JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

PEOPLE'S COMMITTEE OF HO CHI MINH CITY (PCHCMC)
MINISTRY OF PLANNING AND INVESTMENT (MPI)
THE SOCIALIST REPUBLIC OF VIET NAM

THE DETAILED DESIGN STUDY
ON
HO CHI MINH CITY
WATER ENVIRONMENT IMPROVEMENT PROJECT
IN
THE SOCIALIST REPUBLIC OF VIET NAM

FINAL REPORT

DESIGN REPORT

VOLUME 2

JUNE 2001

PACIFIC CONSULTANTS INTERNATIONAL

TABLE OF CONTENTS

VOLUME 1
(Structural Calculation)

VOLUME 3
(Quantity Estimation)

3. Structures Works
4. Other Works

7.1.10

Blower Building

BLOWER BUILDING CALCULATION SHEET

* THE WEIGHT OF WORK :

- LOAD AT BOTTOM COLUM OF 1ST FLOOR :

$(40.473 + 92.078 + 54.480) \times 11$ = 2.387.341 KG

- WALL UPPER LEVEL +2,50M :

$(70 + 24) \times 2 \times 7.5 \times 0,2 \times 2500$

$+ [59.3 \times 2 \times 8 \times 0,2 + 59.7 \times 5 \times 0,2$

$+ 5,2 \times 3 \times 0,2] \times 2500$

$+ 2.2 \times 0,2 \times 59.3 \times 2500$ = 1.473.280 KG

$+ (4.2 \times 8 \times 0,2 \times 2 + 19 \times 4 \times 0,2) \times 2500$

- SLAB OF 1ST FLOOR : ($t \geq 30$ CM)

DL+LL $[70 \times 24 - (59,3 \times 2 + 3 \times 3)] \times (0,3 \times 2500 + 500)$ = 2.248250 KG

- BEAMS :

$0,7 \times 0,7 \times 2500 \times 16 \times 9 + 1,2 \times 0,8 \times 2500 \times 8 \times 9$

$+ 0,8 \times 1,3 \times 2[70 + 24] \times 2500$ = 963.370 KG

$+ 2 \times 0,6 \times 0,7 \times 59,7 \times 2500$

- WALL UNDER LEVEL +2.50 :

$[(70 + 24) \times 2 - 8 \times 2] \times 4,3 \times 0,5 \times 2500$ = 1.099.645 KG

$+ 59,3 \times 0,2 \times 5,3 \times 2500 + 9 \times 4 \times 0,2 \times 2500$

- COLUMNS :

$[0,8 \times 0,8 \times 18 \times 4,6 + 22 \times 0,3 \times 4,3$

$+ 4 \times 0,3 \times 0,3 \times 4,3] \times 2500$ = 207.300 KG

- BOTTOM SLAB :

$(72,4 \times 26,4) \times 0,85 \times 2500$ = 4.061.640 KG

$69,2 \times 23,2 \times 0,1 \times 2000$ (SURFACE LAYER) = 321.088 KG

- LEAN CONCRETE :

$72,6 \times 26,6 \times 0,2 \times 2000$ = 772.464 KG

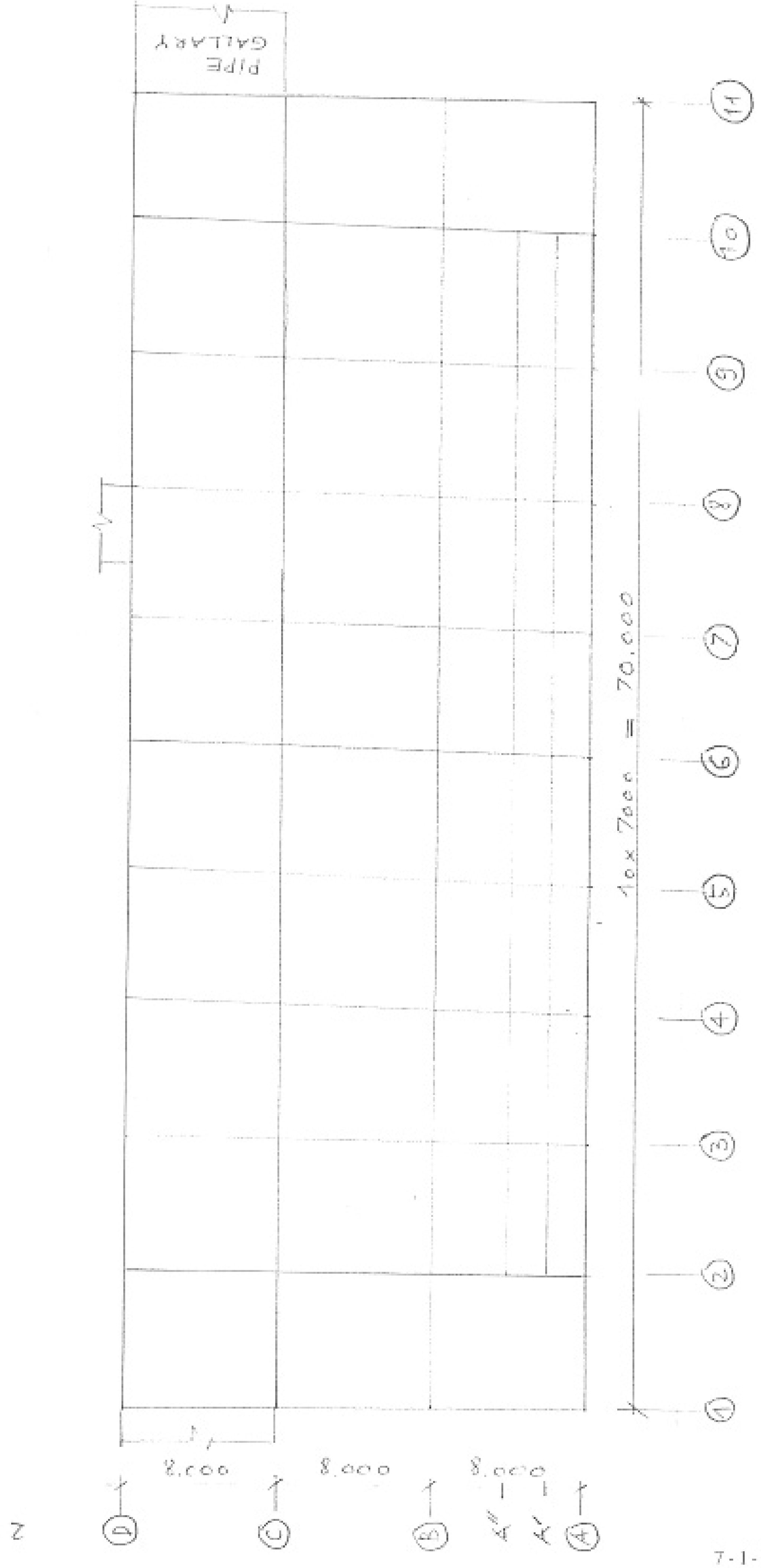
- EQUIPMENT : $13,2 \times 9$ = 118.800

- LL OF B1 FLOOR

$69,8 \times 23,8 \times 500$ = 830.620

SUM = 14 483.798 KG

* 14.484 TONS


PIPE GALLARY
10x 7000 = 70,000
8,000
8,000
8,000
D
C
B
A''
A'
A
N
1
2
3
4
5
6
7
8
9
10
11

4 LOAD AT BOTTOM COLUMN B1 FLOOR :

NAME OF COLUMN	KIND OF LOAD	TOTAL
D_2, D_3, D_4, D_5, D_6, D_7, D_8, D_9, D_{10}	COLUMN 1. LOAD AT BOTTOM/1ST FLOOR = 84.450 KG 2. DL+LL 1ST FLOOR SLAB : $4 \times 7 \times (750 + 500)$ = 35.000 KG 3 BEAM : $[0,8 \times 1,3 \times 7 + 0,7 \times 1 \times 4] \times 2500$ = 25.200 KG 4. WALL : $7 \times 0,2 \times 7,5 \times 2000$ = 21.000 KG 5. COLUMN : $4,6 \times 0,8 \times 0,8 \times 2500$ = 7.360 KG SUM =	173.040 KG
D_1, D_{11}, A_1, A_{11}	(1) : = 84.480 KG (2) : $3,5 \times 4 \times (750+500)$ = 17.500 (3) : $(0,8 \times 1,3 \times 7,5) \times 2500$ = 19.500 (4) : $7,5 \times 0,2 \times 7,5 \times 2000$ = 22.500 (5) : $4,3 \times 0,8 \times 0,8 \times 2500$ = 6.880 SUM =	150.860 KG
C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9	(1) : = 0 (2) : $7 \times 8 \times (750+500)$ = 70.000 KG (3) : $0,7 \times 1 \times (8+7) \times 2500$ = 26.250 KG (4) : 0 (5) : $4,3 \times 0,8 \times 0,8 \times 2500$ = 6.880 (6) : EQUIPMENT = 13.200 SUM =	116.330
C_1, C_{11}	(1) : = (2) : $3,5 \times 8 \times (750+500)$ = 35.000 (3) : $(0,8 \times 1,3 \times 8 + 0,7 \times 3,5) \times 2500$ = 26.925 (4) : $8 \times 0,2 \times 7,5 \times 2000$ = 24.000 (5) : COLUMN : $4,3 \times 0,8^2 \times 2500$ = 6.880 SUM =	92.130

