CE 383 STRUCTURAL ANALYSIS

2012 Spring Semester

RECITATION NO:1

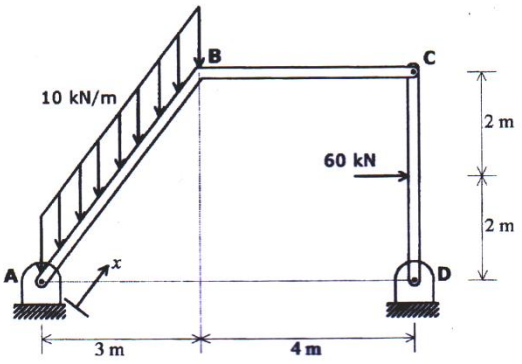
Q.1) The frame formed by two rigid members ABC and CD is pin-supported at A and D. There is a pin at C. The distributed load acts in the vertical direction which is equivalent to a resultant force of magnitude

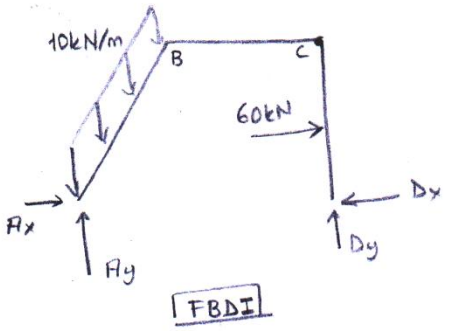
(10 kN/m)(5 m)= 50 kN.

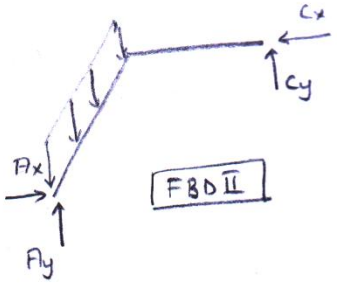
a) Derive the axial force function N(x), shear force function V(x), and bending moment function M(x), for part AB in terms of coordinate x, which is directed from A to B.

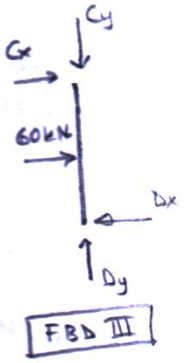
b) Draw the axial force, shear force, and bending moment diagrams for parts AB and BC.

***NOTE:** Show all important values on the diagrams.*









FBD I

$\curvearrowright +\Sigma M_D = 0 \quad -A_y \cdot 7 + 50 \cdot 5.5 - 60 \cdot 2 = 0$

$A_y = 22,143 \text{ kN}$

$\curvearrowright +\Sigma M_A = 0 \quad D_y \cdot 7 - 60 \cdot 2 - 50 \cdot 1.5 = 0$

$D_y = 27,857 \text{ kN}$

$\rightarrow +\Sigma F_x = 0 \quad A_x - D_x + 60 = 0 \quad \text{---} (1)$

FBD II

$\curvearrowright +\Sigma M_C = 0 \quad -A_y \cdot 7 + A_x \cdot 4 + 50 \cdot 5.5 = 0$

$A_x = -30 \text{ kN}$

From eq. (1):

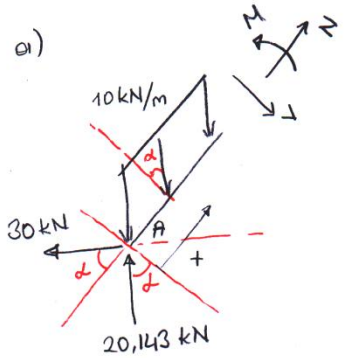
$A_x - D_x + 60 = 0 \quad \therefore D_x = 30 \text{ kN}$

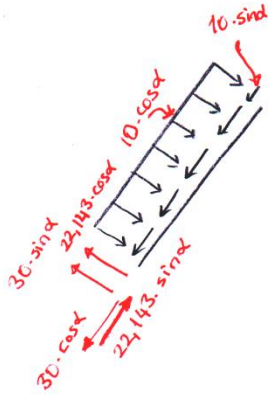
FBD III

$\Rightarrow \rightarrow +\Sigma F_x = 0 \quad C_x - D_x + 60 = 0 \quad \therefore C_x = -30 \text{ kN}$

$+\uparrow \Sigma F_y = 0 \quad C_y = D_y = 27,857 \text{ kN}$

a)





$\sin\alpha = 4/5 = 0.8$

$\cos\alpha = 3/5 = 0.6$

$V(x) = 30 \cdot \sin\alpha + 22,143 \cdot \cos\alpha - 10 \cdot x \cdot \cos\alpha$

