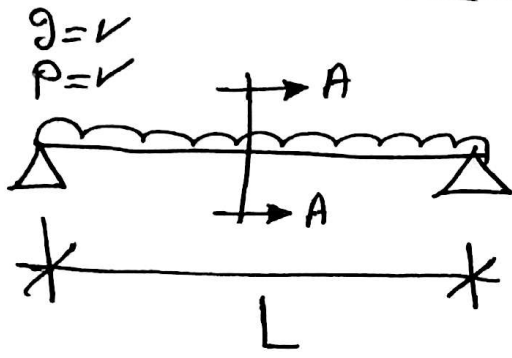


First Principles



given cross section
& reinforcement

sec. (A-A)

Req:-

هذا النوع من المسائل يكون القطاع والتسليح معطى ويكون المطلوب اما الحمل او ال span اللازم لتوفيه الشرط التالي

- * Find the maximum (load/span) to have section free of cracks $\Rightarrow M_{cr}$
- * Find the maximum allowable (load/span) $\Rightarrow M_{all}$
- * Find the maximum safe (load/span) $\Rightarrow M_u$

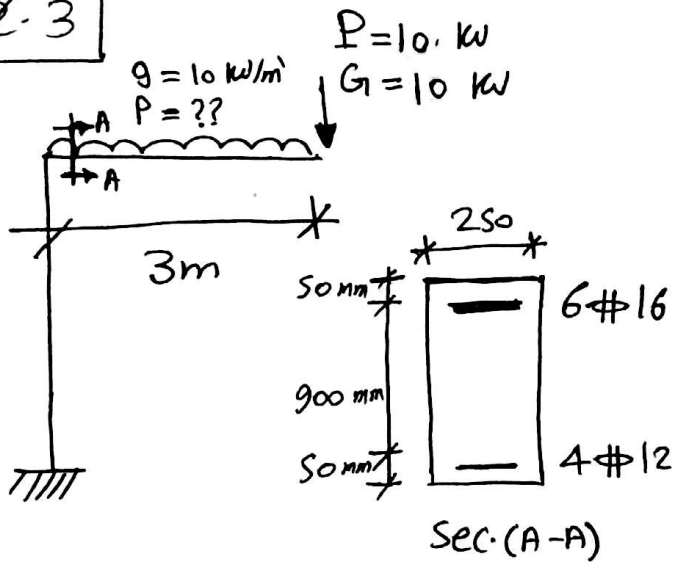
يتم حساب (M_{cr} , M_{all} , M_u) حسب المطلوب ثم مساواة العزم بالعزم الواقع على الكره

$$\left[\frac{WL^2}{8} = M_{cr} \right] \Rightarrow \text{على اجل المثال}$$

للجهول على الحمل او ال span المجهول

مع اعتبار ان الاحمال في (Stage I) و (Stage II) Working (g+p) بدون معاملات تكبير وان الاحمال في (Stage III) ultimate

EX-3



- $f_{cu} = 30 \text{ MPa}$
- $f_y = 360 \text{ MPa}$

→ Calculate the maximum live load to have section free of cracks

→ Calculate the maximum safely live load can be carried by the section

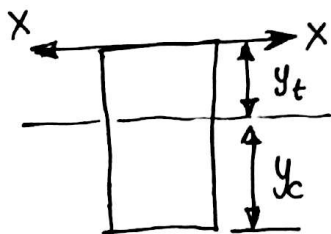
* Calculate (M_{cr}):—

① Properties of section:—

$$A_v = 10(6 \times 201) = 12060 \text{ mm}^2$$

$$\hat{A}_v = 10(4 \times 113) = 4520 \text{ mm}^2$$

$$A_c = 250 \times 1000 = 250,000 \text{ mm}^2$$



$$y_t = \frac{A_c \cdot \frac{t}{2} + A_v \cdot \text{Cover} + \hat{A}_v (t - d')}{A_c + A_v + \hat{A}_v}$$

$$= 487.3 \text{ mm}$$

$$y_c = 512.7 \text{ mm}$$

(6)

