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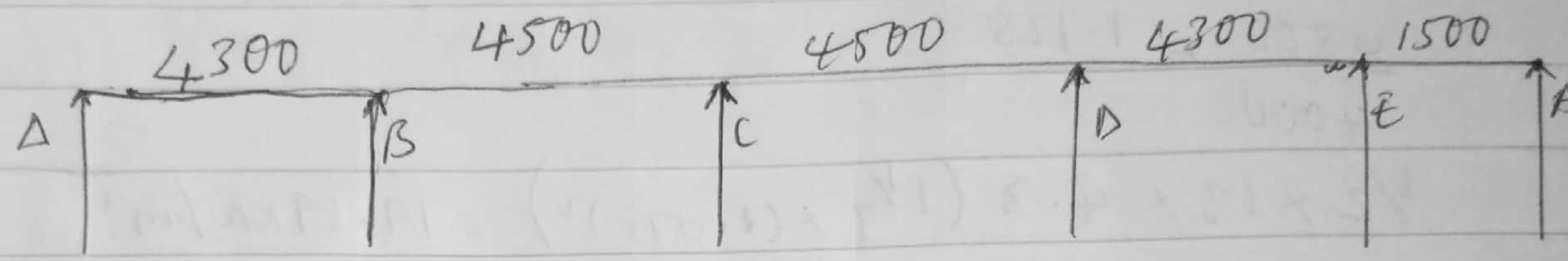
16/ENG03/040
Assignment 2



Assuming thickness; 50mm
$f_{cu} = 25N/mm^2$
$f_y = 410N/mm^2$

Slab loading
slab weight = 0.15 × 24 = 3.8 KN/m²
partition = 1.0KN/m²
finishes = 1.2KN/m
total GK 5.8KN/m²

D.L = 1.4(5.8) + 1.6 (3.0) = 13 KN/m²

Beam loading
Self wt of beam = 0.225 × 0.6 × 24 = 5.24KN/m²
finishes = 1.2KN/m²
wall load = 3 × 3.47 = 10.41 KN/m²
total G.k = 14.85

D.L = 14(14.85) = 20.79KN/m²

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

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

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

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

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

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

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

$= \frac{1}{3} \times 13 \times 1.3 = 6.5 KN/m^2$

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

$= 21.55 + 20.79 = 42.34 KN/m$

$= 6.5 + 20.79 = 27.29 KN/m$

Distribution factor

KAB = 1

$KAB = \frac{1/LBA}{1/LBA + 1/LBA} = \frac{1/4.3}{1/4.3 + 1/4.3} = 0.51$

$KBC = 1 - 0.51 = 0.49$

$KCB = \frac{1/4.5}{1/4.5 + 1/4.5} = 0.5$

$KCB = 1 - 0.5 = 0.5$

KDC = 0.44

KDE = 0.51

$KED = \frac{1/4.3}{1/4.3 + 1/1.8} = 0.26$

$KDA = 1 - 0.26 = 0.79$

$KA'E = 0$

FEM

UDL = $wl^2/12$

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'	A'E	A'
D.F	0	1	0.51	0.44	0.5	0.5	0.44	0.51	0.4	2.14	1	0
FEM		-62.68	68.68	-71.45	71.45	-71.48	71.43	-62.68	62.68	-8.1	5.1	
OBM	-62.68		-8.77		0		8.77		57.88		-5	1
BM	62.68		8.77		0		-8.77		-57.88		5	1
DM	0	62.68	4.97	4.30	0	0	-4.30	-4.47	44.91	-42.61	-5.1	0
TM		2.235	31.34	0	2.15	-2.15	0	-7.44	-2.24	-2.28	-21.50	0
					0		-7.44		-4.79		-21.305	
OBM	2.235		31.34		0		7.44		4.79		21.305	
BM	-2.235		-31.34									
DM	0	-2.235	-15.98	-15.36	0	0	3.67	3.82	1.25	3.54	21.3	0
TM		-7.94	-1.77	0	-7.69	1.34	0	8.63	1.41	10.66	1.25	
OBM	-7.99		-1.12		-5.88		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	-0.31	-3.22	-9.29	-1.77	0
TM	=	0.24	3.40	1.42 ~~-82.88~~	0.28	-0.06	1.47 ~~72.06~~	-1.64 ~~-72.06~~	-0.16 ~~45.46~~	0.84 ~~45.46~~	~~-4.09~~ 0	
OBM	0.24		4.87		0.12		-0.17		-1.05		-4.65	
BM	-0.24		-4.87		-0.12		0.17		1.05		4.65	
DM		0.029	-2.48	-2.39	-0.06	-0.06	0.09	0.09	0.21	0.98	4.95	0
Σ	=	0	22.88	-82.88	69.06	-69.05	72.06	-72.06	49.4	45.46	0	

