

THE PEOPLE'S REPUBLIC OF BANGLADESH
DETAILED DESIGN REPORT
ON
CONSTRUCTION PROJECT
OF
AUTOMOBILE REPAIR & MAINTENANCE WORKSHOP
VOLUME—6

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OCTOBER 1978

Japan International Cooperation Agency

MPI

78-25/(6/6)

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CONTENTS

I. STRUCTURAL ANALYSIS	I
2. CALCULATION SHEET OF VENTILATION AND AIR CONDITIONING	534
3. CALCULATION SHEET OF WATER SUPPLY AND DRAINAGE	552
4. CALCULATION SCHEDULE OF FLOOR AREA	562

(TOTAL 572) |

STRUCTURAL ANALYSIS OF

CONSTRUCTION PROJECT OF
AUTOMOBILE REPAIR & MAINTENANCE
WORKSHOP
in BANGLADESH

JICA.
INTERNATIONAL
COOPERATION
AGENCY

1978

CONTENTS	P
0 GENERAL NOTE	3
I GENERAL OFFICE	8
2 CLASS ROOM	75
3 DORMITORY	107
4 CAFETERIA	155
5 TRAINING ROOM	196
6 CHECK GATE	216
7 AIR COMPRESSOR HOUSE	226
8 PAINT GREASE & OIL STORAGE	236
9 SUB STATION	246
10 HEAVY REPAIR FACTORY	255
11 PARTS STORAGE	316
12 INSPECTION FACTORY	358
13 PERIODICAL REPAIR FACTORY	391
14 PAINT & BODY FACTORY	431
15 RETREADING & METAL CASTING FACTORY	472
16 WATER SUPPLY TOWER	514

[TOTAL 533 P]
 [1978 - AUG.]

O GENERAL NOTE

BUILDING:

'AUTOMOBILE REPAIR AND MAINTENANCE FACTORY'
 of
 BANGLADESH ROAD TRANSPORT CORPORATION

LOCATION:

JOYDEPUR , BANGLADESH

STRUCTURE:

REINFORCED CONCRETE CEMENT OR STEEL FRAME STRUCTURE

MATERIAL:

CONCRETE: PILE . Fc 210 kg/sq cm
 (3000 psi)

FOUNDATION Fc 150 kg/sq cm
 (2200 psi)

SUPER STRUCTURE Fc 180 kg/sq cm
 (2600 psi)

REINFORCEMENT: JIS SD 30 AND M/S BAR

STEEL: JIS SS 4I

HIGH TENSION BOLT: JIS F IG T

LATERAL SEISMIC COEFFICIENT: 0.10

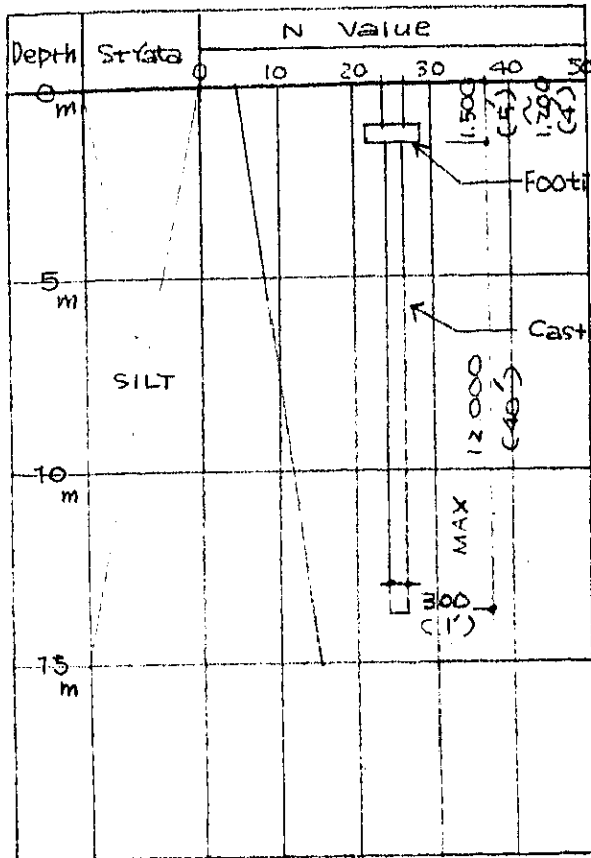
VELOCITY OF WIND: 60 M/SEC (130 MPH)

APPLIED STANDARD AND CODE:

JIS (JAPANESE INDUSTRIAL STANDARD)

AIJ (CODE OF ARCHITECTURAL INSTITUTE OF JAPAN)

Approximate Bore Chart



Bearing Capacity of Soil

Square Footing

8.4 [t/m²]
 (0.78 [t/ft²])

Continuous Footing

6.2 [t/m²]
 (0.58 [t/ft²])

Formula of Bearing Capacity of Pile

$$R_a = \frac{1}{3} \left\{ 15 \bar{N} A_p + \left(\frac{N_s L_s}{4} + 2 N_c L_c \right) \psi \right\} - W \sim A_p f_c - W$$

$$\eta = 1 - \frac{\tan^{-1} d/D}{90} \left\{ \frac{(m-1)l}{m} + \frac{(l-1)m}{l} \right\}$$

e.g. Cf. Above Chart

(1) ψ 300
 L 12,000 ($\frac{1}{4} \psi = 40$)

\bar{N}	15
N_s	0
L_s	0
N_c	10 \rightarrow 4 (Upper Limit)
L_c	12

$$R_a = \frac{1}{3} \left\{ 15 \times 15 \times \frac{\pi \times 0.3^2}{4} + 2 \times 4 \times 12 \times \pi \times 0.3 \right\} - \frac{\pi \times 0.3^2}{4} \times 12 \times 2.4$$

$$= \frac{1}{3} \{ 15.9 + 90.9 \} - 2.0 = 38.4 - 2.0 = 36.4$$

($36.4 / \pi \times 0.3 \times 15 = 2.36$ (t/m²))

$$= \frac{\pi \times 30^2}{4} \times 10 - 2.5 = 47.5 - 2.5 = 45.0$$

$$\eta = 1 - \frac{\tan^{-1} \frac{1}{3}}{90} \left\{ \frac{(3-1) \frac{1}{3}}{3 \times 8 \sim 2 \times 2} + \frac{(3-1) \frac{1}{3}}{3 \times 8 \sim 2 \times 2} \right\} = 0.926$$

DESIGN CAPACITY 25 (t/p) $\leftarrow 36.4 \times 0.78$

(2)

ψ 350

$$R_a = \frac{1}{3} \left\{ 15 \times 15 \times \frac{\pi \times 0.35^2}{4} + 2 \times 4 \times 12 \times \pi \times 0.35 \right\} - \frac{\pi \times 0.35^2}{4} \times 12 \times 2.4$$

$$= \frac{1}{3} \{ 21.6 + 100.8 \} - 2.8 = 42.4 - 2.8 = 39.6$$

$\eta = 0.77$

DESIGN CAPACITY 30 (Ct/p)

(3)

ψ 400

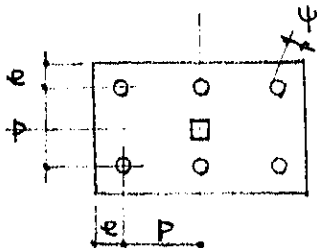
$$R_a = \frac{1}{3} \left\{ 15 \times 15 \times \frac{\pi \times 0.4^2}{4} + 2 \times 4 \times 12 \times \pi \times 0.4 \right\} - \frac{\pi \times 0.4^2}{4} \times 12 \times 2.4$$

$$= \frac{1}{3} \{ 28.3 + 120.6 \} - 3.6 = 49.6 - 3.6 = 46.0$$

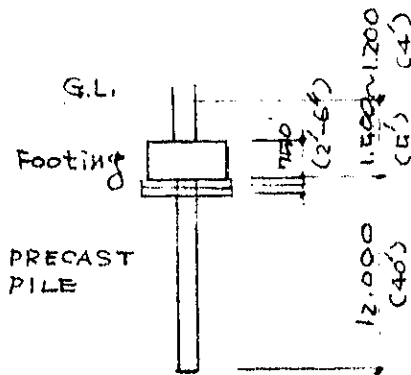
$\eta = 0.77$

DESIGN CAPACITY 35 (Ct/p)

Specification of Pile Works



$e = 1.5 \psi$
 $P = 3 \psi$



Leveling Concrete 50[#] (2")
 Brick Soling 76[#] (3")

ψ	R _a	η Main R _i	η' Spiral Hoop
300 (12")	25 (55)	6-DIG (6-5/8")	D10 (1/4") (ω110)
350 (14")	30 (66)	"	"
400 (16")	35 (77)	"	"
cm	T/P (KIP/P)		

(2.20459[KIP] = 1[t])

Allowable Stress Intensity

[$\frac{K}{in^2}$]

Material		Sustained Loading									Temporary Loading	
		Tension	Compression	Shear	Bond			Welding		Fillet		
					Position Fc	Top R.	In General	Butt				
								In General	Shear			
Concrete	Fc 150 (2,200 PSI)		50								x 2.0	
				5							x 1.5	
	Fc 180 (2,600 PSI)		60								x 2.0	
				6							x 1.5	
	Fc 210 (3,000 PSI)		70								x 2.0	
				7							x 1.5	
Reinforcement	MS Bar	1,265	1,125	1,265							x 1.33	
		(18 KIP) $\frac{1}{in^2}$	(16 KIP) $\frac{1}{in^2}$	(18 KIP) $\frac{1}{in^2}$	150	6.0	9.0				x 1.5	
				180	7.2	10.8					x 1.5	
	SD30	2,000	2,000	2,000								x 1.5
					150	10.0	15.0					x 1.5
					180	12.0	18.0					
Steel	SS41	1,600	1,600	900				1,400	800	800	x 1.5	

