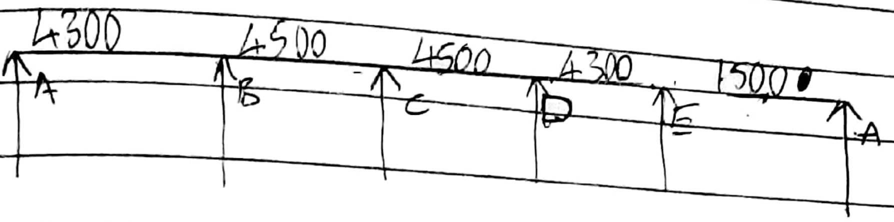
USIAGBE ANTHONY USAGIE

17/ENG03/053

Assignment 2



Assuming thickness : 150mm

$F_{cu} = 25 N/m^2$

$F_y = 410 N/mm^2$

Slab loading

Slab weight = 0.15 x 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 = 1.4(5.8) + 1.6(3.0) = 13 kN/m^2

Beam loading.

Self wt of beams = 0.225 x 0.6 x 24 = 5.24 kN/m^2

finishes = 1.2 kN/m^2

wall load = 3 x 3.47 = 10.41 kN/m^2

total G.k = 14.85

D.L = 1.4(14.85) = 20.79 kN/m^3

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

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

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

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

$\frac{1}{2} \times 13 \times 4.3 \left(1 - \frac{1}{3 \times (1.075)^2}\right) = 19.39 kN/m^2$

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

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

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

Total load $= 19.39 + 20.79 = 40.68 kN/m$

$= 21.55 + 20.79 = 42.34 kN/m$

$= 6.5 + 20.79 = 27.29 kN/m$

Distribution factor:

$K_{AB} = 1$

$K_{BA} = \frac{\frac{1}{L_{BA}}}{\frac{1}{L_{BA}} + \frac{1}{L_{BC}}} = \frac{\frac{1}{4.3}}{\frac{1}{4.7} + \frac{1}{4.5}} = 0.51$

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

$K_{CB} = \frac{\frac{1}{4.5}}{\frac{1}{4.5} + \frac{1}{4.5}} = 0.5$

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

$K_{DC} = 0.49$

$K_{DE} = 0.51$

~~K_{ED}~~

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

$K_{EA'} = 1 - 0.26 = 0.79$

$K_{A'E} = 1$

F.E.M

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

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

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

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

	A	AB	BA	BC	CB	CD	DC	DE	ED	EA	AE	A
D.F	0	1	0.51	0.49	0.5	0.5	0.29	0.51	0.26	0.74	1	0
FEM		-62.68	62.68	-71.45	71.45	-71.45	71.65	-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	4.30	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		3.67	3.82	1.25	3.54	21.31	0
TM		-7.99	-1.12	0	-7.69		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		0.31	-0.37	-3.27	-9.29	-1.77	0
TM		0.29	3.40	1.47	0.28		1.47	-1.64	-0.16	-0.39	-4.65	
OBM		0.29	4.87		0.12		-0.7		-1.05		-4.65	
BM		-0.29	-4.87		-0.12		0.7		1.05		4.65	
DM	0	-0.29	-2.48	-2.39	0.06	-0.06	0.06	0.09	0.27	0.78	4.65	0
Σ	=	0	22.88	-82.88	69.06	-69.05	72.06	-72.6	45.47	-45.46	0	

