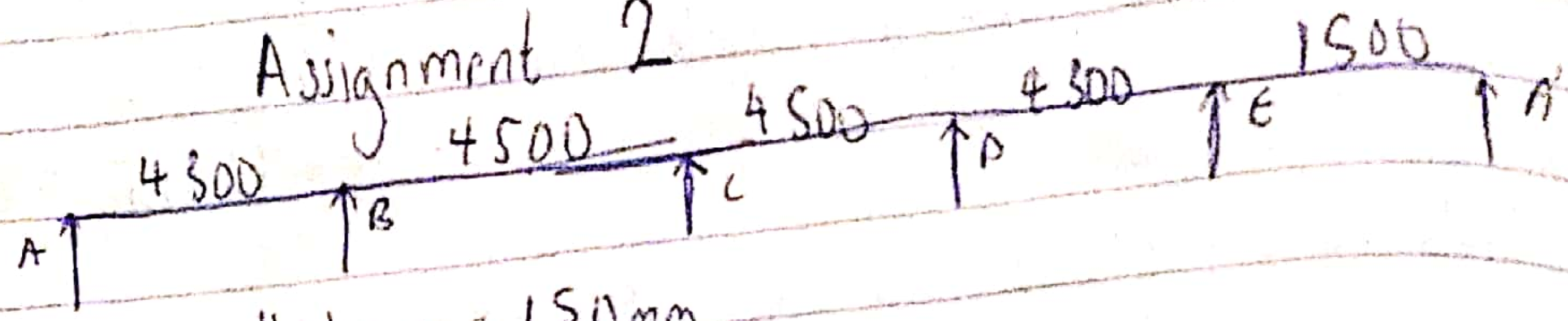
P1

Assignment 2

No 1.



Assuming thickness = 150mm

f_{cu} = 25 N/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) → for classroom = 13kN/m²

Beam Loading

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

finishes = 1.2kN/m²

Wall loading = 3 × 3.47 = 10.41 kN/m²

Total G.K = 14.85

D.L = 1.4(14.85) = 20.79 kN/m²

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

$k = l_y / l_x$

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

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

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

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

A'E	A'
1	0
5.1	
-5.1	
-5.1	
-5.1	0
-21.308	
-21.308	
21.303	
21.30	0
1.77	
1.77	
-1.77	
-1.77	0
-4.85	
-4.85	
4.85	
4.85	0
0	

Slab loading on beam in shorter direction $= \frac{1}{3} wl_x$

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

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

$K_{AB} = 1$

$K_{BA} = \dfrac{1/L_{BA}}{1/L_{BA} + 1/L_{BC}} = \dfrac{1/4.3}{1/4.3 + 1/4.5} = 0.51$

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

$K_{CB} = \dfrac{1/4.5}{1/4.5 + 1/4.5} = 0.5$

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

$K_{DC} = 0.49$

$K_{DE} = 0.51$

$K_{ED} = \dfrac{1/4.3}{1/4.3 + 1/1.5} = 0.26$

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

$K_{A'E} = 1$

F.E.M

UDL $= \dfrac{wl^2}{12}$

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

2. $\dfrac{42.34 \times 4.5^2}{12} = 71.45 \, kN/m$

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

P3

	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
F.E.M		-62.68	62.68	-71.45	71.45	-71.45	71.45	-62.68	62.68	-51	51	
D.B.M		-62.68		-8.77		0		8.77		5.58		-5.1
BM		62.68		8.77		0		-8.77		-5.58		5.1
DM	0	62.68	4.45	4.30	0	0	-4.30	-4.47	1.45	-4.13	-5.1	0
TM		2.235	31.34	0	2.15	-2.15	0	7.44	-2.24	-2.55	-21.08	
OBM		2.235		31.34		0		-7.49		-4.79		-21.308
BM		-2.235		-31.34		0		7.49		4.79		21.308
DM	0	-2.235	-15.98	-15.36	0	0	3.67	3.82	1.25	3.54	21.30	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	-3.28	-9.24	-1.77	0
TM		0.29	3.40	1.47	0.28	-0.10	1.47	4.64	-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	0.09	0.01	0.27	0.18	4.65	0
Σ	=	0	82.88	-82.88	69.06	-69.06	72.06	-72.06	45.47	-45.47	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