Allowable Stress of F10T

[t]

	Sust. L.		Temp. L.
	Single Surface	Double Surface	
M 16	3.02	6.03	x 1.5
20	4.71	9.42	
22	5.70	11.4	
24	6.78	13.6	

(1 [psi] = 0.001 [KIP/in²] = 0.0703 [K_G/cm²])

I GENERAL OFFICE

1-1. LOAD

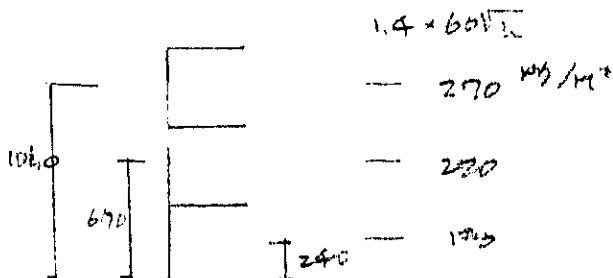
(i) DEAD LOAD

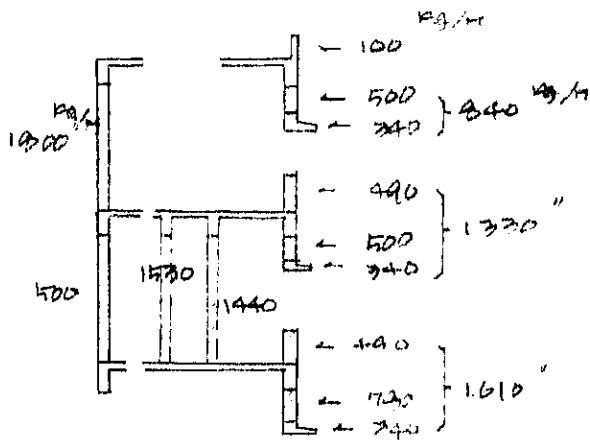
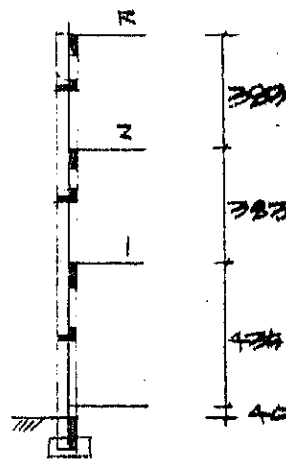
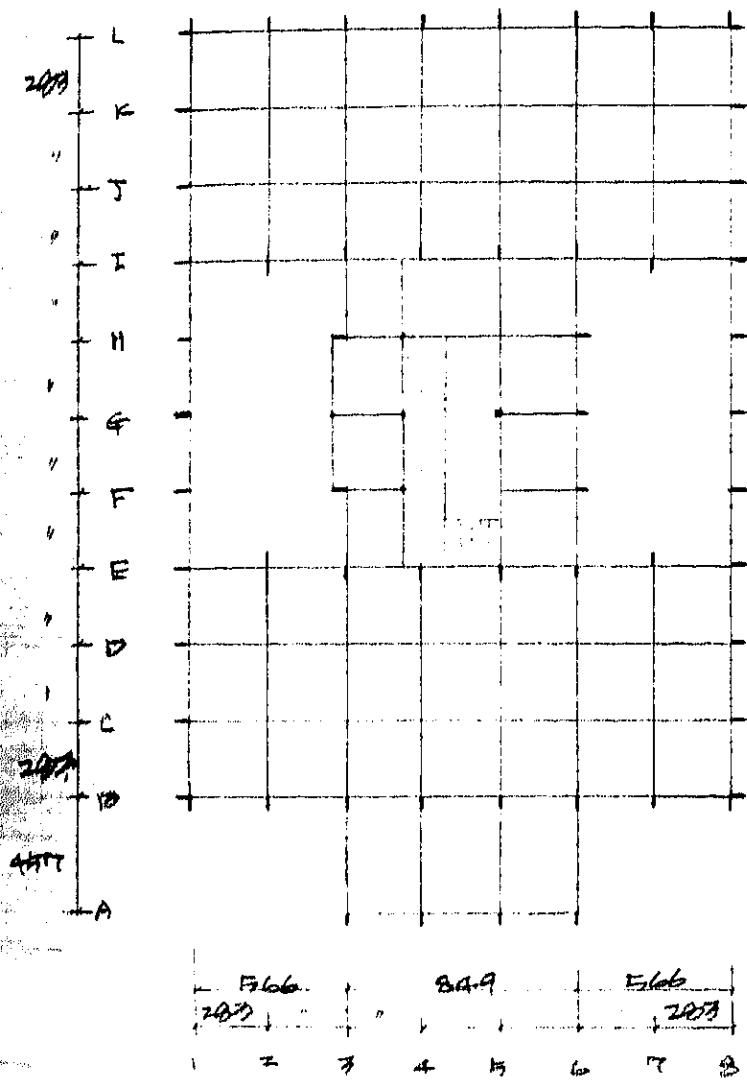
<u>ROOF</u>	LIME CONCRETE	10 ^{cm}	200	} 460 ^{kg/m²}
	RC. SLAB	10	240	
	CEILING		20	
<u>FLOOR</u>	TERRAZZO TILE	5	100	} 360
	RC SLAB	10	240	
	CEILING		20	
<u>WALL</u>	BRICK	25.4	490	} 540
	CEMENT MORTAR	2.5	50	
<u>COLUMN</u>	28 x 75		510	kg/m
<u>BEAM</u>	28 x 50		340	
	28 x 75		510	

(ii) LIVE LOAD

	SLAB	FLAKE	EARTHQUAKE
FLOOR	300	180	90
ROOF	100	50	0

(iii) WIND PRESSURE





1-2

C.M.O. OF BEAM

$$W_R = 460 + 50 = 510 \text{ kg/m}^2$$

$$W_M = 360 + 180 = 540 "$$

G.A.34



$$l_x = 283$$

$$\lambda = 1.00$$

$$C = 0.60W + w' \times 2.83^2 / 12$$

$$I_{x0} = 1.00W + w' \times 2.83^4 / 8$$

$$Q = 1.05W + w' \times 2.83^3 / 2$$

$$0.34 + 0.10 = 0.44 \quad 0.34 + 0.49 = 0.83$$

$$0.31 + 0.30 = 0.61 \quad 0.32 + 0.66 = 0.98$$

$$0.51 + 0.44 = 1.0 \quad 0.54 + 0.83 = 1.37$$

$$0.54 + 0.63 = 1.17 \quad 0.57 + 1.18 = 1.75$$

G.B.34



$$l_x = 283$$

$$\lambda = 1.00$$

$$w' = 0.34$$

$$C = 0.6 \times 2W + 0.2w'$$

$$0.8$$

$$0.9$$

$$I_{x0} = 1.0 \times 2W + 0.74$$

$$1.4$$

$$1.4$$

$$Q = 1.05 \times 2W + 0.48$$

$$1.6$$

$$1.6$$

G.C.13



$$l_x = 283$$

$$l_y = 566$$

$$\lambda = 2.00$$

$$w' = 0.51$$

$$C = 3.6 \times 2W + 1.36$$

$$5.0$$

$$5.2$$

$$I_{x0} = 5.4 \times 2W + 2.04$$

$$7.5$$

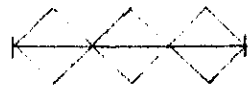
$$7.9$$

$$Q = 3.0 \times 2W + 1.40$$

$$4.5$$

$$4.7$$

G.C.36



$$l = 283$$

$$w' = 0.51$$

$$C = 3.074W + 3.06$$

$$7.5$$

$$7.8$$

$$I_{x0} = 13.22W + 4.60$$

$$11.3$$

$$11.7$$

$$Q = 6.01W + 2.16$$

$$5.2$$

$$5.4$$

G434



$l_x = 2.40$

$\lambda = 1.00$

$w_{11} = 0.34 + 1.53 = 1.87$

$C = 0.36 \times 2W + w' \times 2.4^2 / 2$

$0.37 + 0.15 = 0.5$

$0.39 + 0.90 = 1.29$

$\Gamma_0 = 0.6 \times 2W + w' \times 2.4^2 / 3$

$0.61 + 0.24 = 0.9$

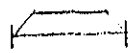
$0.65 + 1.35 = 2.0$

$Q = 0.75 \times 2W + w' \times 2.4 / 2$

$0.75 + 0.61 = 1.2$

$0.91 + 0.24 = 1.1$

G3AB



$l_x = 2.40$

$l_y = 4.57 \quad \lambda = 1.61$

$w_{11} = 0.34 + 1.80 = 2.14$

$C = 2.1W + w' \times 4.57^2 / 1.4$

$1.07 + 0.17 = 1.24$

$1.13 + 3.72 = 4.85$

0.24

2.6

$\Gamma_0 = 2.35W + w' \times 4.57^2 / 3$

$1.71 + 1.15 = 2.86$

$1.41 + 5.49 = 6.9$

4.0

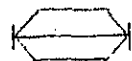
$Q = 2.7W + w' \times 4.57 / 2$

$1.17 + 1.01 = 2.18$

$1.24 + 4.89 = 6.13$

3.1

G4AB



$l_x = 2.40$

$l_y = 4.57 \quad \lambda = 1.61$

$w = 0.51 + 1.44 = 1.95$

$C = 2.1 \times 2W + 0.44W$

3.0

3.2

5.48

5.7

$\Gamma_0 = 2.35 \times 2W + 1.33W$

4.4

5.0

6.7

$Q = 2.7 \times 2W + 1.17W$

3.5

3.6

6.9

R G434



$l_x = 2.40$

$l_y = 3.60$

$\lambda = 1.20$

$w' = 0.51$

$l_x = 2.40$

$l_y = 2.40$

$\lambda = 1.00$

$C = (3.4 + 3.4) \times 0.51 + 1.36$

5.2

$\Gamma_0 = (3.3 + 5.6) \times 0.51 + 2.04$

3.4

$Q = (3.4 + 3.4) \times 0.51 + 1.44$

4.7

B61

$l = 0.66$

$w = (1.54 + 0.24) \times 1.4 / 2 + 0.36 = 1.06$

$\Gamma_0 = 1.06 \times 0.66^2 / 3 = 4.9$

$Q = 1.06 \times 0.66 / 2 = 4.6$

m G434



$l = 2.40$

$l_x = 2.40$

$l_y = 2.40 \quad \lambda = 1.0$

$C_{DG} = (3.4 + 1.5) \times 0.54 + 1.36$

4.0

$C_{GB} = (3.4 + 0.6) \times 0.54 + 1.36$

3.5

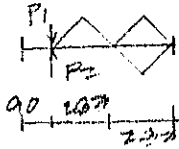
$\Gamma_0 = (5.6 + 1.4) \times 0.54 + 2.04$