$$I_c = \frac{bt^3}{12} + A_c (t/2 - y_t)^2 = 2.083 \times 10^{10} \text{ mm}^4$$

$$I_v = A_v (y_t - \text{cover})^2 = 2.306 \times 10^9 \text{ mm}^4$$

$$I'_v = A_v (y_c - d)^2 = 9.676 \times 10^8 \text{ mm}^4$$

$$I = I_c + I_v + I'_v = 2.414 \times 10^{10} \text{ mm}^4$$

② Concrete tensile strength

$$f_{ctr} = 0.6 \sqrt{f_{cu}} = 3.29 \text{ MPa}$$

③ Cracking Moment

$$M_{cr} = \frac{f_{ctr} I}{y_t} = 162.7 \text{ kN.m}$$

* Calculate (M_u) : ———

① assume $f_s = f_y / \gamma_s$ (Tension failure)

② $d'/d < 0.1$ (st-400) $\rightarrow \therefore f_s = f_y / \gamma_s$

$$\textcircled{3} \quad 0.67 \times \frac{30}{1.5} \times 2 \times 250 + (4 \times 113) \times \frac{360}{1.15} = (6 \times 201) \times \frac{360}{1.15}$$

$$\therefore 2 = 70.45 \text{ mm} \quad C = 88.1 \text{ mm}$$

④ check Tension failure $\rightarrow C < C_b$ (Tension failure) OK

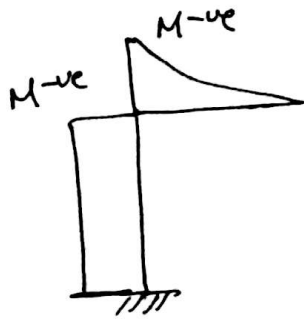
⑤ Calculate M_u

$$M_u = 0.67 \times \frac{30}{1.5} \times 70.45 \times 250 \left(950 - \frac{70.45}{2} \right) + (4 \times 113) \times \frac{360}{1.15} \left(950 - 50 \right)$$

$$= 343.2 \text{ kN.m}$$

⑦

* Maximum live load to have section free of cracks



Free of cracks $\rightarrow M \leq M_{cr}$

Stage (I) \rightarrow عمل الاعمال
Working

$$\therefore M^{-ve} = (G+P) * L + \frac{(9+P) * L^2}{2}$$

$$= 20 * 3 + (10+P) * \frac{3^2}{2}$$

$$\therefore M^{-ve} = M^{cr}$$

$$60 + 45 + 4.5P = 162.7 \text{ kN.m}$$

$$\therefore P = 12.8 \text{ kN/m} \text{ (maximum L.L.)}$$

* Maximum live load to have safe section:—

Safe section $\rightarrow M^{-ve} \leq M_u$

Stage (III) \rightarrow ultimate عمل الاعمال

الحل المركز

$$\begin{aligned} & 0.75G < P \\ \therefore W_u &= 1.4G + 1.6P \\ &= 30 \text{ kN} \end{aligned}$$

الحل الموزع

$$\begin{aligned} & \text{assume } 0.75G > P \\ \therefore W_u &= 1.5(10+P) \\ &= 15 + 1.5P \end{aligned}$$

$$\therefore M^{-ve} = 30 * 3 + (15 + 1.5P) * \frac{3^2}{2} = M_u = 343.2 \text{ kN.m}$$

$$\therefore 90 + 67.5 + 6.75P = 343.2$$

$$\therefore P = 27.5 \text{ kN/m}$$

فصل ٨ ~ $0.75G < P$ وده عكس ما افترضنا عند حساب ال ultimate للحل الموزع

$$\begin{aligned} \therefore W_u &= 1.4q + 1.6P \\ &= 14 + 1.6P \end{aligned}$$

$$\therefore 30 * 3 + (14 + 1.6P) * \frac{3^2}{2} = 343.2$$

$$\therefore P = 26.4 \text{ kN/m} \text{ (maximum l.l.)}$$