Fixed Moment

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

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

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

$3 : \frac{27.29 \times 1.5^2}{8} = 7.68 \text{ kN/m}^2$

Span Moment

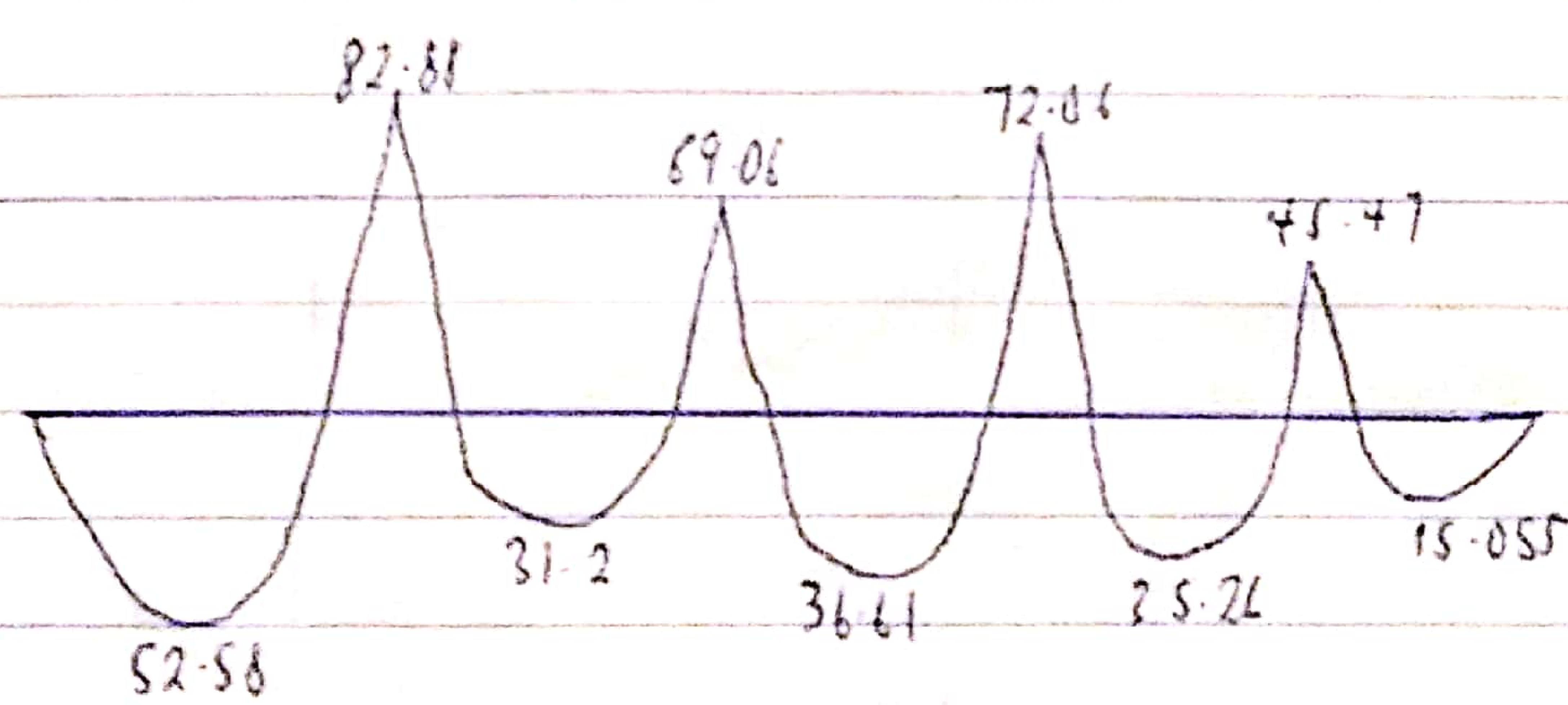
$M_{AB} = M^f - \left(\frac{M_A + M_B}{2}\right) = 94.02 - \left(\frac{0 + 82.88}{2}\right) = 52.58 \text{ kNm}$

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

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

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

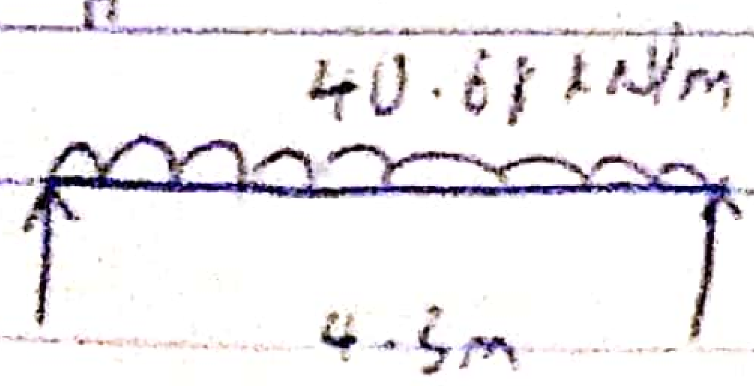
$M_{EA'} = M^f - \left(\frac{M_E + M_{A'}}{2}\right) = 7.68 - \left(\frac{45.47 + 0}{2}\right) = -15.055 \text{ kNm}$



