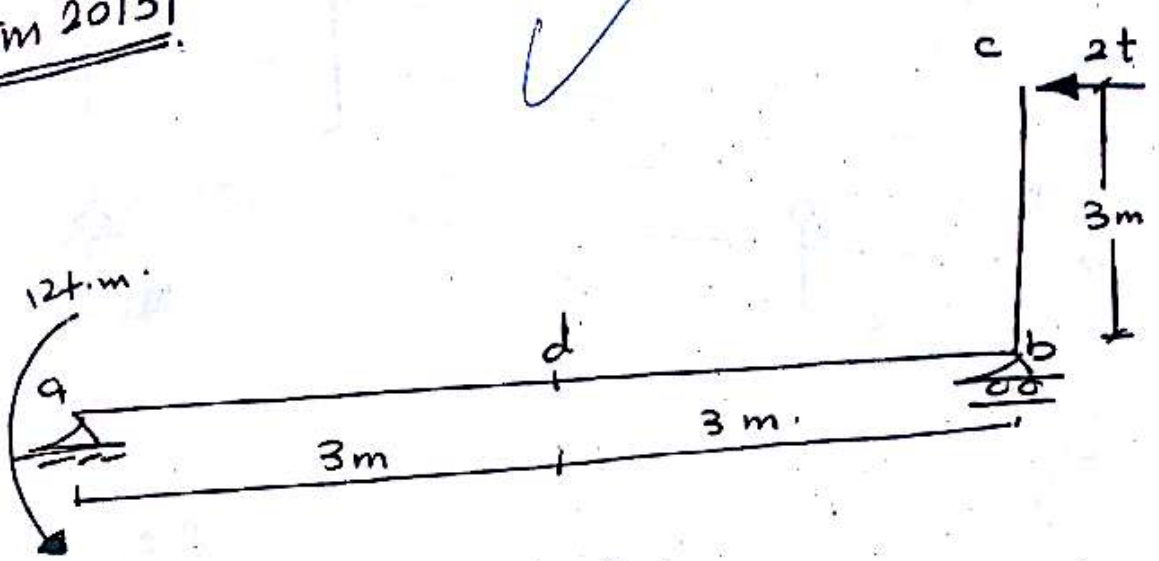
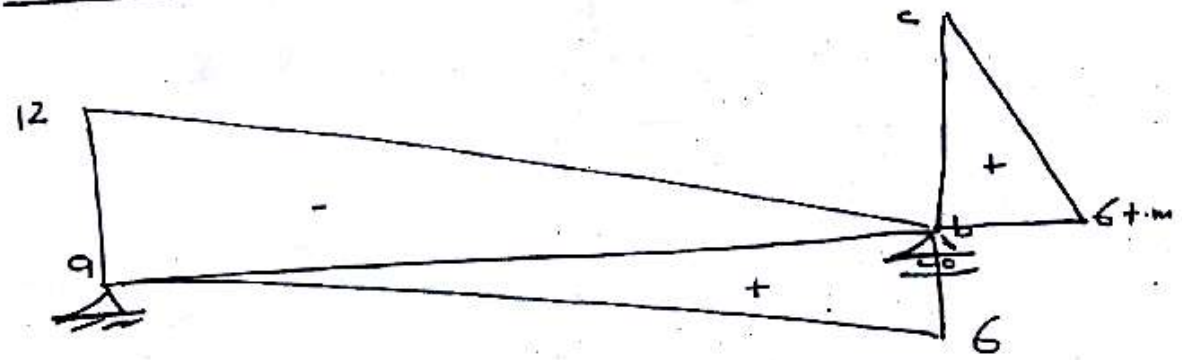
Exam 2013