NAME OF COLUMN	KIND OF LOAD (KG)		TOTAL (KG)
C_{10}	(1)	= 0	
	(2) : $7 \times 8 \times (750+500)$	= 70.000	
	(3) : $0,7 \times 1 \times (7+8) \times 2500$	= 26.250	
	(4) :	= 0	
	(5) : $0,8 \times 0,8 \times 4,6 \times 2500$	= 7.360	
	(6) : $13.200/2$	= 6.600	
		Sum =	110.210
B_3, B_4, B_5 B_6, B_7, B_8 B_9	(1) :	= 92.078	
	(2) : $7 \times 8 \times (750+500)$	= 70.000	
	(3) : $(7+4) \times 0,7 \times 1 \times 2500$ $+ 7 \times 0,6 \times 0,7 \times 2500 \times \frac{1}{2}$ $+ 7 \times 0,6 \times 0,7 \times 2500 \times \frac{1}{4}$ $+ 2 \times 0,8 \times 1,5 \times 2500$	= 30.763	
	(4) : $3,5 \times 9 \times 0,2 \times 2500 \times 2/2$	= 15750	
	$+ 7 \times 10 \times 0,2 \times 2500 \times 1/4$	= 8750	
	(5) : $0,8 \times 0,8 \times 4,6 \times 2500$	= 7.360	
		Sum =	224.701
B_2, B_{10}	(1) :	= 92.078	
	(2) : $2 \times 7 \times (750+500)$	= 17.500	
	(3) : $(7+4) \times 0,7 \times 1 \times 2500$ $+ 2 \times 0,8 \times 1.5 \times 2500$ $+ 3.5 \times 0.6 \times 0,7 \times 2500 \times 1/2$ $+ 3.5 \times 0,6 \times 0,7 \times 2500 \times 1/4$	= 28.006	
	(4) : $3,5 \times 3,0 \times 0,2 \times 2500 \times 1/2$ $+ 3.5 \times 10,0 \times 0,2 \times 2500 \times 1/4$ $+ 4,2 \times 8.2 \times 0,2 \times 2500 \times 1/4$	= 16555	
	(5) : $0,8 \times 0,8 \times 4.6 \times 2500$	= 7.360	
	(4) : $4.2 \times 4 \times 0,2 \times 2500 \times 1/4$ $+ 3.5 \times 4 \times 0,2 \times 2500 \times 1/2$ $+ 3.5 \times 4 \times 0,2 \times 2500 \times 1/4$	= 7.350	
		Sum =	168849

NAME OF COLUMN	KIND OF LOAD		TOTAL
A_2, A_3, A_4 A_5, A_6, A_7 A_8, A_9	(1):	= 40.480	
	(2): $2 \times 7 \times (750 + 500)$	= 17.500	
	(3): $7 \times 0,8 \times 1,3 \times 2500$ $+ 2 \times 0,8 \times 1,5 \times 2500$ $+ 3,5 \times 0,6 \times 0,7 \times \frac{3}{4} \times 2500 \times 2$ $+ 3,5 \times 0,6 \times 0,7 \times \frac{1}{2} \times 2500 \times 2$	= 29.788	
	(4): $7 \times 0,2 \times 7,5 \times 2000$ $+ 7 \times 8,2 \times 0,2 \times 2500 \times \frac{3}{4}$ $+ 7 \times 7,2 \times 0,2 \times 2500 \times \frac{1}{2}$	= 55.125	
	(5): $0,8 \times 0,8 \times 4,3 \times 2500$	= 6.880	
		Sum =	149.773
A_{10}	(1)	= 40.480	
	(2) $(2 \times 7 + 2 \times 3,5) \times (750 + 500)$	= 26.250	
	(3) $7 \times 0,8 \times 1,3 \times 2500$ $+ 2 \times 0,8 \times 1,5 \times 2500$ $+ 3,5 \times 0,6 \times 0,7 \times \frac{3}{4} \times 2500$ $+ 3,5 \times 0,6 \times 0,7 \times \frac{1}{2} \times 2500$	= 28.799	
	(4): $7 \times 0,2 \times 7,5 \times 2000$ $+ 3,5 \times 8,2 \times 0,2 \times 2500 \times \frac{3}{4}$ $+ 3,5 \times 7,2 \times 0,2 \times 2500 \times \frac{1}{2}$ $+ 4,2 \times 6 \times 0,2 \times 2500 \times \frac{3}{4}$	= 38.063 = 9.450	
	(5): $0,8 \times 0,8 \times 4,3 \times 2500$	= 6880	
	(4): $4,2 \times 4 \times 0,2 \times 2500 \times \frac{3}{4}$ $+ 3,5 \times 4 \times 0,2 \times 2500 \times 2 \times \frac{5}{8}$	= 15.050	164.967
$B_1 \ldots B_{11}$	(C_1) + 92.078	=	184.208

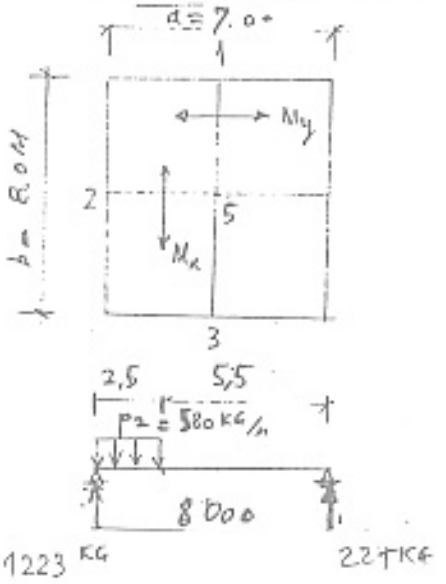
+ 1ST FLOOR – SLAB UNDER BLOWER PUMP : (t = 30 cm) –

SLAB SUBTAINNING :

DL : 0,30 × 1 × 1 × 2500 = 750 KG/M² –
LL1 : = 500 KG/M² –
LL2 : 16.200/3×5 − 500 = 580 KG/M² –
(AT BLOWER PUMP)

$p_1 = DL + LL_1 = 750 + 500 = 1250$ KG/M² –
$p_2 = 580$ KG/M²

* SLAB 1 ; SLAB 2 –

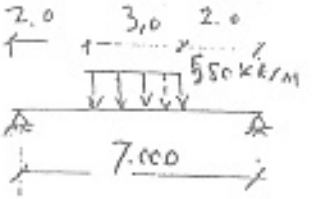


* $p_1 = 1250$ KG/M² ; $b/a = \frac{8}{7}$:

$M_{1y2} = -0,060 \times 1250 \times 7^2 = -3675$ KGM
$M_{1y5} = 0,023 \times 1250 \times 7^2 = 1409$ KGM
$M_{1x3} = -0,054 \times 1250 \times 7^2 = -3308$ KGM
$M_{1x6} = 0,017 \times 1250 \times 7^2 = 1041$ KGM

