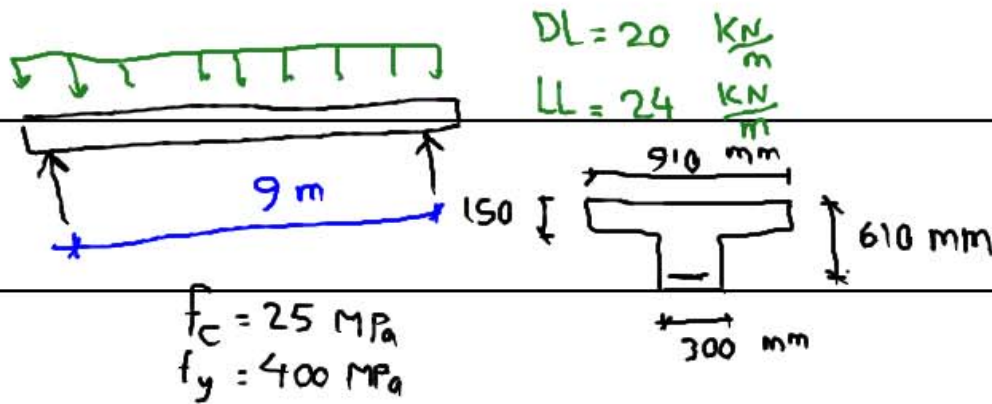


فصل ٢ N, V, M

بجاءه تعالى



مثال ١

$A_s = ?$

$$M_u = 1.25 M_D + 1.5 M_L \quad q_u = 61 \frac{KN}{m} \quad (1)$$

$$M_D = \frac{20 \times 9^2}{8} = 202.5 \text{ KN}\cdot\text{m}$$

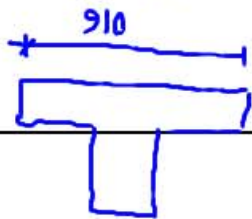
$$M_L = 243 \text{ KN}\cdot\text{m}$$

$$M_u = 617.6 \text{ KN}\cdot\text{m}$$

$$M_u = 617.6 \text{ KN}\cdot\text{m} \rightarrow A_s = ? \quad (2)$$

$$b_{eff} = \min\left(\frac{2}{5} \times 9000, 300 + 16 \times 150, 910\right) = 910 \text{ mm}$$

$$b_{eff} = \min\left(\frac{2}{5} \times 9000, 300 + 16 \times 150, 910\right) = 910 \text{ mm}$$



$$a \leq h_f = 150$$

$$M_u = .85 f_{cd} a b \left(d - \frac{a}{2}\right)$$

$$617.6 \times 10^6 = .85 (.6 \times 25) \times a \times 910 \left(610 - \frac{a}{2}\right)$$

$$.5a^2 - 610a + 53223 = 0$$

$$a = \frac{(610 \pm 588)}{.5} = 44 \text{ mm} < 150 \text{ mm}$$

$$x = \frac{a}{\gamma} = \frac{44}{1.25} = 35.2 \text{ mm}$$

52 mm

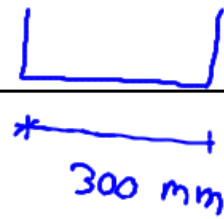
x = 52 mm

$$\beta_1 = 0.85 = 32 \text{ mm}$$

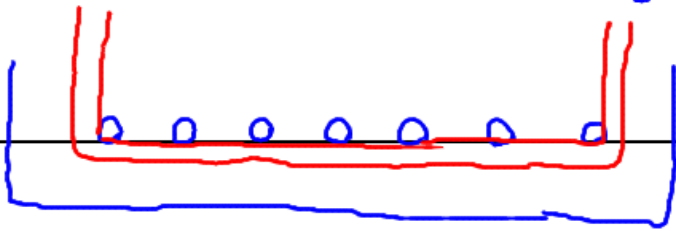
$$\frac{f_c}{d} = \frac{32}{610} = 0.08 < 0.6$$

$$A_s = \frac{617.6 \times 10^6}{(400 \times 0.85)(610 - 22)} = 3089 \text{ mm}^2$$

$$7\Phi 24 \rightarrow A_s = 3167$$



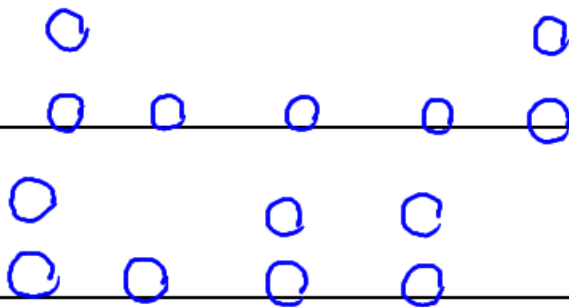
$$\max(25, 13d_a, d_b) = \max(25, 26, 24) = 26 \text{ mm}$$