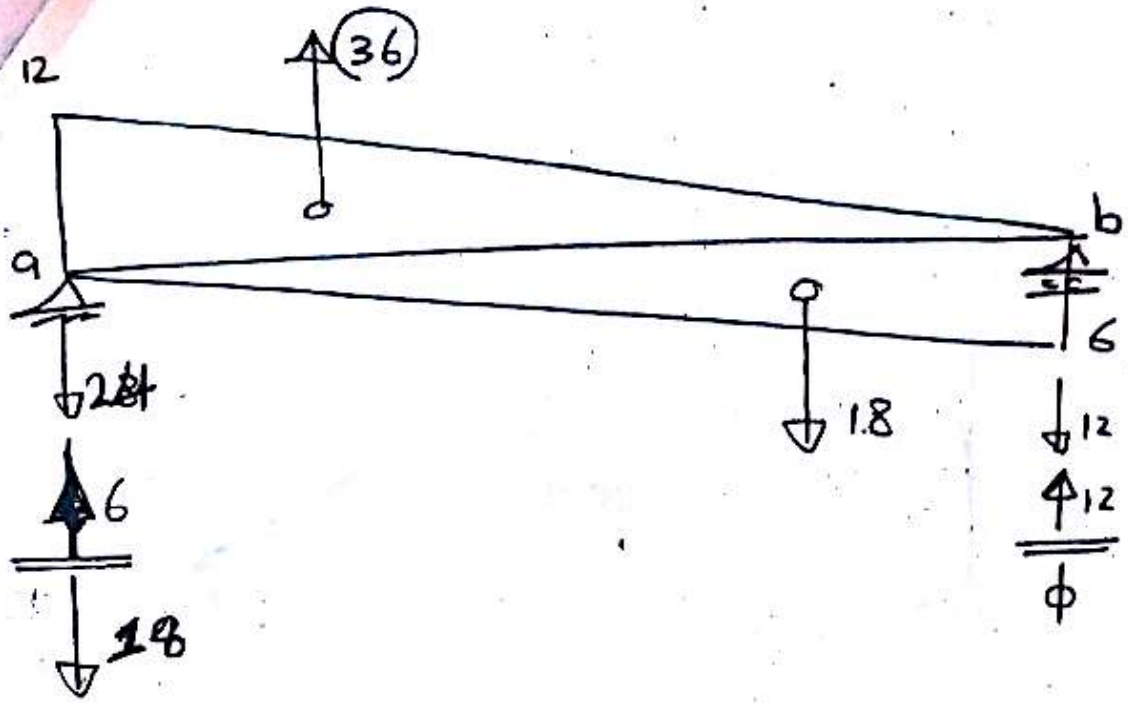
- Find Slope at Point a & b.
- Find deflection at Point d
- Find horizontal displacement at Point c.

←Sol→

1. B.M.D:

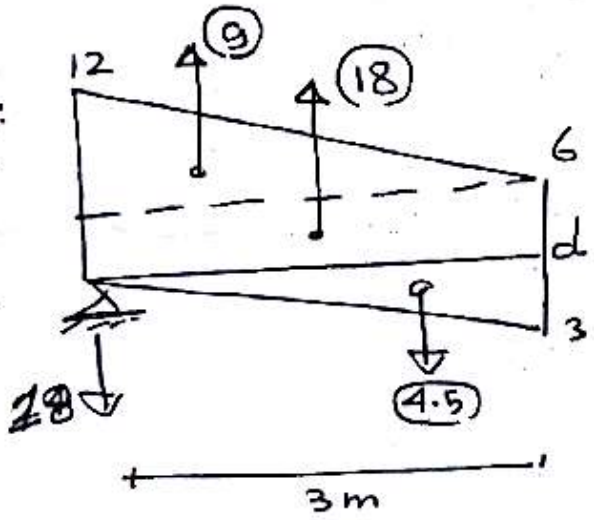


To find $\alpha_a, \alpha_b, \delta_d$:



$$\theta a = \frac{-18}{EI} \quad , \quad \theta b = 0.0$$

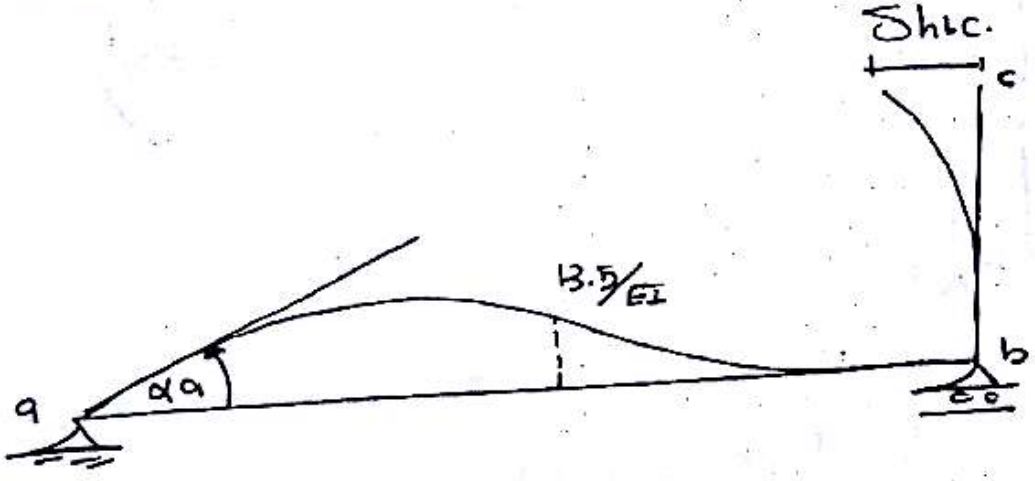
at Point d:

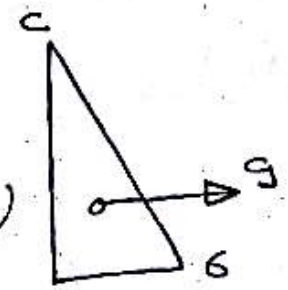


$$\theta d = \frac{18*1.5 + 9*2 - 4.5*1 - 18*3}{EI}$$

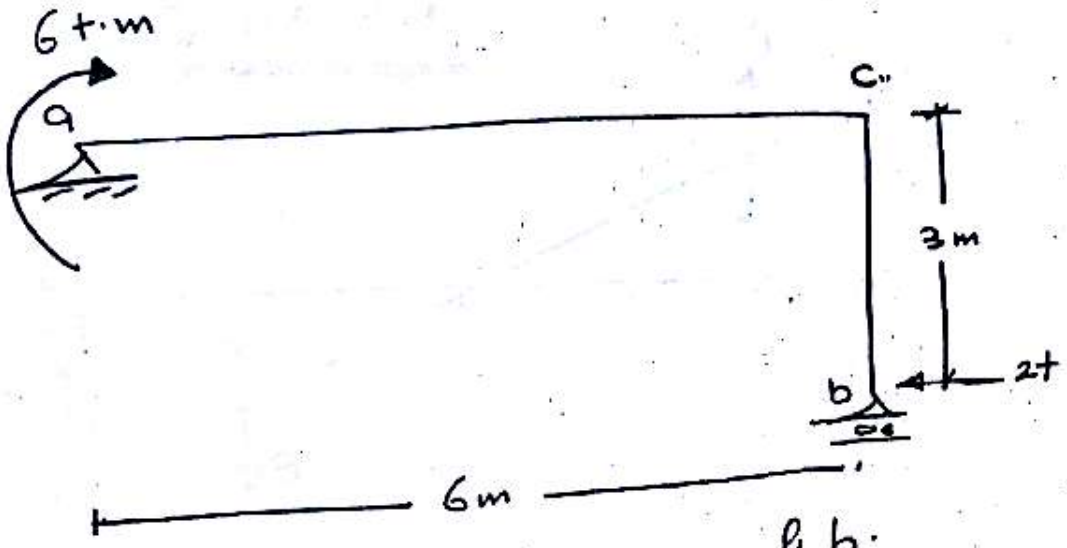
$$= \frac{-13.5}{EI}$$

oint c:





$$Shl_C = \frac{-9 * 2}{EI} = \frac{-18}{EI} \quad \text{To left}$$



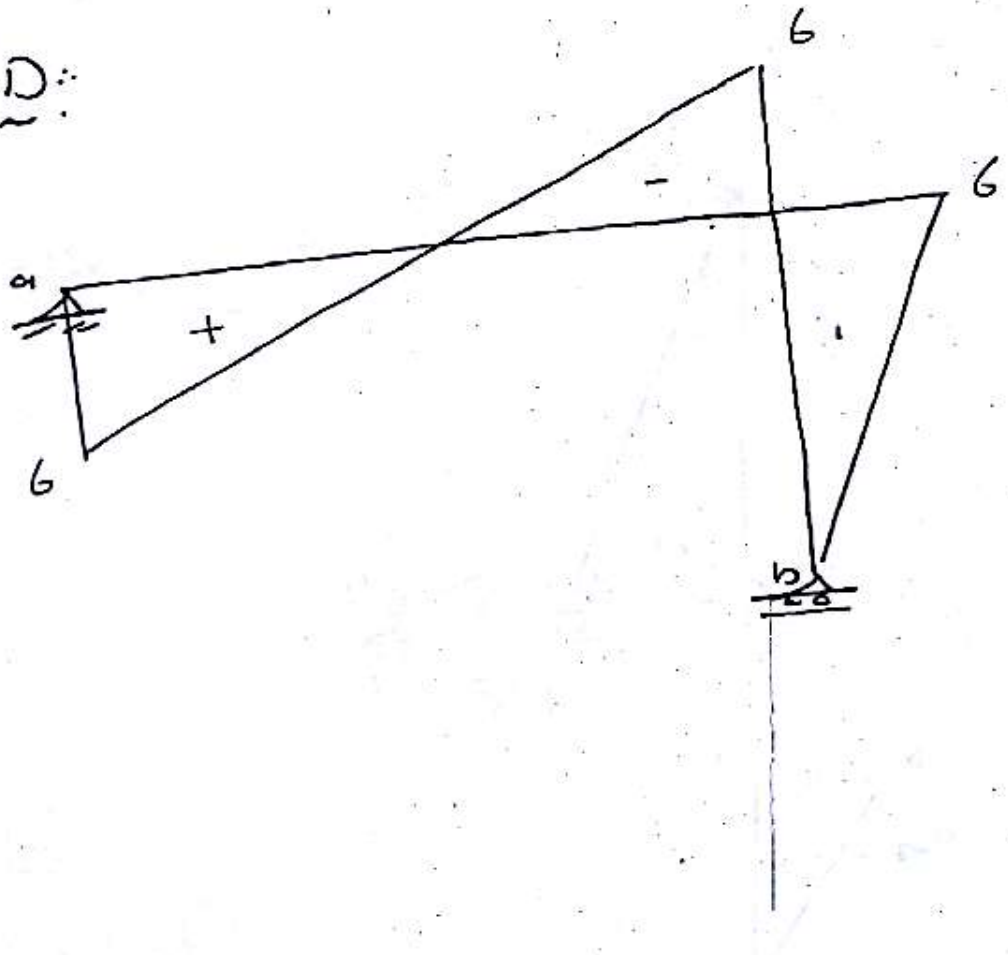
a) Find slopes at supports a & b.

