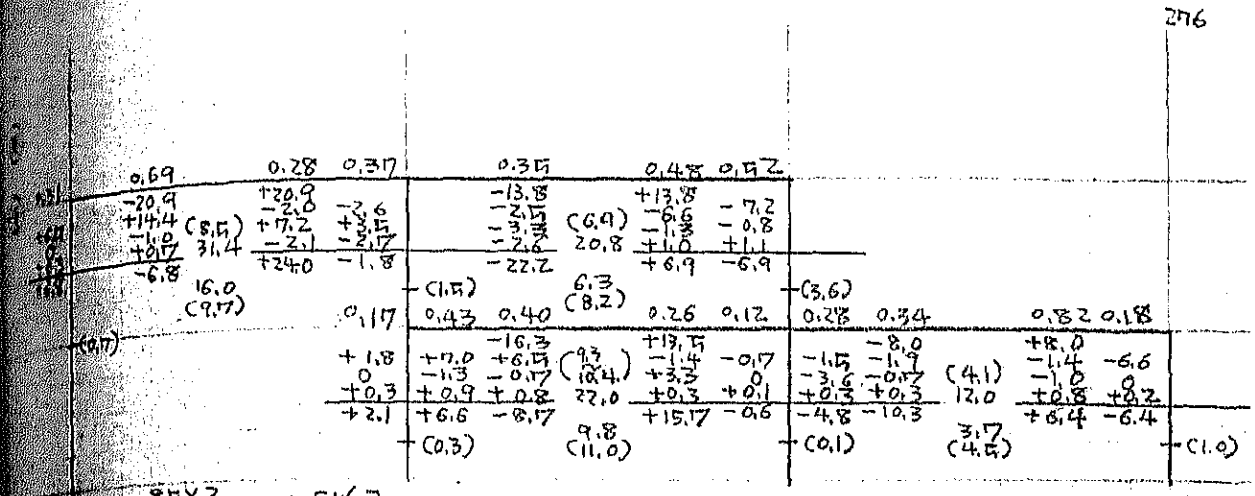
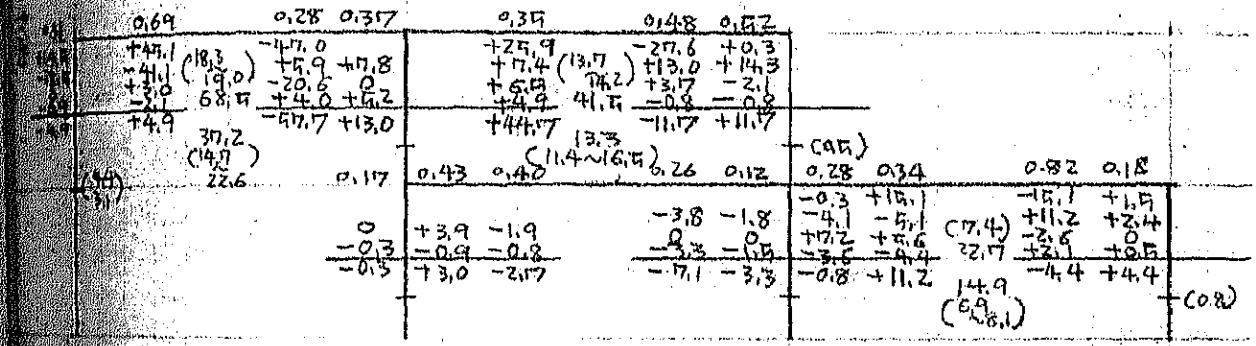
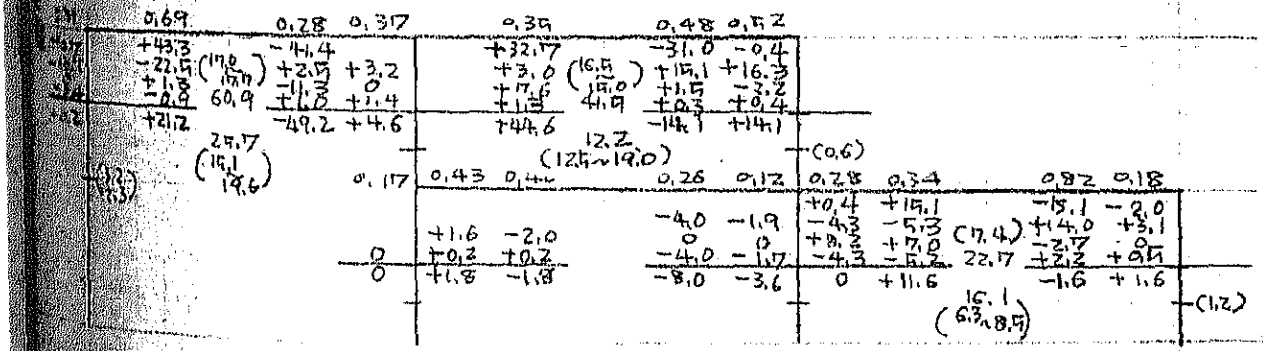


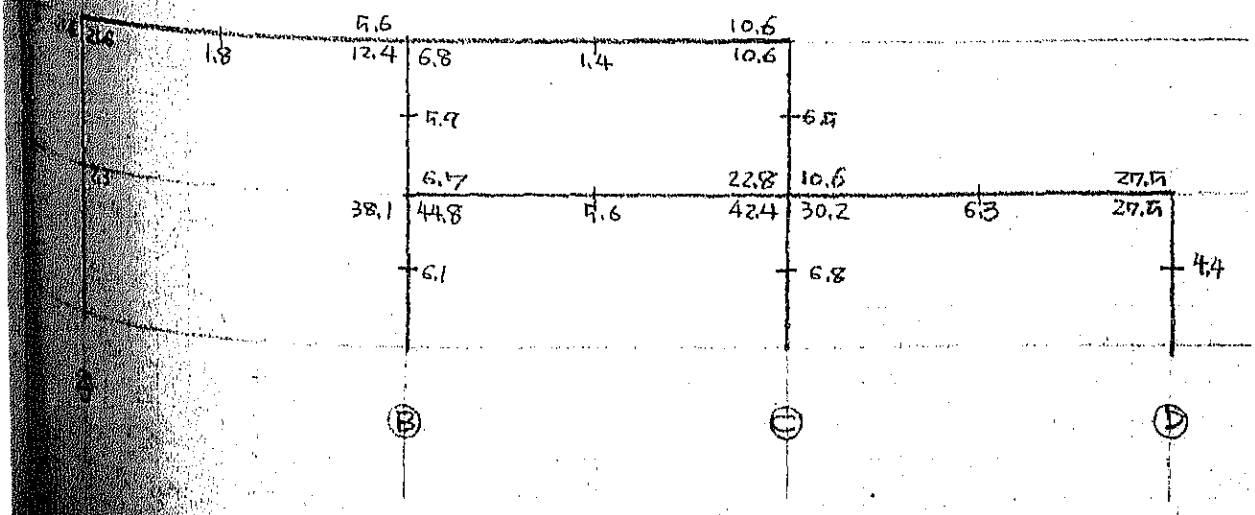
$$\gamma = \frac{8.15 \times 2}{140} = 1.21 \ [t/m]$$