$$6 \times 26 + 7 \times 24 + 2 \times 10 + 2 \times 45 =$$

1-9-2-1 ج ب ج د ه ز ح ط

$$= 434 \text{ mm} > 300 \text{ mm}$$

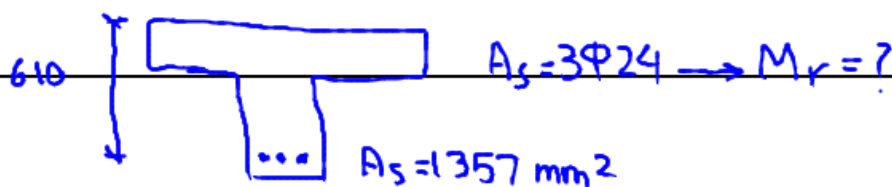


$$4 \times 26 + 5 \times 24 + 2 \times 10 + 2 \times 45 =$$

$$= 334 \text{ mm}$$

$$A_s = 3167 \text{ mm}^2$$

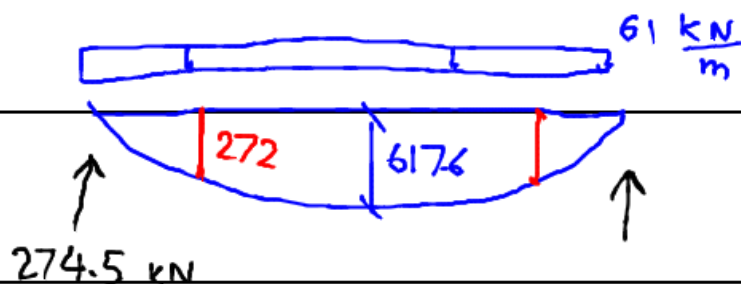
$$\frac{1}{3} A_s = 1056 \quad 3\Phi 24 = 1357 \text{ mm}^2$$



$$C = T$$

$$a = \frac{\overbrace{.85 \times 400 \times 1357}^T}{.85 \times (.6 \times 25) \times 910} = 40 \text{ mm}$$

$$M_r = T \left(610 - \frac{40}{2} \right) \times 10^{-6} = 272 \text{ kN}\cdot\text{m}$$

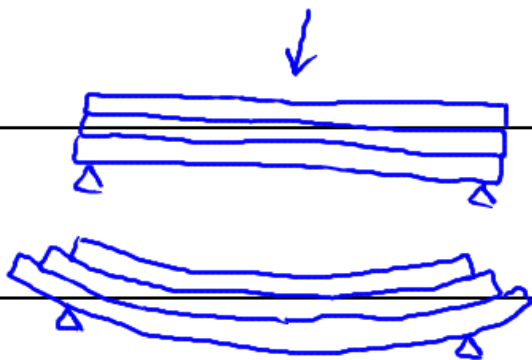


$$M = 274.5x - \frac{61}{2}x^2 = 272$$

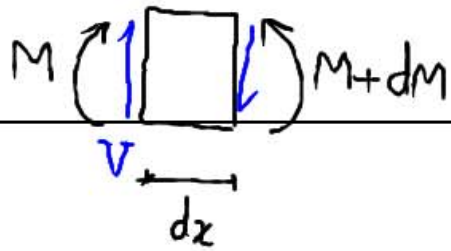
$$30.5x^2 - 274.5x + 272 = 0$$

$$x = \frac{274.5 \pm 258.9}{61} \begin{cases} \nearrow 2.5 \text{ m} \\ \searrow 8.7 \end{cases}$$

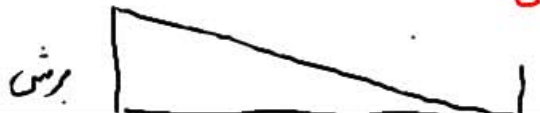
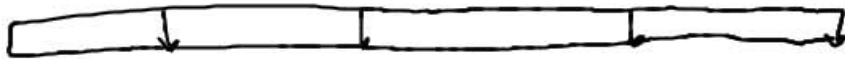
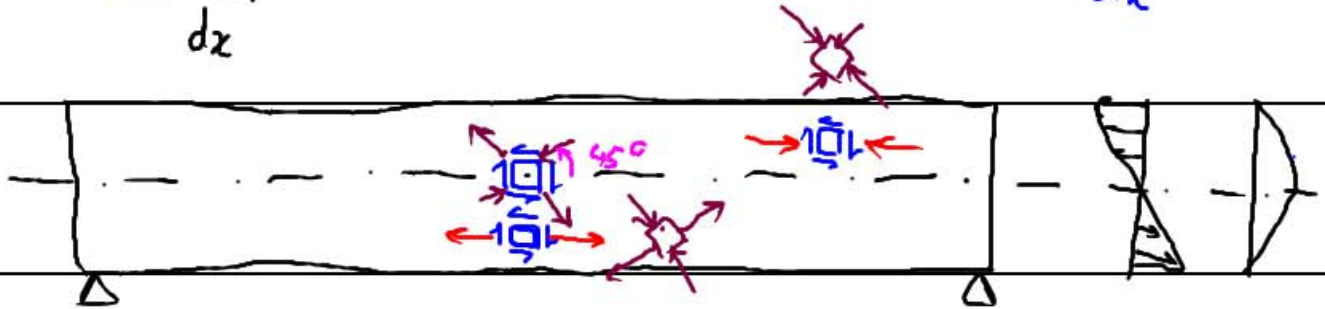
طراحی برشی تیرارستنه مسلح



