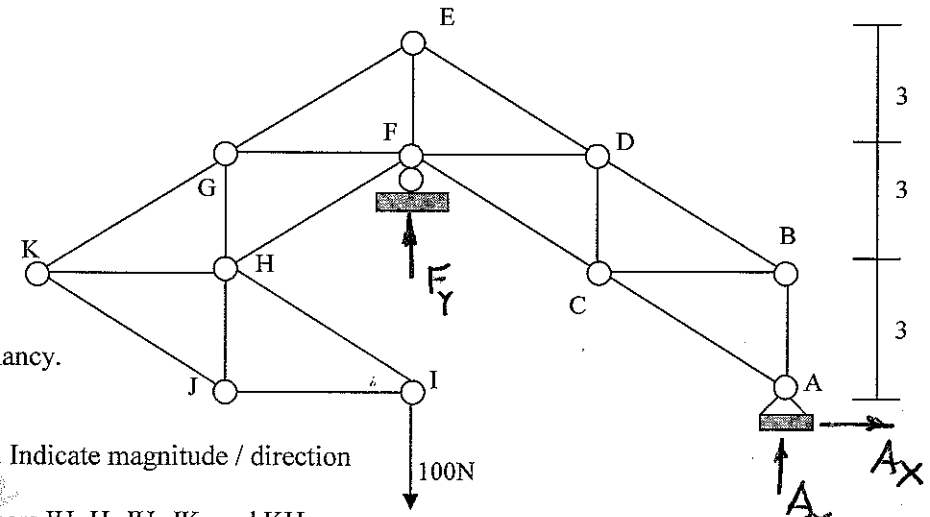
# American University of Beirut
## Department of Civil and Environmental Engineering
**Fall 2008-2009** **Instructor: Professor Fouad Kasti**

| CIVE 210 | Statics | Exam II | Sat Dec 20, 08 | 1/2 |
|---|---|---|---|---|

**1½ Hour Exam, Closed Books**


Problem #1: (50%)

For the truss shown to the right, hinge supported at A, roller supported at F, with an applied concentrated vertical 100 N force at I: answer the following with clear Free Body Diagrams and equilibrium equations:




1- Briefly study stability and determinancy.

2- Determine the reactions at A and F. Indicate magnitude / direction

3- Determine the axial forces in members IH, IJ, JH, JK, and KH by the joint method only. Indicate magnitude / direction, state whether tension / compression.

4- Without using the results in 3- above, determine the axial forces in members KG, GH, FH, FG, and GE using the section method only. Indicate magnitude / direction, state whether tension / compression.

(1) STABILITY & DETERMINANCY:

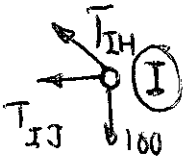
STABILITY $\Sigma F_x = 0$, AT LEAST $A_x$ IN X-DIR
$\Sigma F_Y = 0$, AT LEAST $A_Y$ IN Y-DIR

$N=3, R=3(A_x, A_Y, F_Y) \rightarrow$ EXT DET $\Sigma F_Z = 0$, AT LEAST $(A_Y // F_Y)$ & $d(A_Y, F_Y) \neq 0$

$M=19, J=11, R=3 \rightarrow 2J = M+R \rightarrow$ INT DET

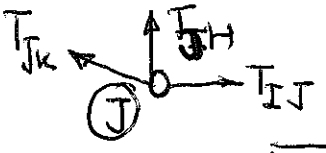
(2) REACTIONS: $\Sigma F_x = 0 \rightarrow \boxed{A_x = 0}$ $\Sigma M_{1@F} = 0 \rightarrow \boxed{A_Y = 0}$ $\Sigma F_Y = 0 \rightarrow \boxed{F_Y = 100\uparrow}$

(3) JOINT METHOD:




$\Sigma F_Y = 0 \quad \frac{3}{5} T_{IH} = 100, \quad \boxed{T_{IH} = 166.67 (T)}$

$\Sigma F_x = 0 \quad \frac{4}{5} T_{IH} + T_{IJ} = 0 \quad \boxed{T_{IJ} = -133.33 (C)}$

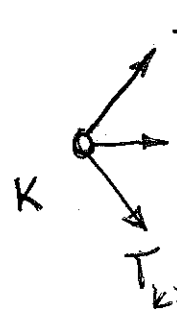



$\Sigma F_x = 0 \quad \frac{4}{5} T_{JK} = T_{IJ} \quad \boxed{T_{JK} = 166.67 (T)}$