b) Find the horizontal displacement at Point b

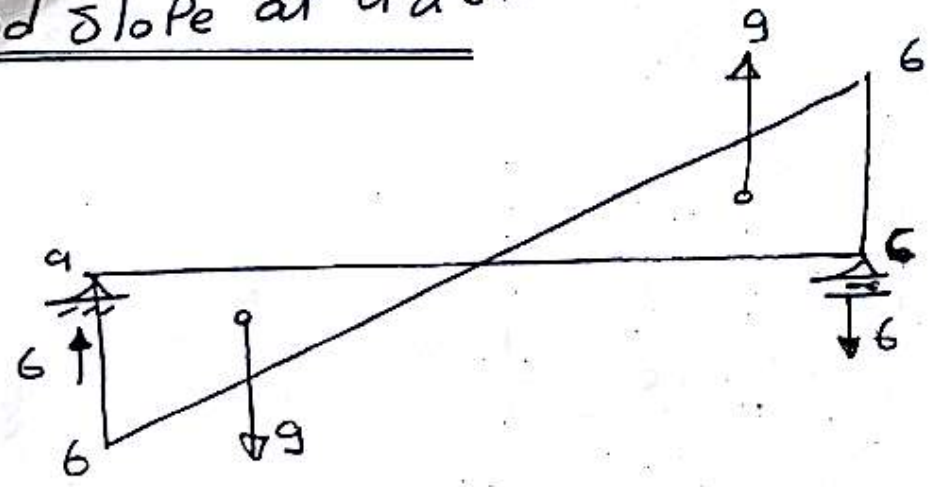
c) sketch the elastic line of the structure (abc)

← scl →

1 B.M.D:



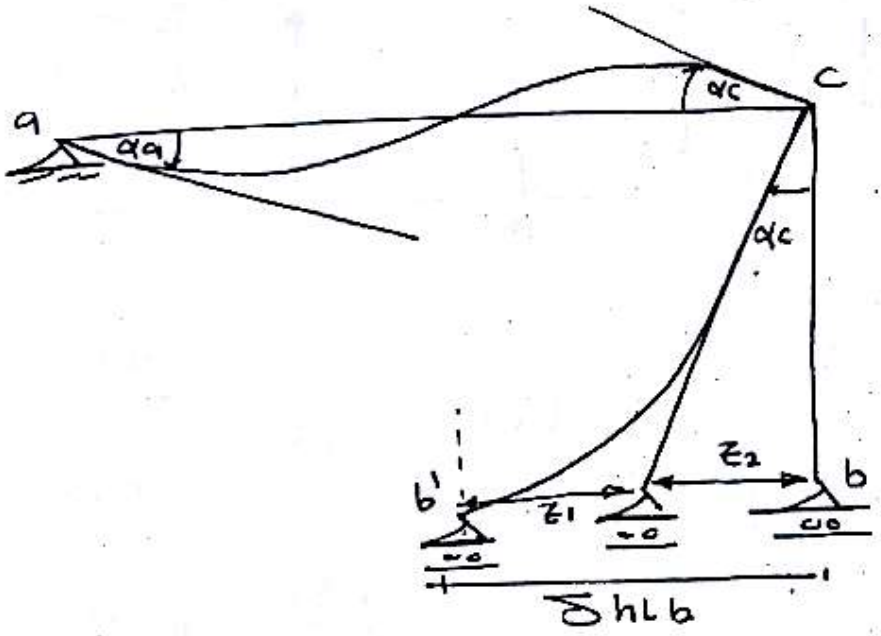
Find slope at a & c:-

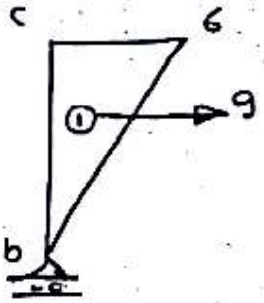


$\alpha a = \frac{+6}{EI}$, $\alpha c = +6/EI$

* To Find αb, $\delta h_{l} b$.