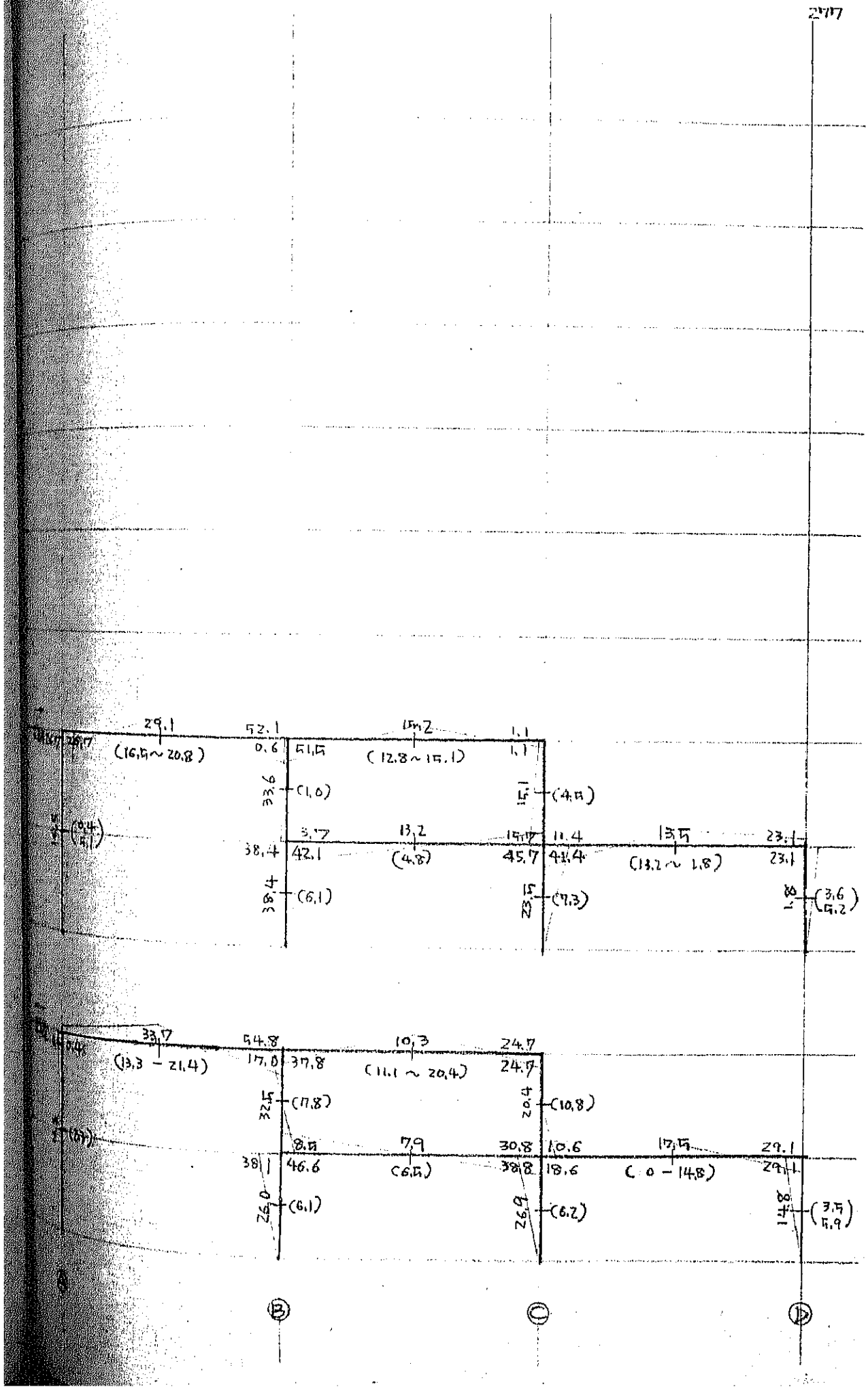
H-700×300

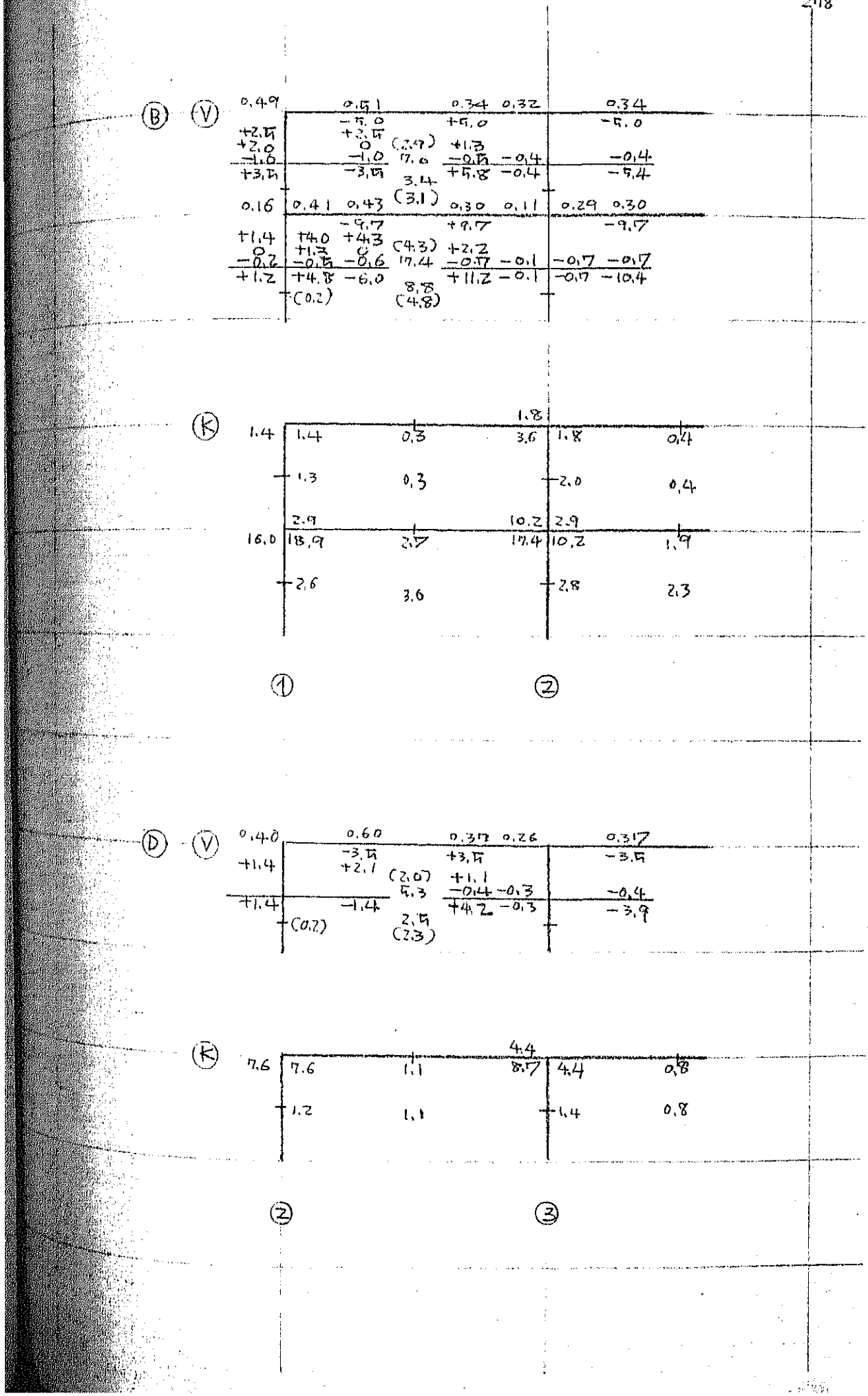
$$\delta = \frac{5 \times 0.012 \times 1475^4}{384 \times 2{,}100 \times 20{,}000} - \frac{(680+2400) \times 1475^2}{16 \times 2{,}100 \times 20{,}000} = 1.177 - 0.99 = 0.178 \ [cm] \quad J = 201{,}000 \ [cm^4]$$

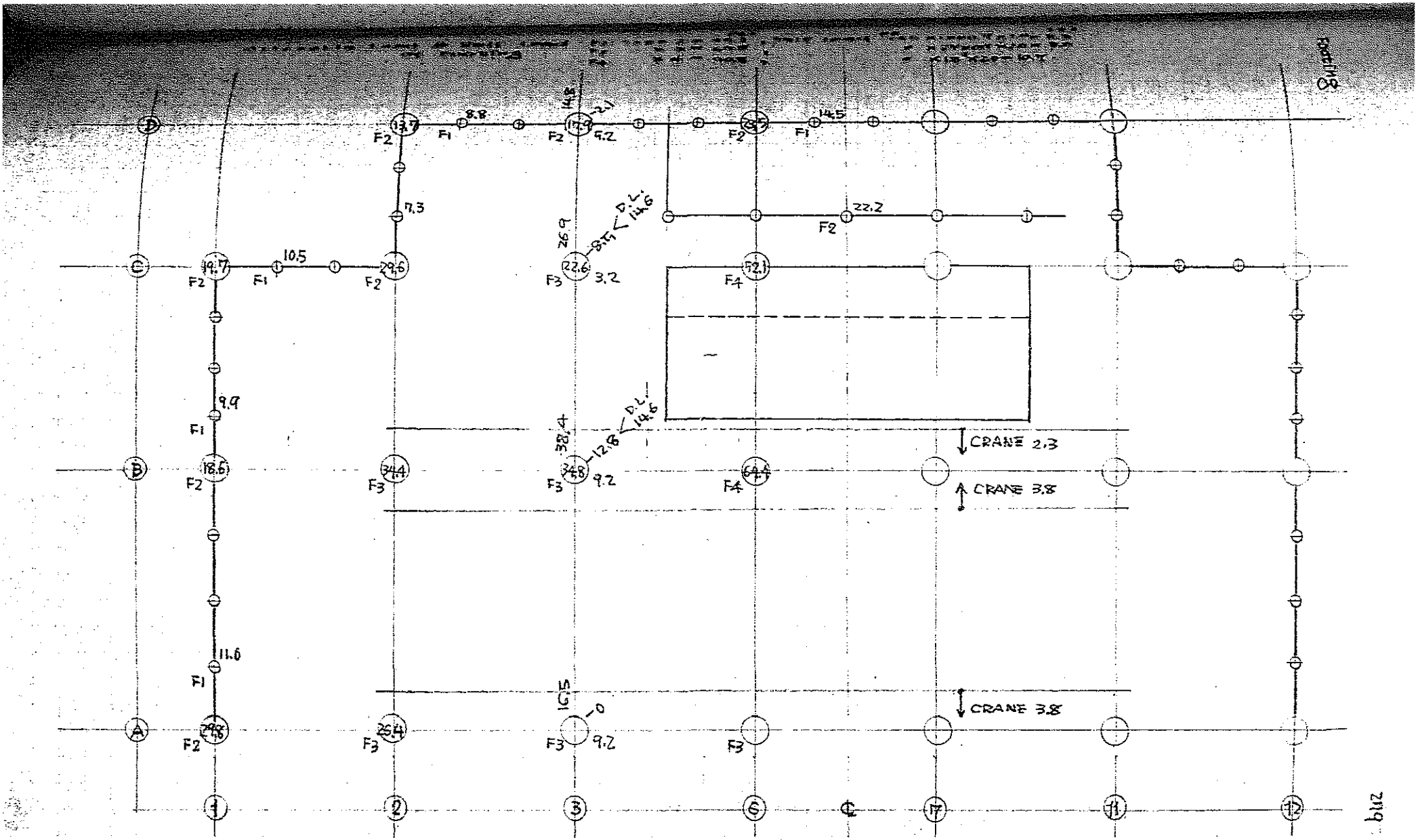







2717
29.1
(16.5~20.8)
52.1
0.6
51.5
15.2
(12.8~15.1)
1.1
1.1
33.6
(1.0)
15.1
(4.5)
3.7
13.2
(4.8)
15.7
11.4
13.5
(13.2~1.8)
23.1
38.4
42.1
45.7
41.4
23.1
38.4
(6.1)
23.5
(7.3)
(3.6
5.2)
33.17
(13.3 - 21.4)
54.8
17.0
37.8
10.3
(11.1~20.4)
24.7
24.7
32.5
(17.8)
20.4
(10.8)
8.5
7.9
30.8
10.6
17.5
29.1
38.1
46.6
(6.5)
38.8
18.6
(0 - 14.8)
29.1
26.0
(6.1)
26.9
(6.2)
(3.5
5.9)
B
C
D


Ⓑ Ⓥ
0.49 0.51 0.34 0.32 0.34
-5.0 +6.0 -5.0
+2.5 +2.5
+2.0 0 (2.9) +1.3
-1.0 -1.0 17.6 -0.5 -0.4 -0.4
+3.5 -3.5 +5.8 -0.4 -5.4
3.4
(3.1)
0.16 0.41 0.43 0.30 0.11 0.29 0.30
-9.7 +9.7 -9.7
+1.4 +4.0 +4.3 (4.3) +2.2
0 +1.3 0 17.4 -0.7 -0.1 -0.7 -0.7
-0.2 -0.5 -0.6 +11.2 -0.1 -0.7 -10.4
+1.2 +4.8 -6.0
8.8
(0.2) (4.8)
Ⓚ
1.8
1.4 1.4 0.3 3.6 1.8 0.4
1.3 0.3 2.0 0.4
2.9 10.2 2.9
16.0 18.9 2.7 17.4 10.2 1.9
2.6 3.6 2.8 2.3
① ②
Ⓓ Ⓥ
0.40 0.60 0.37 0.26 0.37
-3.5 +3.5 -3.5
+1.4 +2.1 (2.0) +1.1
5.3 -0.4 -0.3 -0.4
+1.4 -1.4 +4.2 -0.3 -3.9
(0.7) 2.5
(2.3)
Ⓚ
4.4
7.6 7.6 1.1 8.7 4.4 0.8
1.2 1.1 1.4 0.8
② ③


F2
F1
8.8
F2
9.2
F2
F1
14.5
7.3
D.L. 14.6
22.2
F2
10.5
F1
F2
F3
3.2
F4
9.9
F1
D.L. 14.6
12.6
F3
9.2
F4
CRANE 2.3
CRANE 3.8
11.6
F1
F2
F3
9.2
F3
CRANE 3.8
A
B
C
D
1
2
3
6
11
12

Design of Piling Footing

n≥2 (R 100%)

Pile φ	L	R	ΔW	Re
[illegible]	12,000	25	$0.9^2 \times 1.5 \times 2.0 = 2.4$	22.6
[illegible]	〃	30	$1.05^2 \times$ 〃 $= 3.3$	26.7
[illegible]	〃	35	$1.2^2 \times$ 〃 $= 4.3$	30.7

n=1 (R 80%)

Pile φ	L	R	ΔW	Re
[illegible]	12,000	20	2.4	17.6
[illegible]	〃	24	3.3	20.7
[illegible]	〃	28	4.3	23.7

φ=300 Type

2D+a 195 D 170 j 54.3 [cm]

Q_F = 22.6 [t]

M_F = 22.6 × (0.65 − 0.275) = 8.5 [tm]

