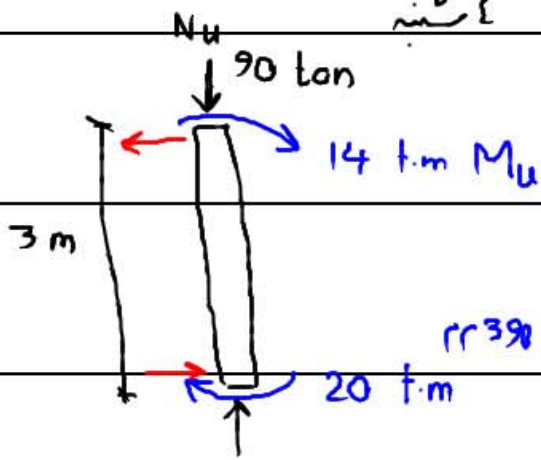


با استفاده از

ACI 318

و



$$V_u = \frac{20 + 14}{3} = 11.3 \text{ ton}$$



$$V_u = 11.3 \text{ ton}$$



$$f_c = 25 \text{ MPa}$$

$$f_y = 400 \text{ MPa}$$

$$f_y = 300$$

$$V_c = .2 \phi_c \sqrt{f_c} b d$$

$$V_c = .2 \times .6 \sqrt{25} \times 450 \times 390 = 105 \text{ kN} \quad (144 \text{ kN})$$

$$V_r = V_c + V_s \geq V_u = 113$$

$$V_s = 113 - 105 = 8 \text{ kN} < 4 V_c$$

$$V_s = A_v f_y d \frac{d}{s}$$

$$2\phi 6 \quad A_v = 2 \times \frac{\pi \times 6^2}{4} = 56.5 \text{ mm}^2$$

$$\left(\frac{A_v}{s b_w}\right)_{\min} = \frac{.35}{f_y}$$

$$\frac{A_v}{s} = \frac{8000}{.85 \times 300 \times 390} = .08 \text{ mm} \gg \frac{.35 \times 450}{300} = .53$$

$$s = \frac{56.5}{.53} = 108 \text{ mm} \leq s_{\max} = \frac{390}{2} = 195$$

2φ6 @ s = 100 mm

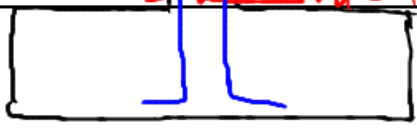
$$1 + \frac{N_u}{12 A_g} = 1 + \frac{900000}{12 \times (450)^2} = 1.37 \rightarrow V_c = 144 \text{ kN}$$

طراحی می شود و سازه را  
تک، منفرد  
ترکیب، با سازه

محقق  
نظاری

$P_u = 90 \text{ ton}$      $P_D = 61.3 \text{ t}$ ,  $P_L = 8.9 \text{ ton}$      $P_{ea} = \pm 11.8 \text{ tm}$   
 $M_u = 20 \text{ t.m}$      $M_D = 2 \text{ t.m}$ ,  $M_L = -5$      $M_{ea} = \pm 14.2 \text{ t.m}$   
 $V_u = 11.3 \text{ ton}$

برش / اصطکاک



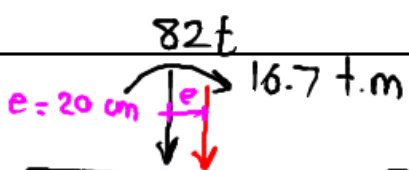
فصل  
مقاومت مجاز  $f_{all} = 200 \text{ kPa}$

$V_r = \mu A_{vf} f_{yd} = 5 \times 3927 \times 340 = 668 \text{ kN}$

$\rho = 0.02 \times \delta \Delta \sigma^2 = 4050 \text{ mm}^2$      $8 \Phi 25$      $A_{vf} = 3927 \text{ mm}^2$

D+L    کاسه ابعادی:

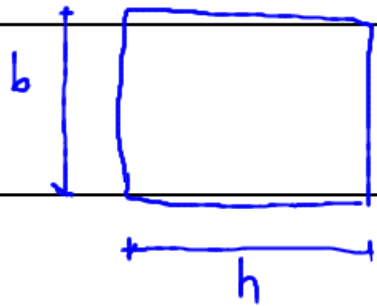
D+L+E     $P = 82 \text{ ton}$ ,  $M = 16.7 \text{ t.m}$



$\sigma = \frac{P}{A} \pm \frac{M}{S} = \frac{P}{bh} \pm \frac{6M}{bh^2}$

$\sigma_{min}$

$\sigma_{max} < \sigma_{all} = 1.33 \times 200 = 266 \text{ kPa} \quad -32$

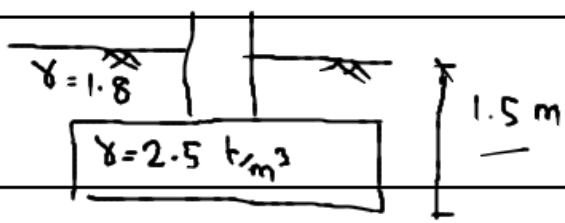


$\frac{820}{h^2} + \frac{6 \times 167}{h^3} \leq 266 \quad -32$

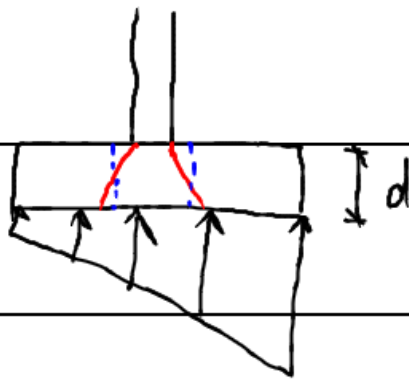
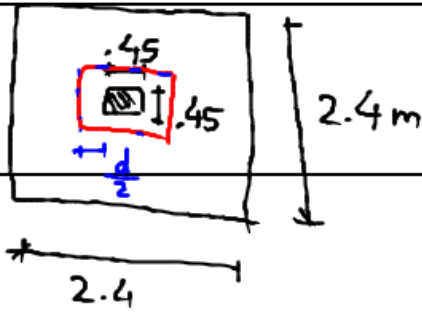
$820h + 1002 \leq 266h^3 \quad 234$

$h^3 - 3.08h \geq 3.77$   
 $3.5 \quad 4.28$

$h = 2.4 \text{ m}$



$\sigma = \frac{820}{2.4^2} + \frac{6 \times 167}{2.4^3} = 214 < 266 \text{ kPa}$   
 $140 \quad 70$



برش سوراخ کننده

$$b_o = 4(450 + d)$$

$$1 + \frac{2}{\beta_c} = 1 + \frac{2}{1} = 3$$

$$V_c = 3 \times 0.6 \times 4(450 + d) d$$

$$V_c = 2 \times 0.6 \times b_o d$$

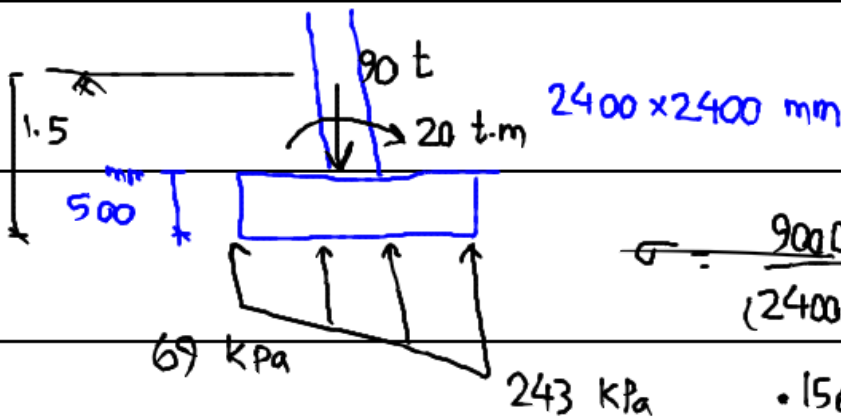
$$1 + \frac{\alpha_s d}{b_o} = 1 + \frac{20d}{4(450 + d)}$$

