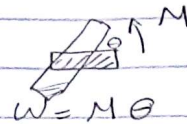


## \* Virtual Work Method

$$W = F d = M \theta$$

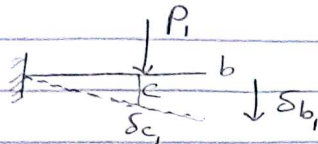


$$W = F d$$



$$W_{ex} = W_{in}$$

ex



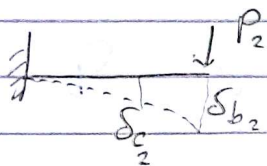
$$W_{ex} = P_1 \times \delta_c$$



$$P_1 \cdot \delta_c = \int M d\theta$$

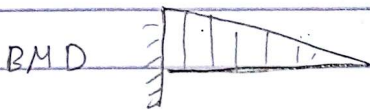
## → Max Wale

\* احدى حمل بنزاج عند نقطة - بنزاج



$$P_2 \delta_{b_1} = P_1 \delta_{c_2}$$

$$W_{ex 21} = W_{ex 12}$$

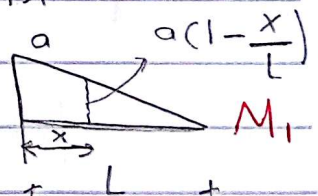


$$P_2 \delta_{b_1} = \int M_1 d\theta_2$$

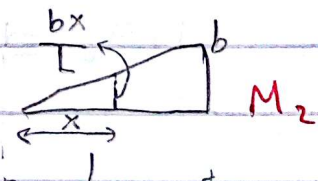
الحمل الذي طاله بنزاج  
البنزاج الذي عاينه بنزاج

$$1 \times \delta_{b_1} = \int \frac{M_1 M_2}{EI} dx$$

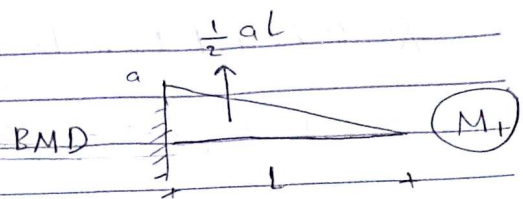
$$\int \frac{M_1 M_2}{EI} dx = \frac{1}{EI} \int M_1 M_2 dx$$



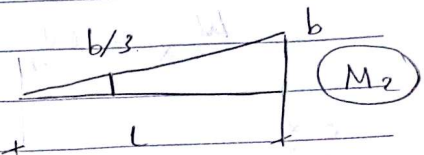
$$= \frac{1}{EI} \int a \left(1 - \frac{x}{L}\right) \times b \frac{x}{L} dx = \frac{ab}{EI} \int \left(\frac{x}{L} - \frac{x^2}{L^2}\right) dx$$



$$= \frac{ab}{EI} \left[ \frac{x^2}{2L} - \frac{x^3}{3L^2} \right]_0^L = \frac{ab}{EI} \left( \frac{L}{6} \right) = \frac{abL}{6EI}$$

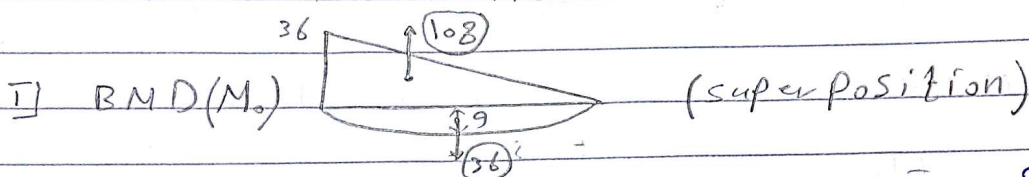
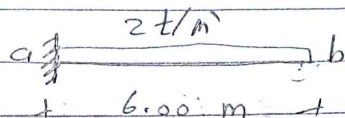


