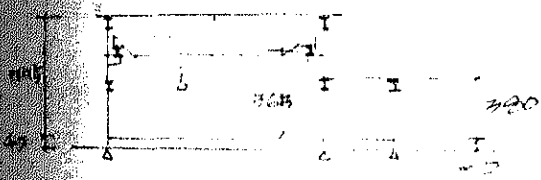
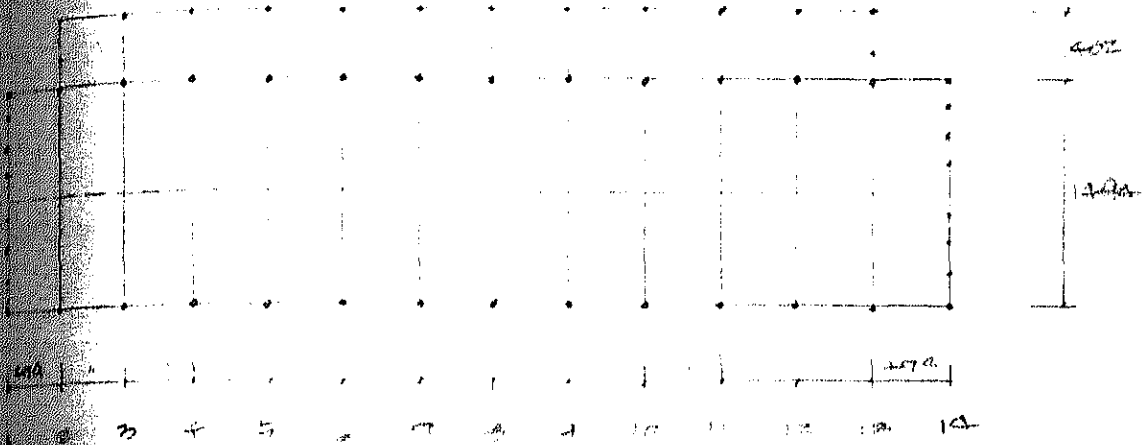


5 TRAINING ROOM



5-2 CRANE GIRDER $I = 479$

$$P = 1.62 \quad J = 100$$

$$\text{MAX } M = 1.62 \cdot (479 - 100) / 2 = 479 = 3.11$$

$$\text{MAX } Q = 1.62 \cdot (1 - 479 - 100) / 479 = 2.90$$

GIRDER $w' = 50 + 22 - 3 = 69 \text{ lb/l}$

$$\pi = 0.004 \cdot 479 / 3 = 0.23$$

$$Q = 0.004 \cdot 479 \cdot 4 = 0.19$$

IMPACT LOAD $\gamma_x = 0.15 P$

$$\gamma_y = 0.1 P$$

$$\Sigma M_x = 3.11 \times 1.15 + 0.23 = 2.91$$

$$\Sigma Q_y = 2.90 \cdot 1.15 - 0.19 = 2.53$$

$$\pi_y = 3.11 \times 0.10 = 0.31$$

$$Q_y = 2.90 \cdot 0.10 = 0.29$$

$$W = 746 \times 174 \times 6 \times 1$$

$$f_b = 2.91 / 174 = 0.0167 \text{ in} < 0.018$$

$$f_y = 2.53 / 174 = 0.0145 \text{ in} < 0.015$$

$$\delta = 2.53 \cdot 479 \cdot 11 \cdot 100 = 0.28 = \frac{479}{1740}$$

$$\gamma_b = 31 / 174 = 0.178 < 1.60$$

$$\gamma_y = 2.53 / 174 = 0.145 < 0.90$$

ADD MEMBER

DIST #1 $l = 479$ $w = 40 \text{ kg/m}$

$$W = 1720 \text{ kg} = -35 \frac{1}{3} - 45$$

$$w' = 40 \times 14.94 \frac{1}{2} = 299 \text{ kg/m}$$

$$\rho_0 = 0.20 \times 479^2 / 3 = 296 \text{ m}$$

$$Q = \dots \times 479 \frac{1}{2} = 0.72 \text{ T}$$

$$H = 200 \times 100 \times 5.5 \times 2$$

$$f_b = 900 / 479 = 30 / 12 \times 0.4 = 0.75$$

$$f_b = 36 / 104 = 0.47 < 0.75$$

$$\delta = 5 \times 2 \times 0.2 \times 21 \times 10^3 \times 1000 = 0.53 \approx 479 / 1000$$