$\Sigma F_Y = 0 \quad \frac{3}{5} T_{JK} + T_{JH} = 0$

$T_{JH} = -\frac{3}{5} \times 166.67 = -100 (C)$

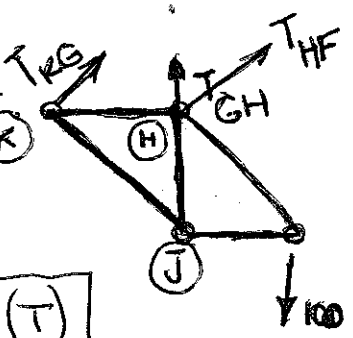
$\boxed{T_{JH}}$




$\Sigma F_y = 0$ $\boxed{T_{KG} = T_{KJ} = 166.67(T)}$

$\Sigma F_x = 0$ $T_{KH} = 2 \times \frac{4}{5} \times 166.67$ $\boxed{= 266.67(C) = T_{KH}}$

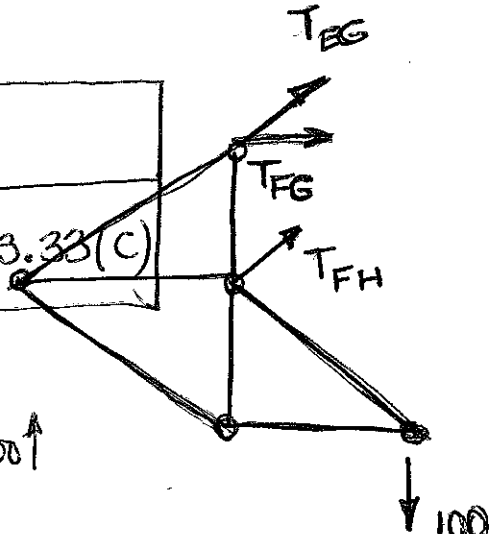
4- SECTION METHOD :




$\Sigma M_H = 0$ $\frac{3}{5} T_{KG} * 4 + 100 \times 4 = 0$ $\boxed{T_{KG} = -166.67(C)}$

$\Sigma F_x = 0$ $T_{KG} + T_{HF} = 0$ $\boxed{T_{HF} = 166.67(T)}$

$\Sigma F_y = 0$ $\frac{3}{5} T_{KG} + \frac{3}{5} T_{HF} + T_{GH} - 100 = 0$ $\boxed{T_{GH} = 100(T)}$




$\Sigma F_y = 0$ $+ \frac{3}{5} T_{FH} + \frac{3}{5} T_{EG} - 100 = 0$ $\boxed{T_{EG} = 0}$

$\Sigma F_x = 0$ $\frac{4}{5} T_{FH} + T_{FG} = 0$ $\boxed{T_{FG} = -133.33(C)}$

SUMMARY :

2- $A_x = 0$, $A_y = 0$, $F_y = 100 \uparrow$

3- $T_{IH} = \frac{500}{3} = 166.67(T)$ $T_{IJ} = -\frac{400}{3} = -133.33(C)$

$T_{JH} = -100(C)$ $T_{JK} = \frac{500}{5} = 166.67(T)$ $T_{KH} = -\frac{800}{3} = -266.67(C)$

4- $T_{KG} = -\frac{500}{3} = -166.67(C)$ $T_{GH} = 100(T)$ $T_{FH} = \frac{500}{3} = 166.67(T)$

$T_{FG} = -\frac{400}{3} = -133.33(C)$ $T_{GE} = 0$

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Problem #2: (50%)

For the one dimensional frame hinged supported at D and roller supported at E only and shown in the attached sheet:

1- Briefly study stability and determinancy (2+2 = 4%)
2- Compute the reactions at D and E (2+2+2 = 6%)
3- Draw **to scale** the shear diagram on the attached sheet, below the frame system. **Indicate relevant information to key points** including slopes, ordinates, location of 0 shear, type of functions, minimum-maximum and other relevant information to key points. (20% > -5% CALC > -10 CONCEPT) (-2 NO DIST 0 SHEAR)
4- Draw **to scale** the moment diagram on the attached sheet, below the frame system. **Indicate relevant information to key points** including slopes, ordinates, location of 0 moment, type of functions, minimum-maximum and other relevant information to key points. (20%, -5% CALC, -10% CONCEPT)

1- STABILITY & DETERMINANCY

$\Sigma F_X = 0$, AT LEAST $D_X$ IN X-DIR
$\Sigma F_Y = 0$, AT LEAST $D_Y$ IN Y-DIR
$\Sigma M = 0$, AT LEAST $D_Z$ IN Z-DIR
} STABILITY

$N = 3$
$R = 3$
$N = R = 3 \rightarrow$ EXTERNAL DETERMINANCY

2- REACTIONS:

$\Sigma F_X = 0 \rightarrow \boxed{D_X = 0}$

$\Sigma M @ E = 0 \rightarrow 40 \times 20 - 50 - 35 \times 30 + 2 \times 10 \times 15 - 10 D_Y = 0$

$\rightarrow 800 - 50 - 1050 + 300 - 10 D_Y = 0$

$\rightarrow \boxed{D_Y = 80 \uparrow}$

$\Sigma F_Y = 0 \rightarrow D_Y + E_Y = 20 - 35 + 20 = 5$

$E_Y = 5 - 80 = \boxed{75 \downarrow = +75 = E_Y}$

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