



Lebanese American University
Department of Civil Engineering
STATICS – CIE 200 - Beirut
TEST 3 – Fall 2011

Date: January 12, 2011, 07:00 p.m.
Duration: 70 minutes

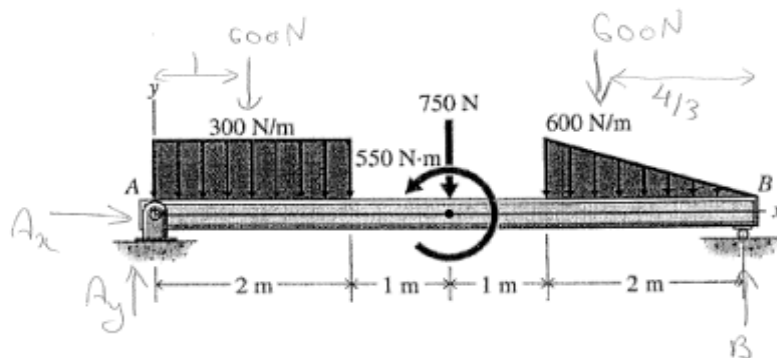
<i>Name</i>	<i>SOLUTION</i>
<i>ID #</i>	

<i>NOTES</i>	<i>Show all calculations, and indicate the proper units</i>
	<i>All problem solutions must include an FBD</i>
	<i>Closed book and notes</i>
	<i>Assume any missing information that is necessary</i>
	<i>Questions have weights as indicated</i>
	<i>Do not unstaple the exam booklet</i>
	<i>Exam booklet consists of 11 pages</i>

Problem I (40%)

A) Derive the shear and moment equations for $4 \leq x \leq 6$ m (A is the origin for the x-axis). This beam is supported by a hinge at A and a roller at B.

B) Draw the shear and moment diagrams for the beam AB.



$$\oplus \sum \Pi_A = -600 \times 1 - 750 \times 3 - 600 \times 4.67 + B \times 6 + 550 = 0$$