5.0

$Q = (3.4 + 1.5) \times 0.54 + 1.44$

3.9

GH 46



$$L = 6.66$$

$$w' = 0.21$$

$$P_1 = 1.6$$

$$P_2 = 4.6 \times 2 = 9.2$$

$$\Sigma P = 10.8$$

$$C_{66} = 17.30 + (1.94 + 3.35) \times 0.21 + 1.47 \quad 12.0$$

$$C_{64} = 11.6 + (1.06 + 1.12) \times 0.21 + 1.47 \quad 9.2$$

$$P_0 = 4.96 + (2.32 + 2.84) \times 0.21 + 2.74 \quad 10.4$$

$$Q = 9.40 + (1.29 + 0.87) \times 0.21 + 1.67 \quad 12.2$$

1-3 AXIAL FORCE OF COLUMN

	ROOF & FLOOR		WALL		BEAM	COLUMN	W	P
C _{1A}	0.51 x 1.42 x 2.29	166	0.10 x 3.7 0.84 x 1.28	0.37 1.08	1.09	0.98	5.18	5.2
C ₁₁	0.54 x "	176	1.40 x 1.91 1.33 x 1.28	3.44 1.69	1.09	1.95	9.43	15.1
C ₁₁	0.54 x "	176	1.40 x 1.91 1.61 x 1.28	3.44 2.06	1.09	3.40	11.75	26.9
C _{1A}	0.51 x 2.83 x 2.29	331	0.10 x 3.7 0.84 x 2.55	0.37 2.14	1.84	0.98	8.55	8.6
C ₁₁	0.54 x "	350	1.33 x 2.55	3.37	1.84	1.95	10.66	19.2
C ₁₁	0.54 x "	350	1.61 x 2.55	4.11	1.84	3.40	12.85	32.1
C ₁₁	0.51 x 1.42 x 1.42	103	0.10 x 2.8 0.84 x 2.55	0.36 2.14	0.91	1.57	5.89	5.9
C ₁₁	0.54 x "	1.09	1.33 x 2.55	3.37	0.91	3.14	7.60	13.5
C ₁₁	0.54 x "	1.09	1.61 x 2.55	4.11	0.91	5.47	11.54	25.0
C ₁₂	0.51 x 2.83 x (1.42 + 0.4)	341	0.10 x 3.7 0.84 x 2.55	0.36 2.14	3.01	0.98	9.82	9.8
C ₁₁	0.54 x "	361	1.33 x 2.55	3.37	3.01	1.95	11.94	21.8
C ₁₁	0.54 x "	361	1.61 x 2.55	4.11	3.01	3.40	14.13	35.9
C ₁₃	0.51 x 1.42 x (1.42 + 0.4)	422	0.10 x 3.7 0.84 x 1.28	0.37 1.08	1.02	0.98	7.67	7.7
C ₁₁	0.54 x "	447	1.33 x 1.28 1.40 x 1.53 1.33 x 1.28	1.64 3.76 1.96	1.02	1.95	13.05	21.5
C ₁₁	0.54 x "	447	1.61 x 1.28 1.33 x 1.28	2.06 1.96	1.02	3.40	12.91	34.4
C _{1A}	0.51 x 2.83 x 4.41	636			3.93	0.98	11.27	11.3
C ₁₁	0.54 x "	674			3.93	1.95	12.62	23.9
C ₁₁	0.54 x "	674			3.93	3.40	14.07	38.0
C ₁₁	0.51 x (1.42 + 0.4) x 2.83	341	0.10 x 3.7 0.84 x 2.55	0.36 2.14	2.25	0.98	9.06	9.1
C ₁₁	0.54 x "	361	1.33 x 2.55	3.37	2.25	1.95	11.18	20.2
C ₁₁	0.54 x "	361	1.61 x 2.55	4.11	2.25	3.40	13.37	33.6
C ₁₃	0.51 x (2.83 + 2.12) x 2.83	647			4.09	0.98	11.54	11.5
C ₁₁	0.54 x "	685	1.53 x 2.55	3.90	4.09	1.95	15.74	27.3

	ROOF & FLOOR		WALL		RAFT	COLUMN	W	F
C ₁₇	0.54 x 4.44 x 2.83	6.85	1.53 x 2.55	3.90	4.09	3.04	17.88	45.2
C ₁₈	0.51 x 1.42 x 1.42	1.03	0.10 x 2.8	0.28				
			0.94 x 2.55	2.14	0.87	0.98	5.30	5.3
			0.50 x 1.28	0.64				
C ₁₉	0.54 x "	1.09	1.73 x 2.55	3.39	0.87	1.95	7.94	13.2
			0.50 x 1.28	0.64				
C ₂₀	0.54 x "	1.09	1.61 x 2.55	4.11	0.87	3.40	11.11	24.4
			0.10 x 2.8	0.28				
C ₂₁	0.51 x 2.83 x 3.54	5.11	0.94 x 2.55	2.14	1.73	0.98	10.24	10.2
			1.53 x 1.28	1.96				
C ₂₂	0.54 x "	5.41	1.73 x 2.55	3.39	1.73	1.95	14.44	24.7
			0.50 x 1.28	0.64				
C ₂₃	0.54 x "	5.41	1.61 x 2.55	4.11	1.73	3.50	14.65	39.3
			0.10 x 2.8	0.28				
C ₂₄	0.51 x 2.83 x 3.54	5.11	1.53 x 3.83	5.86	3.25	0.98	9.34	9.3
			0.10 x 2.8	0.28				
C ₂₅	0.54 x "	5.41	1.53 x 3.83	5.86	3.25	1.95	16.47	30.4
			0.10 x 2.8	0.28				
C ₂₆	0.54 x "	5.41	0.10 x 2.8	0.28	3.25	3.40	17.12	52.9
			0.10 x 2.8	0.28	2.12	0.98	3.38	3.4
			0.50 x 2.55	1.28	2.12	1.95	5.35	8.7
			0.50 x 2.55	1.28	0.87	3.40	5.55	14.3
			0.10 x 2.8	0.28				
C ₂₇	0.51 x 1.07 x 2.83	1.54	0.94 x 2.55	2.14	2.44	0.98	7.38	7.4
			0.10 x 2.8	0.28				
C ₂₈	0.54 x "	1.64	1.73 x 2.55	3.39	2.44	1.95	9.42	16.8
			0.50 x 1.28	0.64				
C ₂₉	0.54 x "	1.64	1.61 x 2.55	4.11	1.14	3.40	10.34	27.1
			0.10 x 2.8	0.28				
C ₃₀	0.51 x 4.25 x 2.83	6.13			2.90	0.36	4.34	9.4
C ₃₁	0.54 x 2.17 x 2.83	4.17	1.53 x 2.55	3.90	1.14	0.72	9.97	19.4
			0.10 x 2.8	0.28				
C ₃₂	0.54 x "	4.17	1.43 x 2.55	3.90	1.14	1.18	10.23	29.8
			0.10 x 2.8	0.28				
C ₃₃	0.51 x 3.31 x 2.83	4.78			2.90	0.98	8.90	9.9
			0.13 x 2.55	0.33				
C ₃₄	0.54 x 1.42 x 2.83	2.17	0.13 x 2.55	0.33	1.14	1.95	5.68	14.6
			0.13 x 2.55	0.33				
C ₃₅	0.54 x "	2.17			1.14	3.40	7.08	21.7
			0.10 x 2.8	0.28				
C ₃₆	0.51 x 1.07 x 2.83	1.54	0.94 x 2.55	2.14	2.44	0.36	6.76	6.8
			1.53 x 1.28	1.96				
C ₃₇	0.54 x "	1.64	1.73 x 2.55	3.39	2.44	0.72	11.10	17.9

	CODE & FLOOR	WALL	THICK	COLUMN	W	P		
C1	0.54 x 1.07 x 2.83	1.64	1.03 x 1.03 1.03 x 2.55	1.95 4.75	3.44	1.10	11.56	29.4
C2	0.51 x 3.31 x 2.93	4.94			3.46	0.53	6.82	4.13
C3	0.54 x 1.47 x 5.66	4.34			3.46	1.16	4.96	17.8
C4	0.54 x	4.34			3.46	1.49	4.60	27.5
C5	0.51 x 4.25 x 2.93	6.13			2.90	0.36	4.37	9.4
C6	0.54 x 2.93 x 2.93	4.32	1.53 x 3.10	3.36	2.90	0.72	11.20	20.77
C7	0.54 x	4.32	1.53 x	3.34	2.90	1.19	11.74	32.4

