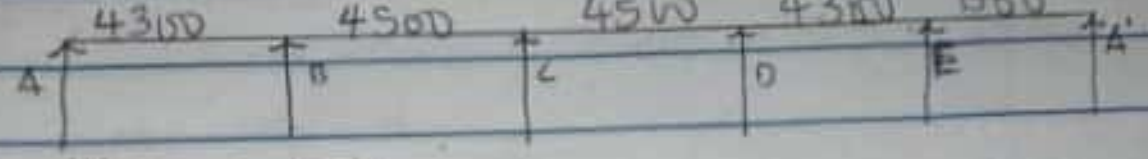
Assignment 2 Q.1



Assuming thickness: 150mm

$f_{cu} = 25 N/mm^2$

$f_y = 410 N/mm^2$

Slab loading

Slab weight = $0.15 \times 24 = 3.6 kN/m^2$

Partition $= 1.0 kN/m^2$

finishes $= 1.2 kN/m^2$

Total G.k $= 5.8 kN/m^2$

D.L (assuming for chevron) $= 1.4(5.8) + 1.6(3.0) = 13 kN/m^2$

Beam loading

Self wt of beam $= 0.225 \times 0.6 \times 24 = 5.24 kN/m^2$

finishes $= 1.2 kN/m^2$

Wall load $= 3 \times 3.47 = 10.41 kN/m^2$

Total G.k $= 14.85$

D.L $= 1.4(14.85) = 20.79 kN/m^2$

Slab load on beam in longer direction $= \frac{1}{2} w l_x \left(1 - \frac{1}{3k^2}\right)$

$k = \frac{l_y}{l_x}$

$\frac{4300}{4000} = 1.075$

$\frac{4500}{4000} = 1.125$

$\frac{1}{2} \times 13 \times 4.3 \left(1 - \frac{1}{3 \times (1.075)^2}\right) = 19.89 \text{ kN/m}^2$

$\frac{1}{2} \times 13 \times 4.5 \left(1 - \frac{1}{3 \times (1.125)^2}\right) = 21.55 \text{ kN/m}^2$

Slab ~~beam~~ load on beam in shorter direction $= \frac{1}{3} w l_x$

$= \frac{1}{3} \times 13 \times 1.5 = 6.5 \text{ kN/m}^2$

Total load $= 19.89 + 20.79 = 40.68 \text{ kN/m}$

$= 21.55 + 20.79 = 42.34 \text{ kN/m}$

$= 6.5 + 20.79 = 27.29 \text{ kN/m}$

Distribution factor

$k_{AD} = 1$

$k_{BA} = \frac{I_{BA}}{I_{BA} + I_{BC}} = \frac{I_{4.3}}{I_{4.2} + I_{4.5}} = 0.51$

