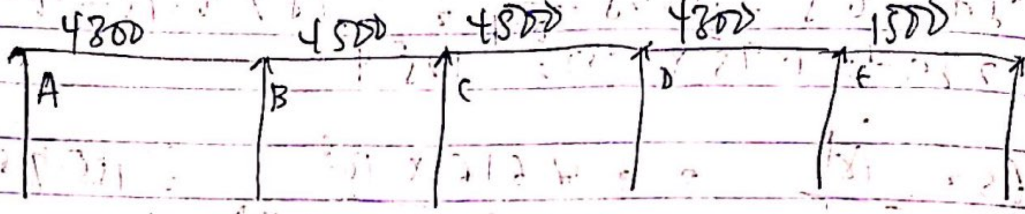
SANI AHMAD DAHIRU
17/ENG03/049
CVE 308.

Assignment 2

1)



Assuming thickness = 150mm

$f_{cu} = 25N/mm^2$

$f_y = 460/410 N/mm^2$

Slab loading

Slab weight = $0.15 \times 24 = 3.6 kN/m^2$

partition = $1.0 kN/m^2$

Finishes = $1.2 kN/m^2$

G.k = $5.8 kN/m^2$

D.L = $1.4(5.8) + 1.6(3.0) = 13 kN/m^2$

(assuming 3.0 for classroom)

Beam loading

Self wt of beam = $0.225 \times 0.6 \times 24 = 3.24 kN/m^2$

finishes = $1.2 kN/m^2$

Wall load = $3 \times 3.47 = 10.41 kN/m^2$

Total G.k = 14.85

D.L = $1.4(14.85) = 20.79 kN/m^2$

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

$k = l_y / l_x$

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

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

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

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

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 = $19.89 + 20.79 = 40.68$ kN/m

$= 21.55 + 20.79 = 42.34$ kN/m

$= 6.5 + 20.79 = 27.29$ kN/m

Distribution factor:

$\phi_{AB} = 1$

$\phi_{BA} = \frac{1/l_{BA}}{1/l_{BA} + 1/l_{BC}} = \frac{1/4.3}{1/4.3 + 1/4.5} = 0.51$

$\phi_{BC} = 1 - 0.51 = 0.49$

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

$\phi_{CD} = 1 - 0.5 = 0.5$

$\phi_{DC} = 0.49$

$\phi_{DE} = 0.51$

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

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

$K_{AE} = 1$

F.E.M

UDL = $\frac{WL^2}{12}$

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
			0.51	0.499	0.5	0.5	0.49	0.51	0.26	0.79	1	0
D.F	0	1										
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		52.58		-5.1	
BM	62.68		8.77		0		-8.77		-52.58		5.1	
DM	0	62.68	4.47	4.30	0	0	-4.30	-4.47	-44.47	-14.61	-5.1	0
TM		2.235	31.34	0	21.5	-2.15	0	7.49	-2.24	-2.55	-21.3	
OBM	22.235		31.34		0		-7.49		-4.79		-21.30	
BM	-2.235		-31.34		0		7.49		4.79		21.30	
DM	0	-2.235	-15.98	-15.86	0	0	3.67	3.82	1.25	3.54	21.3	0
TM		-7.99	-1.12	0	7.69	1.84	0	0.63	1.91	10.86	1.77	
OBM	-7.99		-1.12		-5.58		0.63		12.57		1.77	
BM	7.89		1.12		5.55		-0.63		-12.57		-1.77	
DM	0	7.99	0.57	0.55	2.93	2.95	-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	0.57	-4.65	

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DBM		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	0.05	-0.06	0.006	0.09	0.27	0.78	4.65
Σ		0	27.58	-82.58	69.06	-69.06	72.06	-72.06	45.47	4.46	0