1.-4 SEISMIC FORCE

ROOF	0.46×5777.0	2657.0	
PARAPET	0.10×175.3	17.5	
WALL	$0.85 \times 255 \times 40$	85.7	
	$0.54 \times 1.66 \times 12.54$	11.2	} 48.4
ORNAMENT	$0.15 \times 1.66 \times 20.4$	5.1	
PARTITION	$0.46 \times 1.66 \times 42.1$	32.1	
BEAM	0.34×194.9	66.3	
	0.51×181.3	92.5	
COLUMN	$0.51 \times 2.04 \times 642$	70.7	628.1

2ND FLOOR	0.44×526.4	231.6	
WALL	$178 \times 2.55 \times 40$	174.6	
	FROM UPPER STAIRS	48.0	
	$0.54 \times 1.66 \times 12.54$	11.2	} 64.4
ORNAMENT	$0.15 \times 1.66 \times 20.4$	5.1	
PARTITION	$0.46 \times 1.66 \times 42.1$	32.1	
BEAM	0.34×194.9	66.3	
	0.51×203.9	103.9	
COLUMN	$0.51 \times 3.43 \times 642$	132.3	601.6

1ST FLOOR	0.44×526.4	231.6	
WALL	$161 \times 2.55 \times 20$	82.1	
	$0.44 \times 2.55 \times 20$	22.0	
	FROM UPPER STAIRS	84.6	
ORNAMENT	$0.15 \times 1.92 \times 35.7$	10.3	

PARTITION	$0.46 \times 192 \times 42.4$	37.8	
	$0.54 \times 196 \times 10.2$	10.4	
BEAM	0.34×192.9	6.6	
	0.51×175.0	8.9	
COLUMN	$0.51 \times 4.09 \times 6.6$	14.1	
PORCH ROOF	$0.10 \times 32 \times 5.0$	4.1	70.7

	W	K	q	Q _T
3	628.1	0.1	62.8	62.8
2	801.6	0.1	80.2	143.0
1	733.7	0.1	73.4	221.4

WIND PRESSURE

3	$0.25 \times 260 = 65$	$= 35.7$
2	$0.22 \times \dots$	$= 28.2$
1	$0.13 \times 341 \times 4.7$	$= 21.0$

1 - 5 STIFFNESS RATIO

	$I \times D$	J_{10^4}	Q	K_{10^3}	Φ	δ
2C	28 x 75	98.4	383	25.7		2.57
	75 x 28	13.7	.	3.6		0.36
1C	28 x 75	98.4	475	20.7		2.07
	75 x 28	13.7	.	2.9		0.29
2C	28 x 28	5.1	383	1.3		0.13
		"	475	1.1		0.11
2C	40 A	12.5	383	3.3		0.33
1C		"	475	2.6		0.26
F	28 x 50	29.2	383	10.3	1.33	1.37
				10.3	1.57	1.62
			457	6.4	1.48	0.95
			228	12.8	1.48	1.89
		28 x 75	98.4	566	17.4	1.79
			849	11.6	2.0	2.32
			457	21.5	1.68	3.61
FG	35 x 90	212.6	283	75.1		7.51
			457	46.5		4.65
			566	37.6		3.76
			849	25.0		2.50

$K_0 = 10^3$

ⓑ [ⓔ ⓓ]

1.77	1.77	1.62	1.62
296 (257)	0.76	0.76	0.76
1.77	1.77	1.62	1.62
296 (257)	0.76	0.76	0.76
1.77	1.77	1.62	1.62
219 (207)	0.29	0.29	0.29
7.51	7.51	7.51	7.51
287			283

ⓐ

1.77	1.77	
0.76	0.76	283
1.77	1.77	
0.76	0.76	283
1.77	1.77	
0.29	0.29	475
7.51	7.51	
287	283	

ⓒ ⓓ ⓔ ⓕ

	2.11		2.72
257		2.57	
	2.11		2.72
257		2.57	
	2.11		2.72
207		2.07	
7.76			7.51
566			449

Ⓛ

1.77	1.77	1.77	1.77
296	0.76	0.76	0.76
1.77	1.77	1.77	1.77
296	0.76	0.76	0.76
1.77	1.77	1.77	1.77
219	0.29	0.29	0.29
7.51	7.51	7.51	7.51
287			283

ⓕ

1.74	2.46	2.20	1.74
257	2.57	0.13	2.57
1.74	2.46	1.62	1.74
115	2.57	0.13	2.57
	2.46	1.62	
	2.07	0.11	2.07
3.76	11.47	11.01	3.76
466	196	667	566

(G)

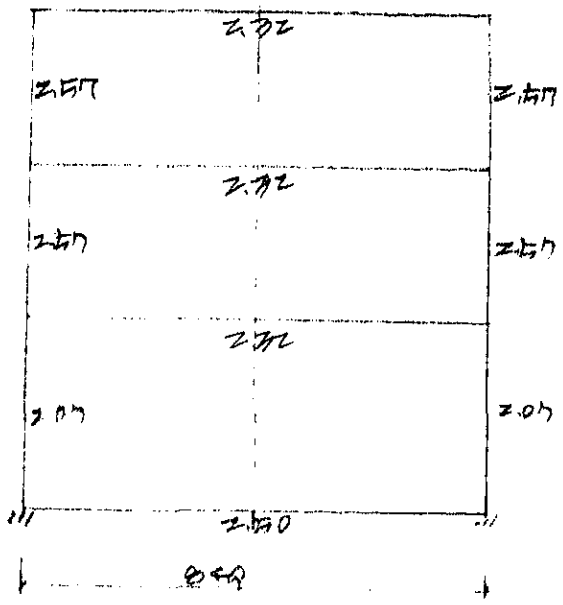
1.89	1.97	1.21	1.62	1.74	
2.57	0.13	0.13	0.33	2.57	2.57
1.89	1.97		1.62	1.74	
1.15	0.13	0.13	0.33	2.57	1.03
	1.97		1.62		
	0.11	0.11	0.26	3.07	
4.18	0.12				
5.19		3.90	7.51	3.76	
5.19		3.90	7.51	5.66	

(H)

1.74	2.46	3.20	1.74	
2.57	2.57	0.13	2.57	2.57
1.74	2.46	3.20	1.74	
1.15	2.57	0.13	2.57	1.03
	2.46	3.20		
	2.07	0.11	2.07	
2.06				
11.33		7.31	3.76	

① (B)

300	1.37	1.37	1.37	1.03	1.03	1.03
300	0.76	0.76	0.76	0.76	0.76	0.76
415	0.24	0.24	0.24	0.24	0.24	0.24
	2.37	2.37	2.37	2.37	2.37	2.37



② ⑦

0.95	1.62	1.62	1.62	1.37	1.37	1.37
2.57	0.76	0.76	0.76	0.76	0.76	0.13 (0.36)
0.95	1.62	1.62	1.62	1.37	1.37	1.37
2.57	0.76	0.76	0.76	0.76	0.76	0.13 (0.36)
0.95	1.62	1.62	1.62	1.37	1.37	1.37
2.57	0.24	0.24	0.24	0.24	0.24	0.11 (0.24)
2.65	2.37	2.37	2.37	2.37	2.37	2.37

③

⑦

④

2.61	2.72	
2.57	2.57	2.57
2.61	2.72	
2.57	2.57	2.57
2.61	2.72	
2.07	2.07	2.07
4.45	2.50	
4.57	6.44	

2.72	2.57
2.72	2.57
2.72	2.07
2.50	2.57
6.54	

⑤

2.61	2.72		2.57
2.57	2.57	2.57	2.72
2.61	2.72		2.57
2.57	2.57	2.57	2.72
2.61	2.72		2.57
2.07	2.07	2.07	2.72
4.45	2.50		2.72
4.57	6.44		5.66

④

(1.03)

(1.22)

1.37	1.37	1.37	1.62
	0.13	0.13	0.13
1.37	1.37	1.37	1.62
	0.13	0.13	0.13
1.37	1.37	1.37	1.62
	0.11	0.11	0.11
7.51	7.51	7.51	7.51
2.87			2.67

1-6 CALCULATION OF STRESS

(1) D, 20

(A)

(B)

(C)

7.61	7.61
0.24	0.29
0.4	0.5
0.65	0.45
7.61	7.61
0.24	0.29
1.1	1.3
0.4	0.5
0.65	-
9.45	9.45
0.23	0.25
1.2	1.3
0.45	0.45
-	-

7.61	7.61	9.00	9.00
0.29	0.29	0.29	0.29
1.1	0.5	0.5	0.5
0.23	0.45	0.45	0.45
0.35	7.61	9.00	9.00
0.49	0.29	0.29	0.29
2.7	1.3	1.3	1.3
0.4	0.5	0.5	0.5
-	-	-	-
9.45	9.45	10.31	11.17
1.22	0.25	0.25	0.26
6.4	1.3	1.3	1.4
0.4	0.45	0.45	0.55
-	-	-	-

2.11	2.11
0.97	1.32
1.7	2.3
0.36	0.40
2.11	2.11
0.97	1.32
4.2	5.7
0.45	0.45
2.62	2.62
1.17	1.40
6.0	7.1
0.57	0.55

(D)

(E)

1.63	27.34	1.34	0.67
0.65	0.12	1.07	0.65
1.2	0.2	1.9	1.2
0.29	0.29	0.26	0.29
1.30	1.92	0.81	1.69
0.66	0.12	0.74	0.61
1.4	0.5	3.4	1.4
0.45	0.5	0.45	0.45
-0.05	-	-0.15	-
1.19	22.76	0.57	0.96
1.10	0.10	0.96	0.96
5.7	0.5	4.5	4.5
0.59	0.55	0.70	0.70
-	-	-	-