Cp 25.7 [cm] Q_{AL} 52.9 [t]

at 7.8 [cm²]

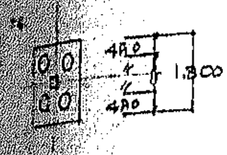
14−D13

For Lift Up

$W = 2.2^2 \times 1.5 \times 2.0 = 14.5$ [t]

$(3.8^2 + 2.2^2)/2 \times 3.0 = 28.9$ [t]

φ = 300 Type



2D+α 145 D 45 j 52.4 [cm]

QF = 22.6 [t]

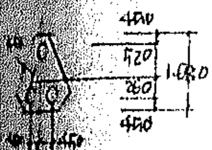
MF = 22.6 × (0.45 − 0.275) = 4.0 [t.m]

φ 46.5 QAL 23.5

at 0.6

12 − D13

W = 9.7



2D+α→B = 90 D 70 j 54.3

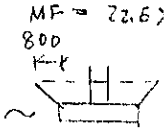
QF = 22.6

MF = 22.6 × (0.52 − 0.275) = 5.5

φ 27.7 QAL 24.4

at 0.5

Upper Bar 7 − D13



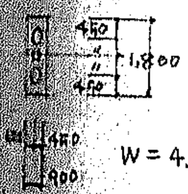
For Lift up

W = 7.3 ≒ 14.6

QF 14.6/3 = 4.9 φ 4.3 Lower Bar 3 − D10

MF 4.9×0.25 = 1.2 at 0.7

B 90 D 70 j 54.3



QF = 22.6

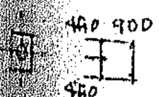
MF = 22.6 × (0.45 − 0.275) = 4.0

φ 27.7 QAL 24.4

at 0.4

W = 4.9

7 − D13



D = 450

6 − D13

w = 1.5 × 2.0 = 3.0 t/m²

D 45

F4 Q = 1.8² × π/4 = 2.43 φ 5.0

M = 2.43 × 0.9 × 1/3 = 0.73 at 0.8

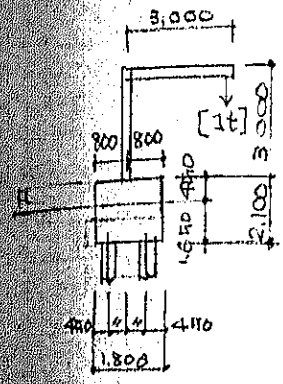
6 − D10

F2 Q = 2.43 = 2.43 φ 5.0

M = 2.43 × 0.45 = 1.09 at 1.1

3 − D10

Footing of Self Standing Crane



SUSTAINED LOADING

$M = 1.0 \times 3 = 3.0$ [t-m]

N = CAPACITY 1.0

SELF LOAD 0.7

FOOTINGE $2.1 \times 1.8^2 \times 2.4 = 16.3$

Σ 18.0 [t]

45° DIRECTION

$$R = \frac{18.0}{4} \pm \frac{3.0}{\sqrt{2} \times 0.9}$$

$= 4.5 \pm 2.4$

$=$ max 6.7

$<$ Ra 22.6

Q_F 5.3 C_F 2.6

M_F $5.3 \times 0.45 = 3.4$ α_T 1.2

D 16m @ 138.3

$\perp$ 12-D13

SEISMIC LOADING

$N = 1.7 \times 0.1 = 0.2$

$16.3 \times 0.1 = 1.6$

$M = (6.2 \times 0.1) + (1.6 \times 1.05) = 2.7$

$$R = \frac{2.7}{\sqrt{2} \times 0.9}$$

$= 2.1$

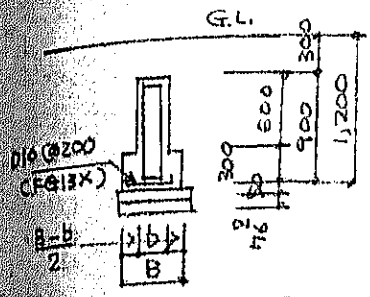
$\Sigma R = 4.5 \pm 2.4 \pm 2.1$

$= 9.0 \sim 0 <$ Ra 27.6×2

$= 0$

O.K.

Design of Foundation Beam



B	b		TOP R.	BTM R.	SIDE R.	Shp.	TIE
450	350		2-D19	2-D19	2-D10	□D10 @200	⌐D10 @600
〃	〃		〃	〃	〃	〃	〃
〃	〃		〃	〃	〃	〃	〃

For Stress Between Piling Footing

w = (FG35) 1.26 + (Brick Wainscot) 0.6×2.9
= 3.0 [t/m]

Span 4.5 [m]

Mo $3.0 \times 4.5^2/8$ 7.6 [tm] at 5.4 [cm²]
Q $\times 4.5/2$ 6.8 [t] Q 6.4 [cm]) 2-D19

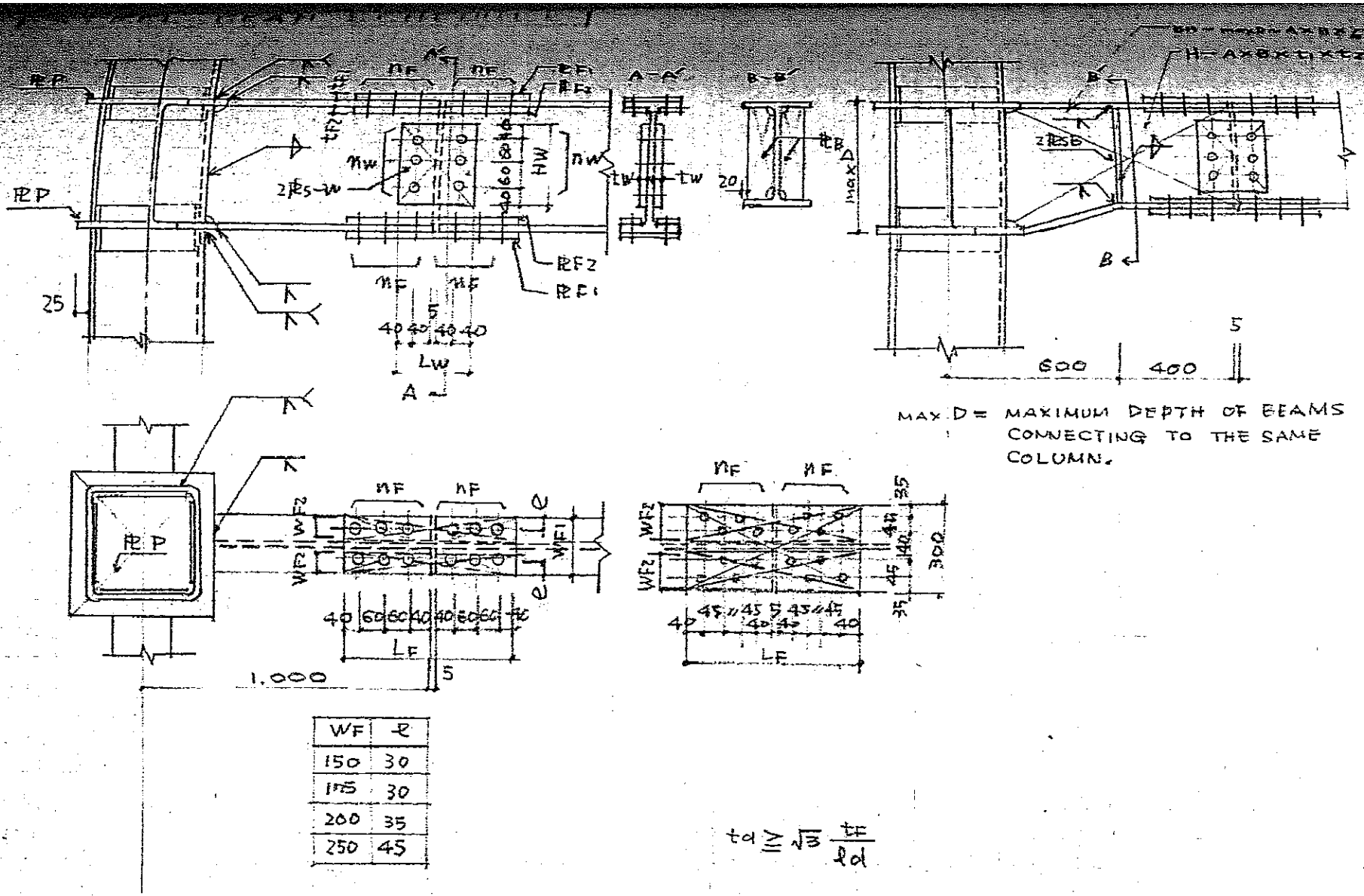
b 35 D 90 j 70.9 QAL 12.4 [t] > Q

w = 1.26 + (0.6×1.5) + (0.08×5.5) = 2.84
Span 5.3

Mo $2.84 \times 5.3^2/8$ 10.0 at 7.0 ~ 3-D19
Q $\times 5.3/2$ 7.5

			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	MAX	Member	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Type	Note
RG Ⓜ	M	Ⓓ	6.9		1.1	24.7	10.5		5.8	12.8		H-700X300 X13X24										
		CENT	6.3		15.2	10.3	11.0		8.9	4.0												
		Ⓒ	22.2		51.5	37.8	33.3		29.3	15.6										OK	G7	
	Q		8.2		+15.1	-20.4	12.3		6.9	12.2												
RG Ⓜ	M	Ⓒ	24.0		52.1	54.8	36.0		28.1	30.8												
		CENT	16.0		29.1	33.7	24.0		13.1	17.7												
		Ⓑ	6.8		26.7	0.4	10.2		19.9	7.2										OK	G7	
	Q		9.7		-20.8	-21.4	14.6		11.1	11.7												
2G Ⓜ	M	Ⓒ	6.4		23.1	29.1	9.6		16.7	22.7												
		CENT	3.7		13.5	17.5	5.6		9.8	21.2												
		Ⓑ	10.3		41.4	18.6	15.5		31.1	28.9										OK	G7	
	Q		4.5		-13.2	-14.8	6.8		8.7	10.3												
2G Ⓜ	M	Ⓑ	15.7		15.7	30.8	23.6		31.4	15.1												
		CENT	9.8		13.2	7.9	14.7		23.0	1.9												
		Ⓐ	8.7		42.1	46.6	13.1		33.4	38.9	38.9		3.03	7.817	38.5	7.65	1.00	1.60	5.760	0.28	G7	
	Q		11.0		±14.8	±16.5	16.5		15.8	17.5	17.5											

			V	K	W1	W2	1.5V	V+K	[illegible]	[illegible]	Max	Member	[illegible]	[illegible]	[illegible]	M	Q	[illegible]	Z	[illegible]	Type	Note
		⓪.E	7.5	1.4			5.3	4.9				H-400X300 X13X24										
RG Ⓑ	M		3.4	0.2			5.1	3.6														
		①.E	5.8	1.8			8.7	7.6													G7	
	Q		3.1	0.3			4.7	3.4														
2G Ⓑ	M	⓪.E	6.0	18.9			9.0	24.9			24.9											
			8.8	4.4			13.2	13.2														
		①.E	11.2	10.2			16.8	21.4					530	7.87	67.3	7.65	1.00	1.60	5.760	0.18	G7	
	Q		4.8	2.7			7.2	7.5			7.5											
	M	○																				
		○																				
	Q																					
2G Ⓓ	M	⓪.E	1.4	7.6			2.1	9.0			9.0	H-488X300 X11X18										
			2.5	1.4			3.8	3.9														
		①.E	4.2	4.4			6.3	8.6					538	7.97	66.5	7.20	1.00	1.60	2.910	0.13	G5	
	Q		2.3	1.1			3.5	3.4			3.5											



