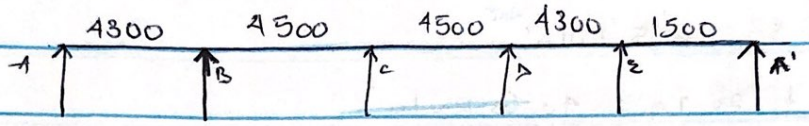
NAME: SAHIL ABDULRAHIMAN O.

DEPARTMENT: CIVIL ENGINEERING

MATRIC NO: 17/ENG08/050

COURSE: STRUCTURAL DESIGN (CIVE 808)

ASSIGNMENT 2 ANSWER



Assuming thickness: 150mm

f_y = 410 N/mm²

f_a = 25 N/mm²

Slab loading

Slab weight = 0.15 × 24 = 36 kN/m²

Partition = 1.0 kN/m²

finishes = 1.2 kN/m²

Total G.k = 5.8 kN/m²

Assuming for classroom

D.L = 1.4 (5.8) + 1.6 (3.0) = 13 kN/m

Beam loading

Self weight of beam = 0.225 × 0.6 × 24 = 5.24 kN/m²

finishes = 1.2 kN/m²

Wall load = 3 × 3.47 = 10.41 kN/m²

Total G.k = 14.85 kN/m²

D.L = 14 (14.85) = 20.79 kN/m²

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

$k = l_x / l_{sc}$: $4800/4000 = 1.075$

$4500/4000 = 1.125$

$\frac{1}{2} \times 13 \times 4.5 \left(1 - \frac{1}{3}(1.075)^2\right) = 19.89 \text{ kN/m}^2$

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

Slab 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 $k_{AB} = \frac{1/l_{BA}}{1/l_{BA} + 1/l_{BA}} = \frac{1/4.3}{1/4.2 + 1/4.5} = 0.51$

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

$k_{CB} = \frac{1/4.5}{1/4.5 + 1/4.5} = 0.5$

$k_{CD} = 1 - 0.5 = 0.5$, $k_{DC} = 0.49$, $k_{DE} = 0.51$

$k_{ED} = \frac{1/4.3}{1/4.3 + 1/1.5} = 0.26$

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

$k_{A'E} = 1$

F.E.M

U.D.L = $wl^2/12$

1) $\frac{40.68 \times 4.3^2}{12} = 62.68 \text{ kNm}$

2) $\frac{42.34 \times 4.5^2}{12} = 71.45 \text{ kNm}$

3) $\frac{27.29 \times 1.5^2}{12} = 5.1 \text{ kNm}$

	A		B		C		D		E		A'
		AB	BA	BC	CB	CD	DC	DE	ED	EA'	A'E	A'
D.F	0	1	0.51	0.49	0.5	0.5	0.49	0.51	0.26	0.74	1	0
FEM		-62.68	62.68	-71.45	71.45	-71.45	71.45	-62.68	62.68	-5.1	5.1	
OBM		-62.68		-8.77		0		8.77		57.58	-5.1	
BM		62.68		8.77		0		-8.77		-57.58	5.1	
DM	0	62.68	4.47	4.38	0	0	-4.30	-4.47	-14.97	-42.61	-5.1	0
TM		2.235	31.34	0	2.15	-2.15	0	-7.49	-2.24	-2.55	-21.305	
OBM		2.235		31.34		0		-7.49		-4.79	-21.305	
BM		-2.235		-31.34		0		7.49		4.79	21.305	
DM	0	-2.235	-15.98	-15.36	0	0	3.67	3.82	1.25	3.54	21.31	0
TM		-7.99	-1.12	0	-7.69	1.84	0	0.63	1.91	10.66	1.77	
OBM		-7.99		-1.12		-5.85		0.63		12.57	1.77	
BM		7.99		1.12		5.85		-0.63		-12.57	-1.77	
DM	0	7.99	0.57	0.55	2.93	2.93	-0.31	-0.32	-3.27	-9.29	-1.77	0
TM		0.29	3.40	1.47	0.28	-0.16	1.47	-1.64	-0.16	-0.89	-4.65	
OBM		0.29		4.87		0.12		-0.17		-1.05	-4.65	
BM		-0.29		-4.87		-0.12		0.17		1.05	4.65	
DM	0	-0.29	-2.48	-2.39	-0.06	-0.06	0.08	0.09	0.27	0.78	4.65	0
Σ		0	22.88	-82.88	69.06	-69.06	72.06	-72.06	45.47	-45.47	0	