0.53
0.54
1.0
0.30
0.53
0.54
2.5
0.45
0.66
0.90
4.7
0.67

$$\{(0.77 + 0.24) \times 2.65 + 1.95\} \times 0.1 = 0.47 \rightarrow \tau_{0.5}$$

05A	07A	07A	07A	07A	07A	07A	07A
097		132			132		097
097		132			132		097
05A	07A	07A	07A	07A	07A	07A	07A
097		101	012		092		097
097		012	011		073	082	097
097		101	012		092		097
05A	07A	07A	07A	07A	07A	07A	07A
097		132			132		097
097		132			132		097
05A	07A	07A	07A	07A	07A	07A	07A
		07A	07A	07A	07A		

$zQ = 1430$

$zR = 37.29$

(108 → 31)

$zQ = 221.4 - 31 = 190.4$

$zR = 91.7A$

122	075	075	075	075	075	075	122
112		140			140		112
112		140			140		112
090	075	075	075	075	075	075	090
		110	011			106	
		010	010		021	045	
		110	010			096	
090	075	075	075	075	075	075	090
112		140			140		112
112		140			140		112
122	075	075	075	075	075	075	122
		075	075	075	075		

①

0.75	7.61	6.67	5.72	
0.59	0.29	0.28	0.27	
1.11	0.5	0.5	0.5	
0.25	0.45	0.45	0.45	
0.75	7.61	6.67	5.72	
0.59	0.29	0.28	0.27	
2.05	1.2	1.2	1.1	
0.45	0.50	0.50	0.50	
0.75	9.45	8.27	7.10	8.58
1.22	0.25	0.25	0.24	0.21
6.3	1.3	1.3	1.2	1.1
0.45	0.55	0.55	0.55	0.55

②

0.90	
0.79	
1.4	
0.75	
0.90	
0.79	
3.1	
0.45	
1.12	
1.07	
5.3	
0.60	

④

1.40	2.30	2.90
1.06	1.37	0.99
1.8	2.4	1.4
		0.35
1.40	2.30	2.90
1.06	1.37	0.99
4.2	5.4	3.1
0.45	0.45	0.45
1.74	2.46	1.12
1.24	1.43	1.07
6.2	7.1	4.3
0.45	0.45	0.60

⑧

③

0.77	1.02	9.00	1.16	7.61	21.07
0.40	0.47	0.29	0.94	0.29	0.12
0.8	1.6	0.5	1.7	0.5	0.2
0.25	0.35	0.55	0.36	0.45	0.45
0.77	1.02	9.00	1.16	7.61	21.07
0.40	0.47	0.29	0.94	0.29	0.12
1.8	3.7	1.2	4.0	1.2	0.5
0.45	0.45	0.50	0.45	0.50	0.50
0.46	1.27	11.17	1.44	9.45	24.91
0.80	1.12	0.26	1.17	0.25	0.10
4.2	5.3	1.3	6.0	1.3	0.5
0.71	0.59	0.55	0.54	0.55	0.55

④

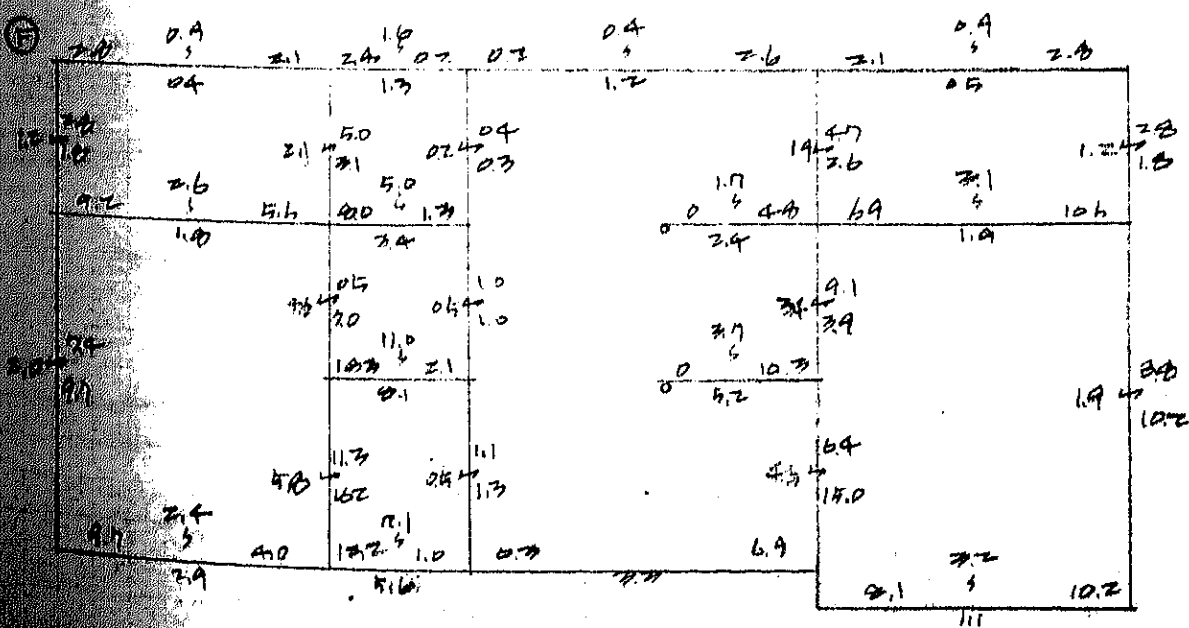
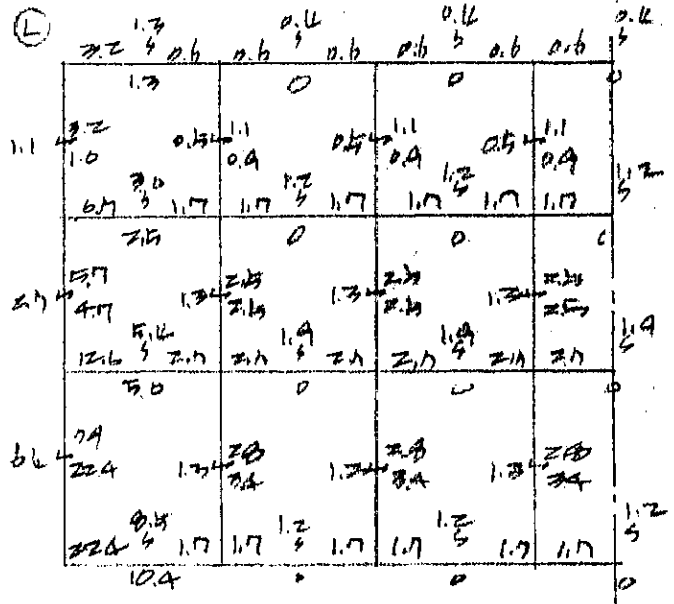
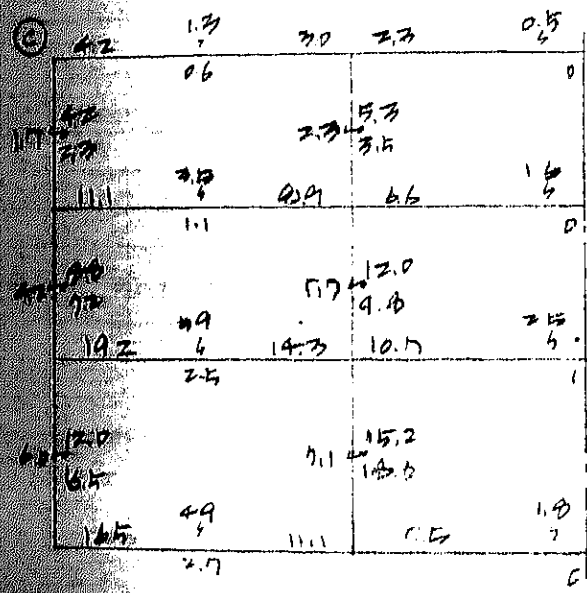
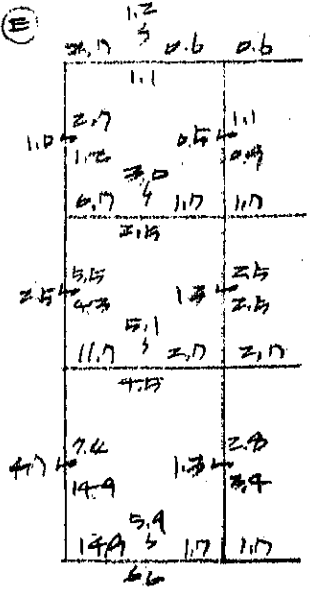
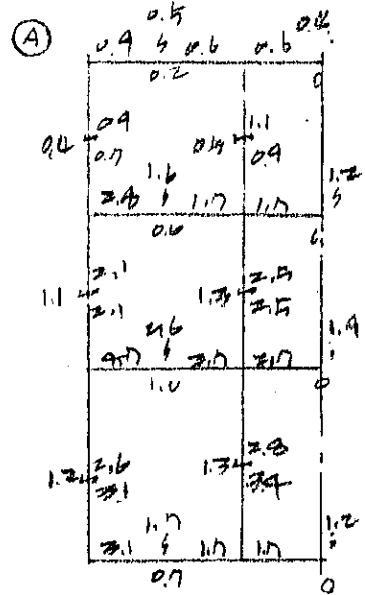
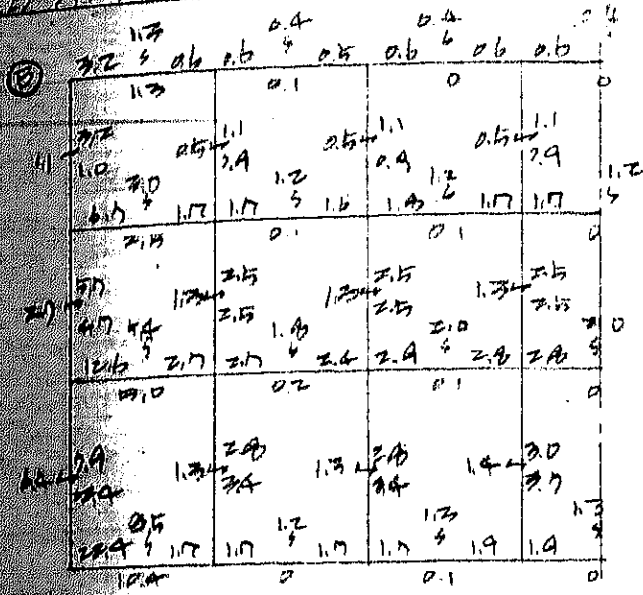
19.46	21.07	19.92
0.12	0.12	0.12
0.2	0.2	0.2
0.45	0.45	0.45
19.46	21.07	19.92
0.12	0.12	0.12
0.5	0.5	0.5
0.50	0.50	0.50
21.42	24.10	23.55
0.10	0.10	0.10
0.5	0.5	0.5
2.55	2.55	2.55