DIST #2 $l = 479$

$$w' = 40 \times 479 \frac{1}{2} + 40 \times 365 = 278 \text{ kg/m}$$

$$\rho_0 = 0.2 \times 479^2 / 3 = 0.16$$

$$Q = \dots \times 479 \frac{1}{2} = 0.55$$

$$H = 290 \times 149 \times 5.5 \times 2$$

$$f_b = 900 / 479 = 30 / 12 \times 0.4 = 0.75$$

$$f_b = 44 / 424 = 0.16 < 0.75$$

DIST #3 $l = 479$ $w = 40$

$$w_x = 40 \times 365 = 150 \text{ kg/m}$$

$$w_y' = 1720 \times 0.2 \times 0.75 / 2 = 520$$

$$\rho_x = 0.15 \times 479^2 / 3 = 0.43$$

$$\rho_y = 0.51 \times \dots = 1.44$$

$$H = 300 \times 150 \times 5.5 \times 2$$

$$f_{bx} = 900 / 479 \times 30 / 12 \times 0.4 = 0.34$$

$$f_{by} = 479 / 479 = 0.089$$

$$m_{by} = 1.5A / 60.6 = 3.25$$

$$0.049 / 0.0475 + 3.25 / 1.60 = 0.105 + 1.274 = 1.48 < 1.5$$

$$l_y = 5.45 \quad l_x = 19.6$$

$$w_x' = 4.47 \times 3.25 = 16.10$$

$$w_y' = 1.70 \times 0.4 \times 0.75 / 2 = 5.20$$

$$r_x = 1.61 \times 1.45^2 / 10 = 0.63$$

$$r_y = 0.43 \times 5.45^2 / 3 = 2.24$$

$$H = 19.4 \times 1.70 \times 0.4 = 5.60$$

$$f_{by} = 9.00 / 5.37 \times 19.4 / 15 \times 0.9 = 1.067$$

$$r_{bx} = 0.7 / 67.6 = 0.017$$

$$r_{by} = 2.24 / 4.75 = 0.474$$

$$0.017 / 1.60 + 0.474 / 1.067 = 0.0173 + 0.754 = 1.331 < 1.5$$

STWB

$$l = 4.75 \quad l = 19.6$$

$$w' = 1.70 \times 0.4 \times 0.75 = 2.70$$

$$r = 0.25 \times 1.70^2 / 10 = 0.56$$

$$H = 19.4 \times 1.70 \times 0.4 = 5.60$$

$$f_b = 2.70 / 4.75 \times 19.4 / 15 \times 0.9 = 1.314$$

$$r_b = 0.7 / 277 = 0.270 < 1.219 \times 1.5$$

$$l = 300$$

$$P = 0.44 \times 1.9 \times 4.75 = 4.47$$

$$r = 0.25 \times 3.0^2 / 10 = 0.30$$

$$\lambda = 300 / 361 = 43 \quad \xi_c = 1.07$$

$$f_c = 1.00 / 300 \times 19.4 / 15 \times 0.9 = 2.08 \rightarrow 1.60$$

$$r_c = 4.47 / 306 = 0.146$$

$$r_b = 30 / 475 = 0.104$$

$$0.146/1.05 + 0.108/1.30 = 0.136 + 0.083 = 0.219 < 1.5$$

$$\text{BASE A} = 4470 / 50 = 89.4 \rightarrow 20 \times 20$$

$$\sigma_c = 4470 / 20 \times 20 = 11.1 \text{ kg/cm}^2$$

$$m = 11.1 \times 10^7 / 2 = 555$$

$$t = \sqrt{6 \times 555 / 1600} = 1.44 \rightarrow \text{R-16}$$

L = 775

$$P = 4470 / 2 + 0.04 \times 1.6 \times 775 = 2.54$$

$$W' = 170 \times 0.8 \times 1.6 = 210 \text{ kg/m}$$

$$P_y = 0.52 \times 5470 / 2 = 1.53$$

$$M = 0.21 \times 205^2 / 8 + 1.53 \times 20 / 2 = 1.58 + 230 = 231.58$$

$$Q = 0.21 \times 205 / 2 + 1.53 \times 4.75 / 7.75 = 0.81 + 0.94 = 1.75$$

$$H = 200 \times 200 \times 8 \times 12$$