Moments

$M_a = 0 kNm$

$M_b = 82.88 kNm$

$M_c = 69.06 kNm$

$M_D = 72.06 kN/m$

$M_E = 45.47 kN/m$

$M_{A'} = 0 kNm$

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) $42.34 \times 4.5^2 = 107.17 kNm^2$

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

Span moment

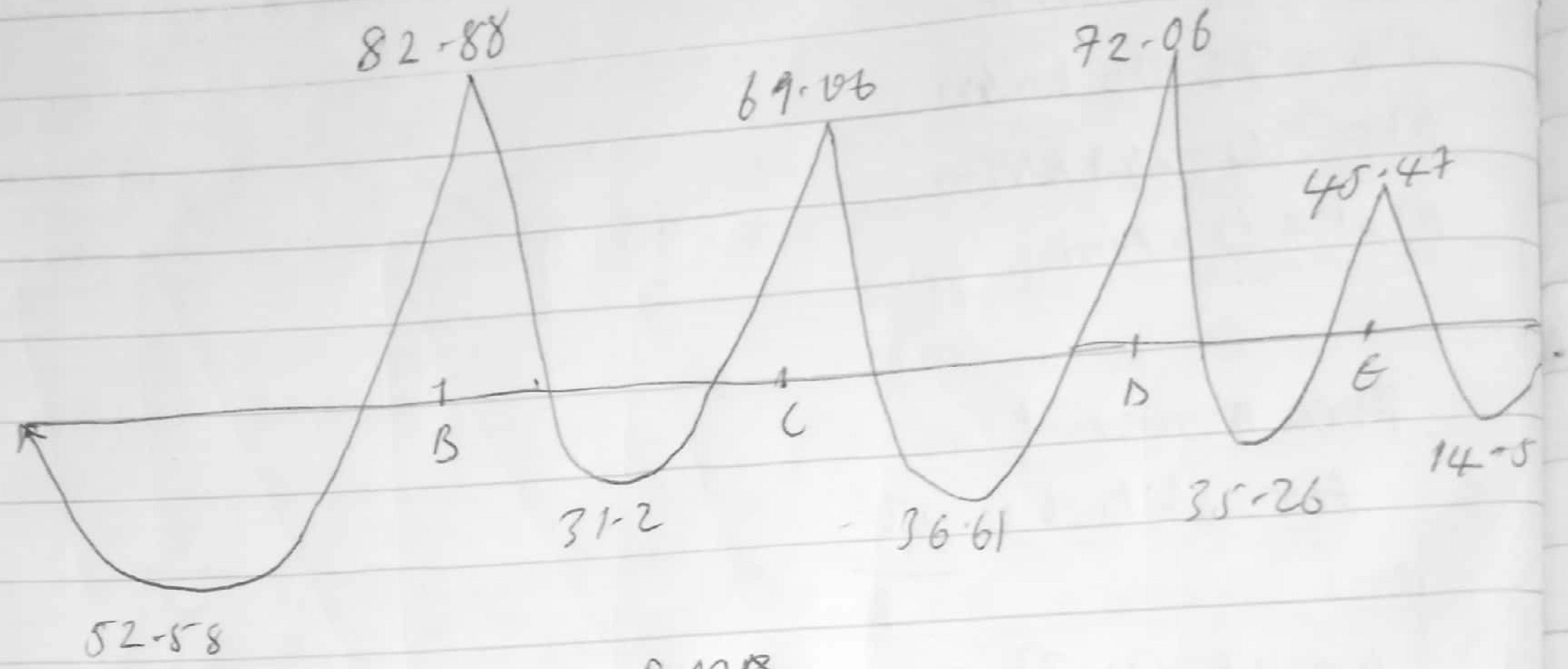
$M_{AB} = M^F - \left(\frac{M_A + M_B}{2}\right) = 94.02 - \left(\frac{0 + 82.88}{2}\right) = 52.58 kNm$

$M_{BC} = M^F - \left(\frac{M_B + M_C}{2}\right) = 107.17 - \left(\frac{82.88 + 89.06}{2}\right) = 31.2 kNm$