$M_0 = 1223 \times 2,5 - 580 \times 2,5 \times 1,25 = 1245$ KGM

$\Rightarrow M_2x_3 = -0,6 \times 1245 = -747$ KGM
$M_2x_5 = 0,6 \times 1245 = 747$ KGM



$$M_0 = \frac{580 \times 3\,(2\times 7 - 3)}{8} = 2393 \text{ KGM}$$

$$\Rightarrow \quad M_2 y_2 = -0{,}5 \times 2393 = 1197 \text{ KGM}$$

$$M_2 y_5 = 0{,}5 \times 2393 = 1197 \text{ KGM}$$

$$\Rightarrow \quad M_{y2} = M_1 y_2 + M_2 y_2 = -(3675 + 1197) = -4872 \text{ KGM}$$

$$M_{y5} = 1409 + 1197 = 2606 \text{ KGM}$$

$$M_{x3} = -(3308 + 747) = -4055 \text{ KGM}$$

$$M_{x5} = 1041 + 747 = 1788 \text{ KGM}$$

x SLAB 3, 4: $p_1 = 1250 \text{ kg/m}^2$

$$M_1 y_2 = -0{,}051 \times 1250 \times 7^2 = -3124 \text{ KGM}$$

$$M_1 y_5 = 0{,}018 \times 1250 \times 7^2 = 1103 \text{ KGM}$$

$$M_1 x_3 = -0{,}051 \times 1250 \times 7^2 = -3124 \text{ KGM}$$

$$M_1 x_5 = 0{,}018 \times 1250 \times 7^2 = 1103 \text{ KGM}$$

$$M_2 x_3 = -747 \text{ KGM}$$

$$M_2 x_5 = 747 \text{ KGM}$$

$$M_2 y_2 = -0{,}5 \times 2393 = -1197 \text{ KGM}$$

$$M_2 y_5 = 0{,}5 \times 2393 = 1197 \text{ KGM}$$

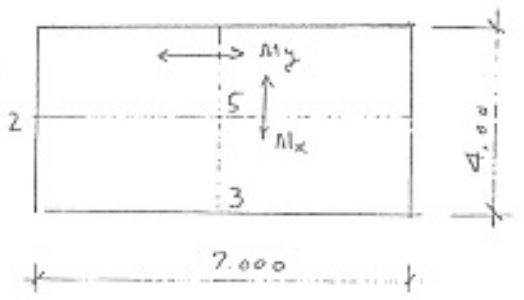
$$\Rightarrow \quad M_{y2} = -(3124 + 1197) = -4321 \text{ KGM}$$

$$M_{y5} = 1103 + 1197 = 2300 \text{ KGM}$$

$$M_{x3} = -(3124 + 747) = -3871 \text{ KGM}$$

$$M_{x5} = 1103 + 747 = 1850 \text{ KGM}$$

H. SLAB 5, 6



$$M_{ox} = \frac{1.250 \times 4^2}{8} = 2500 \text{ KGM}$$

$$M_{x3} = -0,7 M_o = -0,7 \times 2500 = -1750 \text{ KGM}$$

$$M_{x5} = 0,5 M_o = 0,5 \times 2500 = 1250 \text{ KGM}$$

$$M_{y2} = 0,5 M_{x3} = 0,5 \times 1750 = 875 \text{ KGM}$$

$$M_{y5} = 0,5 M_{x5} = 0,5 \times 1250 = 625 \text{ KGM}$$

* Column $A_1 \rightarrow A_{11}$: (80×80)

$P = 150\,860$, $M = 2868 + 37620 = 40.488$ KGM

$e = M/P = 27$ cm

$\Rightarrow F_a = \dfrac{150.860\,(27 + 80/2 - 7)}{1600\,(5C)} = 101\ cm^2$

$\Rightarrow 10\phi 36$ /

(Two sides)

* Column $B_2 \rightarrow B_{10}$ (80×80)

$P = 224.701$ KG ; $M = 3660$ KGM /

$M/P = 1,6$ cm

$\Rightarrow F_a = \dfrac{-224701\,(1.2 + 80/2 - 7)}{1600 \times 56} = 85.8\ cm^2$

$\Rightarrow 9\phi 36$ /

(Two sides)

* Column $D_2 \rightarrow D_{10}$ (80×80) /

$P = 173.040$ KG ; $M = 8850 + 37.620 = 46.470$ KGM

$M/P = 27$ cm

$\Rightarrow F_a = \dfrac{173.040\,(27 + 80/2 - 7)}{1600\,(5C)} = 116\ cm^2$

$\Rightarrow 12\phi 36$ /

* Column $C_2 \rightarrow C_{10}$ (80×80) /

$M = 0,37 \times 18.910 = 6997$ KGM

$P = 116.330$ KG

$e = M/P = 6$ cm

$\Rightarrow F_a = \dfrac{116330\,(6 + 80/2 - 7)}{1600\,(6C)} = 43,3\ cm^2$

$\Rightarrow 5\phi 36$ /

* Column B_1, B_{11} :

$M_{max} = 37620$ KGM

$P = 184.208$ KG $\Rightarrow e = M/P = 20$ CM

$\Rightarrow Fa = \dfrac{184.208\,(20 + 80/2 - 7)}{1600\,(56)} = 109\ cm^2$

$\Rightarrow 11\phi 36$

* Column C_1, C_{11}

$M_{max} = 37.620$ KGM

$P = 92.130$ KG $\Rightarrow e = \dfrac{M}{P} = 41$ CM

$\Rightarrow Fa = \dfrac{92.130\,(41 + 80/2 - 7)}{1600\,(66)} = 64,6\ cm^2$

$\Rightarrow 7\phi 36$

* Column D_1, D_{11}

$M = 37.620 + 11.060 = 48.680$ KGM

$P = 150.860 \Rightarrow e = M/P = 32$ CM

$\Rightarrow Fa = \dfrac{150\,860\,(32 + 80/2 - 7)}{1600\,(56)} = 109,4\ cm^2$

$\Rightarrow 11\phi 36$

* Column $C_2 - C_7$

$M = 6997 + 37.620 = 44.617$ kgm

$P = 116.330$ KG

$e = M/P = 38$ CM

$\Rightarrow Fa = \dfrac{116.330\,(38 + 80/2 - 7)}{1600\,(56)} = 92,2\ cm^2$

$\Rightarrow 10\phi 36$

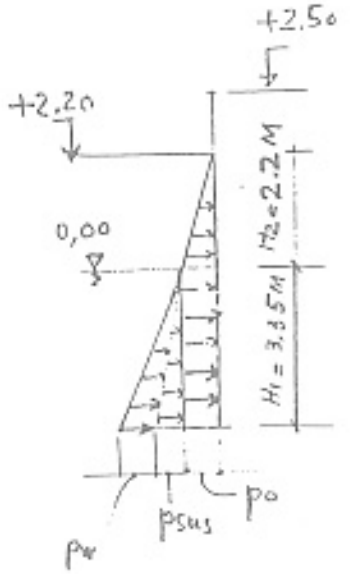
(Two bundles)

* $\sigma_b = \frac{224701}{80 \times 80} = 35,1 \text{ KG/CM}^2 < 63 \text{ KG/CM}^2$

* SHEARING STRESS AT BOTTOM SLAB :

$$\tau_b = \frac{224.701}{4 \times \frac{1}{2} (80+250) \times .85 \sqrt{2}} = 2,83 \text{ KG/CM}^2 < 3,6 \text{ KG/CM}^2$$

* WALL (UNDER LEVEL +2.50)



a) Pressure of soil and water :

$p_{sus} = (\gamma' - \gamma_w) H_1 \times K_o$

$= (1800 - 1000) 3,35 \times 0,5 = 1340\ KG/M$

$p_o = \gamma' \times H_2 \times K_o$

$= 1800 \times 2,2 \times 0,5 = 1980\ KG/M$

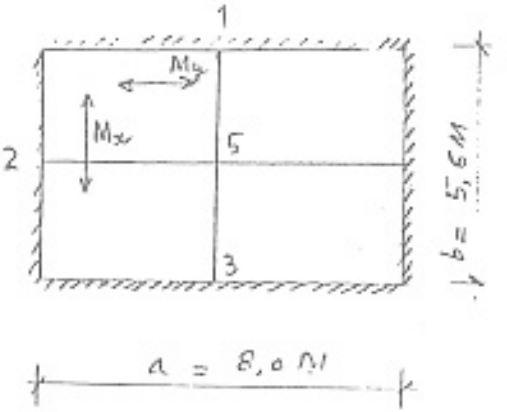
$p_w = \gamma_w \times H_1 = 1000 \times 3,35 = 3350\ KG/M$

$p = p_o + p_{sus} + p_w = 6670\ KG/M$

b) Vehicle load :

$p_v = 500\ KG/M^2$

* SLAB 8 M x 5.6 M : $a/b = 1,4$



a) Soil pressure load :