elastic line:-





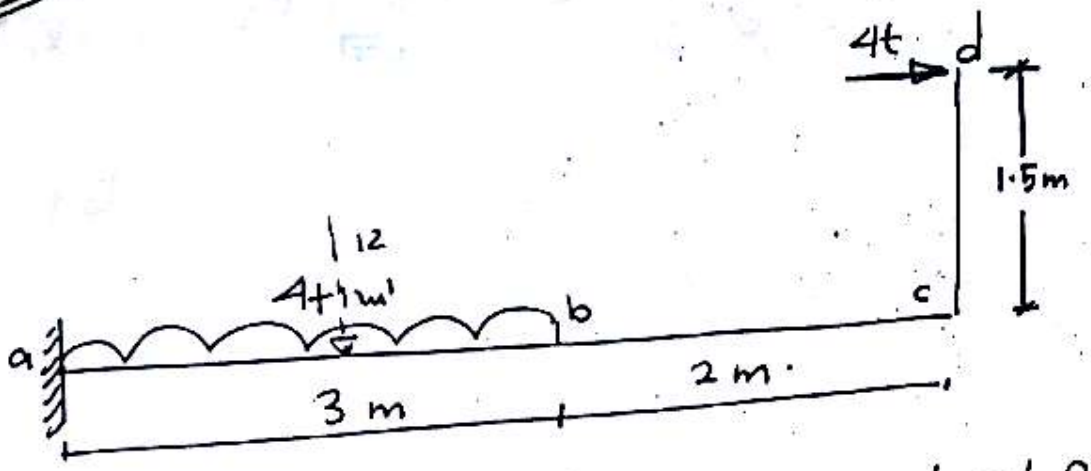
$\alpha b = \frac{+9}{EI}$

$z_1 = \frac{9 * 2}{EI} = \frac{18}{EI}$

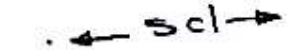
$\frac{z_2}{3} \therefore z_2 = \frac{3 * 6}{2} = \frac{18}{EI}$

36

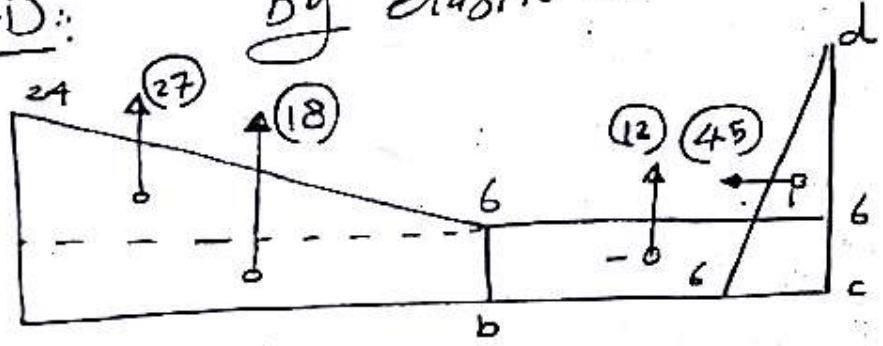
015



- determine The vertical deflections and slope angles at Points b, c, d if $I = 10000 cm^4$, $E = 2000 t/cm^2$. also Find The horizontal deflection at Point d.



1. B.M.D:: by elastic weight Method.



at Point b::

$$\delta b = \frac{18 * 1.5 + 27 * 2}{EI} = \frac{+81}{EI}$$

$$\theta b = \frac{18 + 27}{EI} = \frac{+45}{EI}$$

at Point c::