Moments

$M_a = 0\,kN/m$

$M_b = 82.58\,kN/m$

$M_c = 69.06\,kN/m$

$M_D = 72.06\,kN/m$

$M_e = 45.47\,kN/m$

$M_a = 0\,kN/m$

A	
MF	A
1	0
5.1	
-5.1	
5.1	
1.5	0
21.3	
-21.305	
21.305	
3	0
77	
77	
-77	
-0	

Free moment for U.D.L $= wl^2/8$

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

(2) $\frac{42.34 \times 4.5^2}{8} = 107.17\,kN/m^2$

(3) $\frac{27.29 \times 1.5^2}{8} = 7.67\,kN/m^2$

Span moment

$M_{AB} = M_f - \left(\frac{M_A + A_B}{2}\right) = 94.02 - \left(\frac{0 + 82.58}{2}\right) = 52.55\,kN/m$

$M_{BC} = M_f - \left(\frac{M_B + M_C}{2}\right) = 107.17 - \left(\frac{82.58 + 69.06}{2}\right) =$

$31.2\,kN/m.$

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$M_{CD} = M_f - \left(\frac{M_C + M_D}{2}\right) = 107.17 - \left(\frac{69.86 + 72.85}{2}\right)$

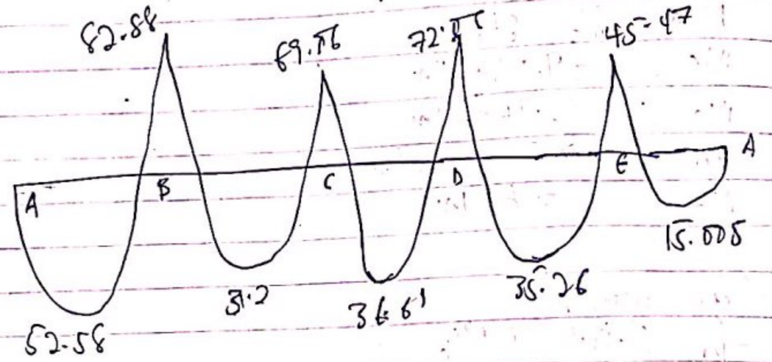
$= 36.61$ kN/m

$M_{DE} = M_f - \left(\frac{M_D + M_E}{2}\right) = 94.02 - \left(\frac{72.86 + 45.47}{2}\right)$

$= 35.28$ kN/m

$M_{EA} = M_f - \left(\frac{M_E + M_A}{2}\right) = 7.67 - \left(\frac{45.47 + 0}{2}\right)$

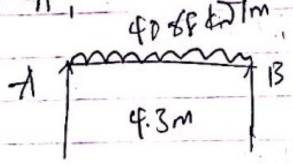
$= -15.055$ kN/m



B.M.D

Shear force

for A,

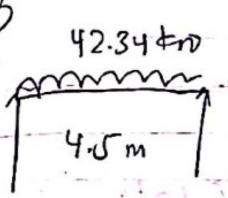


$V_A = wl/2 = \frac{40.88 \times 4.3}{2} = 87.892$ kN

$V_{AB} = V_a + \left(\frac{M_A - M_B}{L}\right) = 87.892 + \left(\frac{0 - 82.88}{4.3}\right) = 68.17$

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

$= (40.88 \times 4.3) - 68.17 = 106.73$ kN for B

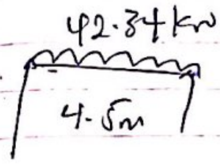


$V_B = \frac{wl}{2} = \frac{42.34 \times 4.5}{2} = 95.27\,kN$

$V_B = V_B + \left(\frac{M_A + M_B}{L}\right) = 95.27 + \left(\frac{62.68 + 69.06}{4.5}\right) = 129.03\,kN$

