CE 383 STRUCTURAL ANALYSIS

2013-2014 Spring Semester

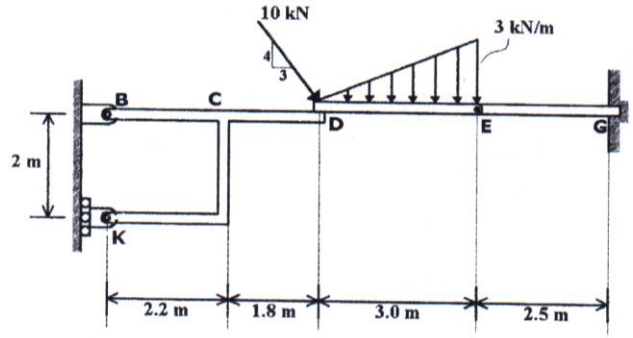
RECITATION NO:2

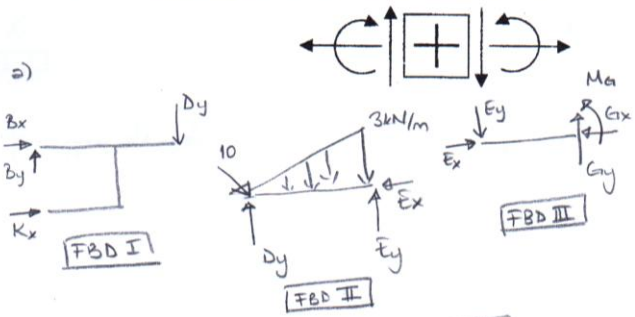
Q.1) Three rigid members *BDK*, *DE* and *EG* are supported by a pin connection at *B*, roller at *K* and a built-in (fixed) support at *G*. Rigid members are connected by a pin at *E* and frictionless contact at *D*.

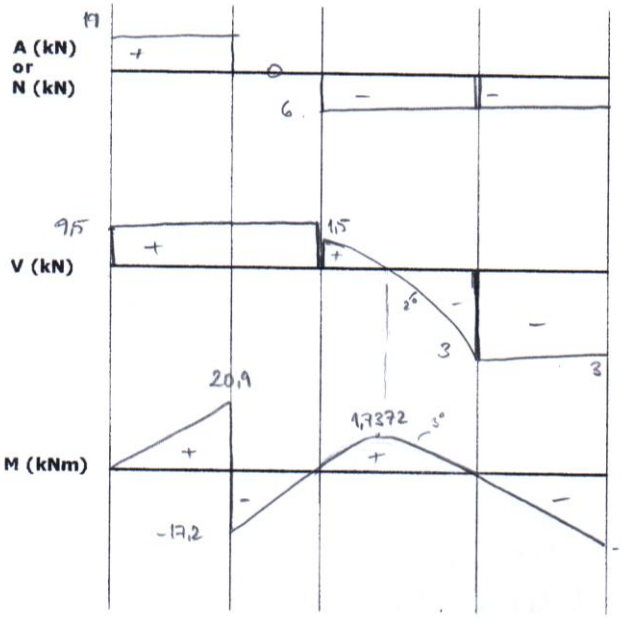
a) Draw necessary free-body diagrams and determine the components of the reactions at *B*, *K* and *G*.

b) Determine the axial force, shear and bending-moment functions between *D* and *E*.

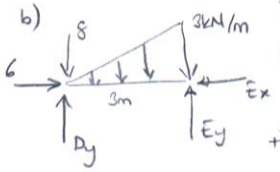
c) Plot the axial force, shear and bending-moment diagrams between B and *G*. Indicate all critical values.







b)



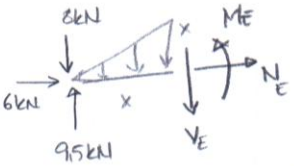
$+\rightarrow \Sigma F_x = 0;\quad E_x = 6\ kN$

$(+\Sigma M_D = 0;\quad E_y \cdot 3 - \frac{3 \cdot 3}{2} \cdot 2 = 0$

$E_y = 3\ kN$

$+\uparrow \Sigma F_y = 0;\quad D_y + E_y - \frac{3 \cdot 3}{2} - 8 = 0$

$D_y = 9.5\ kN$



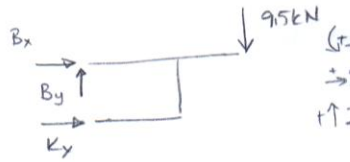
$+\rightarrow \Sigma F_x = 0;\quad N_E = -6\ kN$