$$\delta c = \frac{12 * 1.8 + 18 * 3.5 + 27 * 5.5}{EI}$$

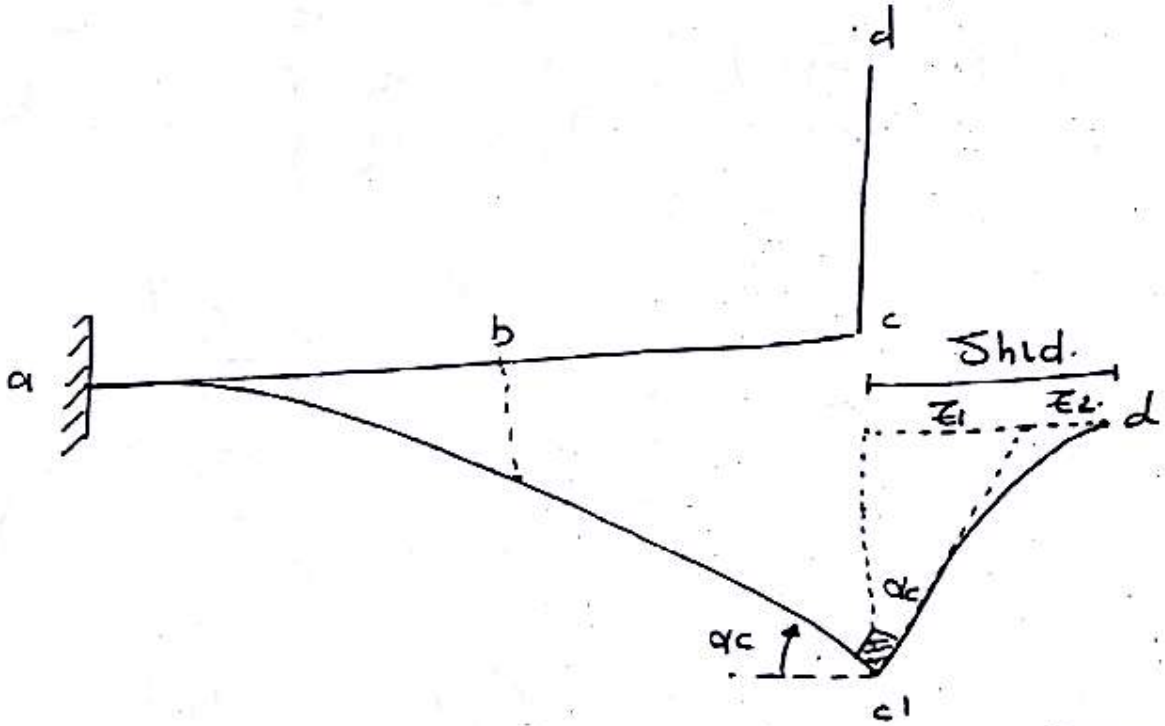
$$= \frac{183}{EI}$$

$$\alpha_C = \frac{27+18+12}{EI} = \frac{+57}{EI}$$

at Point d:

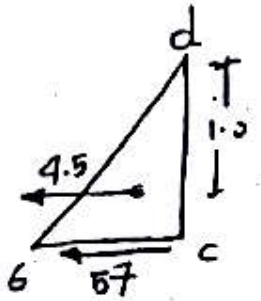
$$\delta_{VLd} = \delta_{VLC} = \frac{183}{EI}$$

To get α_d, δ_{hLd}: Sketch The elastic line..



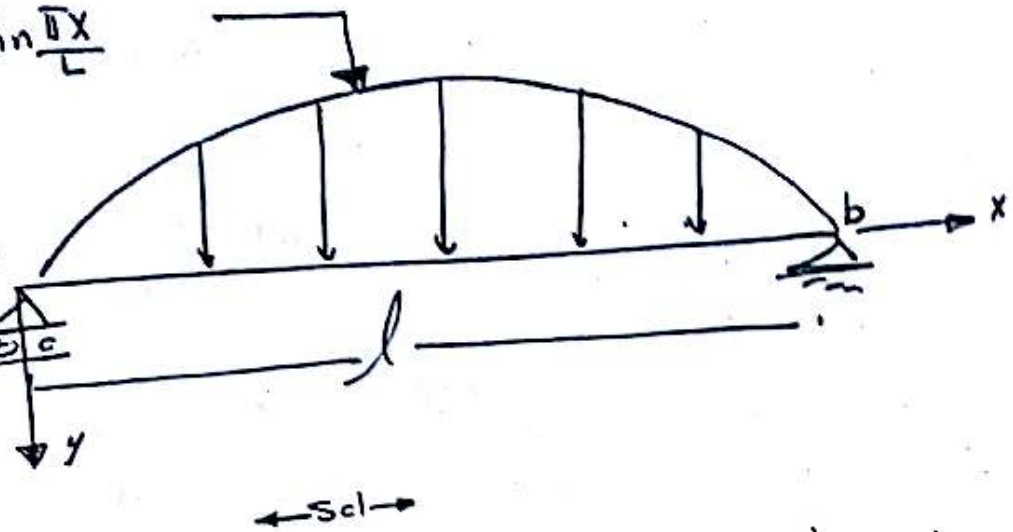
$$\alpha_C = \frac{\varepsilon_1}{1.5} \quad \therefore \varepsilon_1 = 1.5 * \frac{57}{EI} = \frac{85.5}{EI}$$