Moments -

$M_A = 0 kNm$

$M_B = 82.88 kNm$

$M_C = 69.06 kNm$

$M_D = 72.06 kNm$

$M_E = 45.47$

$M_A = 0 kNm$

For U.DL = $\frac{wL^3}{8}$

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

2) $\frac{62.34 \times 4.5^2}{8}$ = 107.17 kN/m²

(3) $\frac{27.29 \times 1.5^2}{8}$ = 7.68 kN/m²

Span moment

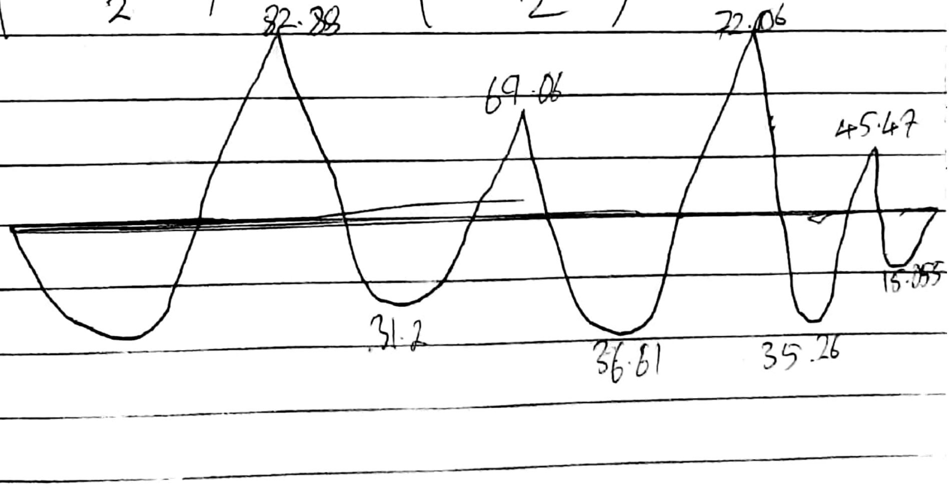
$M_{AB} = M^F - \left(\frac{M_A - M_B}{2}\right) = 94.02 - \left(\frac{0 + 82.88}{2}\right) = 52.88$ kNm

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

$M_{CD} = M^F - \left(\frac{M_C + M_D}{2}\right) = 107.17 - \left(\frac{69.06 - 12.06}{2}\right) = -36.61$ kNm

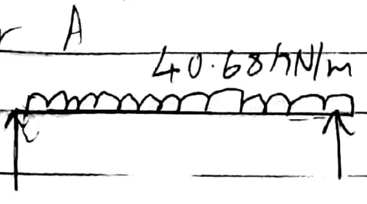
$M_{DE} = M^F - \left(\frac{M_D + M_E}{2}\right) = 94.02 - \left(\frac{72.06 + 45.47}{2}\right) = -35.26$ kNm

$M_{EA} = M^F - \left(\frac{M_E + M_{A'}}{2}\right) = 7.68 - \left(\frac{45.47 + 0}{2}\right) = -15.055$ kNm



Shear Force

for A



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

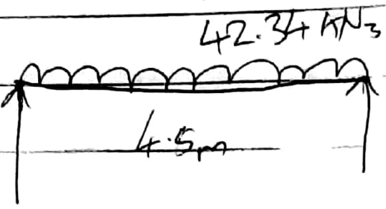
$= \frac{40.68 \cdot 4.3}{2}$

$= 87.462\,kN$

$$V_{AB} = V_2 + \left(\frac{M_A - M_B}{L}\right) = 87.462 + \left(\frac{0 - 82.88}{4.3}\right) = 68.19$$

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

For B



$$V_B = \frac{WL}{2} = V_C$$

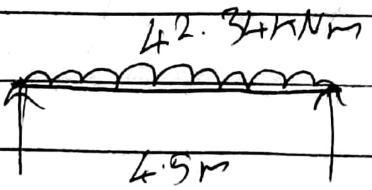
$$= \frac{42.34 \times 4.5}{2} = 95.27\,kN$$

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

$$= 129.03\,kN$$

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

For C



$$V_C = \frac{WL}{2} = V_D$$

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

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

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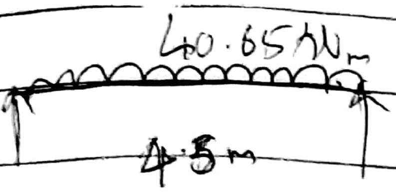
$V_D = \left(95.27 + \left(\frac{69.06 - 72.01}{4.5}\right)\right) = 126.63 kN$

$V_A = (42.34 \times 4.5) - 126.63$

$= 163.19 kN$

For D



$V_D = \frac{wL}{2} = V_E$

$= \frac{40.68 \times 4.3}{2} = 87.4 kNm$

~~$V_{DE} = V_i$~~

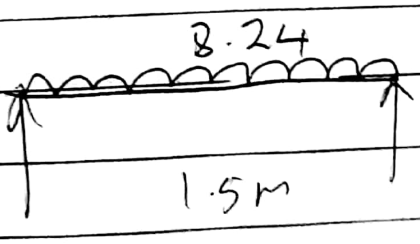
$V_{DE} = 16, - 87.46 - \left(\frac{72.06 + 45.97}{4.5}\right) = 60.13 kN$

