos 45 - F_{CE}$$

$$F_{CE} = F_{EG}\cos 45 - F_{DE}\cos 45$$

$$F_{CE} = -11.8\cos 45 - 11.8\cos 45 = -16.7N$$

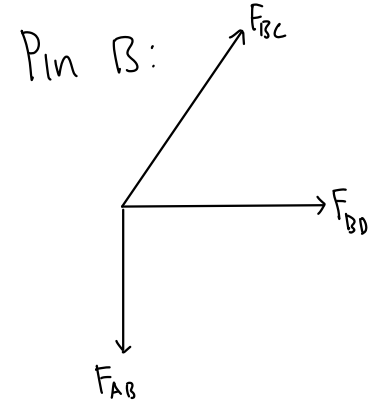
$$\boxed{F_{CE} = 16.7\,N\,(c)}$$

$$+\uparrow \sum F_y = 0 = -F_{DE}\sin 45 - F_{EF} - F_{EG}\sin 45$$

$$F_{DE}\sin 45 = -0 - (-11.8N\sin 45)$$

$$\boxed{F_{DE} = 11.8\,N\,(t)}$$

Pin B:



$$\xrightarrow{+} \sum F_x = 0 = F_{BD} + F_{BC}\cos 45$$

$$F_{BD} = -F_{BC}\cos 45 = 16.7$$

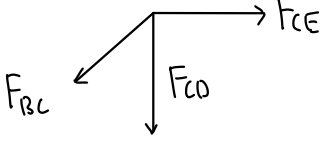
$$\boxed{F_{BD} = 16.7\,N\,(t)}$$

$$+\uparrow \sum F_y = 0 = F_{BC}\sin 45 - F_{AB}$$

$$F_{BC} = \frac{-16.7}{\sin 45} = -23.6N$$

$$\boxed{F_{BC} = 23.6\,N\,(c)}$$

Pin C:



$$\xrightarrow{+} \sum F_x = F_{CE} - F_{BC}\cos 45 = 0$$

$$+\uparrow \sum F_y = 0 = -F_{CD} - F_{BC}\sin 45$$

$$F_{CD} = -F_{BC}\sin 45 = 16.7N$$

$$\boxed{F_{CD} = 16.7\,N\,(t)}$$

Final:

$F_{AB} = 16.7\ N\ (c)$

$F_{AD} = 0\ N$

$F_{FH} = 0\ N$

$F_{GH} = 8.33\ N\ (c)$

$F_{FG} = 8.33\ N\ (t)$

$F_{EG} = 11.8\ N\ (c)$

$F_{DF} = 8.33\ N\ (t)$

$F_{EF} = 0\ N$

$F_{CE} = 16.7\ N\ (c)$

$F_{DE} = 11.8\ N\ (t)$

$F_{BD} = 16.7\ N\ (t)$

$F_{BC} = 23.6\ N\ (c)$

$F_{CD} = 16.7\ N\ (t)$