$k_{BC} = 1 - 0.51 = 0.49$

$k_{CB} = \frac{1/4 \cdot s}{1/4 \cdot s + 1/4 \cdot s} = 0.5$

$k_{CD} = 1 - 0.5 = 0.5$

$k_{DC} = 0.49$

$k_{DE} = 0.51$

$k_{ED} = \frac{1/4 \cdot 3}{1/4 \cdot 3 + 1/4 \cdot 5} = 0.26$

$k_{EA'} = 1 - 0.26 = 0.74$

$k_{A'E} = 0$

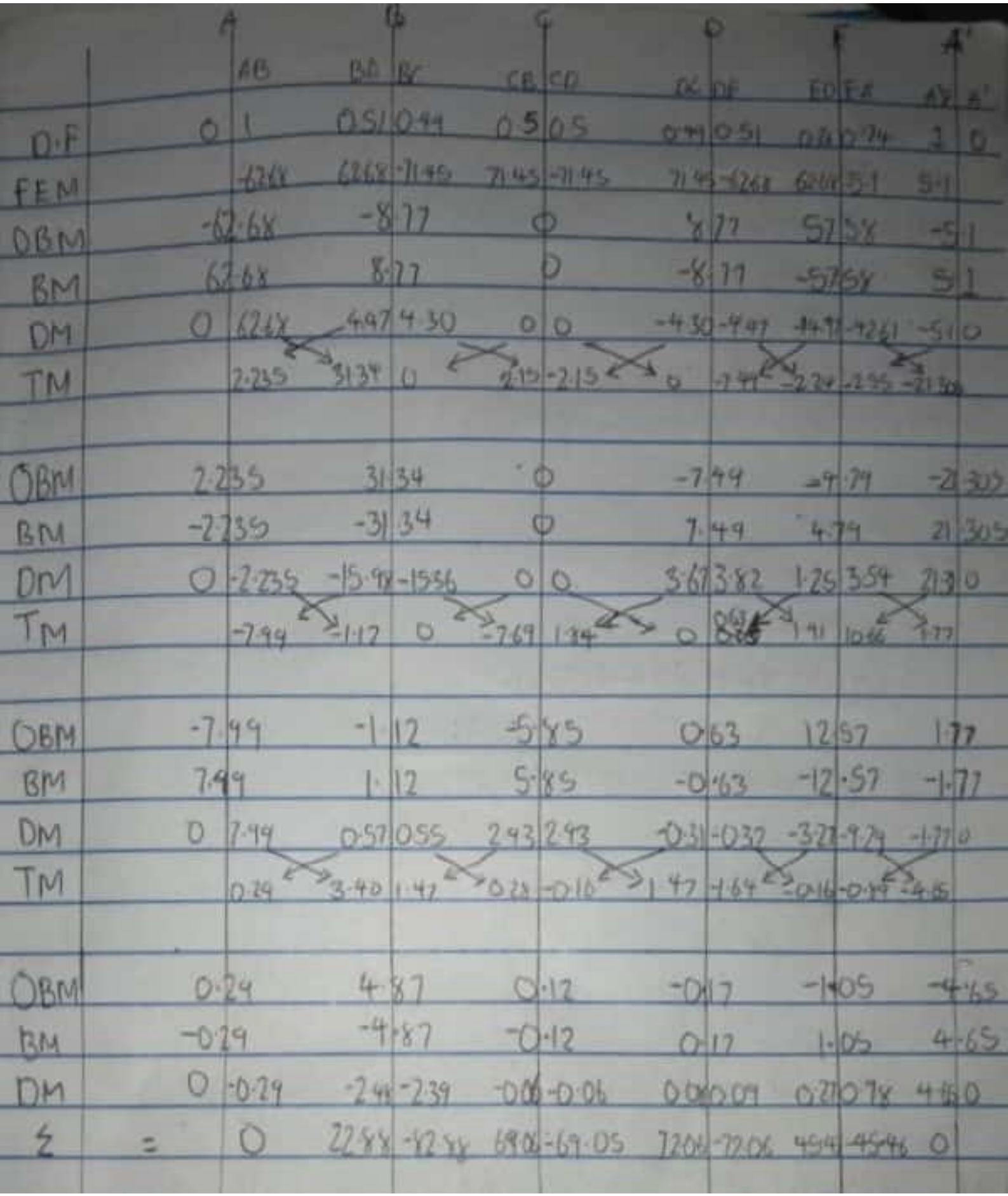
F.E.M

U.D.L $= \frac{wl^2}{12}$

1.) $\frac{40.68 \times 4.3^2}{12} = 62.6 \times kN/m$

2.) $\frac{42.34 \times 4.5^2}{12} = 71.49\ kN/m$

3.) $\frac{27.29 \times 1.5^2}{12} = 5.1\ kN/m$



Moments

$M_a = 0 kNm$

$M_b = 82.88 kNm$

$M_c = 69.06 kNm$

$M_D = 72.06 kNm$

$M_E = 45.47 kNm$

$M_{A'} = 0 kNm$

Free moment

for U.D.L $= \frac{WL^2}{8}$

1.) $\frac{40.68 \times 4.3^2}{8} = 94.02 kN/m^2$

2.) $\frac{42.34 \times 4.5^2}{8} = 107.17 kN/m^2$

3.) $\frac{27.29 \times 1.5^2}{8} = 8.24 kN/m^2$

Span moment

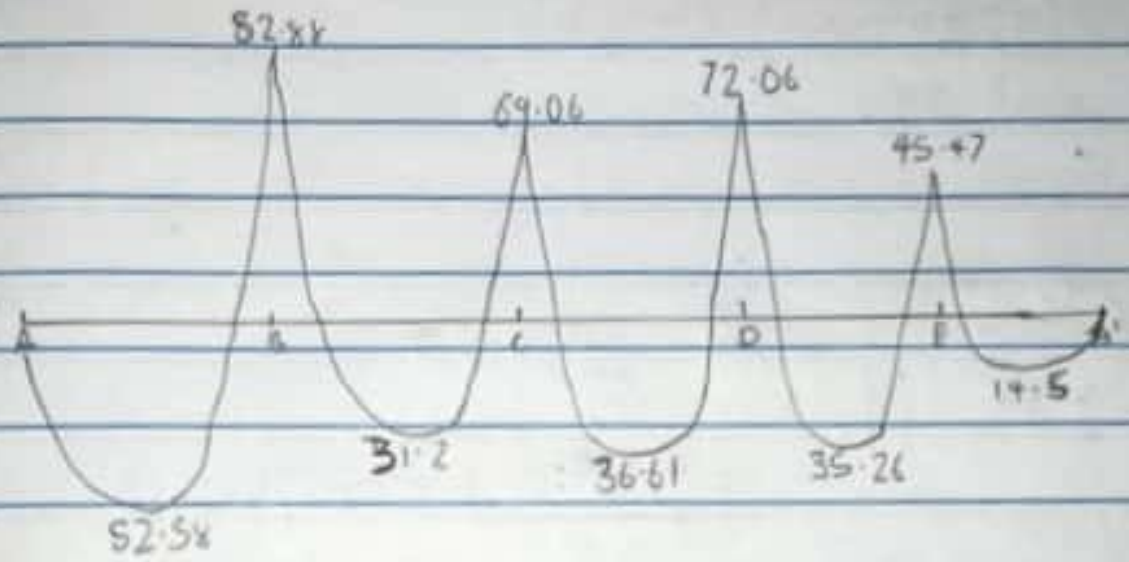
$M_{AB} = M^F - \left(\frac{M_A + M_B}{2}\right) = 94.02 - \left(\frac{0 + 82.88}{2}\right) = 52.58 kNm$