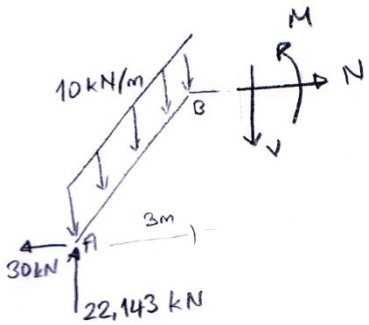
$V(x) = 37,2858 - 6x$

$N(x) = 30 \cdot \cos\alpha - 22,143 \cdot \sin\alpha + 10 \cdot x \cdot \sin\alpha$

$N(x) = 0,2856 + 8x$

$M(x) = (30 \cdot \sin\alpha + 22,143 \cdot \cos\alpha) \cdot x - 10\frac{x^2}{2} \cdot \cos\alpha$

$M(x) = 37,2858x - 3x^2$

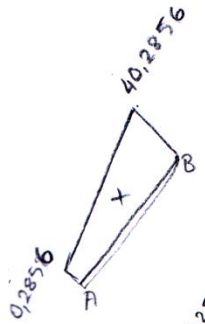


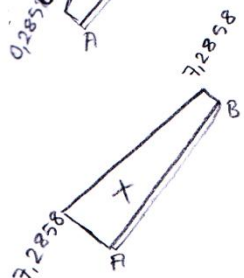
$N = 30\ kN$

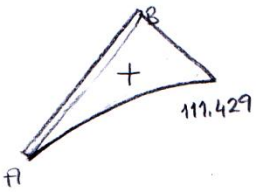
$V = 22,143 - 10 \cdot 5 = -27,857\ kN$

$M_B = 22,143(3) + 30 \cdot 4 - 10(5)(1,5) = 111.43\ kN.m$

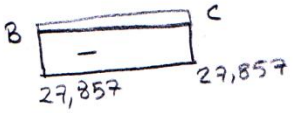
$M_C = 22,143 \cdot (7) + 30 \cdot 4 - 10(5) \cdot (5,5) = 0$ (check)



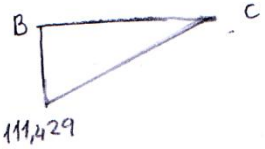




N (kN)

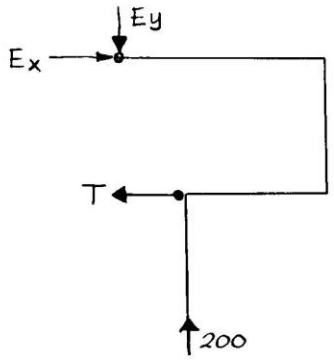


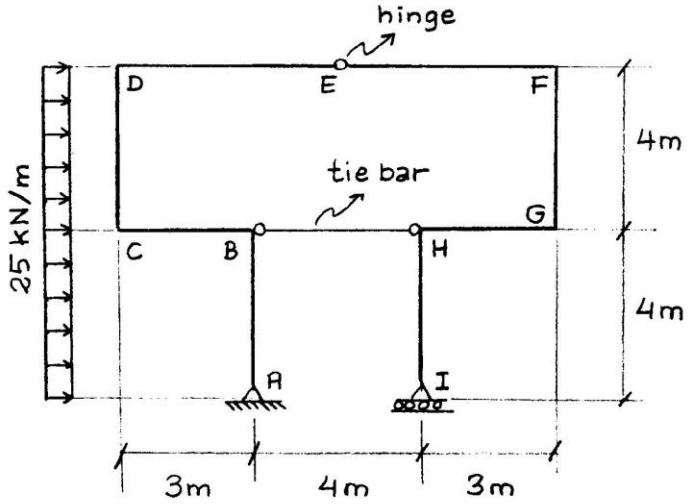
V (kN)



M (kN.m)

Q.2) Analyse the frame. Determine the support reactions and the force in the tie bar. Draw the bending moment diagram. **Show your sign convention clearly.**





$\Sigma F_x = 0$; $H_A - 25(8) = 0$

$\boxed{H_A = 200\ kN}$

$\Sigma M_A = 0$; $25(8)(4) - V_I(4) = 0$

$\boxed{V_I = 200\ kN}$

$\Sigma F_y = 0$; $V_A + 200 = 0 \rightarrow \boxed{V_A = -200\ kN}$

$\Sigma M_{E\ right} = 0$; $4T - 200(2) = 0 \rightarrow \boxed{T = 100\ kN}$