$$\Rightarrow B = 850.33 \text{ N} \uparrow$$

$$\oplus \sum F_y = A_y + B - 600 - 750 - 600 = 0$$

$$\Rightarrow A_y = 1099.67 \text{ N} \uparrow$$

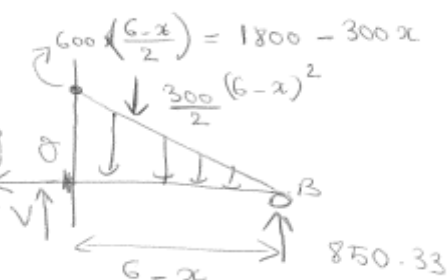
$$\sum F_x = A_x = 0$$

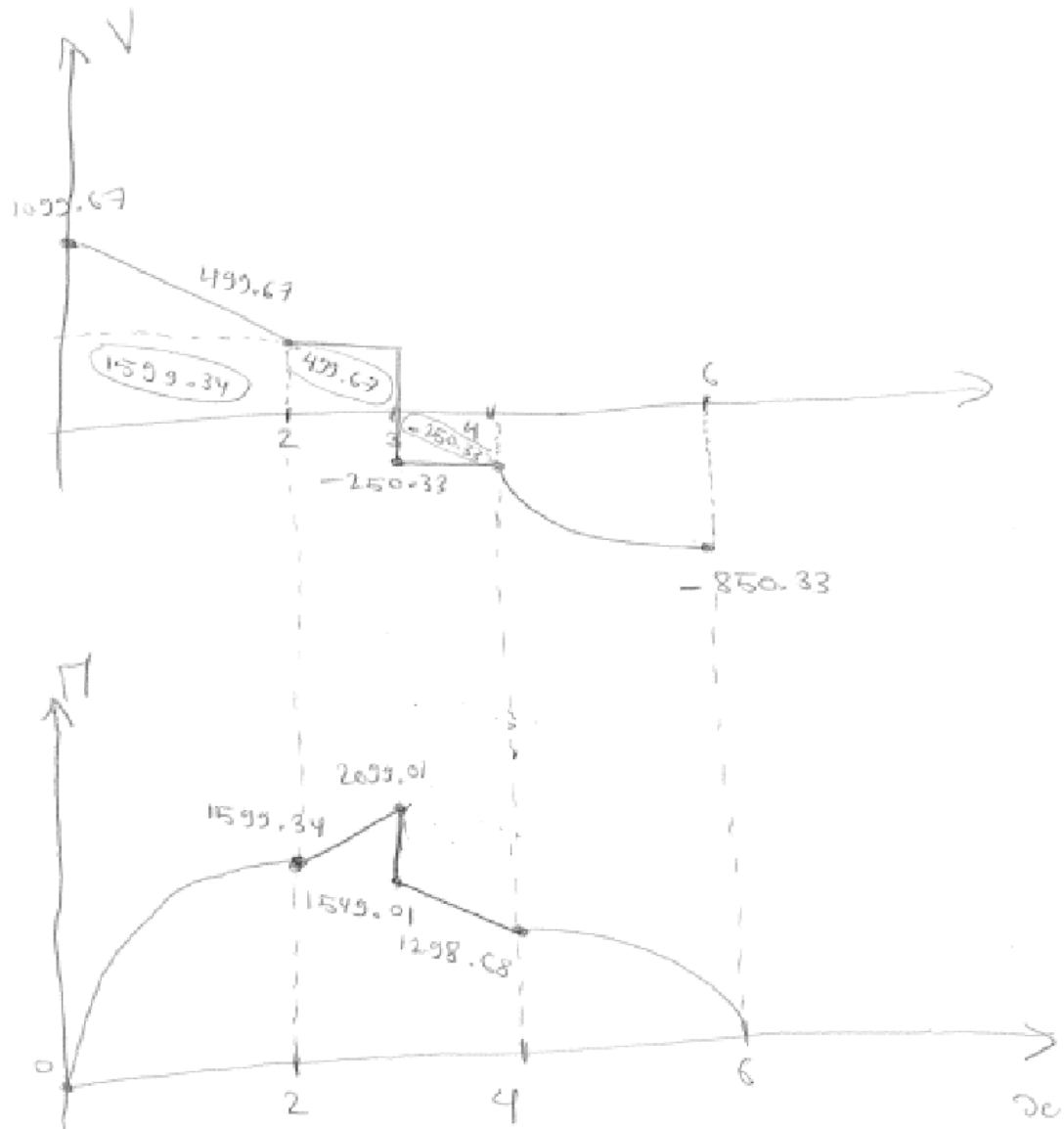
$$\sum F_y = V + 850.33 - 150(6-x)^2 = 0$$

$$\Rightarrow V(x) = 150(6-x)^2 - 850.33$$

$$\oplus \sum \Pi_0 = -\Pi - 150(6-x)^2 \frac{(6-x)}{3} + 850.33 \times (6-x) = 0$$

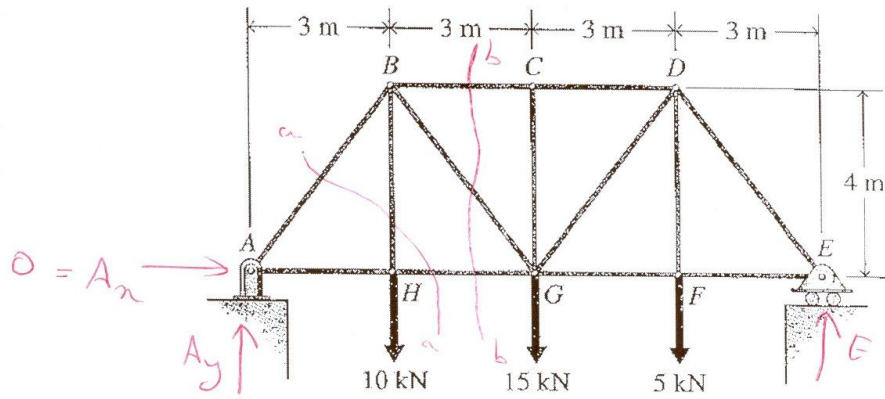
$$\Pi(x) = -50(6-x)^3 + 850.33(6-x)$$





Problem II (30%)

Determine the forces inside the truss members AB, AH, BH, GH, BG, and BC, and indicate whether they are in tension or compression.