$$900000 \text{ N} \leq 2 \times 0.6 \times 4(450 + d) d$$

$$187500 \leq (450 + d) d$$

$$d = 400 \text{ mm} \rightarrow h = 500 \text{ mm}$$

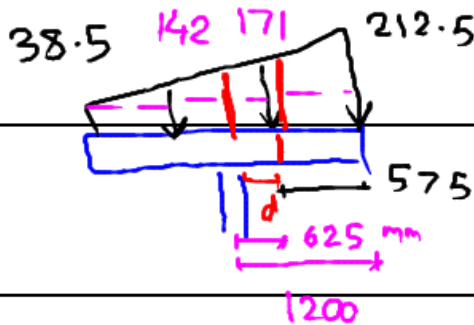
$$1 + \frac{20 \times 400}{4(450 + 400)} = 3.35$$



برش خمشی

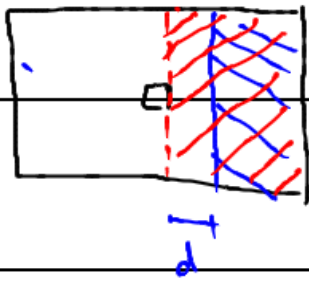
$$\sigma = \frac{900000}{(2400)^2} \pm \frac{200 \times 10^6 \times 6}{(2400)^3} = \begin{cases} 243 \text{ MPa} \\ 69 \text{ MPa} \end{cases}$$

$$0.5 \times 2.5 + 1 \times 1.8 = 3.05 \text{ m}^2 = 30.5 \text{ kPa}$$



$$\frac{142.5}{240} = \frac{x}{174}$$

$$V_u = \frac{(171 + 212.5)}{2} \times 0.575 \times 2.4 = 264 \text{ kN}$$



$$V_c = 0.2 \phi_c \sqrt{f_c} b_w d = 0.2 \times 0.6 \times \sqrt{25} \times 2400 \times 400$$

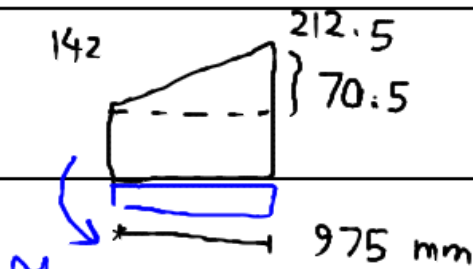
$$f_c = 25 \text{ MPa}$$

$$\times 400$$

$$V_c = 576 > V_u = 264 \text{ kN}$$

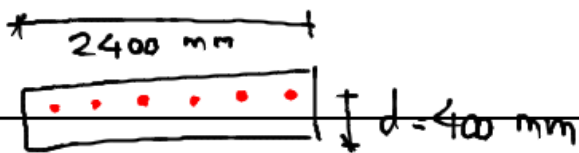
✓ ضوابط پی برای مهارسازی آرماتور و مهارشسی آرماتور

بعد کنترل می شود



طراحی ضعیف

$$M_u = \frac{1}{2.41} \left( 142 \times \frac{(0.975)^2}{2} + 70.5 \times \frac{0.975^2}{3} \right) = 216 \text{ kN}\cdot\text{m}$$



$$A_s = \frac{M_u}{f_{yd} j d} = \frac{216 \times 10^6}{0.85 \times 400 \times (0.87 \times 400)} = 1826 \text{ mm}^2$$

