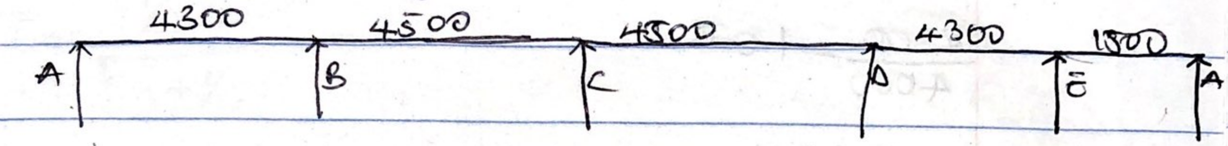
Assignment 2.

1



Assuming thickness = 150mm

F_{cu} = 25N/mm²

F_y = 410N/mm²

Slab loading:

Slab weight = 0.15 × 24 = 3.6 kN/m²

Partition = 1.0 kN/m²

Finishes = 1.2 kN/m²

Total Gk = 5.8 kN/m²

D.L = 1.4(5.8) + 1.6(3.0) = 13 kN/m² (3.0 assumed)

Beam loading:

Self weight of beam = 0.225 × 0.6 × 24 = 3.24 kN/m²

Finishes = 1.2 kN/m²

Wall load = 3 × 3.47 = 10.41 kN/m²

Total Gk = 14.85

D.L = 1.4(14.85) = 20.79 kN/m²

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

$k = l_y / l_x$

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

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

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

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

Slab load on beam in shorter direction $= \frac{1}{3} wlx$

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

Total load $= 19.89 + 20.79 = 40.68$ kN/m

$= 21.55 + 20.79 = 42.34$ kN/m

$= 6.54 + 20.79 = 27.29$ kN/m

Distribution factor

$k_{AB} = 1$

$k_{BA} = \frac{1/L_{BA}}{1/L_{BA} + 1/L_{BC}} = \frac{1/4.3}{1/4.2 + 1/4.5} = 0.51$

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

$k_{CB} = \frac{1/4.5}{1/4.5 + 1/4.3} = 0.5$

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

$k_{DC} = 0.49$

$k_{DE} = 0.51$

$$k_{ED} = \frac{1/4.3}{1/4.3 + 1/\text{[illegible]}5} = 0.26.$$

$$k_{EA}' = 1 - 0.26 = 0.79.$$

$$k_{AE}' = \phi$$

F.E.M,

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

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

2) $$\frac{42.34 \times 4.5^2}{12} = 71.45\ \text{kN/m}.$$

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

	A	AB	BA	BC	CB	CD	DC	DE	ED	EA	AE	A'
D.F	0	1	0.51	0.44	0.5	0.5	0.49	0.51	0.30	0.24	2	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	4.50	0	0	-4.30	-4.47	-14.97	-42.61	-5.1	0
TM		2.235	31.38	0	2.15	-2.15	0	-2.49	-2.24	-2.55	-21.30	
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	21.3	0
TM		2.44	-1.12	0	-7.69	1.84	0	0.63	1.41	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	-3.22	-9.29	-1.77	0
TM		0.29	3.40	1.42	0.28	0.16	1.47	-1.64	-0.16	0.89	-4.15	
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	0.09		0.27	0.78	4.65	0
[illegible]		0	22.88	-82.88	68.06	-69.05	72.06	-72.06	45.46	45.66	0	

Moments

$M_a = 0$ 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.

$M_{A'} = 0$ KN/m.

Free moment

For U.D.L $= \frac{\omega l^2}{8}$

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

2) $\frac{42.34 \times 4.5^2}{8} = 107.17$ KN/m²

3) $\frac{27.29 \times 1.5^2}{8} = 8.24$ kN/m².