120	025	026	025	104	024	024	025	025	025	025	107
107				107							107
112	026	026	025	010	025	010	025	025	026	026	045
143				010	010	010					107
143				025	025	025					107
112	026	026	025	025	025	025	025	025	026	026	025
107				107							107
122	024	025	025	025	021	021	021	021	025	025	022

$$ID_1 = 4399$$

$$10 = 221.9$$

STRESS DIAGRAM OF SEISMIC FORCE

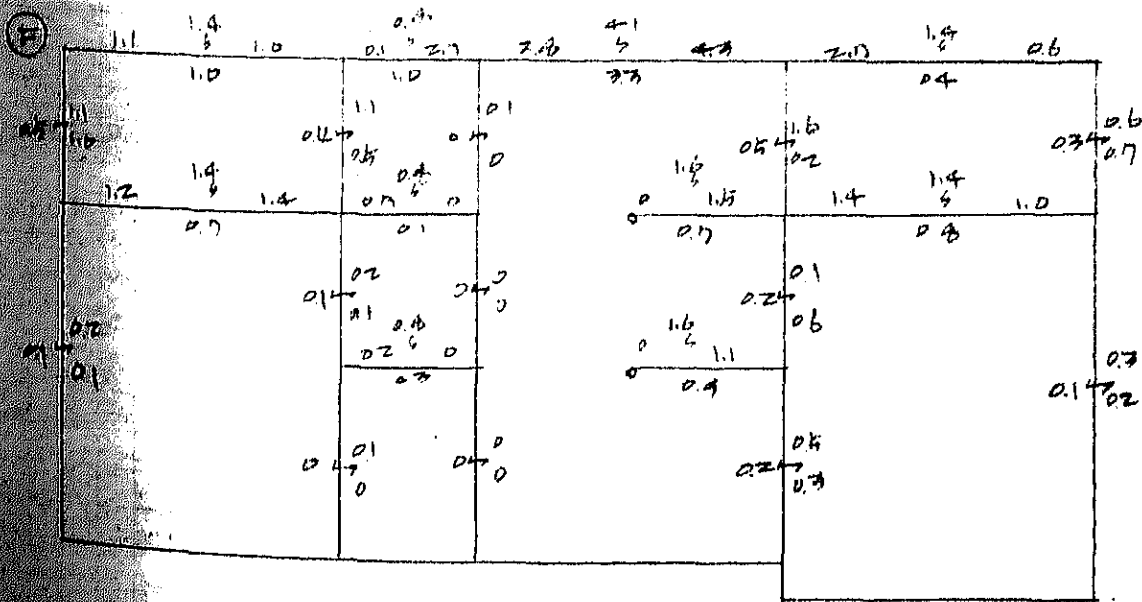
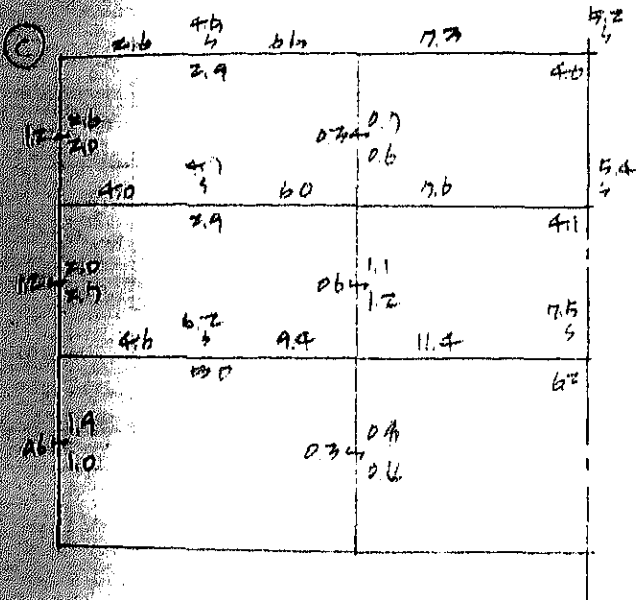
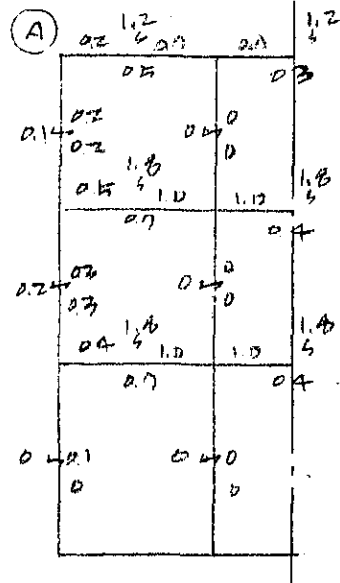
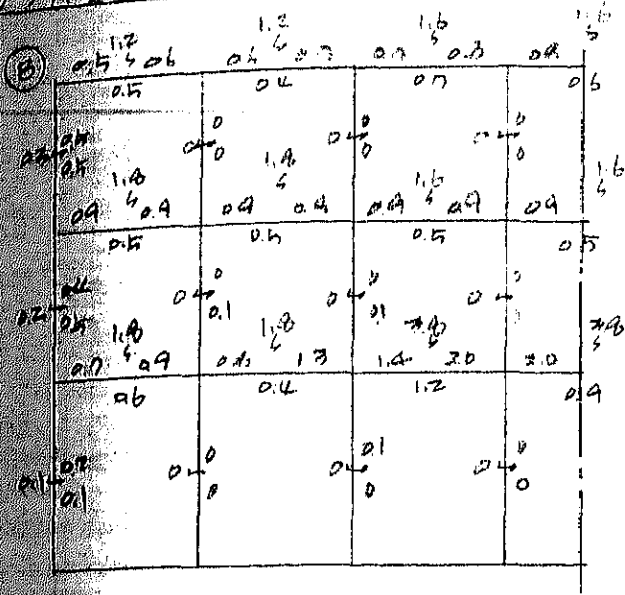


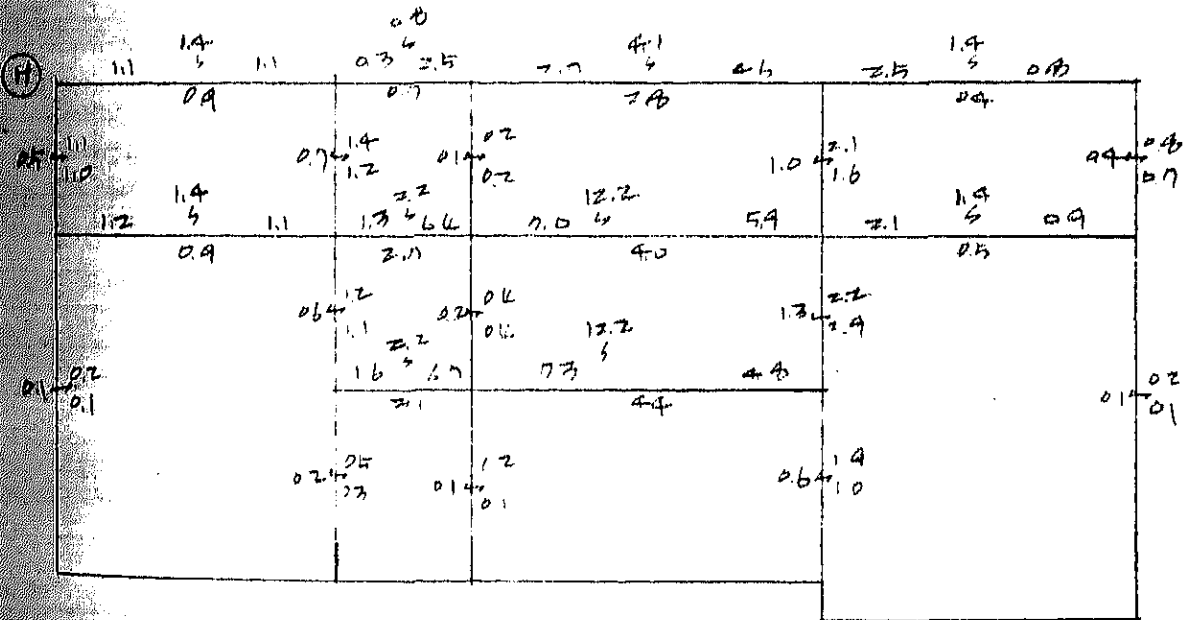
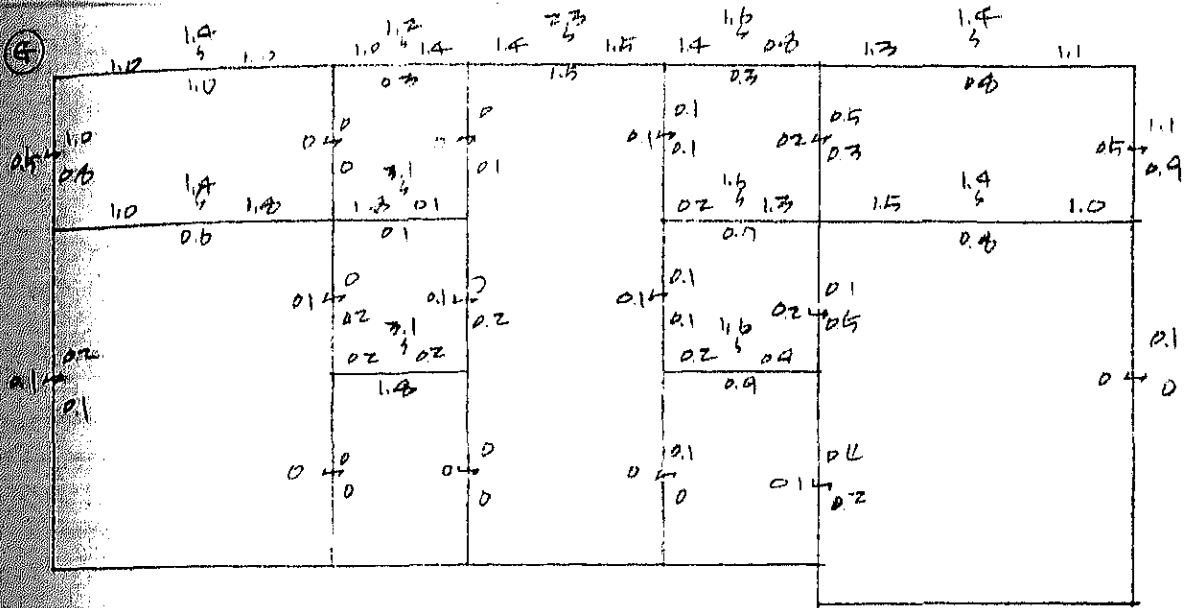
1.7 4.3	3.3	2.1	0.7 0	3.5	0.8 0	3.5
0.15			0.7		0	
1.4 5.0 2.6	2.4 4.5	5.4 3.8		1.4 1.9	3.5 1.9	
11.4 3	0.1	6.3	1.7 3	3.4		
1.2			1.1			
4.8 7.2	5.4 7.7	11.2 9.6		3.1 5.3	6.5 5.3	
20.2 3	18.0	9.7	3.1 3	16.9		
2.0			3.6			
17.0 16.5	21.4 18.1	15.3 10.1		5.3 15.4	11.6 15.4	
16.5 4.3	12.1	6.6	3.6 3	15.4		
4.3			4.4			