WF	R
150	30
175	30
200	35
250	45

$$t_d \geqq \sqrt{3}\,\frac{t_F}{f_d}$$

G8	H 800X300X14X26	28	16	19 X 300 X 615	22 X 107X 615	2X6-M22	12 X 165 X 620	10 - M22	
G7	H 700X300X13X24	25	16	19 X 300 X 525	19 X 107 X 525	2X5-M22	9 X 165 X 560	9 - M22	
G6	H 588X300X12X20	22	16	16 X 300 X 435	16 X 107 X 435	2X4-M22	9 X 165 X 440	7 - M22	
G6A	H 600X200X11X17	19	16	16 X 200 X 40	16 X 73 X 40	2X3-M22	9 X 165 X 440	7 - M22	
G5	H-482X300X11X15	16	16						
G5A	H 500X200X10X16	16	16	12 X 200 X 40	16 X 73 X 40	2X3-M22	9 X 165 X 380	6-M22	
G4	H 390X300X10X16	16	16						
G4A	H 400X200X8X13	16	16	9 X 200 X 28	12 X 73 X 28	2X2-M22	9 X 165 X 260	4 - M22	

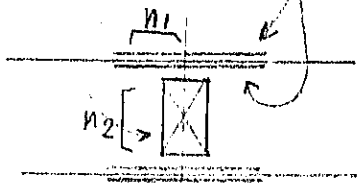
BEAM FIELD JOINT

According to AIJ Standard

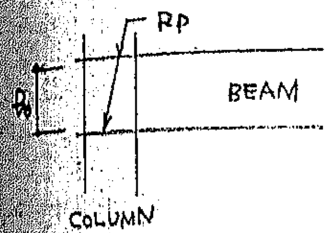
Generally

FLG
- $Ze = 0.8Z$
- $SM = Ze \times f_b$
- $SN = \frac{SM}{\delta}$
- $An = \frac{SN}{ft} < 2.\phi_s A \left(\frac{An}{2} < \phi_A \right)$
- $n_1 = \frac{SN}{R}$

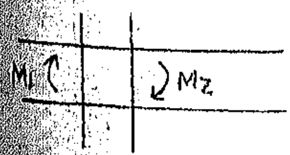
WEB
- $sQ = 0.8\pi t \ell_h f_s$
- $An = \frac{sQ}{f_s} < \phi A$
- $n_2 = \frac{sQ}{R}$



PANEL ZONE



	BEAM	COLUMN	RP	h_0	A
…AVY R.F.	C19A (C19)	G7 (G7)	25 (25)	55 (55)	213.4 (183.5)
…RTS …	C19	G17	25	55	183.5
…ECTION …	C9	G4	16	35.8	92.9
…ODICAL …	C12	G5	16	45	122.5
…T & B. …	C19	G7	25	55	183.5
…READING …	C19	G8	28	74.4	183.5



$$\frac{(M_1 + M_2)}{2Ve} \leq fs$$

$$Ve = \left(\frac{1}{2} A\right) h_0$$

$$fs = 1.35 \quad [t/cm^2]$$

$\sim$

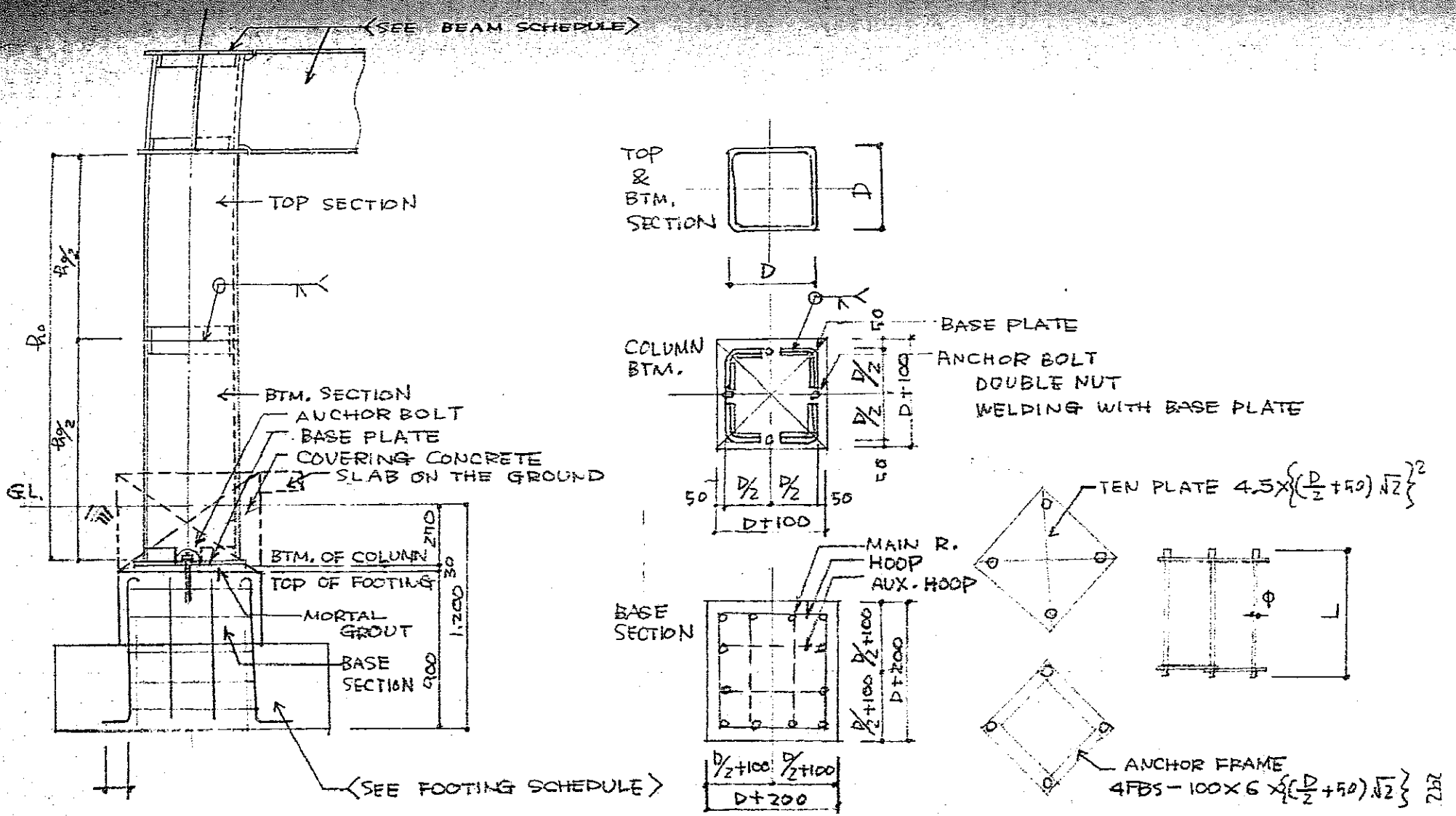
$$(M_1 + M_2) < 2 \times 1.35\, Ve$$

$$< 1.35\, A h_0$$

[t·m]

	$V_e = \frac{1}{2} A h_0$	$1.35 A h_0$	M_1	M_2	ΣM		$\Sigma M < 2V_{afs}$
HWY. S.F.		158.4 (136.2)	30.8 (4.4)	18.6 (4.4)	49.4 (8.8)		OK
ABTS S.F.		136.2			MAX 25.1		//
J.MOTION S.F.		44.9			MAX 8.5		//
PERIODICAL S.F.		114.4			MAX 15.9		//
H.W.T & B_1 S.F.		136.3			MAX 36.6		//
PLEADING LWC.F.		184.3			MAX 31.3		//

		N	42.5	±3.6			35.3	28.5				□															
		M U	1.2	±16.0			1.8	17.2				300×300×19															
		M L	0	0			0	0				~16															
ⓓ		Q	0.2	±2.6			0.3	2.8																			
		N			-1.8	-14.8	35.3		21.7	8.7																	
	1	M U	6.4		23.1	-29.1	9.6		21.9	27.9	27.9																
		M L	0		0	0	0		0	0																	
		Q	1.0		5.2	-5.9	1.5		5.4	5.7															OK	C19	
		N	52.1									□															
	⏋	M U										400×400×19															
		M L										~16															
		Q																									
ⓒ		N			-23.5	-26.9	78.2		18.6	25.2																	
	1	M U	0.6		45.7	-38.8	0.9		46.3	38.2	46.3																
		M L	0		0	0	0		0	0																	
		Q	0.1		7.3	-6.2	0.2		7.4	6.1															OK	C19A	
		N	64.4	±1.1			96.6																				
	⏋	M U	1.4	±7.6			2.1																				
		M L	0	0			0																				
		Q	0.2	±0.2			0.3																				
ⓑ		N			-38.4	-26.0	96.6		26.0	38.4																	
	1	M U	2.1		-38.4	38.1	3.2		37.0	36.7																	
		M L	0		0	0	0		0	0																	
		Q	0.3		-6.1	6.1	0.5		5.9	5.8															OK	C19A	
		N	26.4																								
	⏋	M U																									
		M L																									
		Q																									
ⓐ		N			-16.7	-13.3	39.6		9.9	13.1																	
	1	M U	6.8		-26.7	0.4	10.2		19.9	11.2																	
		M L	0		0	0	0		0	0																	
		Q	0.7		-4.1	2.3	1.1		4.4	3.0															OK	C19A	


(SEE BEAM SCHEDULE)
TOP SECTION
BTM. SECTION
ANCHOR BOLT
BASE PLATE
COVERING CONCRETE
SLAB ON THE GROUND
GL.
BTM. OF COLUMN
TOP OF FOOTING
MORTAL GROUT
BASE SECTION
(SEE FOOTING SCHEDULE)
TOP & BTM. SECTION
D
COLUMN BTM.
BASE PLATE
ANCHOR BOLT
DOUBLE NUT
WELDING WITH BASE PLATE
D/2
D+100
50
D+200
MAIN R.
HOOP
AUX. HOOP
BASE SECTION
TEN PLATE 4.5×{(D/2+50)√2}²
ANCHOR FRAME
4FBS-100×6×{(D/2+50)√2}

C9	□-350×350×9	□-350×350×9	PL 19	×450×450	4-M22	×1000	550×350	12-D19	□D16-@100	#D10-@150	
C12	□-350×350×12	DO	PL 22	×450×450	4-M〃	×〃	DO	DO	DO	DO	
C16	□-350×350×16	□-350×350×12	PL 25	×450×450	4-M〃	×〃	DO	DO	DO	DO	
C19	□-350×350×19	□-350×350×16	PL 28	×450×450	4-M〃	×〃	DO	DO	DO	DO	
C9A	□-400×400×9	□-400×400×9	PL 19	×500×500	4-M24	×1.100	600×600	12-D19	□D10-@100	#D10@150	
C12A	□-400×400×12	DO	PL 22	×500×500	4-M〃	×〃	DO	DO	DO	DO	
C16A	□-400×400×16	□-400×400×12	PL 25	×500×500	4-M〃	×〃	DO	DO	DO	DO	
C19A	□-400×400×19	□-400×400×15	PL 28	×500×500	4-M〃	×〃	DO	DO	DO	DO	