$M_{BC} = M^F - \left(\frac{M_B + M_C}{2}\right) = 107.17 - \left(\frac{82.88 + 69.06}{2}\right) = 31.2 kNm$

$$M_{CD} = M^F - \left(\frac{M_C + M_D}{2}\right) = 107.17 - \left(\frac{69.06 + 72.06}{2}\right) = 36.61\,kN\,m$$

$$M_{DE} = M^F - \left(\frac{M_D + M_E}{2}\right) = 94.02 - \left(\frac{72.06 + 45.47}{2}\right) = 35.26\,kN\,m$$

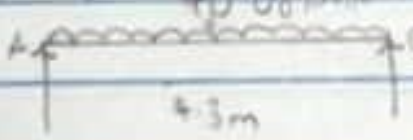
$$M_{EA'} = M^F - \left(\frac{M_E + M_{A'}}{2}\right) = 8.24 - \left(\frac{45.47 + 0}{2}\right) = -14.5\,kN\,m$$



B.M.D

Shear force

For A



$$V_A = W/2 = V_B$$

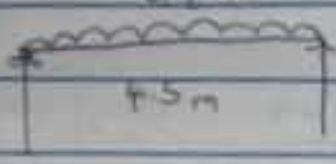
$$= \frac{40.68 \times 4.3}{2} = 87.462\,kN$$

$$V_{AD} = V_{at}\left(\frac{M_A - M_B}{L}\right) = 87.462 + \left(\frac{0 - 82.88}{4.3}\right) = 68.19$$

$$V_{DA} = wL - V_{AB}$$

$$= (40.68 \times 4.3) - 68.19 = 106.73\,kN$$

for B



$V_B' = \frac{wl}{2} = V_C$

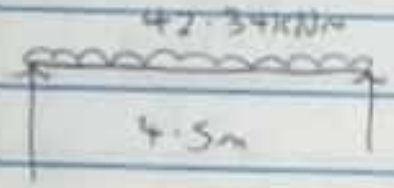
$= \frac{42.34 \times 4.5}{2} = 95.27\,kN$

