CE 383 STRUCTURAL ANALYSIS

2013-2014 Spring Semester

RECITATION NO:1

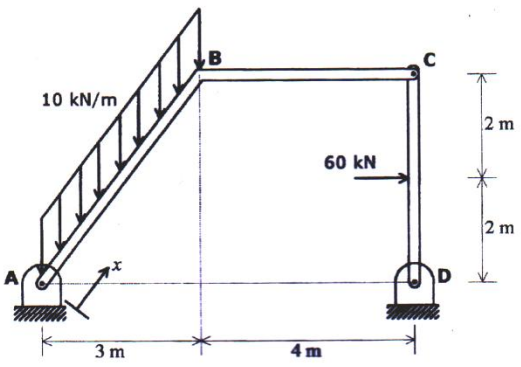
Q.1) The frame formed by two rigid members ABC and CD is pin-supported at A and D. There is a pin at C. The distributed load acts in the vertical direction which is equivalent to a resultant force of magnitude

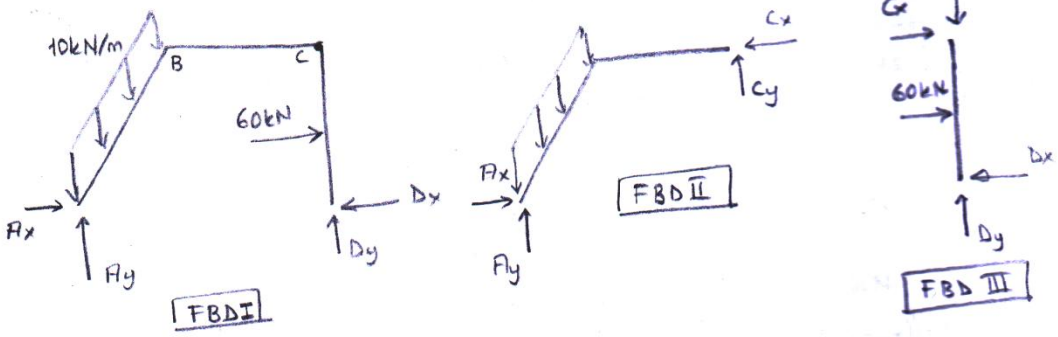
(10 kN/m)(5 m)= 50 kN.

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

$\circlearrowleft + \sum M_D = 0$ $\quad -A_y \cdot 7 + 50 \cdot 5.5 - 60 \cdot 2 = 0$

$A_y = 22,143$ kN

$\circlearrowleft + \sum M_A = 0$ $\quad D_y \cdot 7 - 60 \cdot 2 - 50 \cdot 1.5 = 0$

$D_y = 27,857$ kN

$\rightarrow + \sum F_x = 0$ $\quad A_x - D_x + 60 = 0 \quad \cdots (1)$

FBD II

$\circlearrowleft + \sum M_C = 0$ $\quad -A_y \cdot 7 + A_x \cdot 4 + 50 \cdot 5.5 = 0$

$A_x = -30$ kN

From eq. (1);

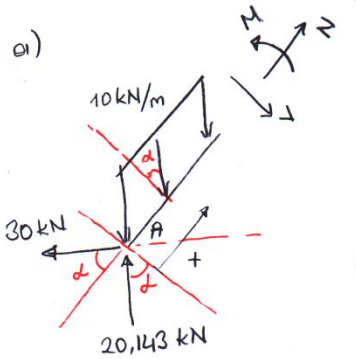
$A_x - D_x + 60 = 0 \quad \therefore D_x = 30$ kN

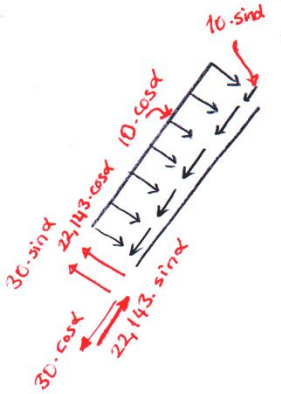
FBD III

$\Rightarrow \rightarrow + \sum F_x = 0 \quad C_x - D_x + 60 = 0 \quad \therefore C_x = -30$ kN

$+ \uparrow \sum F_y = 0 \quad C_y = D_y = 27,857$ kN

a)