$$\frac{1}{2} al \times \frac{b}{3} = \frac{abl}{6EI}$$

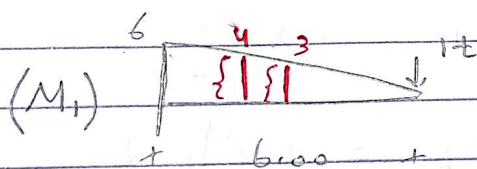


افضل مساحة هذه الشكليات \* البعد القابل مع الشكل الآخر

ex



1 \* delta\_b = M في b في (1 t) في b

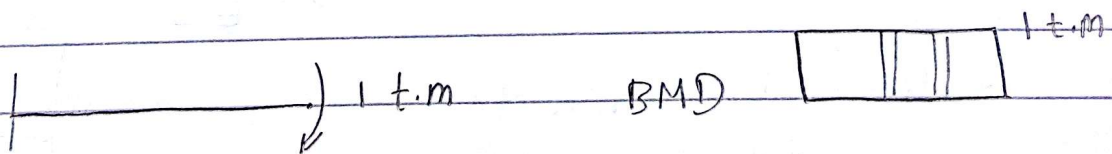


مساحات M0 و M1

$$1 * \delta_b = \frac{1}{EI} [108 * 4 - 36 * 3] = \frac{324}{EI}$$

Find theta\_b, alpha\_b

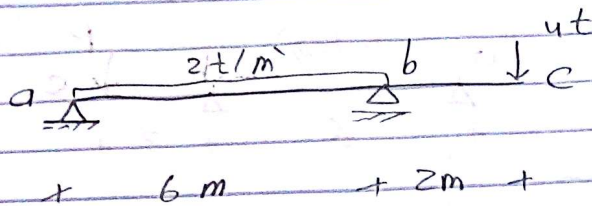
1 t في b



$$1 * \alpha_b = \frac{1}{EI} [108 * 1 - 36 * 1] = \frac{72}{EI} \text{ rad}$$



(ex)



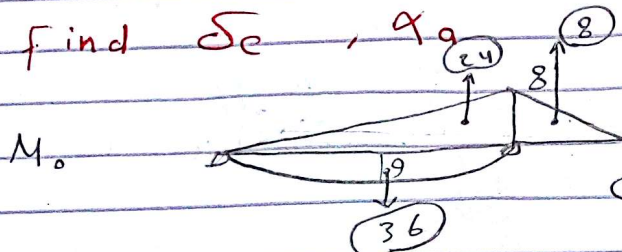
MoM. الـ

1t في

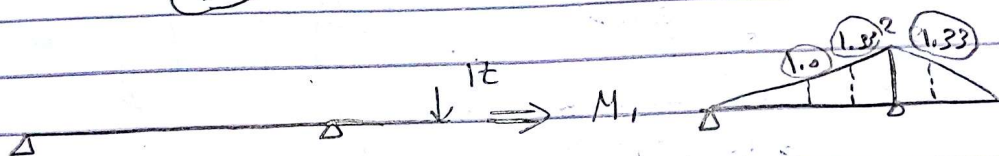
الـ

مـ الـ

find  $\delta_c$ ,  $\alpha_a$

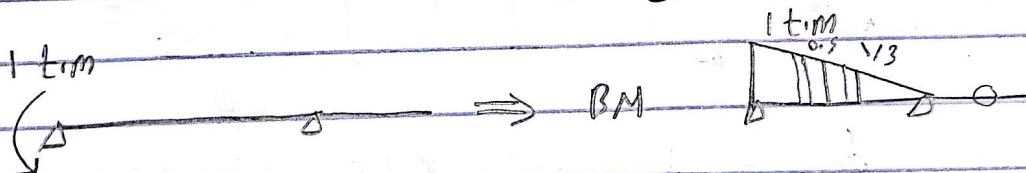


c is 1t في  $\delta_c$  الـ



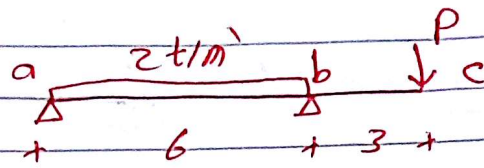
$$\delta_c = \frac{1}{EI} (-36 \times 1 + 24 \times 1.33 + 8 \times 1.33) = \frac{6.66}{EI}$$