$V_{BC} = V_B + \left(\frac{M_B - M_C}{L}\right) = 95.27 + \left(\frac{82.68 + 69.06}{4.5}\right) = 129.03\,kN$

$V_{CB} = (42.34 \times 4.5) - 129.03$

$= 61.5\,kN$

for C



$V_C' = \frac{wl}{2} = V_D$

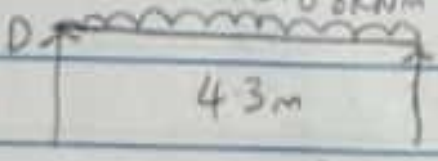
$= \frac{42.34 \times 4.5}{2} = 95.27\,kN$

$V_{CD} = 95.27 + \left(\frac{69.06 + 72.06}{4.5}\right) = 126.63\,kN$

$V_{DC} = (42.34 \times 4.5) - 126.63$

$= 63.44\,kN$

for D



$V_D' = \frac{wl}{2} = V_E$

$= \frac{40.68 \times 4.3}{2} = 87.46\,kN$

$$V_{DL} = V_D - \left(\frac{M_D + M_E}{L}\right)$$

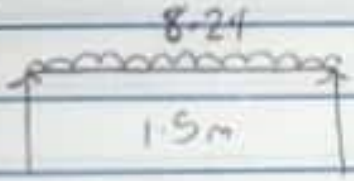
$$= 87.46 - \left(\frac{72.06 + 45.47}{4.3}\right) = 60.13kN$$