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

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

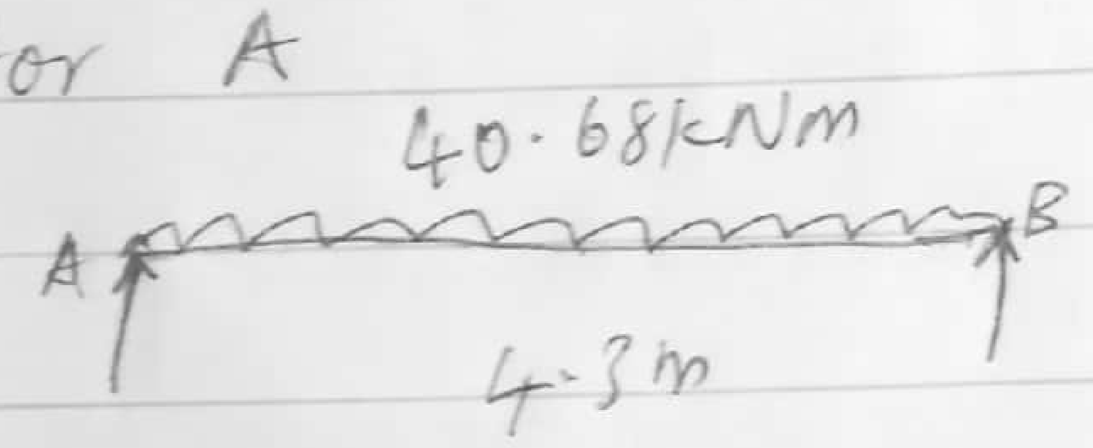
$M_{FA'} = M_i' \left(\frac{M_F + M_{A'}}{2}\right) = 8.24 - \left(\frac{45.47 + 0}{2}\right) = -14.5\,kNm$



BMD

Shear force

for A



$V_A = wl/2 = V_B$

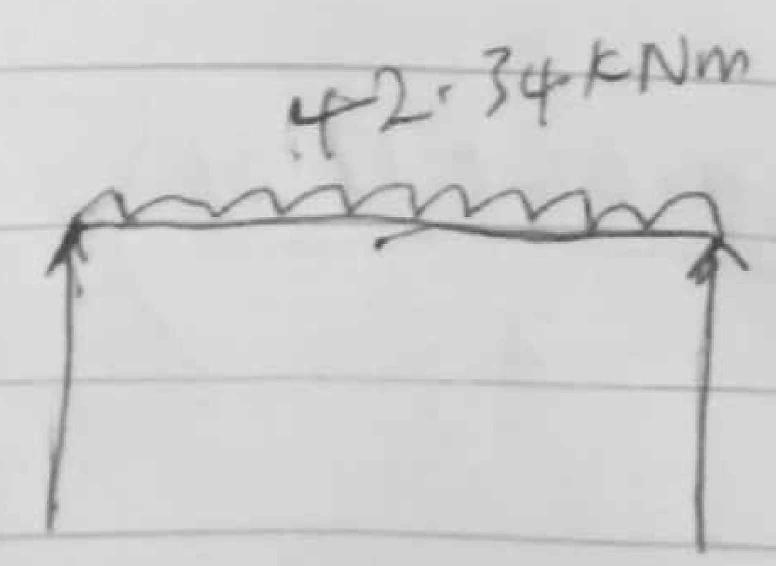
$= \frac{40.68 \times 43}{2} = 87.462\,kN$

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

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

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

for B



$V_B = wl/2 = V_C$

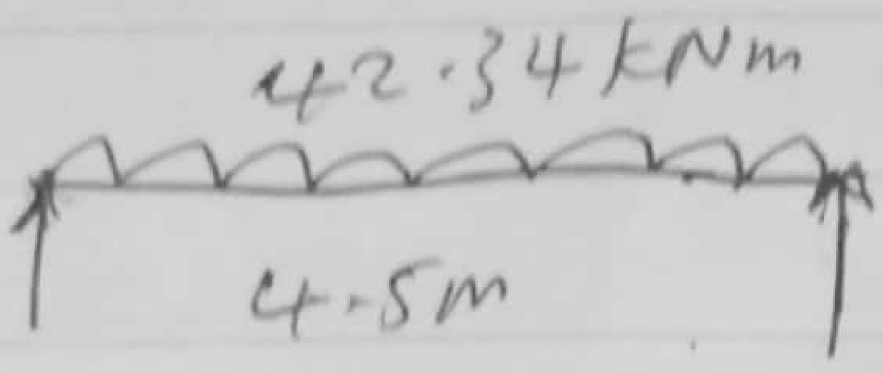
$= \frac{42.34 \times 45}{2} = 95.27\,kN$