$+\uparrow \Sigma F_y = 0;\quad 9.5 - 8 - \frac{x \cdot x}{2} - V_E = 0$

$V_E = 1.5 - \frac{x^2}{2}$

$(+\Sigma M_E = 0\quad M_E - 1.5x + \frac{x \cdot x}{2} \cdot \frac{x}{3} = 0$

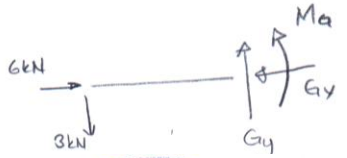
$M_E = 1.5x - x^3/6$



$(+\Sigma M_B = 0\quad K_x \cdot 2 - 9.5 \cdot 4 = 0\quad \therefore K_x = 19\ kN$

$+\rightarrow \Sigma F_x = 0\quad B_x = -19\ kN$

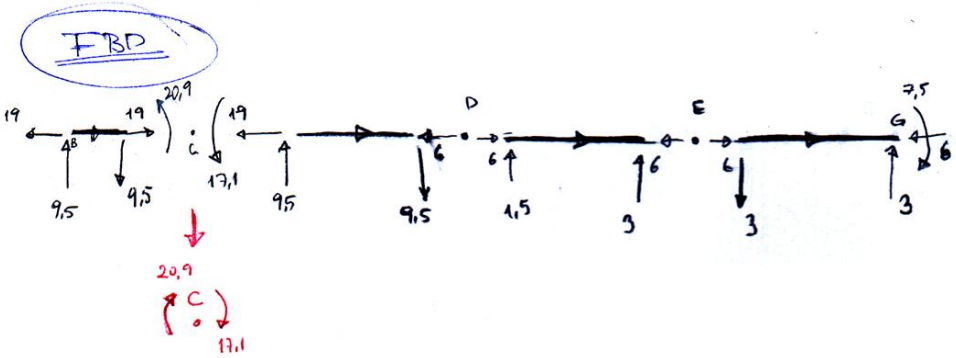
$+\uparrow \Sigma F_y = 0\quad B_y = 9.5\ kN$



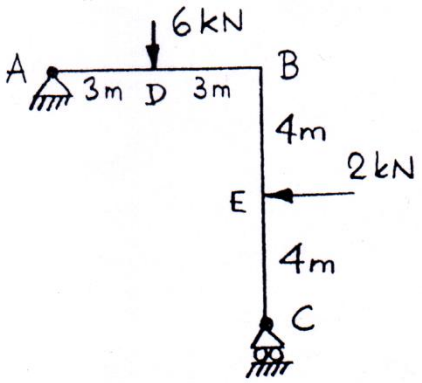
$\Sigma F_x = 0;\quad G_x = 6\ kN$

$\Sigma F_y = 0;\quad G_y = 3\ kN$

$\Sigma M_G = 0;\quad M_G = -3 \cdot 2.5 = -7.5\ kNm$



Q.2) For the frame with EI constant as shown, calculate the horizontal displacement Δ_{CH} at C and the vertical displacement Δ_{DV} at D by the unit dummy load method using either integrals or given chart.



Segment	Origin	M	m_h	m_V
EB	E	$-2x$ ✓	$-(4+x)$	0
BD	B	$-8+\frac{13x}{3}$	$-8+\frac{4x}{3}$	$\frac{x}{2}$
DA	A	$\frac{5x}{3}$	$-\frac{4x}{3}$	$\frac{x}{2}$

$$EI\Delta_{CH} = \int_0^4 -(-2x)(4+x)\,dx + \int_0^3 \left(-8+\frac{13x}{3}\right)\left(-8+\frac{4x}{3}\right)dx + \int_0^3 -\frac{20x^2}{9}\,dx$$

$$= \int_0^4 8x\,dx + \int_0^4 2x^2\,dx + \int_0^3 64\,dx - \int_0^3 \frac{136x}{3}\,dx + \int_0^3 \frac{32x^2}{9}\,dx$$

$$= 4\left(x^2\right)_0^4 + \frac{2}{3}\left(x^3\right)_0^4 + 192 - \frac{136}{6}\left(x^2\right)_0^3 + \frac{32}{27}\left(x^3\right)_0^3$$

$$= 64 + \frac{128}{3} + 192 - 204 + 32 = \frac{380}{3} \rightarrow \Delta_{CH} = \frac{380}{3EI} \leftarrow$$

$$EI\Delta_{DV} = \int_0^3 -4x\,dx + \int_0^3 \frac{13x^2}{6}\,dx + \int_0^3 \frac{5x^2}{6}\,dx$$

$$= -\frac{4}{2}\left(x^2\right)_0^3 + \frac{13}{18}\left(x^3\right)_0^3 + \frac{5}{18}\left(x^3\right)_0^3$$

$$= -18 + 13\cdot\frac{3}{2} + 5\cdot\frac{3}{2} = -18 + 27 = 9$$

$$\Delta_{DV} = \frac{9}{EI} \downarrow$$