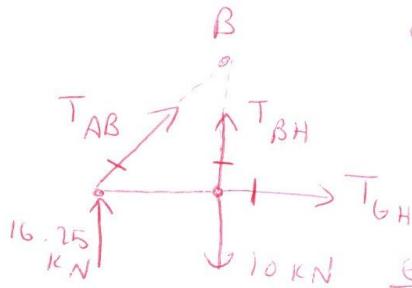


$$\sum \mathcal{M}_A = -10 \times 3 - 15 \times 6 - 5 \times 9 + E \times 12 = 0$$

$$E = \frac{165}{12} = 13.75 \text{ kN}$$

$$\sum F_y = A_y + E - (10 + 15 + 5) = 0$$

$$A_y = 30 - E = 30 - 13.75 = 16.25 \text{ kN}$$



$$\sum \mathcal{M}_B = T_{GH} \times 4 - 16.25 \times 3 = 0$$

$$T_{GH} = 12.1875 \text{ kN (T)}$$

$$\sum F_x = T_{AB} \times \frac{3}{5} + T_{GH} = 0$$

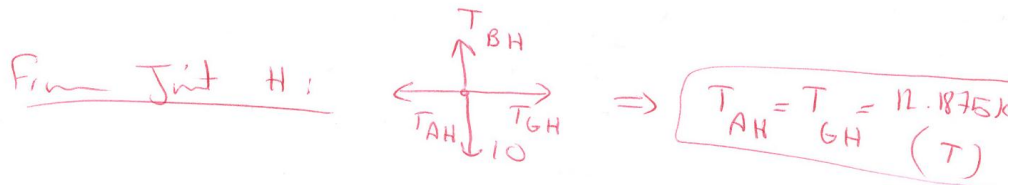
$$T_{AB} = -\frac{5}{3} T_{GH}$$

$$T_{AB} = -20.3125 \text{ kN (C)}$$

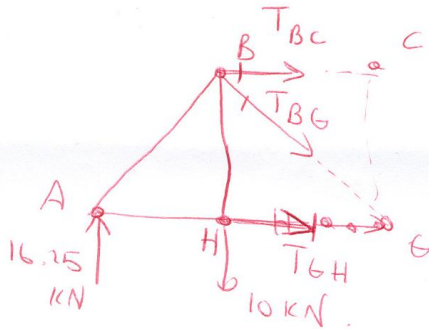
$$\uparrow \sum F_y = T_{BH} + T_{AB} \times \frac{4}{5} + 16.25 - 10 = 0$$

$$T_{BH} = -0.25 + 20.3125 \times \frac{4}{5} = -0.25 + 16.25$$

$$\boxed{T_{BH} = 10 \text{ kN (T)}}$$



FBD of section bb:



$$\oplus \curvearrowright \sum M_G = -T_{BC} \times 4 + 10 \times 3 - 16.25 \times 6 = 0$$

$$\boxed{T_{BC} = \frac{30 - 6 \times 16.25}{4} = -16.875 \text{ kN (C)}}$$

$$\oplus \uparrow \sum F_y = 16.25 - 10 - T_{BG} \times \frac{4}{5} = 0$$

$$\boxed{T_{BG} = \frac{5}{4} (6.25) = 7.8125 \text{ (T)}}$$

Problem III (30%)

Determine all forces acting on member ABCD of the frame shown below.
(The support at A is a pin).