$M_{1y_2} = -0,025 \times 6670 \times 5,6^2 = -5229\ KGM$

$M_{1y_5} = 0,009 \times 6670 \times 5,6^2 = 1883\ KGM$

$M_{1x_1} = -0,033 \times 6670 \times 5,6^2 = -6902\ KGM$

$M_{1x_3} = -0,050 \times 6670 \times 5,6^2 = -10458\ KGM$

$M_{1x_5} = 0,025 \times 6670 \times 5,6^2 = 5229\ KGM$

b) Vehicle load :

$M_{2y_2} = -0,051 \times 500 \times 5,6^2 = -800\ KGM$

$M_{2y_5} = 0,018 \times 500 \times 5,6^2 = 282\ KGM$

$M_{2x_1} = -0,083 \times 500 \times 5,6^2 = -1301\ KGM$

$M_{2x_3} = -0,083 \times 500 \times 5,6^2 = -1301\ KGM$

$M_{2x_5} = 0,041 \times 500 \times 5,6^2 = 643\ KGM$

$\Rightarrow$ $M_{y2} = M_1 y_2 + M_2 y_2 = -6029$ KGM

$M_{y5} = M_1 y_5 + M_2 y_5 = 2165$ KGM

$M_{x1} = M_1 x_1 + M_2 x_1 = -8702$ KGM

$M_{x3} = M_1 x_3 + M_2 x_3 = -11759$ KGM

$M_{x5} = M_1 x_5 + M_2 x_5 = 5872$ KGM

* Pressure of water inside : $p = \gamma \times h = 1000 \times 5,35 = 5350$ KG/M

$M_{y2} = -0,025 \times 5350 \times 5,6^2 = -4194$ KGM

$M_{y5} = 0,009 \times 5350 \times 5,6^2 = 1510$ KGM

$M_{x1} = -0,033 \times 5350 \times 5,6^2 = -5537$ KGM

$M_{x3} = -0,050 \times 5350 \times 5,6^2 = -8389$ KGM

$M_{x5} = 0,025 \times 5350 \times 5,6^2 = 4194$ KGM

* BEAM Ⓒ, Ⓘ axis (Level +2.5) : HORIZONTAL LOAD.

$q = 1800 \times 2,7 \times 0,5 \times \frac{2,7}{2} = 3281$ KG/M

$M_o = q\frac{l^2}{12} = 3281 \times \frac{8^2}{12} = 17499$ KGM

$\Rightarrow M_B = M_C = -0,7 \times M_o$

$= -12249$ KGM

$M_{BC} = 0,5\, M_o = 8756$ KGM

• $V_B = V_C = ql/4 = 6562$ KG

* L = 7,00M (Beam A, D axis - Level +2,5)

$M_o = 3281 \times \frac{7^2}{12} = 13397$ KGM

$\Rightarrow M_a$ (edgespan) $= -0,7 M_o = -9378$ KGM

M_t (") $= 0,7 M_o = 9378$ KGM

M_a (Midspan) $= -0,5 \times M_o = -6699$ KGM

M_t (Midspan) $= 0,5 \times M_o = 6699$ KGM

$V = 5742$ KG

* REINFORCEMENT ($t = 50$ cm)

. $M1 = -1759$ KGM * (vertical – outer layer)

$\Rightarrow \quad Fa = \dfrac{175900}{1600 \times 0{,}94 \times 43} = 18{,}1 \text{ cm}^2$ /

$\Rightarrow 4\phi 20 + 4\phi 14 = 18{,}72 \text{ cm}^2$ /

. $M1 = -8203$ KGM

$\Rightarrow \quad Fa = \dfrac{820300}{1600 \times 0{,}96 \times 43} = 12{,}42 \text{ cm}^2$ /

$\Rightarrow 8\phi 14 = 12{,}34 \text{ cm}^2$ /

. $M1 = 4194$ KGM

$\Rightarrow \quad Fa = \dfrac{419400}{1600 \times 0{,}98 \times 43} = 6{,}2 \text{ cm}^2$ /

$\Rightarrow 4\phi 14 = 6{,}16 \text{ cm}^2$

* Horizontal Reinf – outer layer :

. $M = -6029$ KGM

$\Rightarrow \quad Fa = \dfrac{602900}{1600 \times 0{,}97 \times 43} = 9{,}03 \text{ cm}^2$ /

$\Rightarrow 8\phi 12 = 9{,}05 \text{ cm}^2$ /

. $M = 1510$ KGM

$\Rightarrow \quad Fa = \dfrac{151000}{1600 \times 0{,}99 \times 43} = 2{,}2 \text{ cm}^2$ /

RDC $Fa_{min} = 5 \text{ cm}^2$

$\Rightarrow 4\phi 12$

* Vertical Reinf – Inner layer :

. $M1 = -8389$ KGM

$\Rightarrow \quad Fa = \dfrac{838900}{1600 \times 0{,}96 \times 43} = 12{,}7 \text{ cm}^2$ /

$\Rightarrow 4\phi 18 + 4\phi 10 = 13{,}32 \text{ cm}^2$

. $M = -5537$ KGM

$\Rightarrow \quad Fa = \dfrac{553700}{1600 \times 0{,}97 \times 43} = 8.3 \text{ cm}^2$ /

$\Rightarrow 4\phi 18 = 10{,}18 \text{ cm}^2$ /

. $M = 5872$ KGM

$\Rightarrow \quad Fa = \dfrac{587200}{1600 \times 0{,}97 \times 43} = 8{,}8 \text{ cm}^2$

$\Rightarrow 4\phi 18 = 10{,}18 \text{ cm}^2$

* Horizontal Reinf – Inner layer :

. M = – 4194 KGM

$$\Rightarrow F_a = \frac{419400}{1600 \times 0{,}98 \times 43} = 6{,}2\ CM^2$$

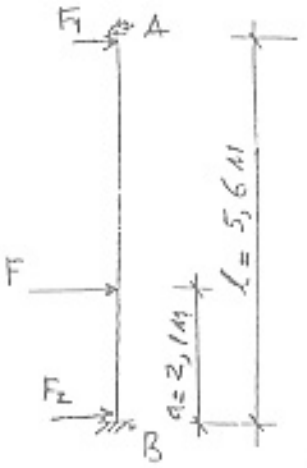
$\Rightarrow 4\phi 14 = 6{,}16\ CM^2$

. M = 2165 KGM

$$\Rightarrow F_a = \frac{216500}{1600 \times 0{,}99 \times 43} = 3{,}2\ CM^2$$

$\Rightarrow$ RSC $F_{a\,min} = 5\ CM^2 \Rightarrow 4\phi 14 = 6{,}16\ CM^2$

K SOIL PRESSURE EFFECTING AT COLUMN :



$F = 45.860$ KG

$a = d = 2{,}1$ M

$l = 5{,}6$ M

$$F_2 = V_B = \frac{F(l-a)^2(l+2a)}{l^3}$$

$$= \frac{45\,860\,(5.6-2.1)^2\,(5{,}6+2\times 2{,}1)}{5{,}6^3}$$

$$= 31.990 \text{ KG}$$

$$F_1 = V_A = 45.860 - 31.990 = 13.870 \text{ KG}$$

$$M_A = -\frac{Fa^2(l-a)}{l^2} = \frac{-45.860\times 2{,}1^2(5.6-2{,}1)}{5.6^2}$$

$$= -22592 \text{ KGM}$$

$$M_B = \frac{-Fxa(l-a)^2}{l^2} = \frac{-45.860\times 2{,}1\times(5{,}6-2.1)^2}{5.6^2}$$

$$= -37.620 \text{ KGM}$$

* 1ST FLOOR SLAB (h = 30 cm)

- UPPER LAYER :

. M = - 4872 KGM

$\Rightarrow \quad Fa = \frac{487200}{1600 \times 0,93 \times 25} = 13,1 \text{ cm}^2$

$\Rightarrow 4\phi 18 + 4\phi 12 = 14,7 \text{ cm}^2$

AT MIDSPAN, USE $Fa_{MIN} = 3 \text{ cm}^2$

$\Rightarrow 4\phi 12 = 4,52 \text{ cm}^2$

- UNDER LAYER :

. M = 2606 KGM

$\Rightarrow \quad Fa = \frac{260600}{1600 \times 0,97 \times 25} = 6,72 \text{ cm}^2$