Moment

M_A = 0 kN/m

M_B = 82.88 kN/m

M_C = 69.06 kN/m

M_D = 72.06 kN/m

M_E = 45.47 kN/m

$M_{A'}$ = 0 kNM

Free moment for u.d.l = $wL^2/8$

1.) $40.68 \times 4.3^2 / 8 = 94.02$ kN/m²

2) $42.34 \times 4.5^2 / 8 = 107.17$ kN/m²

3) $27.29 \times 1.5^2 / 8 = 7.67$ kN/m²

Span Moment

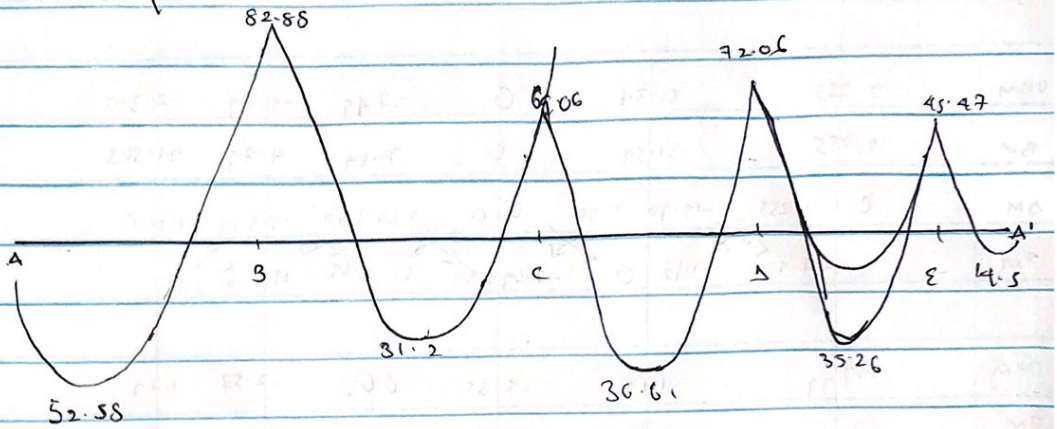
$M_{AB} = 94.02 - \left(\frac{0 + 82.88}{2}\right) = 52.58$ kN/m