1.7 4.3	3.3	2.1	1.5 0	2.4	2.7	0.6 0	0.6	0.6
0.15			0.2			1.1		
1.4 5.0 2.6	2.4 4.5	5.4 3.8		2.2 5.1 3.3			0.5 0.9	1.1
11.4 3	0.1	6.3	1.3 3	6.5	7.1	1.6 3	1.6	1.6
1.2			0.1			2.3		
4.8 7.2	5.4 7.7	11.2 9.6		4.9 10.3 3.4			1.2 2.3 3.3	2.3
20.2 3	18.0	9.7	2.2 3	10.0	11.9	2.7 3	2.8	2.8
2.0			0.6			4.7		
17.0 16.5	21.4 18.1	15.3 10.1		6.7 14 17			1.2 2.6 3.2	2.6
16.5 4.3	12.1	6.6	1.7 3	7.5	10.0	2.1 3	1.6	1.6
4.3			0.5			4.2		

0.1	0.2	0.2	0.1	0.2	0.1	0.2	0.1	0.2
0.1			0					0.1
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
0.2	0.6	0.1	0.1	0.1	0.1	0.1	0.1	0.2
0.2			0					0.2
0.3	0.5	0.1	0.5	0.1	0.5	0.1	0.5	0.1
0.3	0.9	1.1	1.1	1.1	1.1	1.1	1.1	0.1
0.5			0					0.1
0.5	1.1	0.5	1.1	0.5	1.1	0.5	1.1	0.2
0.5	1.3	0.5	1.3	0.5	1.3	0.5	1.3	0.2
0.5	0.6	0.1	0.7	0.1	0.7	0.1	0.7	0.2
0.7			0					0.2

STRESS DIAGRAM OF VERTICAL LOAD





④

0.7	1.7	4.2	5.7
1.1	1.0	2.1	3.5
1.1	1.4	4.6	9.0
1.2	1.2	7.5	2.3
1.2	1.1	1.1	3.6

⑤

1.7	2.1	4.7	4.9
1.1	1.5	1.8	2.0
1.1	1.9	2.0	2.5
1.1	1.2	0.9	0.9

⑥

1.0	1.0	1.0	1.0
1.7	1.2	1.2	1.6
1.1	1.2	1.6	2.6
1.1	1.2	1.2	1.6

DESIGN OF SECTION

(1) BEAM

STAB NO	μ_{OE}	μ_{LC}	μ_{IE}	β
L	0.2	0.5	0.7	1.2
E	0.9	0.3	0.6	0.5
B	1.1	0.7	1.3	2.2
	0.7			

$$b \times d = 24 \times 50 \quad \lambda = 4.5 \quad \gamma' = 39.3$$

$$Q_{FA} = 24 \times 34.3 \times 6 = 6600 \text{ kg}$$

$$Q_{OE} = 110 / 34.3 \times 3.0 = 0.9$$

$$Q_S = 1200 / 34.3 \times 0.2 = 4.2$$

} Z-D13

STAB NO	μ_{OE}	μ_{LC}	μ_{IE}	β
L	0.5	0.7	1.0	1.8
E	2.8	0.6	1.7	1.6
B	3.3	1.3	2.0	5.0
	3.3		0.7	

$$b \times d = 24 \times 50$$

$$Q_{FA} = 330 / 34.3 \times 3.0 = 2.8$$

Z-D16

$$Q_{IE} = 340 / \dots = 2.4$$

STAB NO	μ_{OE}	μ_{LC}	μ_{IE}	β
L	0.4	0.7	1.0	1.4
E	4.7	1.0	3.7	1.6
B	5.1	1.7	4.7	7.0
	4.3		2.7	

$$b \times d = 24 \times 50$$

$$Q_{OE} = 510 / 34.3 \times 3.0 = 4.7$$

Z-D19

$$Q_{IE} = 470 / \dots = 4.0$$

WFB	π_{EF}	π_c	π_{FF}	Q	π_E	π_c	Q
L	0.5	0.5	0.6	12	0.5	0.7	16
E	3.2	1.3	0.6	13	0.6	0	0.4
S	3.7	1.8	1.2	38	1.4		
$b \times D = 2.3 \times 5.0$							
A	3.1	1.5	1.0		1.2	0.9	2.0
n	4-D13		2-D13		2-D13		
		2-D13				2-D13	

WFB	π_{EF}	π_c	π_{FF}	Q	π_E	π_c	Q
L	0.9	0.8	0.9	13	0.9	0.5	18
E	6.7	2.6	1.7	30	1.8	0.1	12
S	7.6	3.0	2.6	78	2.7		4.2
$b \times D = 2.3 \times 5.0$							
A	6.4	2.5	2.2		2.3	0.6	
n	4-D16		2-D16		2-D16		
		2-D16				2-D16	

WFB	π_{EF}	π_c	π_{FF}	Q	π_E	π_c	Q
L	0.7	0.6	0.9	1.8	2.0	1.2	3.8
E	12.6	5.0	3.3	5.4	3.4	0.1	2.0
S	12.3	5.6	3.6	12.6	4.9		7.8
$b \times D = 2.3 \times 5.0$							
A	11.3	4.7	3.1		4.1	1.5	
n	4-D19		2-D19		2-D19		
		2-D19				2-D19	

$\Delta Q_A = 2.9 \times 3.9 \times 1.9 = 9.9 \text{ A}^T$

$\Delta Q = 12.6 \cdot 9.9 = 2.7$

$\Delta Q / b_j = 2.45$

$PW = 0.36$

$D10 \times 2 = 16.4 / 200 \times 0.36 = 14.2 \rightarrow 10 \text{ @}$

RECUMB	Flor	Flc	Flm	Q	FlE	Flc	Q
L	2.6	2.9	6.6	4.5	7.2	4.0	5.2
E	4.2	0.6	3.0	1.3	2.3	0	0.5
S	6.8		4.6	7.1	4.6		

$b \times d = 2.8 \times 7.5 \rightarrow 61.2$

$W_A = 2.6 \times 61.2 \times 1.0 = 10.3^T$ $SW_A = 15.4$

a	3.7	2.4	5.2		5.2	3.3	
m	2-D16		4-D16		4-D16		2-D16

RECUMB	FlE	Flc	Flm	Q	FlE	Flc	Q
L	4.0	2.9	6.0	4.7	7.6	4.1	5.4
E	11.1	1.1	3.9	3.5	6.6	0	1.6
S	15.1		14.9	11.7	14.2		4.6

$b \times d = 2.8 \times 7.5$

A	2.3	2.4	2.1		7.4	3.3	
M	4-D19		4-D19		4-D19		2-D19

RECUMB	FlE	Flc	Flm	Q	FlE	Flc	Q
L	4.0	5.0	9.4	6.2	11.4	6.2	7.5
E	19.2	2.5	14.3	6.9	10.7	0	2.5
S	23.4		23.7	18.0	22.1		12.5