$\Rightarrow 5\phi 14 = 7,69 \text{ cm}^2$

. M = 2300 KGM

$\Rightarrow \quad Fa = \frac{230000}{1600 \times 0,98 \times 25} = 5,8 \text{ cm}^2$

$\Rightarrow 5\phi 12 = 5,65 \text{ cm}^2$

. M = 1850 KGM

$\Rightarrow \quad Fa = \frac{185000}{1600 \times 0,98 \times 25} = 4,7 \text{ cm}^2$

$\Rightarrow 5\phi 12 = 5,65 \text{ cm}^2$

. M = 1788 KGM $\Rightarrow$ $5\phi 12 = 5,65 \text{ cm}^2$

* BEAM ABC (FROM ② TO ① AXIS)

$M_A^- = -(18.720 + 0{,}5\, M_{AB}) = -(18.720 + 0{,}50 \times 195121)$

$= -116.281$ KGM

$M_B^- = -(16.630 + 156097) = -172.727$ KGM

$M_D^- = -(18910 + 0{,}5\, M_{BC}) = -(18.910 + 0.5 \times 66135)$

$= -51.978$ KGM

$M_C^- = -52.908$ KGM

$M_{AB} = 156097 + 23.990 = 180.087$ KGM

$M_{BC} = 39681 + 4320 = 44.001$ KGM

$M_{CD} = 52.908 + 15\,130 = 68.038$ KGM

- $N_{AB} = 4880 + F_{sol} = 4880 + 2 \times 5742 + 13.870 = 30.234$ KG
- $N_{BC} = 7280 + F_{sol} = 7280 + 2 \times 5742 + 13.870 = 32\,614$ KG
- $N_{CD} = 7930 + F_{sol} = 7930 + 2 \times 5742 + 13.870 = 33.284$ KG

* REINFORCEMENT :

- $M = -116.281$ KGM ; $N = 30.234$ KG ; $M/N = 385$ CM

$\Rightarrow F_a = \dfrac{30234\,(385 + 150/2 - 7)}{1600\,(136)} = 62{,}94$ CM^2

$\Rightarrow 8\,\phi\,32$

- $M = 180087$ KGM ; $N = 30234$ KG ; $M/N = 596$ CM

$\Rightarrow F_a = \dfrac{30234\,(596 + 150/2 - 7)}{1600 \times 136} = 92{,}30$ CM^2

$\Rightarrow 9\,\phi\,36 = 94.62$ CM^2

- $M = -51.978$ KGM ; $N = 33284$ KG ; $M/N = 156$ CM

$\Rightarrow F_a = \dfrac{33284\,(156 + 100/2 - 7)}{1600 \times 86} = 48{,}1$ CM^2

$\Rightarrow 6\,\phi\,32 = 48{,}25$ CM^2

- $M = 44.001$ KGM ; $N = 33284$ KG ; $M/N = 132$ CM

$$\Rightarrow \quad Fa = \frac{33284\left(132 + 100/2 - 7\right)}{1600 \times 86} = 42{,}3 \text{ CM}^2$$

$\Rightarrow 6\phi 32 = 48{,}25 \text{ CM}^2$

- $M = 68038$ KGM , $N = 33284$ KG ; $M/N = 204$ CM

$$\Rightarrow \quad Fa = \frac{33284\left(204 + 100/2 - 7\right)}{1600 \times 86} = 59{,}7 \text{ CM}^2$$

$\Rightarrow 8\phi 32 = 64{,}34 \text{ CM}^2$

- $M = 23862$ KGM

$$\Rightarrow \quad Fa = \frac{2386200}{1600 \times 0{,}98 \times 93} = 16{,}36 \text{ CM}^2$$

$\Rightarrow 5\phi 22$

* BEAM $C_1 C_{11}$ (70 × 100 CM)

$N = 2 \times 6562 + 13.870 = 26.994$ KG

. $M = 31.757$ KGM ; $N = 26.994$ KG ; $M/N = 118$ CM

$$\Rightarrow F_a = \frac{26.994\,(118 + 100/2 - 7)}{1600 \times 86} = 31,5\ CM^2$$

$\Rightarrow 5\ \phi\ 28$

* BEAM $B_1 B_{11}$ (70 × 100 CM)

$M_o = 10.719$ KGM + 40.833 KGM = 51.552 KGM

$M_a = -0,5\ M_o = -25\,776$ KGM

$M_t = 0,5\ M_o = 25\,776$ KGM

$N = 26.994$ KG

. $M = 25\,776$ KGM ; $N = 26.994$ KG ; $M/N = 95$ CM

$$\Rightarrow F_a = \frac{26.994\,(95 + 100/2 - 7)}{1600 \times 96} = 27.07\ CM^2$$

$\Rightarrow 5\ \phi\ 28 = 30,73\ CM^2$

SHEAR :

* BEAM ② To ⑨ Axis : BEAM $B_9 - C_9$ = 8M (70 x 100 cm)

N_1 = 0,7 x 1 x 1 x 2500 x 4 = 7000 KG /

$N_2 = \frac{(1+8)}{2} \times 3.5 \times 1250$ = 19.688 KG /

N = 26.688 KG

$\Rightarrow \tau = \left[26.688 \times \frac{3.25}{1}\right] / 70 \times 93$ = 3,3 KG/CM² < 3,6 KG/CM²

* BEAM UNDER BLOWER ($C_8 - C_9$ = 7M) 70 x 100 CM

N_1 = 0,7 x 1 x 1 x 2500 x 3,5 = 6125 KG /

N_2 = 7 x 3,5 x 1250 x $\frac{1}{2}$ = 15.313 KG /

N_3 = (13.200 - 3x5x500) x $\frac{1}{2}$ = 2.850 KG /

N = 24.288 KG /

$\Rightarrow \tau = \frac{3.25}{3.5} \times 24.288 / 70 \times 93$ = 2,3 KG/CM² < 3,6 KG/CM²

* BEAM ① AXIS - $A_1 B_1$ = 8M (80 x 130 CM)

. Vertical load : N_{V_1} = 0,8 x 1,3 x 2500 x 4 = 10400 KG (BEAM)

N_{V_2} = 0,2 x 7.6 x 2000 x 4 = 12.160 KG (WALL)

$N_{V_3} = 1250 \times 3,5 \times \frac{(1+8)}{2 \times 2}$ = 9.844 KG (DL+LL)

Jadi N_V = 32.404 KG

. Horizontal load : N_h = 1844 x 4 = 19.376 KG

$\Rightarrow$ N = 33062 KG
33.062

τ = 33062 / 80 x 123 = 3,4 KG/CM²

→

* BEAM A_9-B_9 = 8 M (80 x 150 CM)

$N_1 = 0{,}8 \times 1{,}5 \times 2500 \times 4 = 12.000$ KG (BEAM)

$N_2 = 1250 \left[\left(\frac{8+1}{2} \right) \times 3{,}5 - 2 \times \frac{2}{2} \right] = 17.188$ KG ($^{DL+LL}_{SLAB}$)

$N_3 = 3{,}5 \times 7 \times 0{,}2 \times 2500 + 2 \times 9 \times 0{,}2 \times 2500 = 21.250$ KG (WALL)

SUM = 50.438 KG

$$\tau = \left[(12.000 + 17.188) \times \frac{2.6}{4} + 21250 \right] / (80 \times 143) = 3{,}5 \text{ KG/CM}^2 \quad (< 3{,}6 \text{ KG/CM}^2)$$

* BEAM AT A" AXIS SPAN 7M (65 x 100 CM)

$N_1 = 0{,}65 \times 1 \times 2500 \times 3{,}5 = 5688$ KG (BEAM)

$N_2 = \frac{1250}{2} \times \left[\left(\frac{3+7}{2} \right) \times 2 + \left(\frac{5+7}{2} \right) \times 1 \right] = 15250$ KG ($^{DL+LL}_{SLAB}$)

$N_3 = \frac{1}{2} \times 7 \times 0{,}2 \times 7 \times 2500 = 12\,250$ KG (WALL)

SUM = 33.188 KG

$$\tau = \left[33188 + \frac{2{,}25}{3{,}5} \right] / (65 \times 93) = 3{,}5 \text{ KG/CM}^2 < 3{,}6 \text{ KG/CM}^2$$

* BEAM AT A' AXIS SPAN 7M (65 x 100 CM)