$$V_{ED} = WL - V_{DL}$$

$$= (40.6 \times 4.3) - 60.13$$

$$= 114.79kN$$

For E



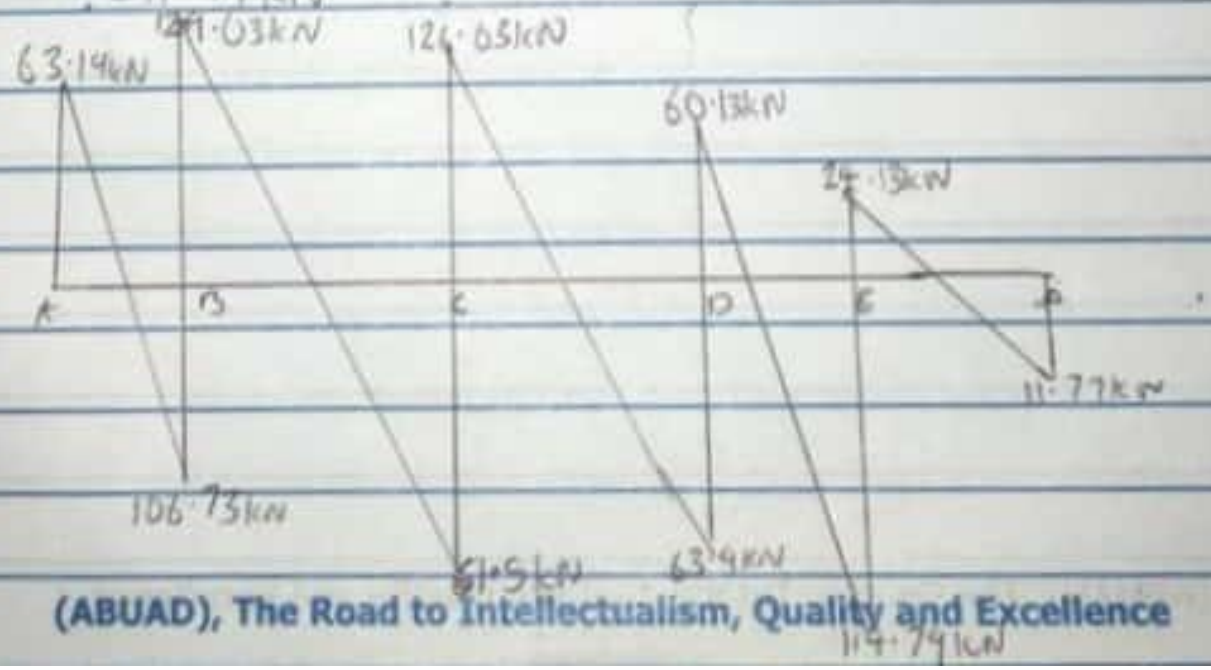
$$V_{E'} = \frac{WL}{2} = V_{D'}$$

$$= \frac{8.24 \times 1.5}{2} = 6.18kN$$

$$V_{EA'} = V_E - \left(\frac{M_E + M_{A'}}{L}\right) = 6.18 - \left(\frac{45.47 + 0}{15}\right) = 24.13kN$$

$$V_{AE} = (8.24 \times 1.5) - 24.13$$

$$= 11.77kN$$



Assignment 2 No 2

Base design

N = 1200 kN

Strength = 25 - 410 N/mm²

Fb = 150 kN/m²

Area of base req = $\frac{N \times 1.1}{A \times F_b}$ $A = 1.46$

$\frac{1200 \times 1.1}{1.46 * 150} = 6.027 m^2$

$\sqrt{6.027} = 2.45m \simeq 2.5$

Net pressure, $F_{net} = \frac{N \times 1.4}{B}$

$\frac{1200 \times 1.1}{2.5} = 24 \times 0.660 \times 1.4$

$= 505.824 kN/m$

Moment, $M = \frac{F_{net} L^2}{2}$

where $L = \frac{1}{2}(B - h)$ h = depth of base = 660

$L = \frac{1}{2}(2.5 - 0.225) = 1.138 \simeq 1.14m$

$M = \frac{505.824 \times 1.14^2}{2} = 328.68 kN/m$

$d = h - cover - \frac{1}{2}\phi$

$= 660 - 50 - 10 = 600mm$

$k = \frac{M}{bd^2 f_{ck}} = \frac{328.68 \times 10^6}{1000 \times 600^2 \times 25} = 0.032$

$R_u = 0.5 + \sqrt{0.25 + \frac{0.032}{0.9}} = 0.96 > 0.95$

$z = R_d d = 0.95 \times 600 = 570\ mm$

$A_s = \frac{M}{0.95 f_{yd} z} = \frac{328.68 \times 10^6}{0.95 \times 410 \times 570} = 1480.44\ mm^2$

Provide Y25 @ 300 c/c (1640)

Punching Shear

Column size = 225 × 450 mm

Provide = 25-410 mm

Area footing = 6.027 m^2

Size of footing = 2500 × 2500

q_n, Net pressure = 505.824 kN/m

depth = 600

critical section, $\frac{d}{2}$ = 300

300 + 300 + 225 = 825 mm

300 + 300 + 450 = 1050 mm

Shear force V_n = q_n × [Area of footing − (0.3 + d)^2]

= 505.824 [2.5 × 2.5 − (0.3 + 0.6)^2]

V_n = 2281.68 kN

Nominal shear stress $\tau_v = \frac{V_s}{bd}$

b = perimeter of critical section
d = effective span depth
$\tau_v = \frac{2751.68 \times 10^3}{((2 \times (825) + 2(1050)) \times 600)}$

$\tau_v = 1.223 \text{ N/mm}^2$

Permissible shear stress
$\tau_c' = k_s \times \tau_c$

$k_s = (0.5 + \beta_c)$ but not greater than 1
β_c = Ratio of shorter to larger side of columns
$\tau_c = 0.25 \sqrt{f_{ck}}$
$k_s = 1$

$\tau_c' = 0.25\sqrt{25} = 1.25 \text{ N/mm}^2$
$\tau_v = 1.223 \text{ N/mm}^2$
$\tau_v \leq \tau_c'$

three depth assumed is ok ✓

Checking for Pb with actual size of footing
Unit weight of concrete = 24 kN/m^3
Unit weight of soil = $1.091 \times 10^{-6} \text{ kN/mm}^3$

Actual pressure footing below
$q = (1200/2.5 \times 2.5) + (24 \times 0.660) + (1.091 \times 10^{-6} \times 0.66$

$q = 214.94 \text{ kN/m}^2$