$b \times d = 2.8 \times 7.5$

a	17.0	4.1	12.9		12.1	5.1	
M	4-D22		4-D22		4-D22		2-D22

$\Delta Q = 18.0 - 15.4 = 2.6$

$\Delta Q / Q = 1.52$ $PW = 0.30$

$D10 \approx 1.43 / 2.0 \times 0.70 = 17.0 \rightarrow 15 \text{ (A)}$

GF INB	π_{OE}	π_C	π_{IF}	Θ	π_E	π_C	Θ	π_E	π_C	Θ		
L	1.1	1.0	1.3	1.4	2.0	1.0	0.8	4.6	3.3	4.1		
E	3.5	1.7	2.4	1.0	0.2	1.4	1.6	2.5	1.3	0.4		
S	4.6	2.7	3.1	3.4		2.4	4.0	7.3		4.5		
	$b \times D = 2.0 \times 7.5$				2.0×5.0				2.0×7.5			
A	2.5	1.5	2.0		3.4	2.0		4.0	2.7			
M	2-D16		2-D16		2-D16		2-D16	2-D16		2-D16		

GF INB	π_{OE}	π_C	π_{IF}	Θ	π_E	π_C	Θ	π_E	π_C	Θ		
L	1.3	0.8	2.1	1.4	6.0	2.7	2.2	5.9	4.0	12.2		
E	10.6	4.4	6.4	3.1	0.7	3.7	5.0	7.5	3.5	1.3		
S	11.8	5.2	9.0	2.6		6.4	12.2	13.4	7.5			
	$b \times D = 2.0 \times 7.5$				2.0×5.0				2.0×7.5			
					$\Delta Q = 12.2 - 9.9 = 2.3$			$\Delta Q = 12.2 - 10.3 = 1.9$				
					$\Delta Q / \pi_{in} = 2.09$			$\Delta Q / \pi_{in} = 1.11$				
					PW = 2.33			PW = 0.31				
					$\pi_{10} \pi = 15.4 \rightarrow 10 \text{ @}$			$\pi_{10} \pi = 16.5 \rightarrow 10 \text{ @}$				
A	6.4	2.8	4.9		9.7	5.2		7.3	4.1			
M	4-D19		2-D19		4-D19		2-D19	4-D19		2-D19		

GF INB	π_E	π_C	π_{IF}	Θ	π_E	π_C	π_{IF}	Θ	π_E	π_C	π_{IF}	Θ
L	0.4	1.4	1.1	1.4	1.6	2.1	6.7	2.7	7.3	4.4	4.8	12.2
E	13.7	4.5	6.3	3.1	13.9	9.6	1.2	3.4	11	8.0	17.1	2.1
S	14.3	5.5	15.2	2.6	20.0	11.7	19.0		15.4	21.9		
	$b \times D = 2.0 \times 7.5$				2.0×5.0				2.0×7.5			
A	12.1	4.6	12.0		16.9	9.9	8.5		6.0	6.8	9.3	
M	4-D22		4-D22		2-D22		4-D22		2-D22		4-D22	
					$\Delta Q = 4.3$			$\Delta Q = 9.1$			$\Delta Q / \pi_{in} = 4.26$	
					PW = 0.75			D13 2.2 = 12.1 → 10 @				

AVI	ME	MC	TEE	Q	TEE	MC	Q
L	0.5	0.5	0.6	1.2	0.5	0.5	1.2
E	2.3	1.4	0.6	1.4	0.6	0	2.4
S	2.3	1.2	1.2	4.0	1.1		2.0

$b \times D = 2.8 \times 5.0$

A	3.2	1.6	1.0	0.9	0.6
M	4-D13	2-D13	2-D13	2-D13	2-D13

AVI	ME	MC	TEE	Q	TEE	MC	Q
L	0.9	0.5	0.9	1.6	0.7	0.6	1.8
E	6.3	2.9	1.6	2.7	1.8	0.1	1.2
D	7.2	2.9	2.5	7.2	2.5		4.2

$b \times D = 2.8 \times 5.0$

A	6.1	2.4	2.1	2.1	0.8
M	4-D16	2-D16	2-D16	2-D16	2-D16

AVI	ME	MC	TEE	Q	TEE	MC	Q
L	0.7	0.5	0.9	1.8	0.7	0.6	1.8
E	12.1	4.8	2.6	5.2	2.9	0.2	1.9
S	12.8	5.4	3.5	12.2	3.1		5.6

$b \times D = 2.8 \times 5.0$

A	10.8	4.6	3.0	3.0	0.8
M	4-D19	2-D19	2-D19	2-D19	2-D19

$\Delta Q = 12.2 - 9.9 = 2.3$

$\Delta Q / b \times D = 2.09 \quad PW = 0.33$

$b \times D = 15.7 / 2.09 = 7.5 \rightarrow 10 \text{ @}$

20x20E	RF	RL	Q
L	5.3	5.5	5.7
E	3.5	0	0.2
S	4.3		
b x D = 20 x 15			
A	5.1	4.5	
M	4-16	2-D16	

20x20	RF	RL	Q
	1.0	0.9	1.6
	0.2	0.1	0.1
b x D = 20 x 15			
	1.3	1.1	
	2-D13	2-D13	

20x20E	RF	RL	Q
L	12.4	4.2	5.4
E	8.2	0	2.0
S	15.4		4.6
b x D = 20 x 15			
A	8.6	3.5	
M	4-D14	2-D14	

20x20	RF	RL	Q
	2.4	1.7	3.3
	0.7	0.3	0.5
b x D = 20 x 15			
	3.0	2.2	
	2-D16	2-D16	

20x20E	RF	RL	Q
L	8.4	6.2	6.4
E	16.4	0	4.0
S	25.4		14.4
b x D = 20 x 15			
A	14.1	5.6	
M	4-D22	2-D22	

20x20	RF	RL	Q
	2.4	1.7	3.3
	1.2	0.5	0.8
b x D = 20 x 15			
	3.0	2.2	
	2-D16	2-D16	

DRIVE I	Γ_{OE}	Γ_C	Γ_{IE}	α	Γ_{LE}	Γ_C	Γ_{RE}	α
L	1.5	1.3	1.3	2.2	1.1	0.7	0.8	1.6
E	2.3	0.4	1.5	0.6	2.5	1.0	0.6	1.1
B	3.6		3.3	3.7	3.6	1.7	1.4	3.8

$b \times D = 2.8 \times 75$

2.8×50

α	2.1	1.1	1.8		3.0	1.4	1.2	
m	2-D13		2-D13		4-D13		2-D13	
		2-D13				2-D13		

DRIVE I	Γ_{OE}	Γ_C	Γ_{IE}	α	Γ_{LE}	Γ_C	Γ_{RE}	α
L	2.4	1.5	2.7	3.1	2.0	2.9	2.0	3.9
E	4.6	0.4	3.8	1.8	6.2	2.3	1.6	2.7
B	7.0		6.5	6.7	6.2	3.2	3.6	9.2

$b \times D = 2.8 \times 75$

2.8×50

α	3.6	1.2	2.1		6.9	2.7	3.0	
m	2-D16		2-D16		4-D16		2-D16	
		2-D16				2-D16		

DRIVE I	Γ_{OE}	Γ_C	Γ_{IE}	α	Γ_{LE}	Γ_C	Γ_{RE}	α
L	2.2	1.6	2.7	3.1	2.1	0.9	1.9	3.8
E	2.9	1.1	6.1	3.9	11.0	4.2	2.6	4.8
B	12.1	2.7	9.4	9.9	13.1	5.1	4.5	13.4

$b \times D = 2.8 \times 75$

2.8×50

α	6.6	1.4	5.1		11.1	4.3	3.8	
m	4-D19		2-D19		4-D19		2-D19	
		2-D19				2-D19		

$\Delta \alpha = 13.4 - 9.9 = 3.5$

$\Delta \alpha / \alpha_0 = 3.18$

$PW = 0.41$

$D10 \pi = 1.43 / 2.8 \times 0.41 = 12.4 \rightarrow 100$

STAGE	μ_{OE}	μ_C	μ_{IE}	β	μ_{IE}	μ_C	μ_{OE}	β
L	2.7	1.7	15.5	3.5	7.6	4.7	15.7	5.2
E	4.3	2.5	2.3	1.7	2.1	0.7	2.5	0.7
B	15.0		14.4	6.2			15.7	
$b \times D = 2 \phi \times 17.5$								
A	2.7	1.4	4.90		6.2	4.0	4.9	
M	2-D16	2-D16	4-D16		4-D16	2-D16	4-D16	

STAGE	μ_{OE}	μ_C	μ_{IE}	β	μ_{IE}	μ_C	μ_{OE}	β
L	11.6	1.8	4.4	3.6	3.9	4.6	9.0	6.9
E	11.4	1.5	4.1	4.5	6.7	1.1	8.6	1.7
B	17.0	2.1	14.0	12.6	15.2		17.4	10.3
$b \times D = 2 \phi \times 17.5$								
A	7.1	1.5	7.6		10.7	3.6	9.5	
M	4-D19	2-D19	4-D19		4-D19	2-D19	4-D19	

STAGE	μ_{OE}	μ_C	μ_{IE}	β	μ_{IE}	μ_C	μ_{OE}	β
L	1.2	1.2	6.4	3.6	11.6	7.5	4.3	17.6
E	20.2	2.6	15.0	7.0	9.8	7.6	16.9	3.1
B	21.4	3.4	21.4	19.0	21.4		26.2	10.1
$b \times D = 2 \phi \times 17.5$								
A	11.7	2.1	11.7		11.7	6.1	14.3	
M	4-D22	2-D22	4-D22		4-D22	2-D22	4-D22	

$\Delta \phi = 19.0 - 15.4 = 3.6$
 $\Delta \phi / b_j = 2.10 \quad F_w = 0.77$
 $D10 \pi = 14.7, 2 \phi \times 0.77 = 15.4 \rightarrow 10 \text{ (D)}$