B.M.D

Shear Force

for A



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

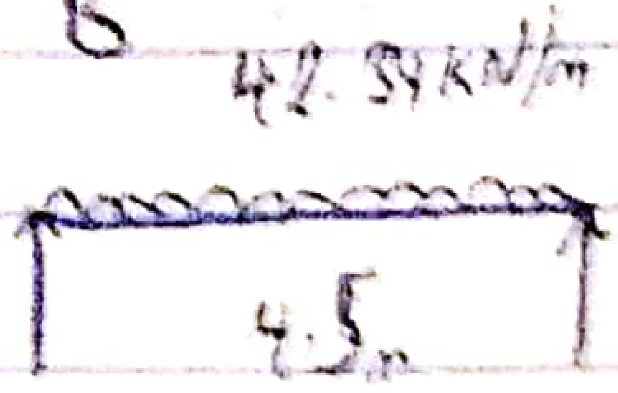
$= \frac{40.68 \times 4.3}{2}$

$= 87.462 \text{ kN}$

$V_{AB} : V_A + \left(\frac{M_A - M_B}{L} \right) = 87.462 + \left(\frac{0 - 82.82}{4.3} \right) = 68.19$

$V_{BA} : wL - V_{AB}$
$= (40.68 \times 4.3) - 38.19 = 106.73\,kN$

for B



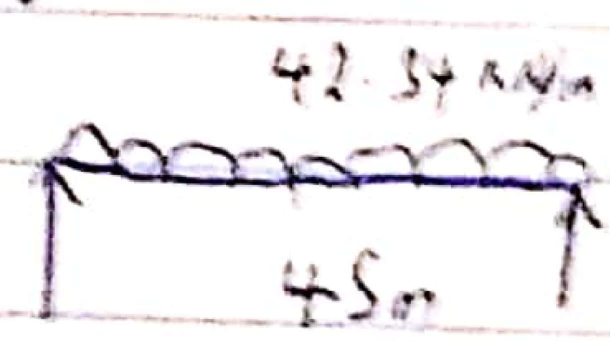
$V_B = wl/2 = V_C$
$= \frac{42.34 \times 4.5}{2} = 95.27\,kN$

$V_{BC} = V_B + \left(\frac{M_B + M_C}{L} \right) = 95.27 + \left(\frac{82.83 + 69.06}{4.5} \right)$