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

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

$= 61.8 kN$

for C



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

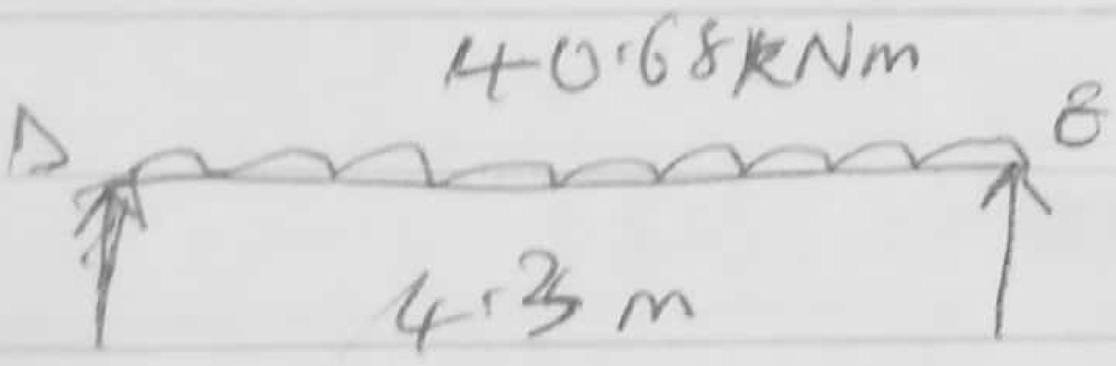
$= \frac{42.34 \times 4.5}{2} = 95.27 kN$

$V_{CD} = 95.27 + \left(\frac{59.06 + 72.06}{4.5}\right) = 126.63 kN$

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

$= 63.19 kN$

for D



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

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

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

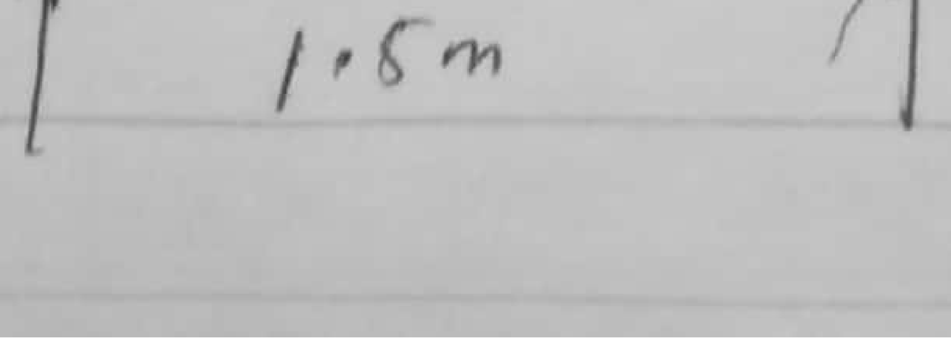
$= 87.46 - \left(\frac{72.06 + 45.47}{4.3}\right) = 60.13 kN$