$$\varepsilon_2 = \frac{1.5*1}{EI}$$



$$\therefore \delta_{hLd} = \frac{4.5+85.5}{EI} = \frac{90}{EI}$$

$P = P_o \sin \frac{\pi x}{L}$



Find The value a of Max. deflection

←Sol→

* في حالة إعطاء معادلة الحمل (P) يتم التكامل مرة واحدة للحصول على معادلة الـ Shear (Φ) ثم تكامل مرة أخرى للحصول على معادلة العزم (M).

$$\therefore \frac{d\Phi}{dx} = -P$$

$$\therefore \Phi = -\int P \cdot dx \quad \rightarrow [1]$$

$$\therefore \frac{dM}{dx} = \Phi$$

$$\therefore M = \int \Phi \cdot dx$$

$$p = P_o \sin \frac{\pi x}{L}$$

$$\therefore Q = -\int p\, dx$$

$$= -\int P_o \sin \frac{\pi x}{L}\, dx$$

$$\therefore Q = + P_o * \frac{l}{\pi} \cos \frac{\pi x}{L} + C_1$$

$$\therefore M = \int Q\, dx$$

$$\therefore M = \frac{P_o l^2}{\pi^2} \sin \frac{\pi x}{L} + C_1 x + C_2$$

* بتشكل لي وجود توابت داخل معادلة العزم لذا يجب تطبيق B.C خاصة بالمسألة.

at $x = 0.0$ $\quad M = 0.0$

$x = l$ $\quad M = 0.0$

at $x = 0.0$ $\quad M = 0.0$

$$\therefore M = 0.0 = \frac{P_o l^2}{\pi^2} \sin 0.0 + C_1(0.0) + C_2$$

$$\therefore C_2 = 0.0$$

at $x = l$, $M = 0.0$

$$0.0 = \frac{P_o l^2}{\pi^2} \sin\frac{\pi \cdot l}{L} + C_1 \cdot l$$

$\sin \pi = 0.0$

$$\therefore C_1 = 0.0$$

$$\therefore M = \frac{P_o l^2}{\pi^2} \cdot \sin\frac{\pi x}{L}$$

$$y'' = +1/EI \left[-\frac{P_o l^2}{\pi^2} \sin\frac{\pi x}{L} \right]$$

$$\therefore y' = 1/EI \left[\frac{P_o l^3}{\pi^3} \cos\frac{\pi x}{L} + C_3 \right]$$

$$y = 1/EI \left[\frac{P_o l^4}{\pi^4} \sin\frac{\pi x}{L} + C_3 x + C_4 \right]$$

B.C:: at $x = 0.0$ $y = 0.0$

$$\therefore C_4 = 0.0$$

at $x = l$ $y = 0.0$

$$\therefore C_3 = 0.0$$

$$\therefore y' = \frac{1}{EI}\left[\frac{Pol^3}{\pi^3}\cos\frac{\pi x}{L}\right]$$

$$y = \frac{1}{EI}\left[\frac{Pol^4}{\pi^4}\sin\frac{\pi x}{L}\right]$$

To Find y_{max}, y_{max} at $y' = c.c.$

$$0.0 = \cos\frac{\pi x}{L}$$

$$\therefore \frac{\pi x}{L} = \pi/2$$

$$\therefore x = l/2$$

$\therefore y_{max}$ at $x = l/2$.

بالتعويض في معادلة الـ y

$$\therefore y_{max} = \frac{Pol^4}{\pi^4 EI}$$