Base Plate & Anchor Bolt

[tcm]

	N max	A	σc	M1	M2	Zn	tn		t	M
C9	24.8	2025	12.25	12.25×6²/2 153.1	12.25×35²/16 937.9	0.59	19		19	4-M24
C12	30.5	〃	15.06	188.3	1153.0	0.72	22		22	〃
C16		〃							25	〃
C18	36.1	〃	17.83	222.9	1365.1	0.85	25		28	〃

(fb=1600)

For Tension

MAX-N=17.17 ~ 17.17/4 = 4.425 ~ M = 4.425×10/4 = 11.0625 [tcm] ~ Zn = 4.61

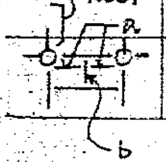
(Parts Storage) (fb=2,400)

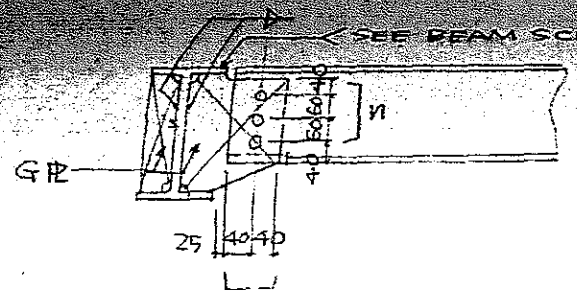
B = 10

4-M24 R=(5.92×1.5)×4 = 32.5 [t]

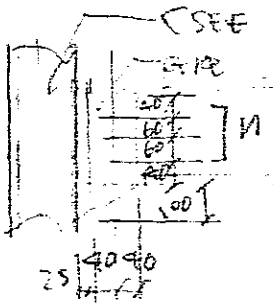
$t = \sqrt{6 \times 4.61/10} = 1.66$

Design of Sub Beam

	l	ℓ	@	ω D.L.	ω W.L.	ω T.L.	g	Mo	Q	Jn	Zn	Member	J	Z	lb	ib	λb	η	C	fb	b/f	Type
	12.93	3.53	3.93	0.02	0.8×0.22	0.156	0.563	0.88	0.99	460.7	36.5	H-200×100	1,840	184	353	2.60	135.8	6.49	1.00	0.80	0.36	B2
	10.45	10.6	3.69	0.02	0.8×0.20	0.140	0.467	6.55	2.47	10337	272.9	H-350×175	13600	775	530	4.58	115.7	8.33	1.75	1.25	0.45	B3A
	7.03	〃	3.06	〃	0.8×0.16	0.168	0.280	3.93	1.48	6,203	163.8	H-300×150	7,210	481	〃	3.87	137.0	8.61	〃	1.10	0.50	B3
	7.15	〃	2.06	0.51		1.051	1.100	15.45	5.83	43,553	965.6	H-500×200	47,800	1,910	〃	5.14	103.1	8.03	〃	1.20	0.67	B5
	〃	5.3	〃	〃		〃	〃	3.86	2.92	3,046	241.3	H-300×150	7,210	481	〃	3.87	137.0	8.61	1.00	1.25	0.64	B3
	〃	12.1					0.62	11.35	3.55	41,202	1098.4	H-500×200	47,800	1,910	205	5.14		8.03	1.00			B5
	P = {0.51×2.65×4.125}+{0.05×(2.65×3+12.1)}+{0.08×(2.65×3+4.1)} = 5.57+1.00+0.96 = 7.53 ~ 7.53/12.1 = 0.62																					
	7.03	10.6	2.25	0.02	1.6×0.14	0.224	0.409	5.74	2.17	9,061	239.2	H-350×175	13,600	775								B3A
	5.00	〃	1.5	0.02	〃																	B3A
	3.95	10.6	D.L. (0.05×6.5)+0.05				0.305	5.27	1.99	8307.9	219.5	H-350×12×19	13,600	776	353	9.65	36.6	5.08	1.00	1.60		B35
			W.L. 0.8×0.14×3.5				0.392	5.51	2.68	8684.5	229.4		48300	2300								
	〃	6.05	2.65	0.51			1.40	6.41	4.24	5814.9	400.6	H-300×150	7,210	508								B3
	5.00	8.25	3.53	〃			1.80	15.31	7.43	25,857.0	956.9	H-450×200										B4A
MONITOR ROOF	〃	3.53	2.06	〃			1.05	1.63	1.85	859.1	101.9	H-200×100										B2
	a 10.45 b 〃		3.69/2	0.02	0.8×0.2	0.14	0.24			1,226.0	52.8 / 65.0	H-200×100 / 〃	1,840	184 / 〃	650	2.60	250	6.49	1.00	0.55×1.5		B2 / 〃
	P = 0.34×6.5/2 = 0.78 ~ ×2 = 1.56 ; M = 1.56×1 = 1.56																					

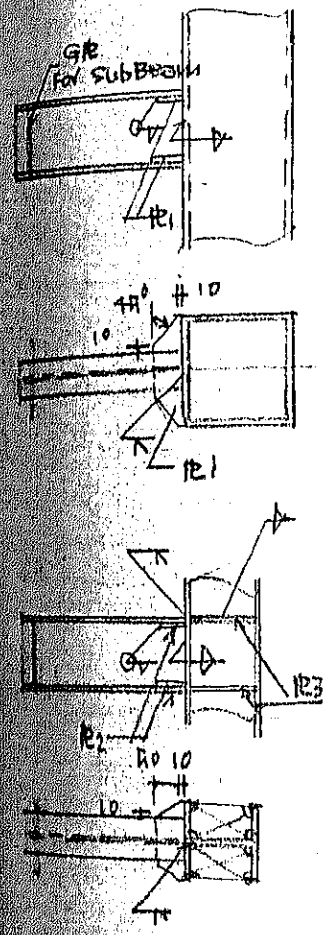


ONE SIDE FLANGE CUT



符号	寸法	枚数	備考
B4A	H-450×200×9×14	〃	〃
B4	H-400×200×8×13	〃	4-M22
B3A	H-350×175×7×11	〃	〃
B3	H-300×150×6.5×9	〃	3-M22
B2A	H-250×125×6×9	9	〃
B2	H-200×100×5.5×8	〃	2-M22
B9	H-900×300×16×43	19	12-M22
B6A	H-588×300×12×20	16	17-M22
B6	H-600×200×11×17	〃	〃
B5	H-500×200×10×16	12	6-M22
B3F	H-350×350×12×19	12	2×3-M22

SCHEDULE OF CANTILEVER



MARK	MEMBER	PL1	PL2	PL3
CG4	H-400×200×8×13	PL12	PL12	PL12
CG3A	H-350×175×7×11	〃	〃	〃
CG3	H-300×150×6.5×9	PL9	PL9	PL9
CG2	H-200×100×5.5×8	〃	〃	〃

Design of Cantilever

h	ℓ	@	wL			P (S.L., D.L.)	Mo	Q	Jn	Zn	Member	J	Z	ℓb	ib	λb	η	C	fb	b/t	Type
			D.L.	W.L.	T.L.																
5.0	3.6	5.3	0.02	1.6×0.4	0.204	1.6	4.9	1.6	5.714	306	H-300×175										cG3A

DESIGN OF POST

	BTM	TOP	h_1	@	D.L. w	D.L. $\frac{a}{t}$	N	W.L. w	W.L. $\frac{a}{t}$	M_D	Q	J_H	Z_H	Member	J	ρ_k / ρ_b	i_k / i_b	λ_k / λ_b	η / C	f_c / f_b	A / Z	σ/f	Type
	10.35	12.93	2.58	3.53	0.05	0.230	0.58	0.8X0.22	0.67	0.52	0.80	198.1	21.7	H-100x100	383	2.58	2.42	106.6	3.42	0.81	21.9	0.62	P1
																//	2.73	94.5	1.00	1.60	765	0.29 / 0.31	
	0.45	10.45	10.0	3.69	0.02	0.124	1.24	0.8X0.15	0.472	2.90	2.36	3,098	245.8	H-350x175	13.600	5.00	3.95	128.6	8.33	0.60	6314		P3A
																//	4.58	109.2	1.75	1.30	775		
			6.4					0.8X0.12						H-300x150									P3