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

for C,

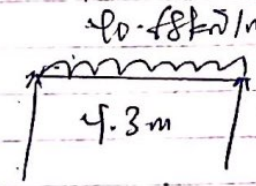


$V_C = \frac{wl}{2} = \frac{42.34 \times 4.5}{2} = 95.27\,kN$

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

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

for D,



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

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

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

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30·313

for E, 7·67

1·5m

$V_E = \frac{wl}{2}$ 7·67

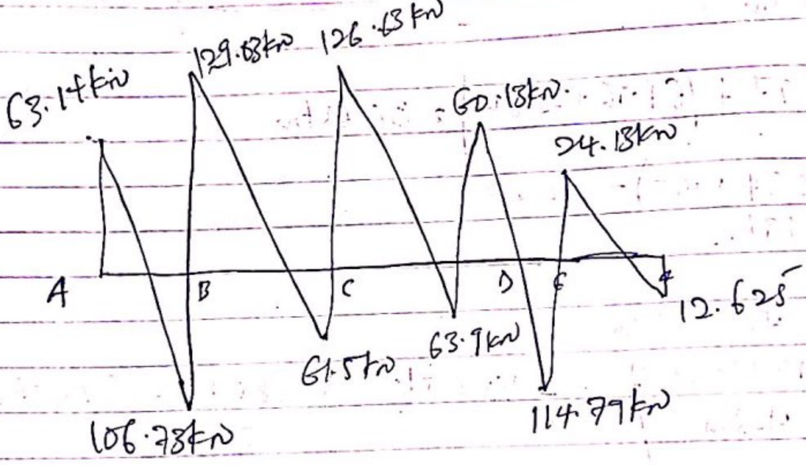
$= \frac{7·67 \times 1·5}{2} = 5·7525$

$V_{EA} = V_E - 5·7525 - \left(\frac{48·47 + 0}{1·5}\right) = 24·56$ kN

$V_{AE} = (7·67 \times 1·5) - 24·13$

$11·505 - 24·13$

$= 12·625$ kN



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Question 2

Base design

$N = 1200 kN$

Strength = 25 - 410 N/mm^2

$f_b = 150 kN/m^2$

Area of base say = $\frac{N \times 1.1}{\gamma_f \times f_b}$, $\gamma_f = 1.46$

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

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

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

$\frac{1200 \times 1.1}{2.5} = 24 \times 0.660 \times 1.4$

$= 585.824 kNm$

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

where $l = 1/2 (B - h)$ & depth of base = 660.

$L = 1/2 (2.5 - 0.225) = 1.628 \simeq 1.7 m$

$m = \frac{585.824 \times 1.14^2}{2} = 328.68 kNm$

$d = h - cover - 1/2 \phi$

$= 660 - 50 - 10 = 600 mm$

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

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

$z = j_a d = 0.95 \times 600 = 570mm$

$A_s = \frac{M}{0.95 f_y z} = \frac{328.68 \times 10^6}{0.95 \times 400 \times 570} = 1483.44 mm^2$

Provide Y25 @ 300 c/c (1640)

Punching Sheer

Column size = 225 x 450mm

fck - fy = 25 - 410mm
Area footing = 6.027m²
Size of footing = 2500 x 2500
q³, net pressure = 505.824 kN/m
depth = 600
Critical section, d/2 = 300

300 + 300 + 225 = 825mm
300 + 300 + 450 = 1050mm

$V_u = q_u \times$ [Area of footing − (0.3+d)]

= 505.824 [2.5×2.5 − (0.3 + 0.6)]
V_u = 2731.68

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$\tau_v = V_u / bd$

b = perimeter of critical section
d = effective span depth

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

$\tau_v = 1.223$ N/mm²

permissible shear stress

$\tau_c = k_s \times \tau_c$

$k_s = (0.5 + \beta_c) < 1$

β_c = ratio of shorter to longer side of column

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

$k_s = 1$

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

$\tau_v = 1.223$ N/mm²

$\tau_v < \tau_v'$

Here depth assumed is ok

Checking for fb with actual size of footing

Unit weight of concrete = 24 kN/mm³

Unit weight of soil = 1.091×10^6 kN/mm³

Actual pressure footing below

$q = (1200 \times 2.5 \times 2.5) + (24 \times 0.660) + (1.091 \times 10^6 \times 0.66)$

$q = 214.94$ kN/m²

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