$$\rho_{\min} = \begin{cases} \rho_{\min} & \text{بال} \\ \frac{1.4}{f_y} = \frac{1.4}{400} = 0.0035 & \text{پای} \end{cases} \quad \rho_{\min} = 0.0018$$

$$A_{s \min} = 0.0035 \times 400 \times 2400 = 3360 \text{ mm}^2$$

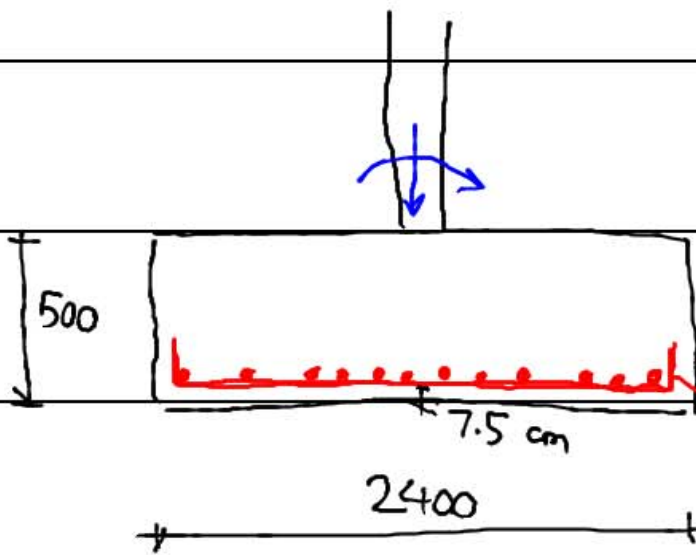
$$1.33 A_s = 2429 \text{ mm}^2$$

$$12 \phi 18 = 12 \times 254 = 3054 \text{ mm}^2$$

$$a = \frac{340 \times 3054}{.85 \times 15 \times 2400} = 34 \text{ mm} \quad \lambda = \frac{34}{.85} = 40 \text{ mm}$$

$$\frac{\lambda}{d} = \frac{40}{400} = .1 < \frac{.6}{.45}$$

$$M_r = 340 \times 3054 \left( 400 - \frac{34}{2} \right) = 398 \text{ kN}\cdot\text{m} > 216$$

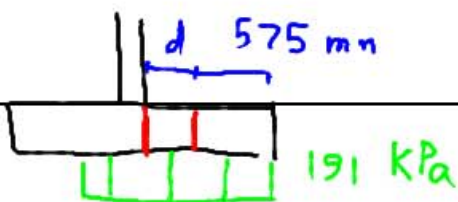
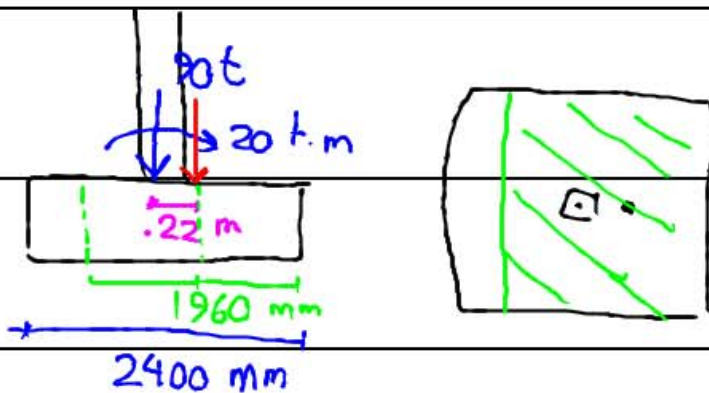


$$d = h - 75 - \frac{18}{2} = 416$$

$$d = h - 75 - 18 - \frac{18}{2} = 398$$

$$d = 407 = 400 \text{ mm}$$

12φ18



$$V_u = 191 \times .575 \times 2.4 = 264 \text{ kN}$$

$$M_u = 191 \times \frac{.975^2}{2} \times 2.4 = 218 \text{ kN}\cdot\text{m}$$

264

216

191 kPa