Span moment:

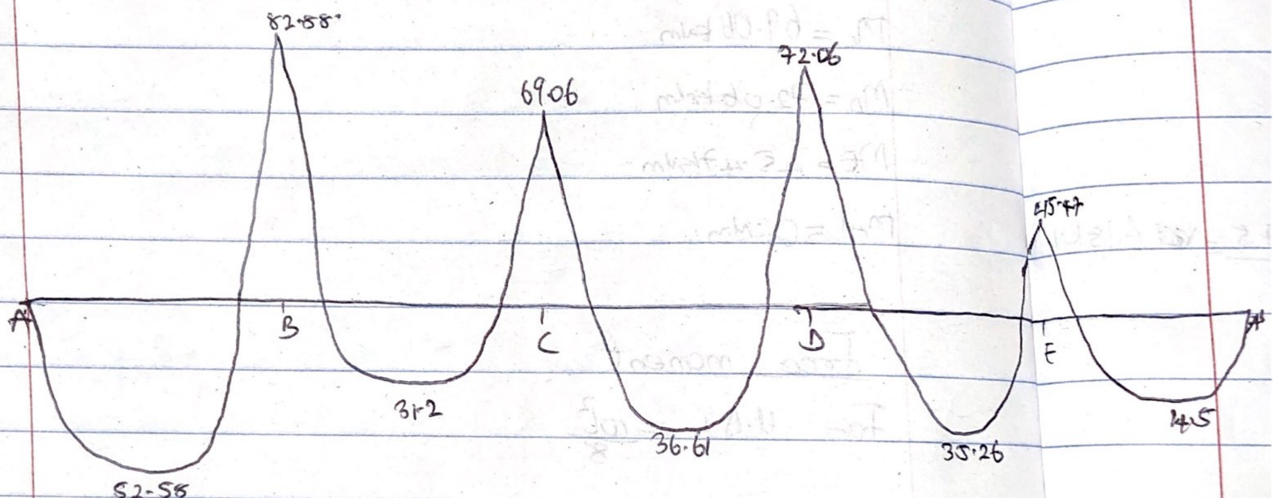
$M_{AB} = M^F - \left(\frac{M_A + M_B}{2}\right) = 94.02 - \left(\frac{0 + 82.88}{2}\right) = 52.88$ kN/m

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

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

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

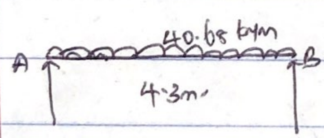
$M_{EA'} = M^F - \left(\frac{M_E + M_{A'}}{2}\right) = 8.24 - \left(\frac{45.47 + 0}{2}\right) = -14.5 kNm$



B.M.D.

Shear force

For A



$V_A = \frac{wl}{2} = V_B$

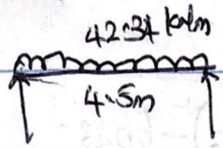
$= \frac{40.68 \times 4.3}{2} = 87.462 kN$

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

$V_{BA} = wl - V_{AB}$

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

For B:



$V_{BC} = \frac{wl}{2} = V_C$

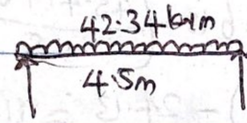
$= \frac{42.34 \times 4.5}{2} = 95.27\,kN$

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

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

$= 61.5\,kN.$

For C



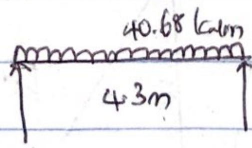
$V_C = \frac{wl}{2} = V_D.$

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

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

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

For D



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

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

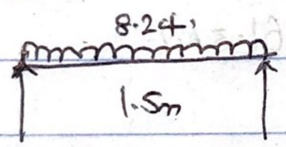
$V_{DE} = V_D - \left(\frac{M_D + M_E}{L}\right) = 87.46 - \left(\frac{72.06 + 45.47}{4.3}\right) = 60.13\,kN.$

