Design 1

Assignment 5

ملاحظة: تم استخدام قطر العمود $\phi 10$ بدل من $\phi 12$ بسبب عدم الانتباه

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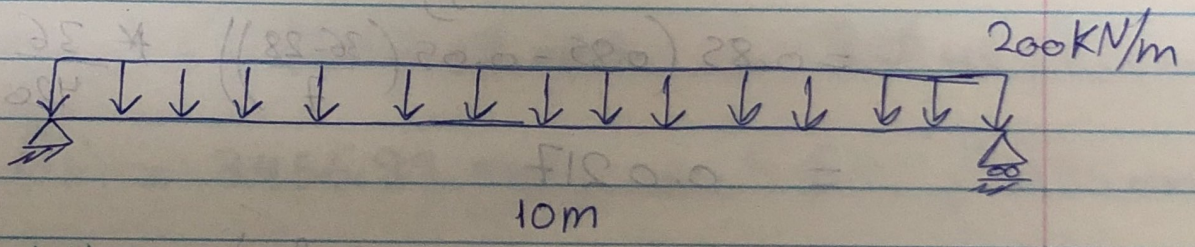
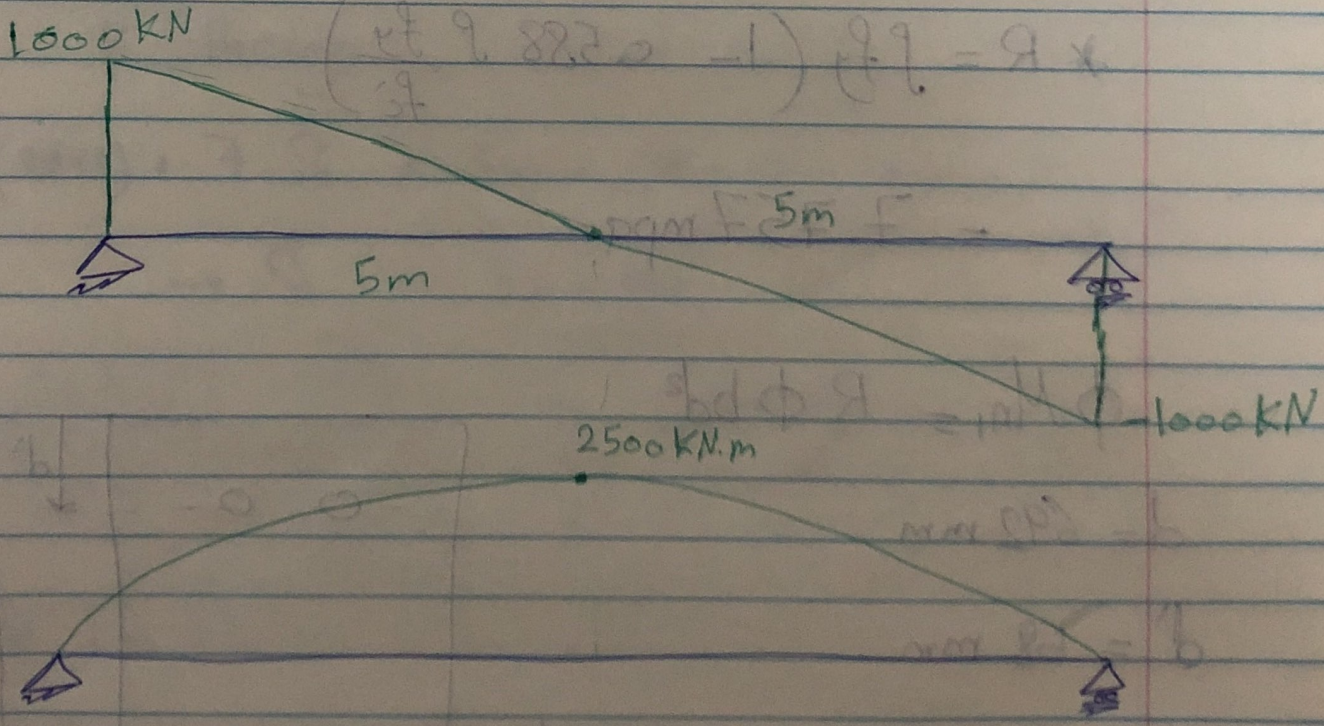
Ans:- ①





$V_u = 1000\ KN$

$M_u = 2500\ KN.m$

② $R = \frac{M_u}{\phi b d^2} = \frac{2500\,(10^3)}{(0.9)(500)(692)^2} = 11.6$ mpa

→ Doubly Reinforcement

$f_c' = 36$ mpa

→ $\rho = 0.85 * \beta_1 * \frac{f_c'}{f_y} * \frac{0.003}{0.003+0.005}$

$= 0.85\left(0.85 - 0.05\left(\frac{36-28}{7}\right)\right) * \frac{36}{420}\,(0.375)$