$= 129.03\,kN$

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

for C



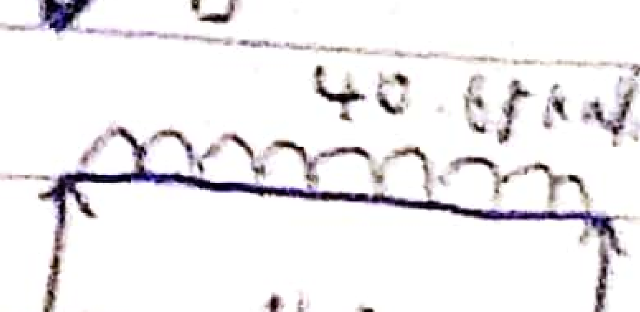
$V_C : \frac{wl}{2} = V_D$

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

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

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

for D



$V_D = wl/2 = V_E$
$= \frac{40.68 \times 4.3}{2} = 87.46\,kN$

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

$V_{ED} = wl - V_{DE}$
$= (40.68 \times 4.3) - 60.13$
$= 114.79\,kN$

for E

8.24

1.5m

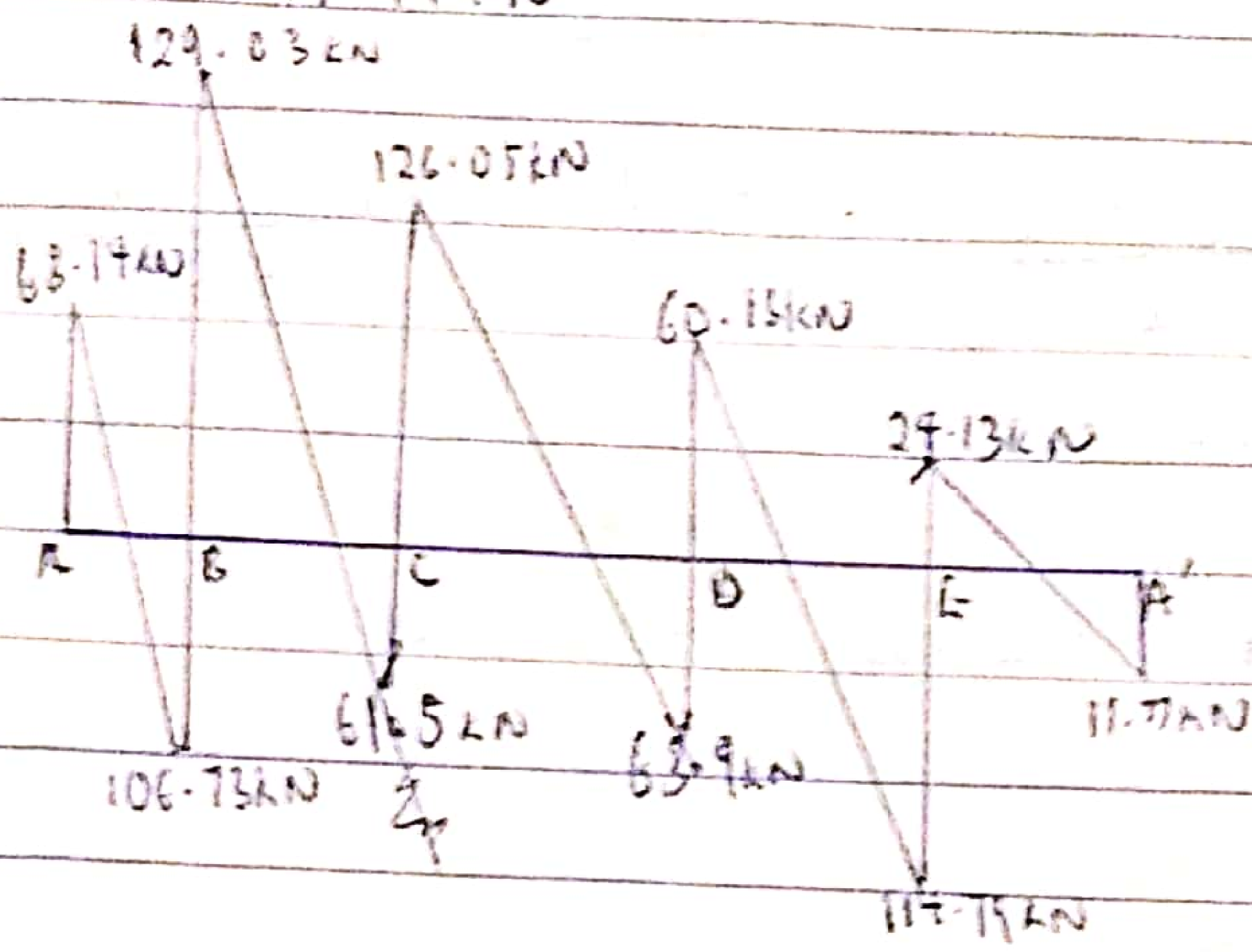
$V_E = wl/2 = V_{A'}$

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

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

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

$= 11.77\ kN$



Number 2

Base design

$N = 1200\ kN$

strength = 25 - 410 N/mm²

$f_b = 150\ kN/m^2$

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

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

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

Net pressure, $F_{net} = \frac{N \times 1.1}{B} = \frac{1200 \times 1.1}{2.5} - \frac{24 \times 0.66 \times}{1.4}$

$= 505.824\ kNm$

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

where $l = \frac{1}{2}(B - h)$

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

$\therefore m = \frac{505.824 \times 1.14^2}{2} = 328.62 kNm$

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

$= 660 - 50 - 10 = 600mm$

$K = \frac{M}{bd^2 f_{cu}} = \frac{328.62 \times 10^6}{1000 \times 600^2 \times 25} = 0.037$

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

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

$A_s = \frac{M}{0.95 f_y z} = \frac{328.62 \times 10^6}{0.95 \times 410 \times 570} = 1480.4 mm^2$

Provide Y 25 @ 300 c/c (1600)

Punching Shear

Column size = 225 × 450mm

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

Area footing = $6.027m^2$

Size of footing : 2500 × 25000

q_n^*, Net pressure = 505.824 kNm

depth = 600

critical section, $d/2$ = 300

300 + 300 + 225 = 825 mm

300 + 300 + 450 = 1050 mm

Shear Force $V_B = q_n \times (\text{Area of Footing} - (0.3 + d)^2)$

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

$V_n = 2751.684$

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

b = perimeter of critical section
d = effective depth

$\tau_v = \frac{2751.68 \times 10^3}{(2 \times (825) + 2(1050) \times 600)}$

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

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 larger side of columns

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

$k_s = 1$

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

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

$\tau_v \leq \tau_v'$

Here depth assumed is ok

Checking for P_b 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

$q = (1200 \times 2.5) + (24 \times 0.680) + (1.091 \times 10^{6} \times 0.66)$

$q = 214.94 \ kN/m^2$