$V_{ED} = wl - V_{DE}$

$= (40.68 \times 4.3) - 60.13$

$= 114.79\,kN$

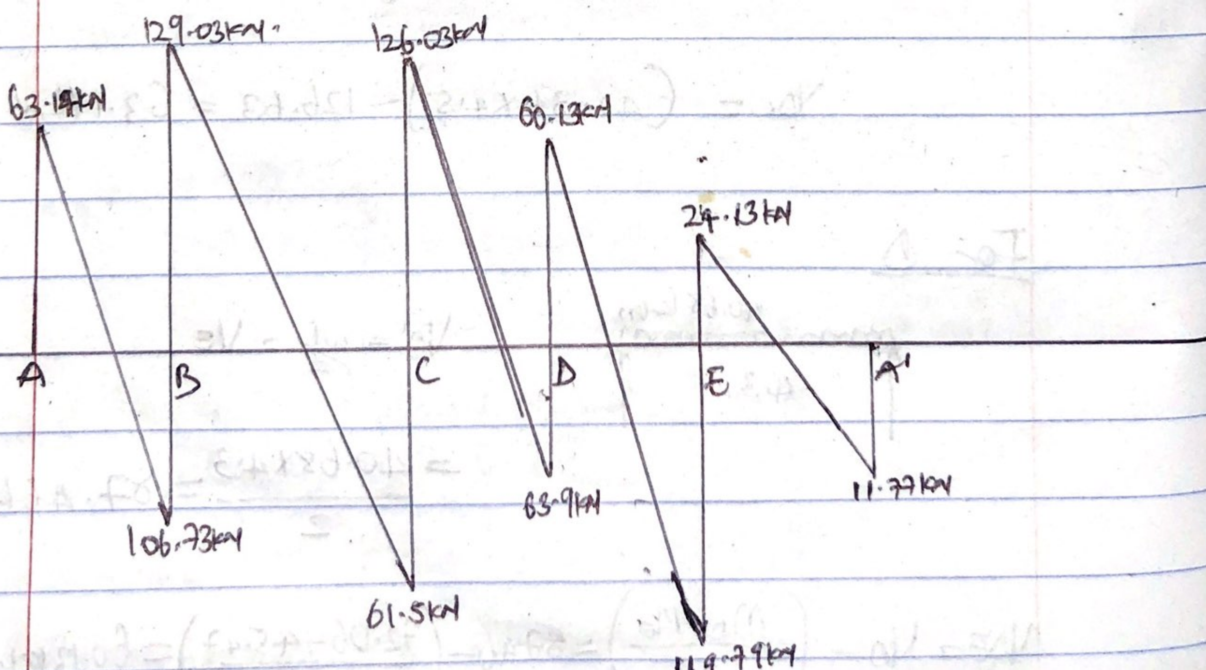
For E':



$V_{E'} = \frac{wl}{2} = V_{A'} = \frac{8.24 \times 1.5}{2} = 6.18\,kN$

$V_{EA'} = V_E - \left(\frac{M_E + M_{A'}}{L}\right) = 6.18 - \left(\frac{45.47 + 0}{1.5}\right) = 24.13\,kN$

$V_{A'E} = (8.24 \times 1.5) - 24.13 = 11.77\,kN$



2)

Base design

$N = 1200$ kN

weigth $= 25 - 410$ N/mm²

$F_b = 150$ kN/m²

Area of base required $= \frac{N \times 1.1}{\alpha \times F_b}$ $\alpha = 1.46$

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

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

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

$\frac{1200 \times 1.1}{3.5} - 24 \times 0.660 \times 1.4 = 505.824$ kN/m

moment, $m = \frac{F_{net} \, C^2}{2}$

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

$h = \frac{1}{2}(2.5 - 0.225) = 1.138$

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

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

$= 660 - 50 - 10 = 600mm$

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

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

$Z = R_a d = 0.95 \times 600 = 570mm$

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

Provide Y25 @ 300 c/c (1640).

Punching shear.

Column size = $225 \times 450mm$

F_{cu} f_y = 25 - 410mm

Area footing = $6.027m^2$

Size of footing = 2500×2500 mm

q =, Net pressure = 505.824 kN/m

depth = 600

Critical section $d/2$ = 300

$300 + 300 + 225 = 825$ mm

$300 + 300 + 450 = 1050$ mm

Shear force $V_n = q_n \times [\text{Area of footing} - (0.3+d)^2]$

$= 505.824 [2.5 \times 2.5 - (0.3 + 0.6)^2]$

$V_n = 2751.68$ kN