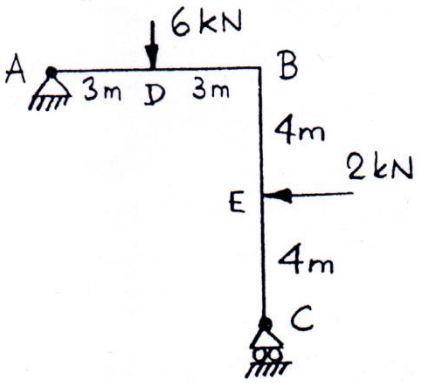
CE 383 STRUCTURAL ANALYSIS

2012 Spring Semester

RECITATION NO:2

Q.1) 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	$\frac{5x}{3}$	$-\frac{4x}{3}$	$\frac{x}{2}$

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

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

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

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

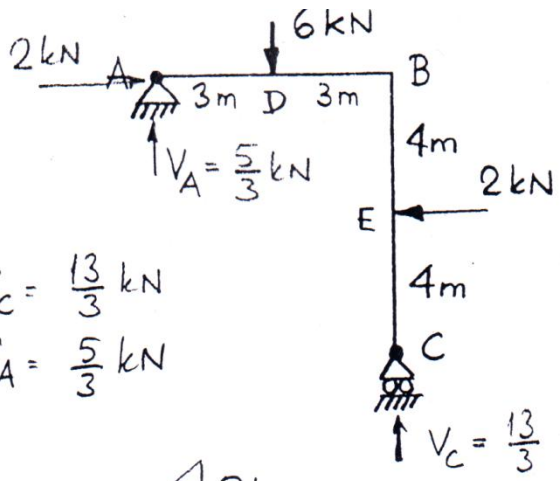
$$EI\Delta_{DV} = \int_0^3 -4x\,dx + \int_0^3 \frac{13x^2}{6}\,dx + \int_0^3 \frac{5x^2}{6}\,dx$$

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

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

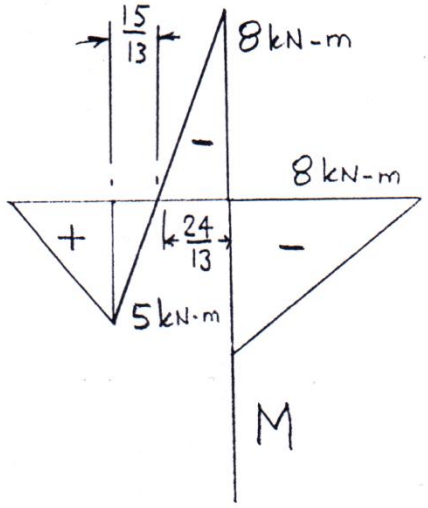
$$\Delta_{DV} = \frac{9}{EI} \downarrow$$

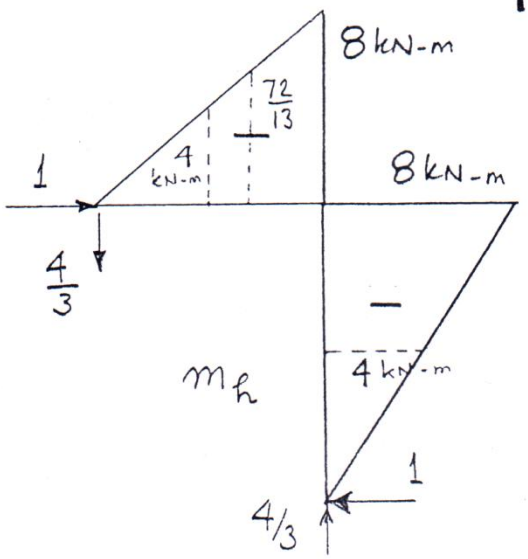
Q.1) For the frame with EI constant as shown, calculate the horizontal displacement Δ_{CH} at C and the vertical displacement Δ_{DV} at D by the unit dummy load method using either integrals or given chart.

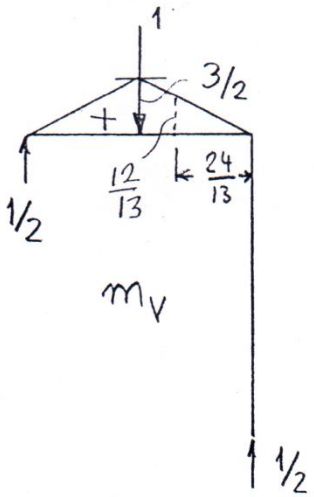


$6V_C = 2\times4 + 6\times3 = 26 \rightarrow V_C = \frac{13}{3}$ kN

$\rightarrow V_A = \frac{5}{3}$ kN







$$EI\Delta_{CH} = \underset{*}{\frac{(4)(-8)(16+4)}{6}} + \underset{**}{\frac{(\frac{24}{13})(-8)(\frac{72}{13}+16)}{6}} - \underset{***}{\frac{(\frac{15}{13})(5)(8+\frac{72}{13})}{6}} - \underset{****}{\frac{(3)(5)(4)}{3}}$$

$$= 106.67 + 53.01 - 13.01 - 20$$

$$= 126\tfrac{2}{3} \rightarrow EI\Delta_{CH} = \frac{380}{3} \leftarrow$$

$$EI\Delta_{DV} = \frac{(3)(\frac{3}{2})(5)}{3} + \frac{(\frac{15}{13})(5)(3+\frac{12}{13})}{6} - \frac{(\frac{24}{13})(8)(\frac{12}{13})}{6}$$

$$= 7.5 + 3.772 - 2.272 = 9$$

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