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

$= (40.68 \times 4.3) - 60.13$

$= 114.79 kN$

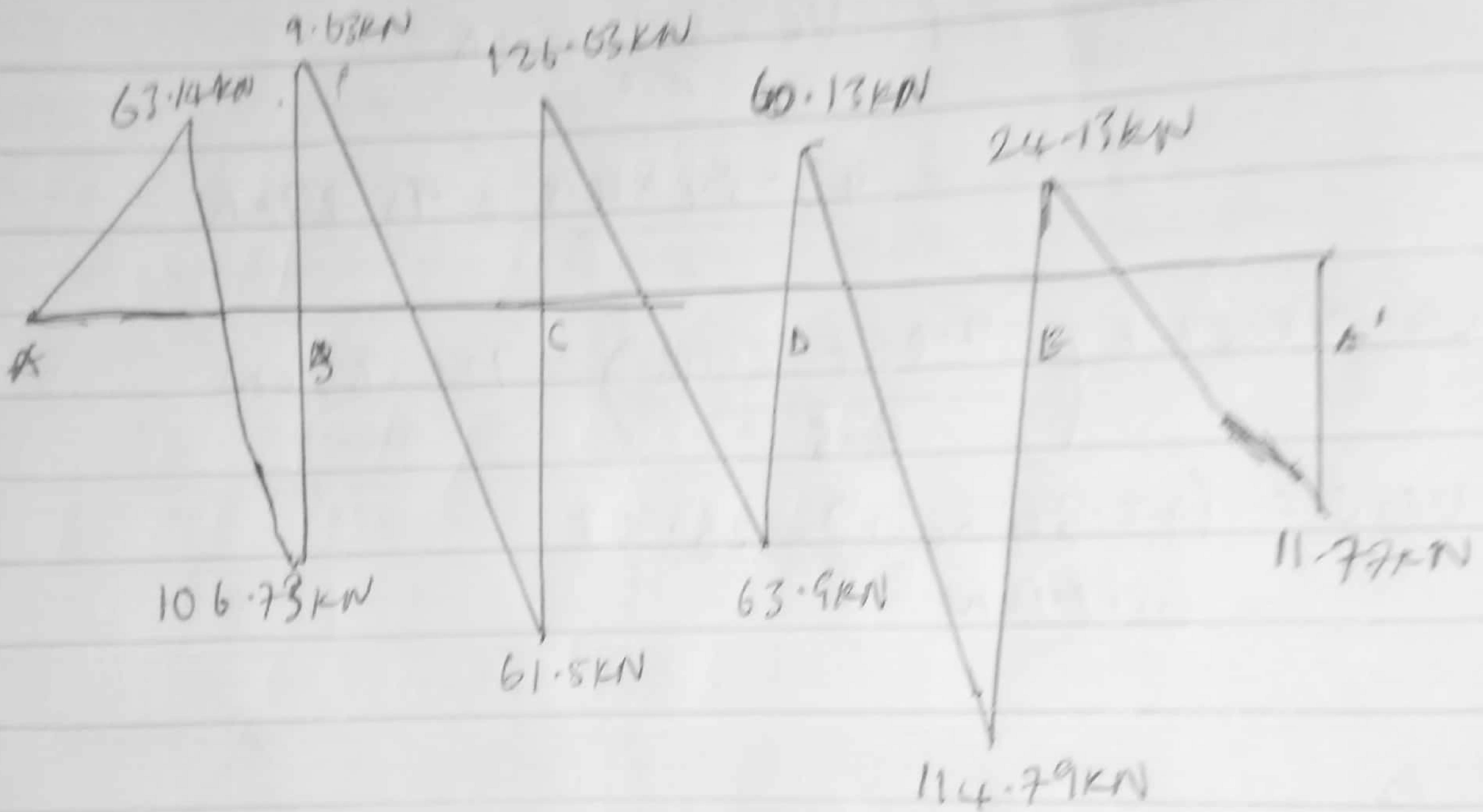
FOR E



$V_E' = \frac{wl}{2} - V_B' = \frac{8.24 \times 1.5}{2} = 6.18 kN$

$$VEA' = VE\left(\frac{ME + MA'}{L}\right) = 6.18 - \left(\frac{48.47+0}{18}\right) = 24.13KN$$

$$VA'E = (8.24 \times 1.5) - 24.73$$
$$= 11.77KN$$



NO 2

Base design

$N = 200 kN$

weight = 28-410 N/mm²

$f_b = 150 kN/m^2$

Area of base req $= \frac{N \times 1.1}{\lambda \times f_o}$ $\lambda = 1.46$

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

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

Net pressure, $f_{net} = \frac{N \times 1.1}{B}$

$\frac{1200 \times 1.1}{2.5} - 24 \times 0.666 \times 1.4$

$= 505.824 kNm$

moment, $M = \frac{f_{net} l^2}{2}$

where $l = 1/2 (B - h_0)$ ϕ = depth of base = 660

$l = 1/2 (2.5 - 0.225) = 1.638 \simeq 1.14 m$

$M = \frac{508.824 \times 1.14^2}{2} = 328.68 kNm$

d = h - cover - 2 ϕ

$= 660 - 50 - 10 = 600 mm$

$K = \frac{M}{bd^2 f_{cu}} = \frac{328.68 \times 10^6}{1000 \times 600^2 \times 25} = 00.32$

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

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

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

Provide 4 25 @ 300 c/c (1640)

Column size = 225 × 450 mm

fck/fy = 25 - 410 mm

Area footing = 6.627 m²

Size of footing = 2500 × 2500

q, net pressure = 500.824 kN/m

depth = 600

critical section, d/2 = 300

300 + 300 + 225 = 825 mm

300 + 300 + 450 = 1050 mm

Shear force Vn

= qn × (Area of footing - (0.3 + d)² q)

= 505.824 (2.5 × 2.5 - (0.3 + 0.6)²)

Vn = 2751.684

Normal shear stress $\tau_v = V_n / bd$

b = peremeter of critical section

d = effective span

$\tau_u = \frac{2751.08 \times 10^3}{((2 \times (825) + 2(1050)) \times 600)}$

$\tau_u = 1.223 \, N/mm^2$

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 longe side of columns

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

$k_s = 1$

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

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

$\tau_u \leq \tau_v$

Hence depth assumed is Ok

Checking for fb 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

$q = (1200 \times 2.5 \times 2.5) + (24 \times 0.660) + (1.091 \times 10^{6} \times 06)$

$q = 214.94\ kN/m^2$