Base Plate & Anchor Bolt

Case A

$N = 10.1$

$A = 25 \times 30$

$\sigma = 13.5$

$M = 13.5 \times 20^2/16 = 336.7$

$Z_M = 0.210$

$t_M = 1.12 \rightarrow$ PL16

Case B

$N = 24.0$

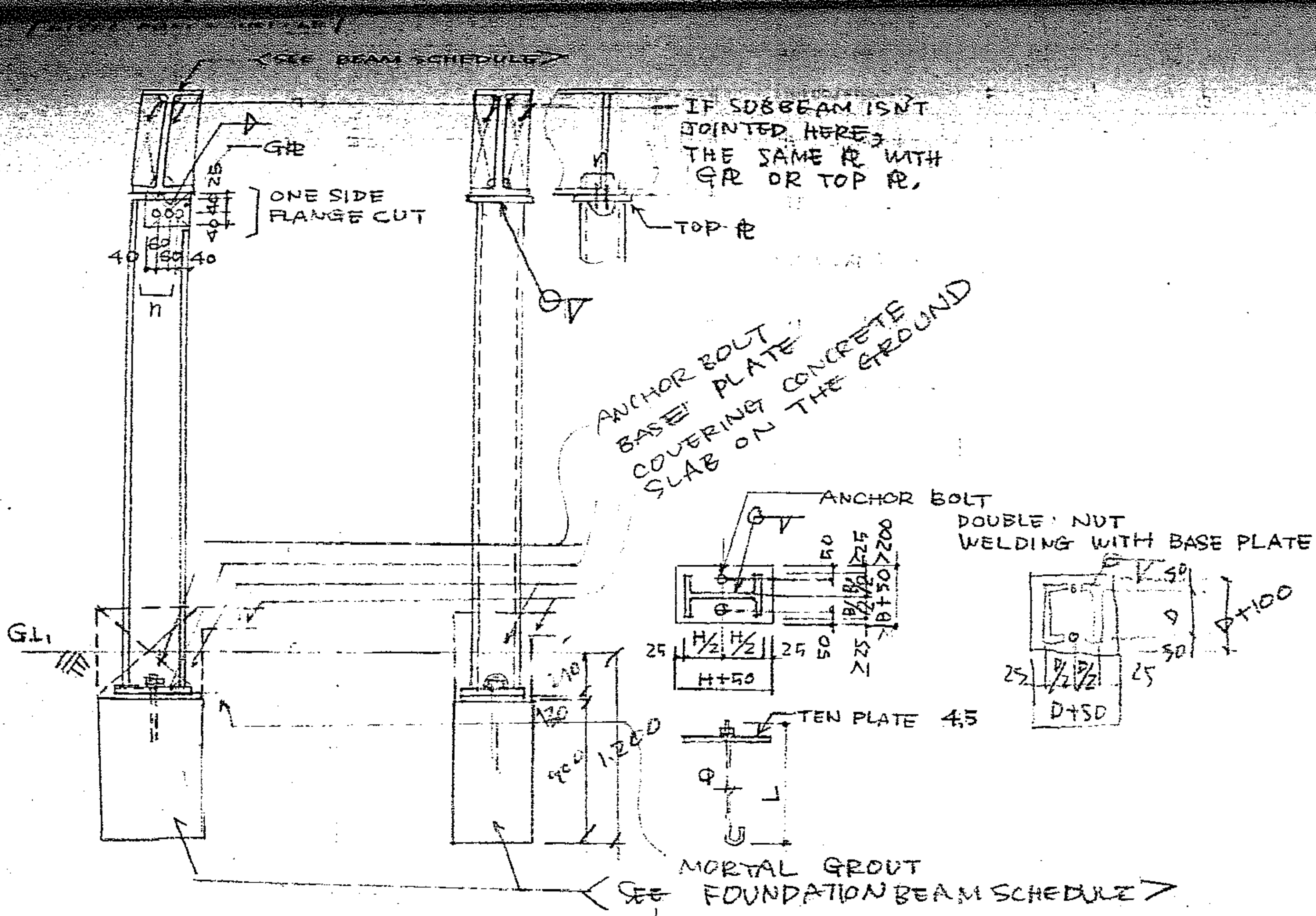
$A = 30 \times 37$

$\sigma = 22.9$

$M = 22.9 \times 25^2/16 = 893.9$

$Z_M = 0.558$

$t_M = 1.82 \rightarrow$ PL19



<SEE BEAM SCHEDULE>
GPL
ONE SIDE FLANGE CUT
IF SUBBEAM ISN'T JOINTED HERE, THE SAME PL WITH GPL OR TOP PL.
TOP PL
ANCHOR BOLT
BASE PLATE
COVERING CONCRETE
SLAB ON THE GROUND
ANCHOR BOLT
DOUBLE NUT
WELDING WITH BASE PLATE
H+50
D+50
D+100
B+50
TEN PLATE 4.5
G.L.
1,200
MORTAL GROUT
<SEE FOUNDATION BEAM SCHEDULE>

P1	H-400×190×6×8	PL9	2-M22	PL16×190×200	2-M20×900	
P2	H-200×100×5.5×8	DO	〃	PL 〃×250×200	2-M 〃 × 〃	
P2A	H-250×125×6.5×9	DO	3-M22	PL 〃×300×200	2-M 〃 × 〃	
P3	H-300×150×6.5×9	DO	〃	PL 〃×350×200	2-M 〃 × 〃	
P3A	H-350×175×7×11	PL12	4-M22	PL 〃×400×225	2-M 〃 × 〃	
P4	H-400×200×8×13	DO	〃	PL 〃×450×250	2-M 〃 × 〃	
P4A	H-450×200×9×14	DO	5-M22	PL 〃×500×250	2-M 〃 × 〃	
P2B	H-250×250×9×14	PL9	2×2-M22	PL19×300×300	〃	
P20A	□-200×200×8	TOP PL 16×300×300	〃	PL16×250×300	〃	
P25A	□-250×250×8	〃 19×350×350	〃	PL19×300×350	〃	

Design of Shell Type Roof

Bldg.	Roof Level [m]	$q = 60\sqrt{h}$	C	Cq [kg/m²]
Heavy Repair Factory	10.5 ~ 13.0	144 ~ 216	1.6	310 ~ 346
Parts Storage	7.0 ~ 9.5	158 ~ 185	〃	253 ~ 296
Inspection Factory	〃		〃	
Periodical Repair F.	〃		〃	
Paint & Body Factory	〃		〃	
Retreading & M.C. F.	〃		〃	

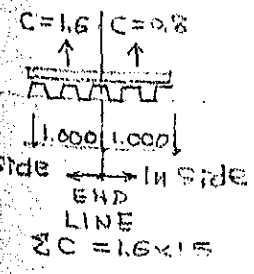
Continuous Beam Type

$$\frac{M}{Z} = \frac{\omega l^2}{8Z} \le f \quad \sim \quad l_Z \le \sqrt{\frac{8Zf}{\omega}}$$

$$\frac{5}{384}\frac{\omega l^4}{EI} \le \frac{l}{300} \quad \sim \quad l_I \ge \sqrt[3]{\frac{384 \times 2{,}100\, I}{300 \times 5\,\omega}}$$

S-60 0.8 M_X/M Use Z 61.33 [cm³/m]
I 619.94 [cm⁴/m]
Self-ω 13.5 [kg/m²]

ω	Net ω	l_Z	l_I	l_{min}
1.1 × 0.346 [t/m²]	0.00492 [t/cm²]	373.6 [cm]	407.6 [cm]	373.6 [cm]
× 0.310	0.00438	396.0	423.8	396.0
× 0.296	0.00417	405.9	430.7	405.9
× 0.253	0.00353	441.1	455.3	441.1



$$l_Z \le \sqrt{\frac{8 \times 61.33 \times 1.4}{\omega}} = \sqrt{\frac{686{,}896}{\omega}}$$

$$l_I \le \sqrt[3]{\frac{384 \times 2{,}100 \times 619.94}{300 \times 5 \times \omega}} = \sqrt[3]{\frac{333{,}279{,}744}{\omega}}$$

Allowable Stress [cm]

	M, Roof	Roof
H.R. Factory	370	390
Generally	400	440

Cantilever Type

$$\frac{M}{Z} = \frac{wl^2}{2Z} \le f \quad \sim \quad l_Z \le \sqrt{\frac{2Zf}{w}}$$

$$\frac{w l^4}{8EI} \le \frac{l}{250} \quad \sim \quad l_I \le \sqrt[3]{\frac{8 \times 2{,}100\, I}{250\, w}}$$

w	Net w	l_Z	l_I	l_{min}
0.346 [t/m]	0.00333 [t/cm]	196.7 [cm]	210.9 [cm]	196.7 [cm]
0.310	0.00297	208.2	219.1	208.2
0.296	0.00283	213.3	222.7	213.3
0.243	0.00240	231.7	235.2	231.7

$$l_Z \le \sqrt{\frac{2 \times 61.33 \times 0.175^* \times 1.4}{w}} = \sqrt{\frac{128.793}{w}}$$

$$l_I \le \sqrt[3]{\frac{8 \times 2{,}100 \times 619.94 \times 0.175^*}{250\, w}} = \sqrt[3]{\frac{31{,}244.9176}{w}}$$

$\sim$

Allowable Span = 190 [cm]

Designed Type

0.8 $\longrightarrow$ Size up to 1.0 M/M

Design of Mezzanine Floor

$w_k = 0.01$ [t/m²]

$t = 1.2$ Deck Plate $Z = 35.5$ $J = 13.6$
(CAL-31)

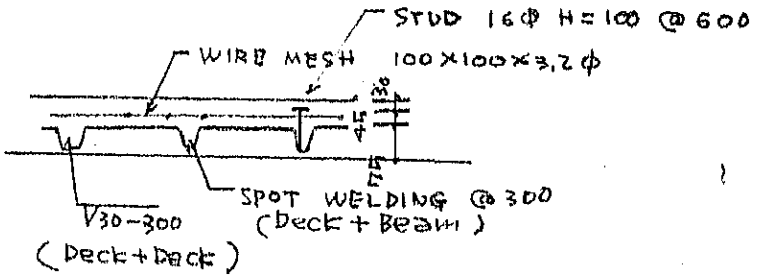
$$\frac{\omega l^2}{8Z} < f \sim l > \sqrt{\frac{8Zf}{\omega}}$$

$$= \sqrt{\frac{8 \times 35.5 \times 1.4}{0.0051}} = 279.2$$

$$\frac{5\,\omega l^4}{384\,EJ} < \frac{l}{300} \sim l > \sqrt[3]{\frac{384\,EJ}{1500\,\omega}}$$

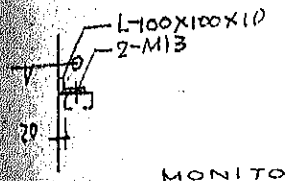
$$= \sqrt{\frac{38.4 \times 2,100 \times 13.6}{1500 \times 0.0051}} = 242.9$$

—— Allowable Span 240 [cm]



Design of Furring Strip

Inside Wall



MONITOR ROOF　[-120×60×25-4.5　@≒900

GENERAL　[-100×50×20-3.2　@≒900
OR　-2.3　@≒1100

MONITOR ROOF ～ GENERAL WALL

	Span		@	D.L.	W.L.	
H.R.F.	3.68	～ 3.85	0.9～0.7	50	220	～ 140
P.S.	3.60	～ 3.60	〃	〃	180	～ 120
L.F.	/	～ 3.38	〃	〃	/	～ 120
P.R.F.	3.53	～ 3.90	〃	〃	180	～ 120
P.B.F.	3.45	～ 3.25	〃	〃	180	～ 120
R.M.C.F.	3.00	～ 3.38	〃	〃	180	～ 120

CASE-1 (H.R.F. MONITOR ROOF)

D.L.　0.05×0.9　= 0.045 [t/m]

W.L.　0.22×0.8×0.9 = 0.158 [〃]

span　3.68　[m]

[-100×50×20-2.3

$$\frac{M}{f} = \frac{3.68^2 \times 100}{8 \times 1.4}\left(\frac{0.045}{6.06} + \frac{0.158}{16.1}\right)$$

$$= 2.08 < 2.10$$

$$\delta = \frac{5 \times 368^4}{384 \times 2100}\sqrt{\left(\frac{0.00045}{19.0}\right)^2 + \left(\frac{0.00158}{80.7}\right)^2}$$

$$= 3.49 \text{ [cm]}$$

[-100×50×20-3.2

$$\delta = \frac{5 \times 368^4}{384 \times 2100}\sqrt{\left(\frac{0.00045}{24.5}\right)^2 + \left(\frac{0.00158}{107}\right)^2}$$

$$= 2.67 \text{ [cm]}$$

[-100×50×20-4.5

$$\delta = \frac{5 \times 368^4}{384 \times 2100}\sqrt{\left(\frac{0.00045}{30.7}\right)^2 + \left(\frac{0.00158}{139}\right)^2}$$

$$= 2.10 \text{ [cm]}$$

[-120×60×25-4.5

$$= \sqrt{\left(\frac{\quad}{58.0}\right)^2 + \left(\frac{\quad}{252.0}\right)^2}$$

$$= 1.13 \text{ [cm]}$$

$\delta/\text{span} = 1.13/368 = 1/324 < 1/300$ O.K.