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

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

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

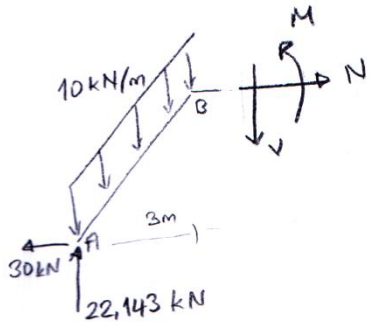
$V(x) = 37,2858 - 6x$

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

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

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

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

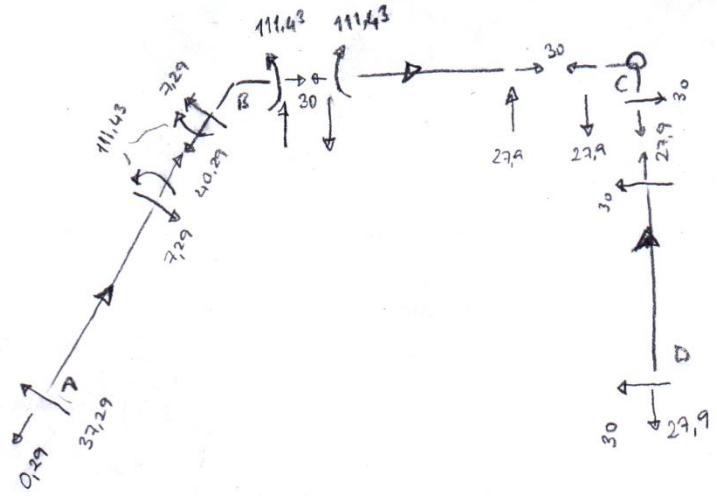


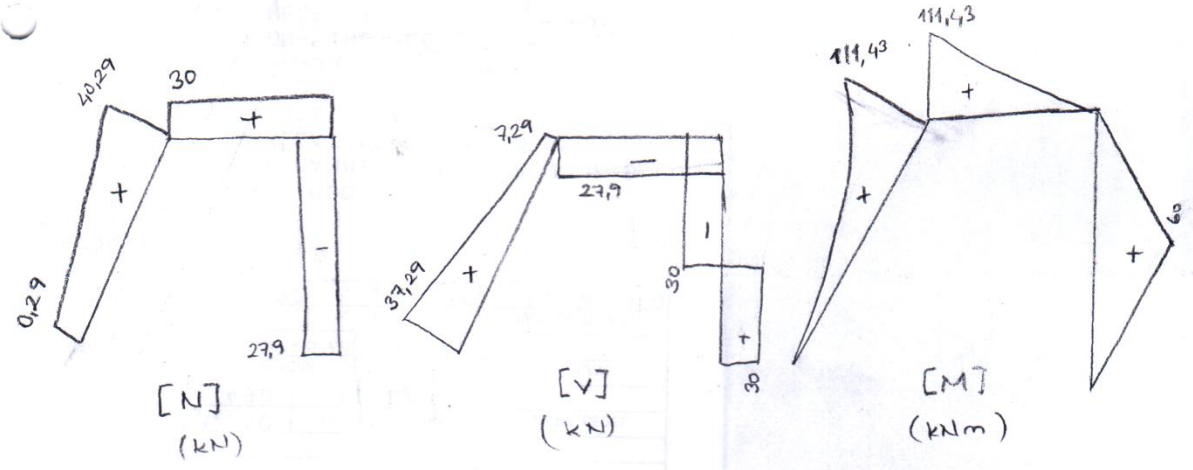
$N = 30\ kN$

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

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

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

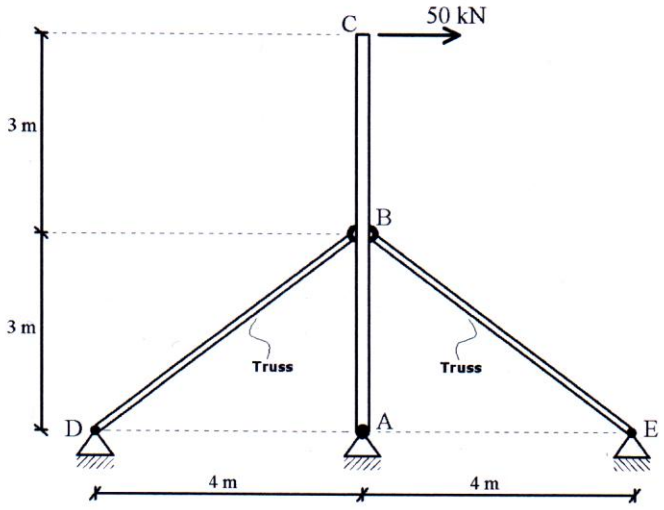


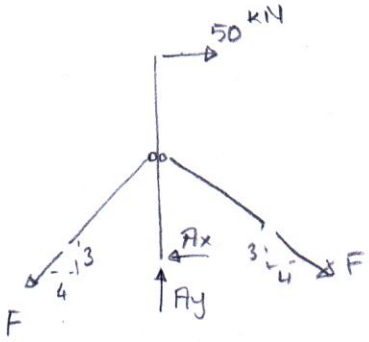


Q.2) Calculate the horizontal deflection at C using unit dummy load method. Ignore axial deformations of member *AC*.

(Hint: Truss members are symmetrically attached to member AC. You can use this information to simplify the analysis.)

$EI_{AC} = \frac{1}{4} EA_{truss}$



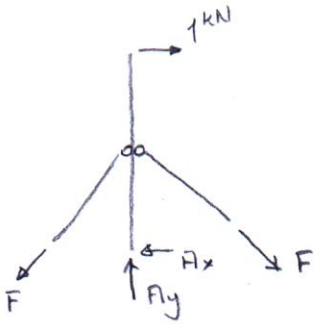


$\circlearrowleft + \Sigma M_A = 0$

$50 \cdot 6 = F \cdot \frac{3}{5} \cdot 8$ $\quad F = 62.5$ kN

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

$+\uparrow \Sigma F_y = 0$; $\quad A_y = 0$



$\circlearrowleft + \Sigma M_A = 0$; $\quad 1.6 = F \cdot \frac{3}{5} \cdot 8$ $\quad F = 1.25$ kN

$A_x = 0$, $A_y = 0$

$EI_{AC} = \frac{1}{4} EA_{truss}$

$$\Delta_D = \frac{1}{3EI}(6)(-150)(-3) + \frac{(62.5)(1.25)}{4EI}(5)\times 2$$

$$\Delta_D = \frac{1095.31}{EI}$$

M [kNm]

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