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

$= (40.68 \times 43) - 60.13 kN$

$= 114.79 kN$

For E



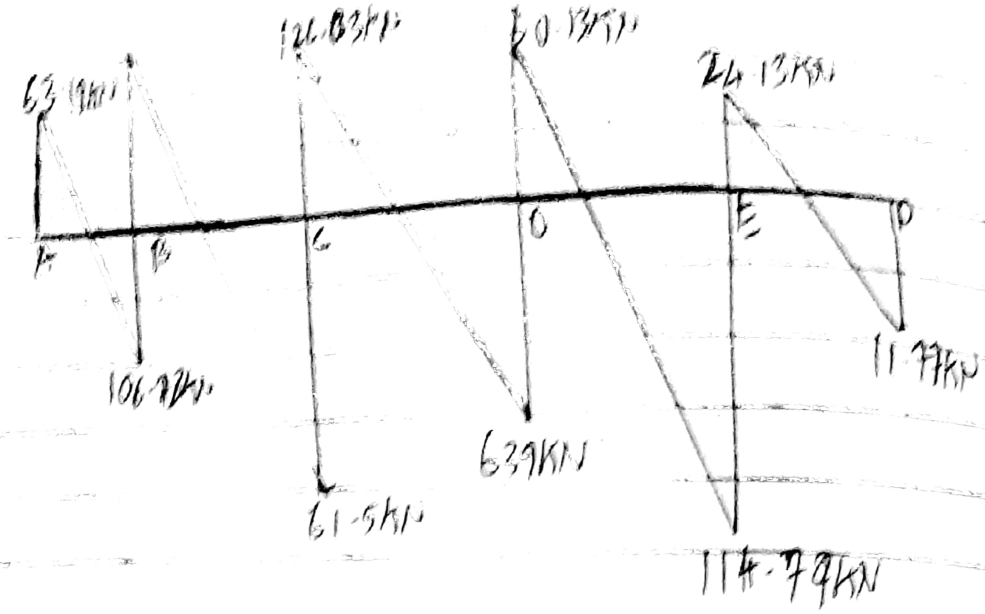
$V_E' = \frac{WL}{2} = V_D$

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

$V_{EA} = V_B = \left(\frac{M_E + M_A}{L}\right) = 6.13 - \left(\frac{45.47 + 0}{1.5}\right) = 24.13 kN$

$V_{AE} = (8.24 \times 1.5) - 241.3$

$= 11.77 kN.$



2)

Base design

$N = 1200 KN$

strength = 25 - 410 N/mm^2

$F_b = 150 KN/m^2$

Area of base required = $\frac{N \times 1.1}{\lambda \times f_b}$ $\lambda = 1.46$

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

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

Net pressure, $f_{net} = \frac{N \times 1.1}{B} = \frac{1200 \times 1.1}{2.5} - 24.0.66 \times 1.4$

$= 505.324 KNM$

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

where $L = \frac{1}{2}(b \cdot h)$

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

$M = \frac{505.824 \times 1.14^2}{2} = 328.69 KNm$

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

$= 660 - 50 - 10 = 600Mm$

$K = \frac{M}{bd^2 f_{cu}} = \frac{328.68 \times 10^6}{1000 \times 600^2 \times 25} = 0.037$

$Bu = 0.5 + \sqrt{0.25 - \frac{0.037}{0.9}} = 0.96 > 0.95$

$Z = Bed = 0.95 \times 600 = 570mm$

$A_s = \frac{M}{0.95 f_y z} = \frac{328.62 \times 10^6}{0.95 \times 410 \times 570} = 1780.44mm$

Provide Y_{25} @ 300 c/c (1600)

Punching Shear

Column size = 225 x 450mm

$f_{cu} - f_y = 25 - 410mm$

Area footing = ~~25~~ $6.027m^2$

Size of footing = 2500 x 25000

q^s, Net pressure = 505.824 KNm

depth = 600

Critical section, $d/2 = 300$

$300 + 300 + 225 = 825$ mm

$300 + 300 + 450 = 1050$ mm

shear force $V_B = q_u \times (\text{Area of footing} - (0.3+d)^2)$

$= 505.824\,(2.8 \times 2.5 - (0.3+0.6)^2)$

$V_n = 2751.684$

Normal shear stress, $\tau_v = \frac{V_n}{bd}$

b = peremeter of critical section

d = effective depth

$\tau_v = \frac{2758.88 \times 10^3}{(2 \times (825) + 2(1050) \times 600)}$

$\tau_v = 1.223\ N/mm^2$

Permisible shear stress

$\tau_i = k_j \times \tau_c$

$k_3 = (0.5 + \beta_c)$ but not greater than 1

β_c = ratio of shorter to larger side of columns.

$\tau_c = 0.25 \sqrt{f_{ck}}$

$k_1 = 1$

$\tau_i = 0.25\sqrt{25} = 1.25\ N/mm^2$

$\tau_v = 1.223\ N/mm^2$

There depth assumed is ok

checking for Fb with actual size of footing.

Unit weight of concrete $= 24\,kN/mm^2$

Unit weight of soil $= 1.091 \times 10^{-6}\,kN/mm^2$

Actual Pressure footing below:

$$q = (1200 \times 2.5) + (24 \times 0.630) + (1.091 \times 10^{-6} \times 168)$$

$$q = 214.44\,kN/m^2$$

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