CASE-2. (H.R.F. MONITOR ROOF)

D.L. $0.05 \times 0.9 = 0.045$ [t/m]
W.L. $0.18 \times 0.8 \times 0.9 = 0.130$ [〃]
span 3.60 [m]

[- 100 × 50 × 20 - 3.2

$$\delta = \frac{5 \times 360^4}{384 \times 2{,}100} \sqrt{\left(\frac{0.000475}{24.5}\right)^2 + \left(\frac{0.00158}{107}\right)^2}$$

$= 2.45$ [cm]

[- 100 × 50 × 20 - 4.5

$$\delta = \sqrt{\left(\frac{\quad}{30.9}\right)^2 + \left(\frac{\quad}{139}\right)^2}$$

$= 1.92$ [cm]

[- 120 × 60 × 25 - 4.5

$$\delta = \sqrt{\left(\frac{\quad}{58.0}\right)^2 + \left(\frac{\quad}{252.0}\right)^2}$$

$= 1.03$ [cm]

$\delta/\text{span} = 1.03/360 = 1/346 < 1/300$ O.K.

CASE-3. (H.R.F. GENERAL WALL)

D.L. $0.05 \times 0.9 = 0.045$ [t/m]
W.L. $0.14 \times 0.8 \times 0.9 = 0.101$ [〃]
span 3.85 m

[- 100 × 50 × 20 - 2.3

$$\delta = \frac{1 \times 385^4}{185 \times 2{,}100} \sqrt{\left(\frac{0.000245}{19.0}\right)^2 + \left(\frac{0.00101}{80.7}\right)^2}$$

$= 1.51$ [cm]

[- 100 × 50 × 20 - 3.2

$$\delta = \sqrt{\left(\frac{\quad}{24.5}\right)^2 + \left(\frac{\quad}{107}\right)^2}$$

$= 1.17$ [cm]

$\delta/\text{span} = 1.17/385 = 1/330 < 1/300$ O.K.

CASE-4. (〃)

D.L. $0.02 \times 0.17 = 0.014$ [t/m]
W.L. $0.14 \times 0.8 \times 0.17 = 0.018$ [〃]
span 3.85 m

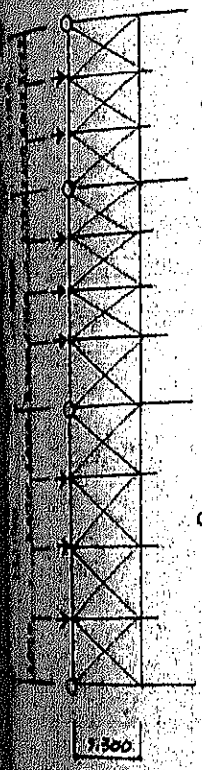
[- 100 × 50 × 20 - 2.3

$$\delta = \frac{1 \times 385^4}{185 \times 2{,}100} \sqrt{\left(\frac{0.00014}{19.0}\right)^2 + \left(\frac{0.000178}{80.7}\right)^2}$$

$= 0.69$ [cm]

$\delta/\text{span} = 0.69/385 = 1/460 < 1/300$ O.K.

Design of Bracing



H 6.6
@ 3.10
C & A $0.8 \times 0.12 \times 3.10 = 0.30$
Q $0.30 \times 6.6/2 = 0.98$
D $0.98 \times 6.14/5.30 = 1.14 \sim \times 1.0 = 1.14$, $An = 1.14/2.4 = 0.5$

$$Jn = \frac{13 \times 0.0002 \times 6.14^3 \times 300}{384 \times 2,100} = 223.9$$

$$Zn = \frac{3 \times 0.07 \times 6.14^2 \times 100}{8 \times 2.4} = 11.8$$

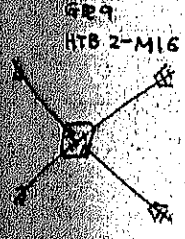
L-130X130X 9
A 22.17 , J 366.0 , Z 38.17

H 10.0
@ 3.69
C & A $0.8 \times 0.16 \times 3.69 = 0.47$
Q $0.47 \times 10.0/2 = 2.36$
D $2.36 \times 6.46/5.30 = 2.88 \sim \times 1.5 = 4.32$, $An = 4.32/2.4 = 1.8$

$$Jn = \frac{13 \times 0.0002 \times 6.43^3 \times 300}{384 \times 2,100} = 297.1$$

$$Zn = \frac{3 \times 0.07 \times 6.43^2 \times 100}{8 \times 2.4} = 12.9$$

L-130 X 130 X 9
A 22.17 , J 366.0 , Z 38.17



$$Jn' = \frac{5 \times 0.0002 \times 3.22^3 \times 300}{384 \times 2,100} = 12.4$$

$$Zn' = \frac{0.02 \times 3.22^2 \times 100}{8 \times 2.4} = 1.1$$

L-75 x 75 x 6
A 8.7 J 46.1 , Z 8.5

Purlin Roof

Vertical

P $0.8 \times 0.22 \times 10.6 \times 2.48/2 = 2.31$
D $2.31 \times 4.58/3.68 = 2.87$, $An = 2.87/2.4 = 1.2$

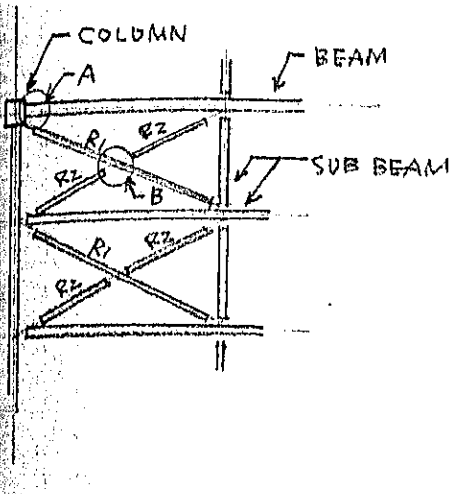
L - 75 x 75 x 6

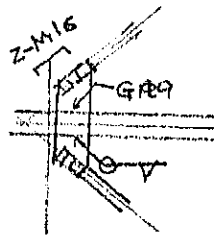
Horizontal

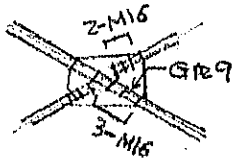
$$Jn = \frac{13 \times 0.0002 \times 5.23^3 \times 300}{384 \times 2,100} = 138.4$$

L-100 x 100 x 10
A 19.0 , J 175.0 , Z 24.4

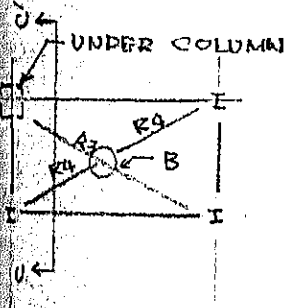
BRACING SCHEDULE

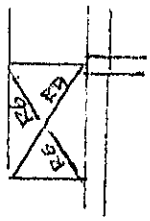






MONITOR ROOF



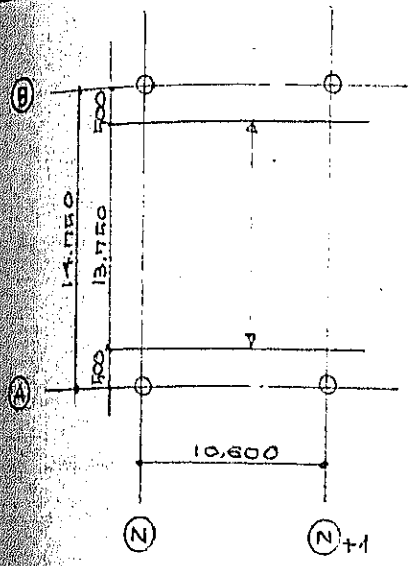


C-C' Section

Mark	Member	Note
R_1	L-130×130×9	At. Paint & Body F. ~ L-130×130×12
2	L-75×75×6	
3	L-100×100×10	
4	L-75×75×6	
5	〃	
6	〃	

Design of Crane Girder

Case - 1.



capacity	2.0 [t]	× Impact 140 [%] =	2.8 [t]
Net Weight			0.2 [t]
Girder			1.6 [t]

Maximum Load $2.8 + 0.2 + \frac{1.6}{2} = 3.8$ [t]

Self Load 0.15 [t/m]

Limit of Deflection $\frac{1}{1,200} \times \text{Span} = \frac{1,060}{1,200} = 0.88$ [cm]

$$J_H = \frac{Pl^3}{48 E \delta} + \frac{5 q l^4}{384 E \delta} = \frac{3.8 \times 1060^3}{48 \times 2,100 \times 0.88} + \frac{5 \times 0.0015 \times 1060^4}{384 \times 2,100 \times 0.88}$$

$$= 51,022.1 + 13,342.9$$

$$= 64,365.0 \quad [cm^4]$$

Q85 H-488×300×11×18

$$J = 71,000 > 64,365.0$$

(S.L. = 128 [kg/m] + Rail 22 = 150 [kg/m])

$$M_0 = \frac{3.8 \times 10.6}{4} + \frac{0.15 \times 10.6^2}{8} = 10.07 + 2.11 = 12.18 \text{ [tm]}$$

$l_b = 1,060$, $i_b = 7.97$, $\lambda_b = 132.9$, $\eta = 7.20$, $C = 1.00$

$\sim$ $f_b = 0.94$, $Z_x = 2,910$

$$\frac{\sigma}{f} = \frac{1218}{2,910 \times 0.94} = 0.45 < 1.00$$

$$\text{Max } Q = 3.8 + \left(0.15 \times 10.6/2\right) = 4.6 \text{ [t]}$$

Horizontal Direction

Sustained Loading 10%
Seismic 〃 20%
Σ 30%

3.8[t] × 10[%] = 0.38 [t]

M_0 $0.38 \times 10.6/4 = 1.00$ [t·m]
$\max Q$ 0.38 [t]

3.8 [t] × 30[%] = 1.14 [t]

M_0 $1.14 \times 10.6/4 = 3.02$ [t·m] $> 1.00 \times 1.5$
$\max Q$ 1.14 [t] $> 0.38 \times 1.5$

J_Y = 8,110 [cm⁴]
Z_Y = 541 [cm³]

$$\delta = \frac{0.38 \sim 1.14 \times 1060^3}{48 \times 2{,}100 \times 8{,}110} = 0.55 \sim 1.66 \text{ [cm]}$$

$$\frac{\delta}{\text{Span}} = \frac{1}{1{,}914} \sim \frac{1}{638}$$

$$\frac{\sigma}{f} = \frac{302}{541 \times 0.94} = 0.59 < 1.50$$

CG4A H-400×400×13×21

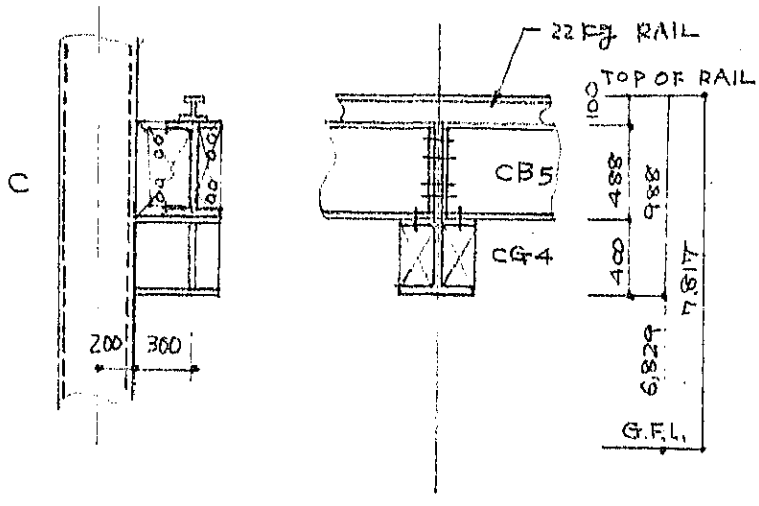
P = 3.8 + (0.15 × 10.6) = 5.4 [t]