$N_1 = 0{,}65 \times 1 \times 2500 \times 3{,}5 = 5688$ KG (BEAM)

$N_2 = \frac{1250}{2} \times \frac{(5+7)}{2} \times 1 = 3750$ KG ($^{DL+LL}_{SLAB}$)

$N_3 = \frac{1}{2} \times 7 \times 9 \times 0{,}2 \times 2500 = 15\,750$ KG (WALL)

$$\tau = 0{,}6 \times 25188 / (65 \times 93) = 2{,}5 \text{ KG/CM}^2 < 3{,}6 \text{ KG/CM}^2$$

* SHEAR :

* BEAM AT MACHINE HATCH : 40 x 80

N_1 = 0,4 x 0,8 x 2500 x 4 = 3200 KG

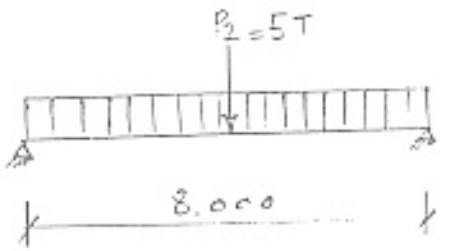
N_2 = 1 x 4 x 1250 = 5000 KG

N_3 = 5000/2 = 2500 KG

SUM = 10700 KG

$\tau = 10700 / 40 \times 73 = 3,6\ KG/CM^2 < 3,6\ KG/CM^2$

* BEAM AT MACHINE HATCH :



. DL : $0,4 \times 0,8 \times 1 \times 2500 = 800\ ^{KG}/_{M}$

$0,3 \times 1 \times 2500 = 750\ ^{KG}/_{M}$

. LL : $= 500\ ^{KG}/_{M}$

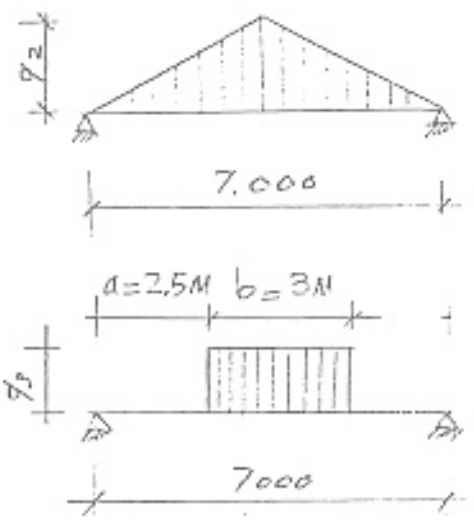
SUM $p_1 = 2050\ ^{KG}/_{M}$

$M_{01} = p_1 l^2/8 = 2050 \times 8^2/8 = 16.400$ KGM

$M_{02} = p_2 l/4 = 5000 \times 8/4 = 10.000$ KGM

SUM = 26.400 KGM

* BEAM UNDER BLOWER PUMP (700 × 1000 MM)



$p_1 = 0,7 \times 1 \times 1 \times 2500 = 1750\ ^{KG}/_{M}$

$M_{01} = 1750 \times 7^2/8 = 10.719$ KGM (BEAM)

$M_{02} = 2 \times q_2 \times l^2/12$

$= 2 \times (750 + 500) \times 4 \times 7^2/12$

$= 40.833$ KGM (DL + LL SLAB)

$M_{03} = \frac{q_3\, b\, (2l - b) \times 2}{8} = \frac{580 \times 2,5 \times 3\,(2 \times 7 - 3) \times 2}{8}$

$= 11.963$ KGM

$M_o = 10.719 + 40.833 + 11.963 = 63.515$ KGM

* EDGE SPAN : $M_a = -0,7 \times 63515 = -44.460$ KGM

$M_t = 0,7 \times 63515 = 44.460$ KGM

* MIDDLE SPAN : $M_a = -0,5 \times 63515 = -31757$ KGM

$M_t = 0,5 \times 63515 = 31757$ KGM

* BEAM { $D_1 - D_{11}$ / $A_1 - A_{11}$ } (LEVEL +2.5 M) (80 × 130 CM) - VERTICAL LOAD :

* 1 SPAN L = 7.00 M = 7 M :

. BEAM : $0.8 \times 1.3 \times 2500 = 2600$ KG/M

. WALL : $0.2 \times 1 \times 2000 \times 7.5 = 3000$ KG/M

SUM = 5600 KG/M

$$M_{01} = \frac{5600 \times 7^2}{8} = 34.300 \text{ KGM}$$

$$M_{02} = \frac{ql^2}{12} = \frac{[3.5 \times (750+500)] \times 7^2}{12} = 17.865 \text{ KGM}$$

$$M_0 = 34.300 + 17.865 = 52.165 \text{ KGM}$$

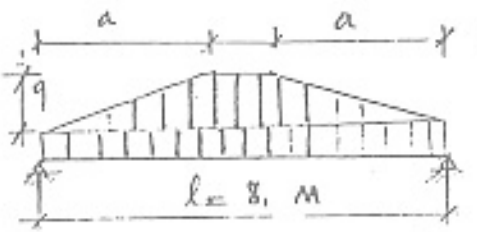
* AT EDGE SPAN : $M_a = -0.7 M_0 = -0.7 \times 52165 = -36516$ KG

$M_t = 0.7 \times M_0 = 0.7 \times 52165 = 36516$ KG

* AT MIDDLE SPAN : $M_a = 0.5 \times M_0 = -0.5 \times 52.165 = -26083$ KG

$M_t = 0.5 \times M_0 = 0.5 \times 52.165 = 26083$ KG.

* BEAM $A_1 D_1 - A_{11} D_{11}$ (LEVEL +2.5 M) (80 × 130 CM) - VERTICAL LOAD



* SPAN $l = 8.1$ M :

$$M_{01} = \frac{5600 \times 8.1^2}{8} = 44.800 \text{ KGM}$$

$$M_{02} = \frac{q}{2}\left(\frac{l^2}{4} - \frac{a^2}{3}\right) = \frac{3.5 \times (750+500)}{2}\left(\frac{8}{4}^2 - \right.$$

$$= 26.68 \text{ KGM}$$

$$\Rightarrow M_0 = 44.800 + 26.068 = 70868 \text{ KGM}$$

$$\Rightarrow M_{C_1} = -0.8 \times 70868 = -56.694 \text{ KGM}$$

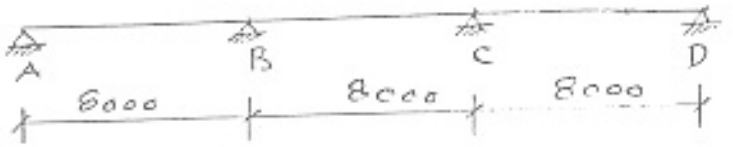
$$M_{C_1 D_1} = 0.8 \times 70868 = 56.694 \text{ KGM}$$

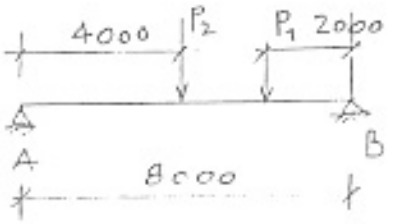
$$M_{B_1} = -0.8 \times 70868 = -56.694 \text{ KGM}$$

$$M_{B_1 C_1} = 0.6 \times 70868 = 42.521 \text{ KGM}$$

$$M_{A_1 B_1} = 0.8 \times 70868 = 56.694 \text{ KGM}$$

* BEAM (2) To (9) Axis : (700 x 1000) AND 800 x 1500 MM (A:)