برش در تیر هگزن الاستیک خطی



$$V dz = dM \rightarrow V = \frac{dM}{dz}$$



$$v = \frac{V}{bd}$$

$$\frac{f}{v} \propto \frac{M}{Vd}$$

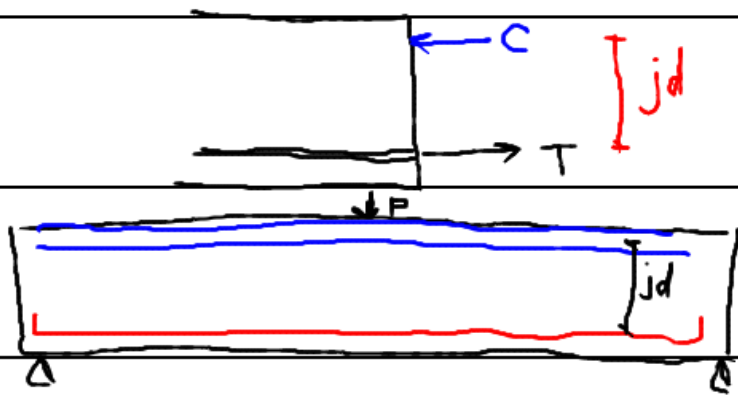


$$f = \frac{6M}{bd^2}$$

ترک خمشی قائم
 ترک خمشی - برشی
 ترک برشی 45° مایل قطری

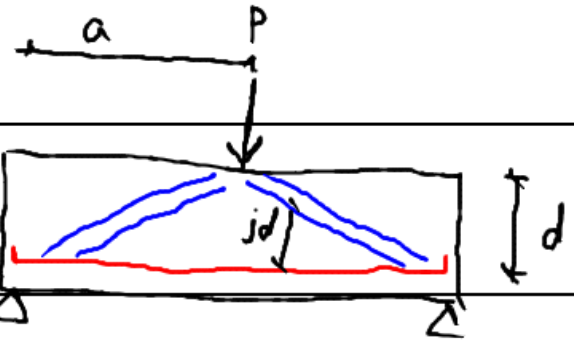
$$V = \frac{dM}{dz} = \frac{d(Tjd)}{dz} = \frac{dT}{dz} jd + T \frac{d(jd)}{dz}$$

\leftarrow جریان برشی \downarrow arch act.



تیر لاغر

ثابت
beam action

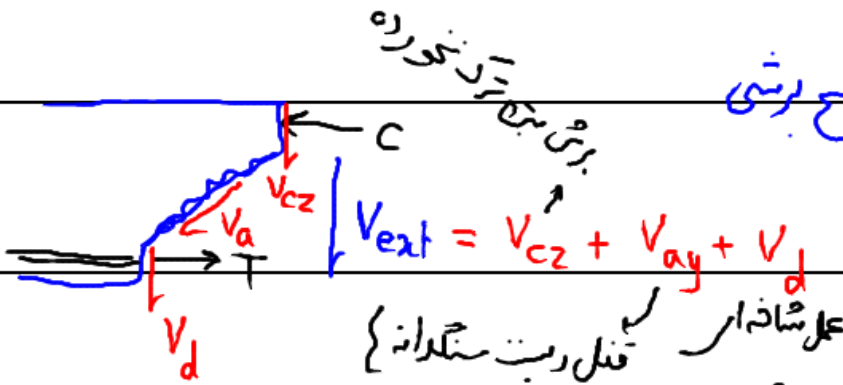


تیر عمیق

$$\frac{a}{d} \leq 2.5$$

$$\frac{l_u}{d} \leq 5$$

برشی رفتار تیر تندی غیر مسلح برشی



عمل سازنده اثر
فصل ریت سنگدان

عوامل مؤثر (در مقاومت برشی) :

مقاومت کششی، م آرمانتورشی،
 $\frac{M}{Vd}$ ، نیرو در محور
 $\frac{a}{d}$
 f_c

رفتار تیر با خاموت برشی مسلح