$= 0.0217$

$* R = \rho f_y \left(1 - 0.588\,\rho \frac{f_y}{f_c'}\right)$

$= 7.757$ mpa

$\phi M_{n_1} = R \phi b d^2$

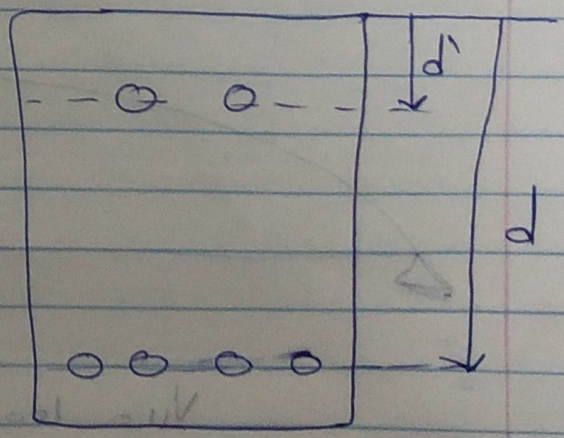
$d = 692$ mm

$d' = 58$ mm

$\frac{d'}{d} = 0.0838 < 0.13$ yield

→ $\phi M_{n_1} = 1671.55$ KN.m

$A_{s_1} = \rho b d = 7508.2$ mm²



$\phi M_{n_2} = 828.45\ kN.m = \phi A_s' f_y (d - d')$

$\rightarrow A_s' = 3456.89\ mm^2$

* $T_2 = C_s$

$A_{s_2} f_y = A_s' f_s \longrightarrow A_{s_2} = A_s'$

$A_{s_2} = 3456.89\ mm^2$

$A_{s\,total} = 11055.09\ mm^2 \rightarrow 8\phi 43\ (11616\ mm^2)$

$A_s' = 3456.89\ mm^2 \rightarrow 4\phi 36\ (4095\ mm^2)$

* Spacing:

2 layers ($8\phi 43$): $7 S_1 = 500 - (4 * 43) - 100$

$\rightarrow S_1 = 32.6\ mm$ ✓

1 layer ($4\phi 36$): $3 S_2 = 500 - (4 * 36) - 100$

$\rightarrow S_2 = 85.33\ mm$ ✓

* $T = C$

$A_s f_y = 0.85 f_c' a (b) + A_s' f_y$

$a = 206.46\ mm$

* $\bar{y} = \frac{a}{0.8 B_1} = \frac{206.46}{0.793} = 260.35\ mm$

* $\frac{\epsilon_s'}{\bar{y} - d'} = \frac{0.003}{\bar{y}}$

$d_{new} = 635.5\ mm$

$d'_{new} = 68$

$\rightarrow \epsilon_s' = 2.216 * 10^{-3}$

$\phi M_{n1} = \phi (0.85)(f_c')(a)(b)(d - \frac{a}{2})$

$= 1811.6\ KN.m$

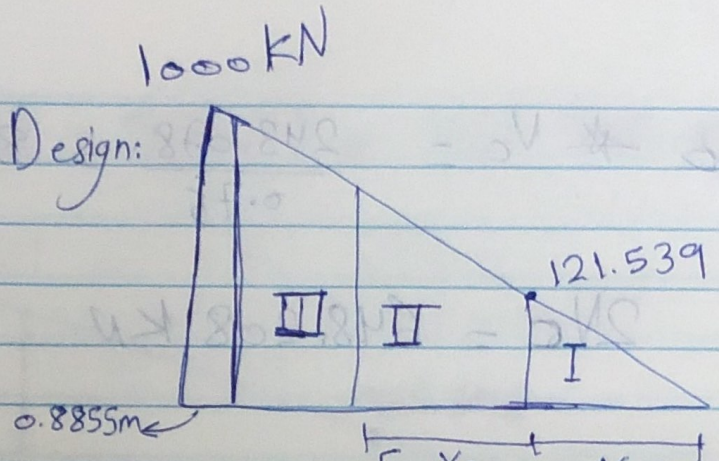
$\phi M_{n2} = \phi A_{s2} f_y (d - d')$

$= 878.44\ KN.m$

$\phi M_{n1} + \phi M_{n2} = 2690.04\ KN.m > M_u$

and (4)

(3): for Shear Design:



Region (I):

No stirrups:

$\phi V_c = 0.75(0.17)\sqrt{36}\,(500)(635.5)$

$= 243.078$ KN

$\frac{\phi V_c}{2} = 121.539$ KN

$\frac{1000}{5} = \frac{121.539}{X_1} \longrightarrow X_1 = 0.608$ m

Region (II): Max spacing Required:

$V_{u@d} = \phi V_c + \phi V_s$

$V_s = \frac{V_{u@d} - \phi V_c}{\phi}$

$250 + 635.5 = 885.5$ mm $= 0.8855$m

$\frac{500}{2}$

$\frac{V_{u@d}}{4.1145} = \frac{1000}{5} \longrightarrow V_{u@d} = 822.9$ KN

$\longrightarrow V_s = 773.096$ KN

* $V_c = \frac{243.078}{0.75} = 324.104\ kN$

$2V_c = 648.208\ kN$

$V_s > 2V_c$

* $S_{max} = \min$ of:

- $\frac{A_v f_y}{0.062\sqrt{f'_c}\, b_w}$ (354.52 mm) $\leq$ $\frac{A_v f_y}{0.35\, b_w}$ (376.8 mm)
- $\frac{d}{4} = 158.875\ mm$
- $\frac{600}{2} = 300\ mm$

$\rightarrow S_{max} = 158.875\ mm$

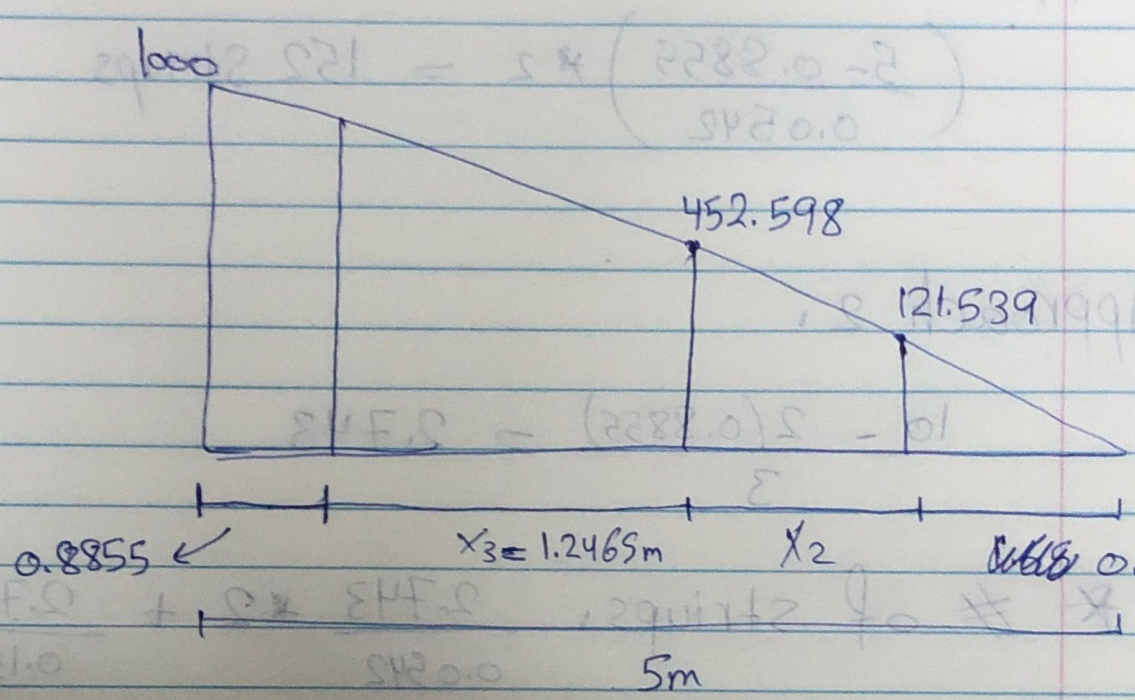
$\approx 150\ mm$

* (5) $V_u = \phi V_c + \phi V_{s\,max}$

$\phi V_{s\,max} = \frac{0.75\,(157)(420)(635.5)}{150}$

$= 209.52\ kN$

* $V_u = 243.078 + 209.52 = 452.598$ KN



$$200 = \frac{452.598}{X_2} \longrightarrow X_2 = 2.26\ m$$

(6)

Region III: Special Design:

$$S = \frac{157(420)(635.5)}{773.096(1000)} = 54.2\ mm$$

$$\#\text{of stirups} = 2\left(\frac{1.2465}{0.0542} + \frac{2.26}{0.15} + 1\right)$$

$$= 78 \text{ stirups}$$

(7), (8)

* Approach 1:

$$\left(\frac{5 - 0.8855}{0.0542}\right) * 2 = 152 \text{ striups}$$

Approach 2.

$$\frac{10 - 2(0.8855)}{3} = 2.743$$

* # of striups: $\frac{2.743}{0.0542} * 2 + \frac{2.743}{0.15}$

= # 120 striups

(9)