a is 1t.m في  $\alpha_a$  الـ

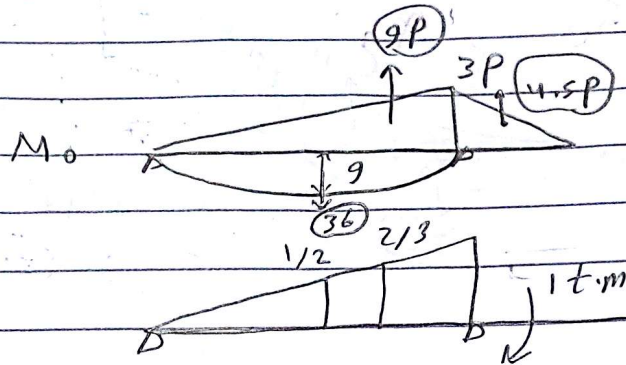


$$\alpha_a = \frac{1}{EI} (-36 \times 0.5 + 24 \times 1/3) = \frac{-10}{EI}$$

سؤال امتحان  
 { اشرح الحل فائق }

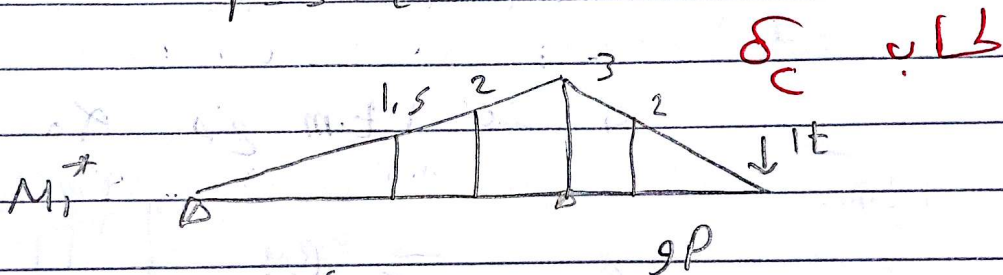


Find  $p$  such that  $\theta_b = 0$  and find  $\delta_c$



$$\theta_b = \frac{1}{EI} \left( -36 \times \frac{1}{2} + 9P \times \frac{2}{3} \right) = 0$$

$$P = 3 \text{ t}$$



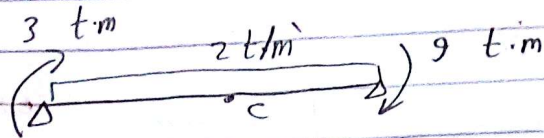
$$\delta_c = \frac{1}{EI} \left( -36 \times 1.5 + (27) \times 2 + 13.5 \times 2 \right)$$

$$= \frac{27}{EI}$$

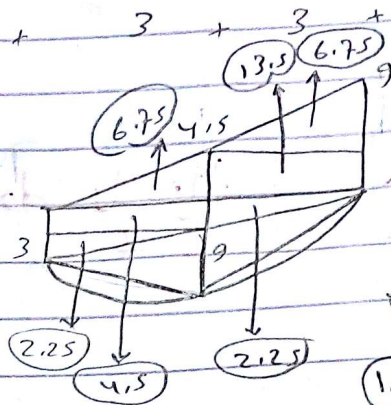


سائلہ مسائل

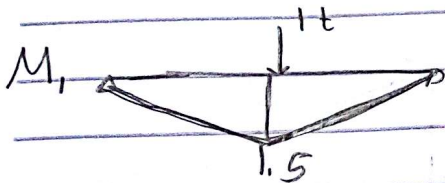
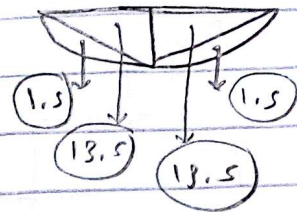
find  $\delta_c$



BMD



super position



$$\delta_c = \frac{1}{EI} \left[ 1.5 \times 0.75 + 13.5 \times 1 + 13.5 \times 1 + 1.5 \times 0.75 + 2.25 \times 0.5 + 4.5 \times 0.75 + 2.25 \times 1 - 6.75 \times 1 - 13.5 \times 0.75 - 6.75 \times 0.5 \right]$$

$$\delta_c = 15.75 / EI$$

طریقہ افری