* SPAN BC AND CD :

$$M_{o\,CD} = 1750 \times 8^2/8 + \frac{1250 \times 3.5}{2}\left[\frac{8^2}{4} - \frac{3.5^2}{3}\right] \times 2$$

$$= 66.135 \text{ KGM} = M_{o\,BC}$$

$$\Rightarrow M_{CD} = 0,8\, M_{o\,CD} = 0,8 \times 66135 = 52.908 \text{ KGM}$$

$$M_C = -0,8 \times M_{o\,CD} = -0,8 \times 66135 = -52.908 \text{ KGM}$$

$$M_{BC} = 0,6\, M_{o\,BC} = 0,6 \times 66135 = 39681 \text{ KGM}$$

* SPAN AB :

$$M_{o1} = 3000 \times 8^2/8 = 24.000 \text{ KGM}$$

$$M_{o2} = (750 + 500) \times 2,25 \times 8^2/8 = 22.500 \text{ KGM}$$

$$M_{o3} = \frac{P_1 \times 2 \times 8}{8} + \frac{P_2 \times 4 \times 4}{8}$$

$$P_1 = 0,65 \times 0,7 \times 2500 \times 7 + 0,2 \times 11 \times 2500 \times 7 = 46463 \text{ KG}$$

$$P_2 = 0,20 \times 9 \times 7 \times 2500 + 0,65 \times 0,7 \times 2500 \times 7 = 39463 \text{ KG}$$

$$M_{o3} = \frac{46463 \times 2 \times 6}{8} + \frac{39643 \times 4 \times 4}{8} = 148.621 \text{ KGM}$$

$$M_o = 24.000 + 22.500 + 148.621 = 195.121 \text{ KGM}$$

$$\Rightarrow M_{AB} = 0,8 \times M_o = 0,8 \times 195.121 = 156.097 \text{ KGM}$$

$$M_B = -0,8 \times M_o = -156.097 \text{ KGM}$$

* BEAM A' AXIS (650 x 1000 MM)

DL : $0{,}65 \times 1{,}00 \times 2500 = 1625$ KG/M (BEAM)

$0{,}20 \times 9 \times 1 \times 2500 = 4500$ KG/M (WALL)

$M_{o1} = (1625 + 4500)\frac{7^2}{8} = 37516$ KGM

$M_{o2} = (500 + 750) \times 2 \times \frac{7^2}{12} = 10209$ KGM

$M_o = 37516$ KGM + 10.209 KGM = 47 725 KGM

$M_A = -0{,}5 \times 47.725 = -23.862$ KGM

$M_t = 0{,}5 \times 47.725 = 23.862$ KGM

* HORIZONTAL FORCE :

. BEAM A_1A_{11} ; D_1D_{11} : $N = \frac{1}{2} \times 13.870 + 6562 = 13.497$ KG

. BEAM A_1D_1 , $A_{11}D_{11}$:

$N = 5742 + 5881 + 13\,870/2 = 18.558$ KG

* REINFORCEMENT :

* BEAM A_1A_{11} ; D_1D_{11} - HORIZONTAL LOAD (800 x 1300)

. $M = 9378$ KGM ; $N = 13.497$ KG ; $M/N = 69$ CM

$\Rightarrow Fa = \frac{13.497\,(69 + 80/2 - 7)}{1600 \times 66} = 13\ CM^2$

$\Rightarrow 4\phi 22$

. $M = 6699$ KGM ; $N = 13497$ KG ; $M/N = 50$ CM

$\Rightarrow Fa = \frac{13497\,(50 + 80/2 - 7)}{1600 \times 66} = 11\ CM^2$

$\Rightarrow 4\phi 22$

* VERTICAL LOAD :

. $M = 36.156$ KGM ; $N = 13497$ KG ; $M/N = 271$ CM

$$\Rightarrow F_a = \frac{13497\,(271 + 130/2 - 7)}{1600 \times 116} = 24\,CM^2$$

$\Rightarrow 7\phi 22 = 26,61\,CM^2$

. $M = 26.083$ KGM ; $N = 13497$ KG ; $M/N = 193$ CM

$$\Rightarrow F_a = \frac{13497\,(193 + 130/2 - 7)}{1600 \times 116} = 18,3\,CM^2$$

$\Rightarrow 6\phi 22$

* BEAM A_1D_1 ; $A_{11}D_{11}$ (800 x 1300) - HORIZONTAL LOAD :

. $M = 12.249$ KGM ; $N = 18558$ KG ; $M/N = 66$ CM

$$\Rightarrow F_a = \frac{18558\,(66 + 80/2 - 7)}{1600 \times 66} = 17,4\,CM^2$$

$\Rightarrow 2\phi 25 + 5\phi 14$

* VERTICAL LOAD :

. $M = 56694$ KGM ; $N = 18558$ KG ; $M/N = 305$ CM

$$\Rightarrow F_a = \frac{18.558\,(305 + 130/2 - 7)}{1600 \times 116} = 36,3\,CM^2$$

$\Rightarrow 8\phi 25 = 39,3\,CM^2$

. $M = 42521$ KGM ; $N = 18558$ KG ; $M/N = 229$ CM

$$\Rightarrow F_a = \frac{18558\,(229 + 130/2 - 7)}{1600 \times 116} = 28,6\,CM^2$$

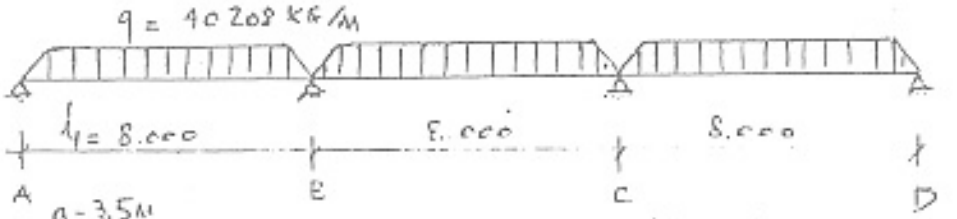
$\Rightarrow 6\phi 25 = 29,45\,CM^2$

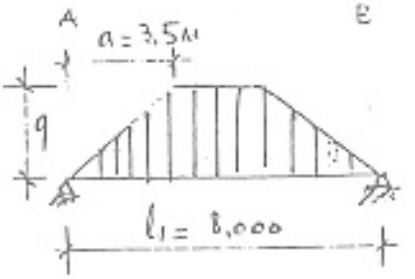
* BOTTOM SLAB

- CALCULATION PRESSURE FOR BOTTOM SLAB :

$$p_c = \frac{14.484.000 - (4061.640 + 772460)}{70 \times 24} = 5744\ KG/M^2$$

- FOR STRIP SPAN 8,00M : $q = p_c \times l_2 = 5744 \times 7 = 40.208\ KG/M$





$$M_o = \frac{q}{2}\left[\frac{l_1^2}{4} - \frac{a^2}{3}\right] = \frac{40.208}{2}\left[\frac{8^2}{4} - \frac{3,5^2}{3}\right] = 239.573\ KGM$$

$M_{CD} = M_{AB} = 0,7 M_o = 0,7 \times 239573 = 167.701\ KGM$

$M_c = M_B = -0,7 M_o = -0,7 \times 239573 = -167.701\ KGM$

$M_{BC} = 0,5 M_o = 0,5 \times 239.573 = 119.786\ KGM$

The width of strip equal $b = 2 \times [0,1 \times l_2] = 2 \times 0,1 \times 7 = 1,40$

TAKEN $t = 850\ MM$.

* REINFORCEMENT :

. $M = 167.701\ KGM$ (UNDER REINF.)

$$\Rightarrow F_a = \frac{16770100}{1600 \times 0.75 \times 68} = 205\ CM^2$$

$\Rightarrow 22\phi 36 = 224\ CM^2$

. $M = 167.701\ KGM$ (UPPER REINF.)

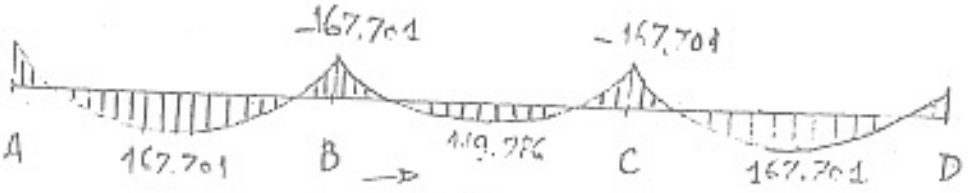
$$\Rightarrow F_a = \frac{167.701.00}{1600 \times 0,79 \times 73} = 181\ CM^2$$