500

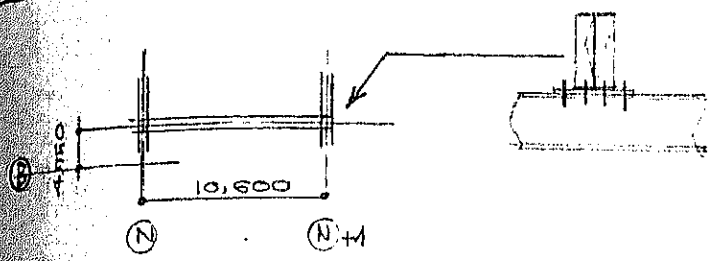
Q = 5.4 [t]
M = 5.4 × 0.5 = 2.7 [t·m]

$$J_n = \frac{P l^3}{3 E \delta} = \frac{5.4 \times 50^3}{3 \times 2{,}100 \times (50/1{,}200)} = 2{,}571.4 \text{ [cm}^4\text{]}$$

$$Z_n = 270/1.6 = 168.8 \text{ [cm}^3\text{]}$$



A5E-Z1 (Monorail)



Capacity 1.0 [t] × Impact 140 [%] = 1.4 [t]
Net Weight 0.1 [t]

Maximum Load 1.4 + 0.1 = 1.5 [t]

Self Load 0.15 [t/m]

$$J_H = \frac{1.5 \times 1060^3}{48 \times 2{,}100 \times 0.88} + \frac{5 \times 0.0015 \times 1060^4}{384 \times 2{,}100 \times 0.88}$$

$$= 20{,}140.3 + 13{,}342.9$$

$$= 33{,}483.2 \quad [cm^4]$$

CB4 H-390×300×10×16

$J = 38{,}700 > 33{,}483.2$

(S.L. = 107 [kg/m])

$$M_0 = \frac{1.5 \times 10.6}{4} + \frac{0.15 \times 10.6^2}{8} = 3.98 + 2.11 = 6.09 \ [tm]$$

$\ell_b = 1{,}060$, $i_b = 8.10$, $\lambda_b = 130.9$, $\eta = 6.58$, $c = 1.00$

$\sim f_b = 1.04$, $Z_x = 1{,}980$

$$\frac{\sigma}{f} = \frac{609}{1{,}980 \times 1.04} = 0.30 < 1.00$$

max Q = 1.5 + (0.15 × 10.6/2) = 2.3 [t]

Horizontal Direction

H = 0.1 ~ 0.3 × 1.5 = 0.15 ~ 0.45 [t]

M_0 0.45 × 10.6/4 = 1.19 [tm]

max Q 0.45 [t]

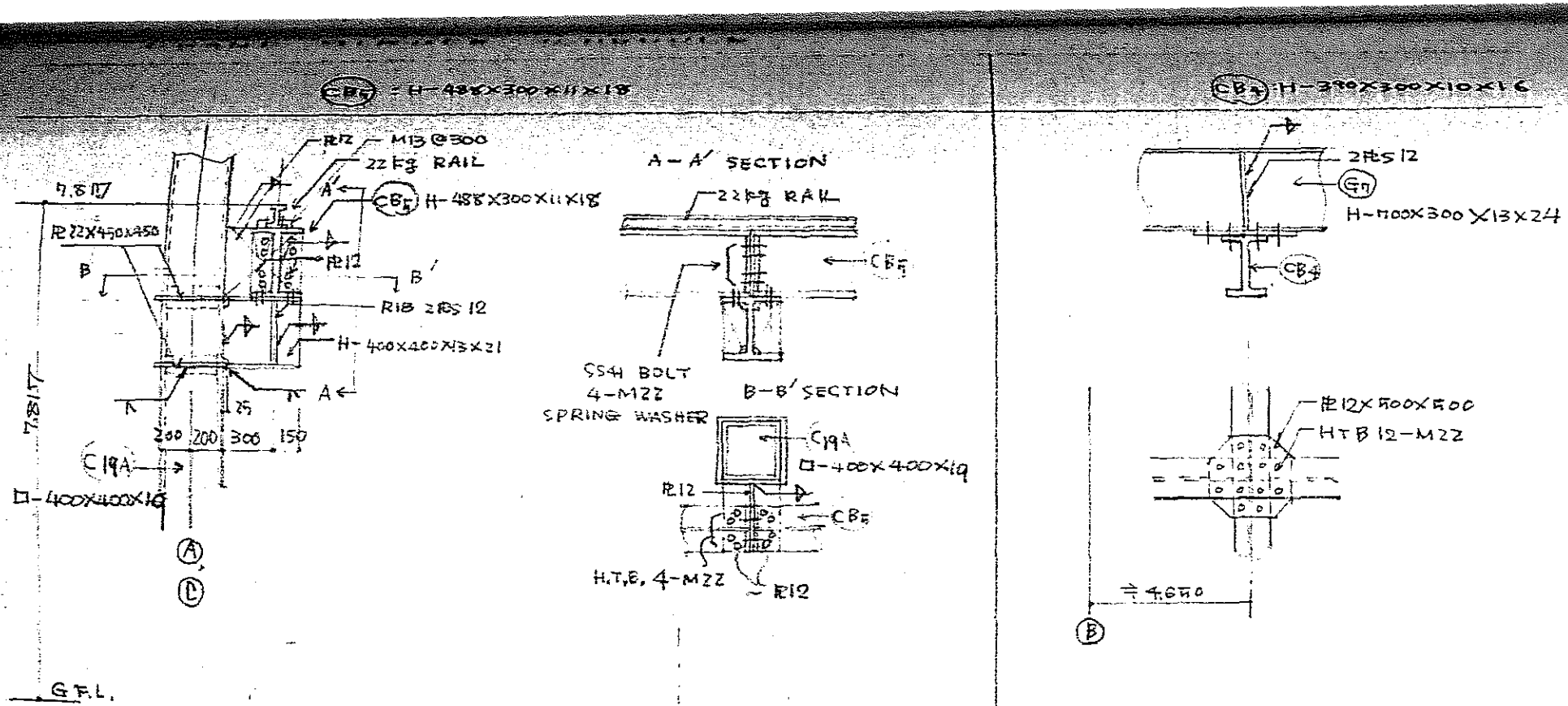
$I_Y = 7{,}210$ [cm⁴]

$Z_Y = 481$ [cm³]

$$\delta = \frac{0.15 \sim 0.45 \times 1060^3}{48 \times 2{,}100 \times 7{,}210} = 0.25 \sim 0.74 \ [cm]$$

$$\frac{\delta}{\text{Span}} = \frac{1}{4312} \sim \frac{1}{14317}$$

$$\frac{\sigma}{f} = \frac{119}{481 \times 1.04} = 0.24 < 1.50$$


CB5 : H-488×300×11×18
PL12
M13@300
22Kg RAIL
A
CB5 H-488×300×11×18
7,817
PL22×450×450
B
B'
PL12
RIB 2PS 12
H-400×400×13×21
A
25
200
200
300
150
C19A
□-400×400×19
7,817
A
L
G.F.L.
A-A' SECTION
22Kg RAIL
CB5
SSH BOLT
4-M22
SPRING WASHER
B-B' SECTION
C19A
□-400×400×19
PL12
CB5
H.T.B, 4-M22
PL12
CB4 : H-340×300×10×16
2PS 12
G7
H-700×300×13×24
CB4
PL12×500×500
H.T.B 12-M22
≒4,650
B

313

Design of Corridor

(1) Roof

S-60 0.8
ℓ 3.850
Cantilever 500

(2) Beam

ℓmax 6.325
Cantilever 2.000

$$W = \text{W.L.} \quad 0.8 \times 0.12 \times 2.425 = 0.24 \ [t/m]$$

$$Z_n = \frac{0.24 \times 6.325^2 \times 100}{8 \times 2.4} \sim \frac{0.24 \times 2^2 \times 100}{2 \times 2.4}$$

$$= 50.0 \sim 20.0 \quad [cm^3]$$

$$J_n = \frac{5 \times 0.0024 \times 632.5^3 \times 300}{384 \times 2,100} \sim \frac{0.0024 \times 200^3 \times 300}{8 \times 2,100}$$

$$= 1129.6 \sim 342.9 \quad [cm^4]$$

H-200×100×5.5×8
Z 184
J 1840

Zb 317 Cb 2.60 λb 121.9 η 6.49 C 1.75 φb 1.20

$$Ze = 184 \times \frac{1.2}{1.6} = 138 > 50.0$$

(3) Column

MAX -N $0.8 \times 0.12 \times 4.1625 \times 2.925 = 0.917$

kw $0.1 \times (0.05 \times 4.1625 \times 2.925) = 0.05 \approx 0$

$M = 0.05 \times 4 = 0.20$

φ − 190.7 × 5.3 A 30.817 Z 139

(4) Brace (Roof)

16 φ

(5) Footing

D.L. $n = 0.917$

Slab on the ground $0.917/0.2 = 4.85 \sim 2.20$ □

Design of Watchman's office

(1) Bridge

L.L. 1.00
D.L. 0.73
T.L. 1.73 [t/m²]

Slab M_o $1.73 \times 1.25^4/8 = 0.34$ [tm] α_t 0.9 D13-@200
@ $1.73 \times 1.25^4/2 = 1.08$ [t] ϕ_p 28

Base D 15 ∴ 10.9

$w \fallingdotseq 3.00$ < fe
$M_o \fallingdotseq 0.34 \times 2 = 0.68$ α_t 3.1 D13-@200
@ $\fallingdotseq 1.08 \times 2 = 2.16$ ϕ 9.4

(2) Roof

S-60 0.8t Span 1.500 ~ Cantilever 200

(3) Floor

L.L. 0.30
D.L. 0.24 RC
0.02 Deck
T.L. 0.56 [t/m²] Span 1.5 m V-1.2

(4) Beam

∴ $0.56 \times$ span + Self load $0.02 = 0.44$ [t/m]
Span 1.5 [m]

$$Z_n = \frac{0.44 \times 1.5^2 \times 100}{8 \times 1.6} = 7.7 \quad < \quad 88.8$$

$$J_n = \frac{5 \times 0.00044 \times 150^3 \times 300}{384 \times 2.100} = 27.6 \quad < \quad 666.0$$

H-150 × 75 × 5 × 17

(5) Column

$N \fallingdotseq 0.56 \times 1.5^2/4 = 0.32 \longrightarrow 1.00$

ϕ 165.2 × 4.5
A 22.72 L 5.68 λ_k 200 > 35.2 ~ fc 1.49
N_a $22.72 \times 1.49 = 33.9 \gg 1.00$

(6) Brace $(\subset N$ $0.8 \times 0.12 \times (1.9^2 + 1.5^2) = 0.56 < N$ 0.5)

16 ϕ