$M_{BC} = 107.17 - \left(\frac{82.88 + 69.06}{2}\right) = 31.2$ kN/m

$$M_{CD} = 107.17 - \left(\frac{69.06 + 12.06}{2}\right) = 36.61 \text{ kNm}$$

$$M_{DE} = 94.62 - \left(\frac{72.06 + 49.47}{2}\right) = 35.26 \text{ kN/m}$$

$$M_{EA'} = 8.67 - \left(\frac{45.47 + 0}{2}\right) = 75.08 \text{ kN/m}$$



B.M.D

Shear force

$$\text{for } A = \frac{40.68 \times 4.3}{2} = 87.462 \text{ kN}$$

$$V_{AB} = 87.462 + \left(\frac{0 - 82.88}{4.3}\right) = 68.19 \text{ kN}$$

$$V_{BA} = wL - V_{AB} = (40.68 \times 4.3) - 68.19 = 106.73 \text{ kN}$$

$$\text{for } B = \frac{42.34 \times 4.5}{2} = 95.27 \text{ kN}$$

$$V_{BC} = 95.27 + \left(\frac{82.88 + 69.06}{4.5}\right) = 129.03 \text{ kN}$$

$$V_{CB} = (42.34 \times 4.5) - 129.03 = 61.5 \text{ kN}$$

for C : $\frac{42.34 \times 4.5}{2} = 95.27$

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

$V_{DC} = (42.34 \times 4.5) - 126.63 = 63.19\ kN$

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

$V_{DE} = 87.46 - \left(\frac{72.06 + 45.47}{4.3}\right) = 60.18\ kN$

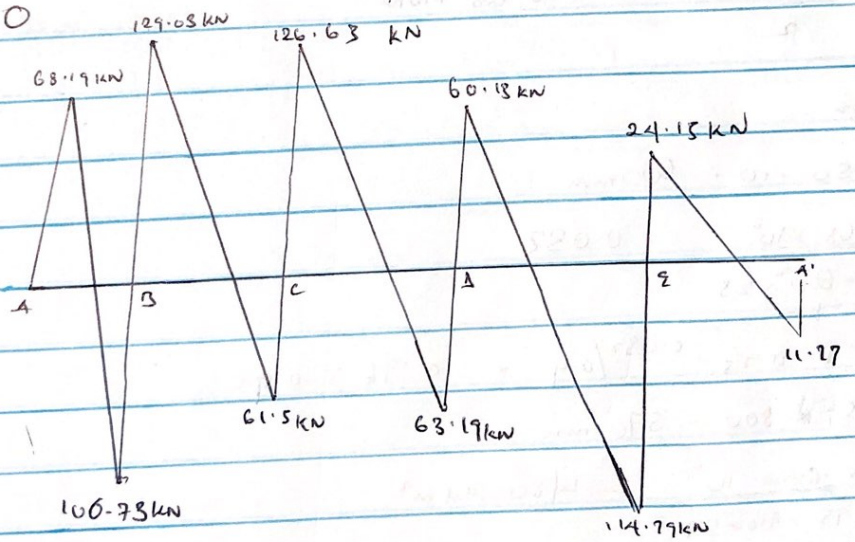
$V_{ED} = wL - V_{DE} = (40.68 \times 4.3) - 60.18 = 114.79\ kN$

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

$V_{EA'} = 6.18 - \left(\frac{15.47 + 0}{1.5}\right) = 24.15\ kN$

$V_{A'E} = (8.24 \times 1.5) - 24.15 = 11.27\ kN$

for A' = 0



S. F. D

~~Assignment~~

Number - (2)

Base design $M = 1200\ kN$

strength = 25 - 410 N/mm²

$F_b = 150\ kN/m^2$

Area of base require = $\frac{M \times 1.1}{1 \times F_2}$ $1 = 1.4 f_b$

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

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

Net pressure, $F_{net} = \frac{M \times 1.1}{B} = \frac{1200 \times 1.1}{2.5} = 24 \times 0.660 \times 1.4$

$= 505.824\ kNm$

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

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

$M = \frac{505.824 \times 1.14^2}{2} = 328.68\ kNm$

$d = h - cover$

$660 - 50 - 10 = 600 mm$

$K = \frac{328.68 \times 10^6}{1000 \times 600^2 \times 25} = 0.032$

$R_{en} = 0.5 + \sqrt{0.25 + 0.032/0.9} = 0.96 > 0.95$

$Z = 0.95 \times 600 = 570 mm$

$A_s = \frac{328.685 \times 10^6}{0.95 \times 410 \times 570} = 1480.44 m^2$

Provide Yrs @ 300 c/c (16+0)

Shear

Column Size = 225 × 450 mm

Area - footing = 6.027 m^2

Size of footing = 2500 × 2500

q, Net pressure = 505.824 kN/m

depth = 600

critical section = 600/2 = 300

300 + 300 + 225 = 825 mm

300 + 300 + 450 = 1050 mm

Shear force V_u = 505.824 [2.5 × 2.5 − (0.3 + 0.6)²]

V_u = 2751.68 N

Nominal shear stress $\tau_v = V_u / b_v d$

$$\tau_v = \frac{2751.68 \times 10^3}{(2 \times (825) + 2(1050)) \times 600} = 1.223 \text{ N/mm}^2$$

Permissible shear stress

$\tau_c' = k_s \times \tau_c$

$\tau_c' = 0.25 \sqrt{25} = 1.25$ N/mm²

$\tau_u = 1.223$ N/mm²

$\tau_u \leq \tau_u'$

Hence depth assumed is ok

checking for f_{ck} with actual size of footing

Unit weight of Concrete = 24 kN/mm²

Unit weight of Soil = 1.091×10^{-6} kN/mm²

Actual Pressure - footing below

$q = (1200 \times 2.5 \times 2.5) + (24 \times 0.600) + (1.091 \times 10^{-6} \times 0.$

$q = 214.94$ kN/m²