$\Rightarrow 23\phi 32 = 185\ CM^2$

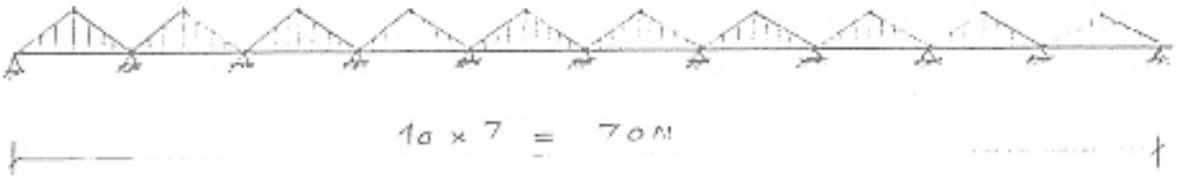
. $M = 119.786\ KGM$ (UPPER LAYER)

$$\Rightarrow F_a = \frac{11978600}{1600 \times 0,86 \times 78} = 111,6\ CM^2$$

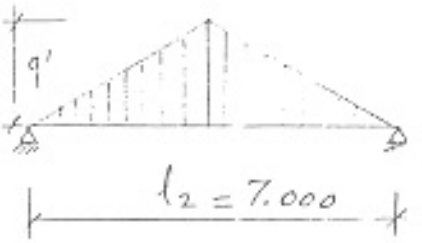
$\Rightarrow 14\ \phi 32 = 112,6\ CM^2$



. FOR STRIP SPAN $L_2 = 7M$ $(10 \times 7 = 70M)$



$10 \times 7 = 70M$



$$M_0 = q' l_2^2 / 12$$

$$= \frac{5744 \times 8 \times 7^2}{12} = 187\,637 \text{ KGM}$$

$$M_{2-3} = \ldots = M_{9-10} = 0,5 M_0 = 93.819 \text{ KGM}$$

$$M_3 = M_4 = \ldots = M_9 = -0,5 M_0 = -93.819 \text{ KGM}$$

- THE WIDTH OF STRIP EQUAL $2 \times 0,1 \times l_1 = 1,6M$

* REINFORCEMENT :

. $M = 93.189$ KGM (UPPER LAYER)

$$\Rightarrow F_a = \frac{9318900}{1600 \times 0,89 \times 78} = 83.9 \text{ CM}^2$$

$\Rightarrow 11 \phi 32 = 88,5 \text{ CM}^2$

. $M = 93.189$ KGM (UNDER LAYER)

$$\Rightarrow F_a = \frac{9318900}{1600 \times 0,94 \times 73} = 84,8 \text{ CM}^2$$

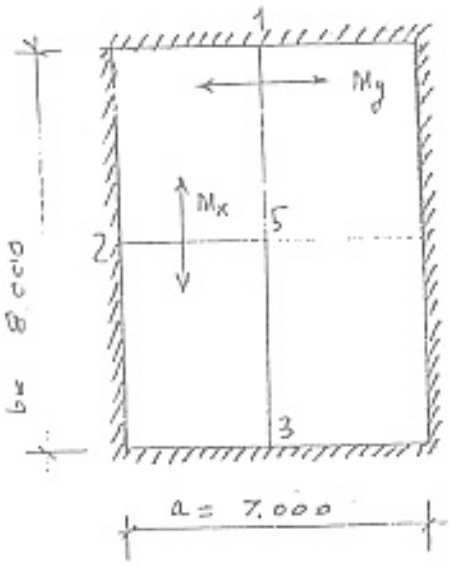
$\Rightarrow 11 \phi 32 = 88,5 \text{ CM}^2$

* BOTTOM SLAB 7M x 8M

a = 7,00 M

b = 8.00 M

b/a = 8/7 = 1,1



$M_{y2} = -0,051 \times 5744 \times 7^2 = -14.354$ KGM

$M_{y5} = 0,018 \times 5744 \times 7^2 = 5066$ KGM

$M_{x3} = -0,051 \times 5744 \times 7^2 = -14354$ KGM

$M_{x5} = 0,018 \times 5744 \times 7^2 = 5066$ KGM

* REINFORCEMENT:

M = -14354 KGM (UNDER LAYER)

$\Rightarrow F_a = \frac{1435400}{1600 \times 0,98 \times 73} = 12,54\ cm^2$

$\Rightarrow 4(\phi 18 + \phi 12) = 14,7\ cm^2$

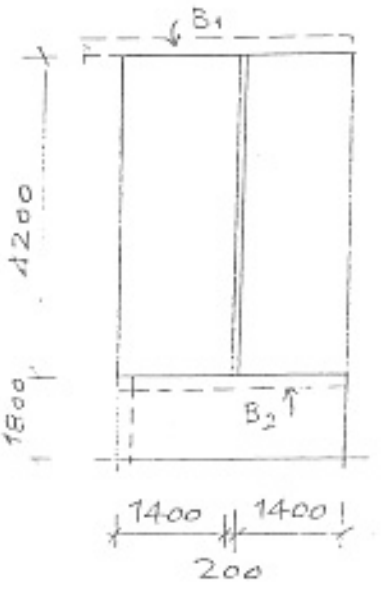
M = 5066 KGM (UPER LAYER)

$\Rightarrow F_a = \frac{506600}{1600 \times 0,99 \times 78} = 4,1\ cm^2$

USE $F_{a\,min} = 0,2\% \times 100 \times 85/2 = 8,5\ cm^2$

$\Rightarrow 4\phi 18 = 10,18\ cm^2$

* STAIR



* SUBBEAM B_1 (400 × 700)

$p_1 = 0{,}40 \times 0{,}70 \times 2500 + (0{,}3 \times 2500 + 500) \times 1$

$= 1950$ KG/M

$M_{01} = 1950 \times \frac{8^2}{8} = 15\,600$ KGM

$P = \frac{(4 \times 0{,}28 \times 2500 \times 1{,}4 + 500 \times 1{,}4 \cdot 4)}{2}$

$= 3360$ KG

$M_{02} = \frac{3360 \times 6 \times 2}{8} = 5040$ KGM

$M = 15\,600 + 5040 = 20\,6400$ KGM

$\tau = \left[1950 \times 4 \times 0{,}9 + 3360 \times \frac{6}{8} \right] / (0{,}4 \times 0{,}7) = 3{,}4$ KG/CM^2

$< 3{,}6$ KG/CM^2

$F_a = \frac{2064000}{1600 \times 0{,}87 \times 63} = 23{,}5$ CM^2

$\Rightarrow 4\,\phi 28 = 24{,}6$ CM^2

* SUBBEAM B_2 : (300 × 600)

$p = 0{,}3 \times 0{,}6 \times 2500 + 0{,}9 \times 0{,}2 \times 2500 + 0{,}90 \times 500 + 0{,}28 \times 2{,}1 \times 2500 + 500 \times 2{,}1 = 3870$ KG/M

$M = 3870 \times \frac{3^2}{8} = 4354$ KGM

$F_a = \frac{435400}{1600 \times 0{,}95 \times 53} = 5{,}4$ CM^2

$\Rightarrow 3\,\phi 16 = 6{,}03$ CM^2

* STAIR SLAB (t = 200 MM)

$p = (500 \times 1{,}4 + 0{,}28 \times 2500 \times 1{,}4) \times 0{,}79 = 1327$ KG/M

$M = 0{,}80(M_0) = 0{,}80 \times 1327 \times \frac{5{,}3^2}{8} = 3728$ KGM

$\Rightarrow F_a = \frac{372800}{1600 \times 0{,}99 \times 15} = 15{,}6$ CM^2

$\Rightarrow 7\,\phi 18 = 17{,}8$ CM^2

* NUMBER OF PILES :

$$p = \frac{14.484.000}{70 \times 24} = 8622 \text{ KG/M}^2$$

. DISTANCE OF PILES :

$$a = \sqrt{\frac{45.000}{5622}} \approx 2,28 \text{ M}$$

. NUMBER OF PILES : $33 \times 12 = 396$ PILES

. BEARING CAPACITY OF 1 PILE $= \frac{14.484.000}{396} = 36,576 \text{ T}$
$< 45 \text{ T}$

. TEMPORARY UPLIFT FORCE :

$P_t = 4061.640 + 321.088 + 772.464 + 207.300$
$+ 924.500 + 0,8 \times 1,3 \times 94 \times 2 \times 2500 = 6.775.792$

$F_w = 70,8 \times 24,8 \times 6,15 = 10.798.416$

- TEMPORARY UPLIFT FORCE : $F_w - P_t = 4022624$
$\approx 10,2 \text{ TONS/P}$
$< 20 \text{T/PILE}$

- IN CASE OF NEGATIVE SKIN FRICTION EFECTING :

$F_{sf} = 1800 \times 6,15 \times \frac{1}{2} \times 6,15 \times 0,3 \times 2 (71+25)/396$
$= 4,95 \text{ T/PILE} < 5 \text{T/PILE}$

$\Rightarrow$ BEARING CAPACITY OF 01 PILE $P < 50$ TONS