$$\chi = 300 / 5.02 = 60 \quad f_c = 1.30$$

$$f_b = 900 / 775 \times 20 / 20 \times 1.2 = 1.393$$

$$\sigma_c = 2.54 / 63.5 = 0.04$$

$$f_b = 231.58 / 472 = 0.422$$

$$0.04 / 1.30 + 0.422 / 1.393 = 0.031 + 0.303 = 0.334 < 1.6$$

$$\text{BASE A} = 2540 / 50 = 50.8 \rightarrow 20 \times 20$$

$$\sigma_c = 2540 / 20 \times 20 = 64$$

$$m = 64 \times 10^7 / 2 = 320$$

$$t = \sqrt{6 \times 320 / 1600} = 1.10 \rightarrow \text{R-16}$$

AB - 4 - B16

1. C No Q OF BEAM



$l = 14.72$

$P = 60 \times 4.79 = 287.4 \text{ kg}$

$-P_w = 304?$

$C = 2.15 \times 14.72^3 / 12 = 4.02 \text{ T-m}$

5.68

$M_0 = \dots / 4 = 8.03$

11.35

$Q = 2.15 / 2 = 1.07 \text{ T}$

1.52



$l = 4.79$

$W = 60 \times (15.75 \times \frac{1}{2} + 100) = 280 \text{ kg/m}$

$-W_w = 650$

$C = 0.20 \times 4.79^3 / 12 = 0.54$

1.24

$M_0 = \dots / 2 = 0.20$

1.06

$Q = \dots \times 4.79 / 2 = 0.67$

1.59



$l = 4.79$

$W = 60 \times 4.00 / 2 = 120$

$C = 0.12 \times 4.79^3 / 12 = 0.23$

$M_0 = \dots / 2 = 0.24$

$Q = \dots \times 4.79 / 2 = 0.28$



$l = 4.79$

$W = 60 \times 4.00 / 2 + \dots \times 30 = 180$

$-W_w = 120 \times 0.5 \times 4.00 / 2 + 120 \times 3.0 \times 3.0 = 840$

$C = 0.18 \times 4.79^3 / 12 = 0.30$

1.61

$M_0 = \dots / 2 = 0.52$

2.41

$Q = 0.18 \times 4.79 / 2 = 0.43$

2.01

$l = 1.00$

$W = 0.20$

$W = 0.12$

$W = 0.18$

$-W_w = 0.84$

$C = 0.20 \times 1.0^3 / 12 = 0.18$

0.06

0.09

0.42

$Q = \dots \times 1.0 = 0.20$

0.12

0.18

0.84

area

$$l = 700$$

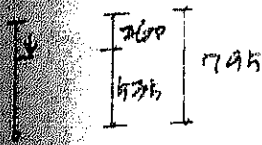
$$w = 40 \times (4.02/2 + 3.0) = 700 \quad -w_w = 120 \times 2.0 \times 4.0 = 960$$

$$c = 0.70 \times 3.0^2 / 2 = 0.55$$

5.40

$$Q = 0.70 \times 3.0 = 2.10$$

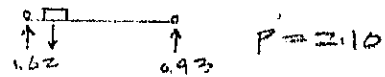
3.60

COLUMN

$$P = 253^T$$

$$e = 40/2 + 20 = 40 \text{ cm}$$

$$M = 253 \times 40 = 10120 \text{ T-cm}$$



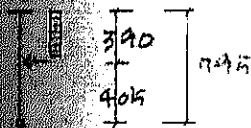
$$H = 1.41 \times 2.6 \times 5.35 + (2.6 - 2 \times 5.35) \times 7.95^2 / (2 \times 7.95^2) = -0.25 + 0.15$$

$$Q = 253 \times 40 / 7.95 = 0.13 \quad n' = 0.45$$

$$W = 120 \times 0.8 \times 4.79 = 620 \text{ kg/m}$$

$$H = 120 = 0.61 \times 7.95^2 / 3 = 15.14$$

$$Q = 0.61 \times 7.95 / 2 = 2.10$$



$$P_w = 120 \times 0.8 \times 4.79 / 2 \times 4.79 = 930 \text{ kg}$$

$$W = 650 \text{ kg/m}$$

$$W = 0.61 \times 3.90 = 2.10$$

$$H = 253 \times 3.90 (2 \times 7.95 - 3.90)^2 / (3 \times 7.95^2)$$

$$+ 0.93 \times 3.90 \times (7.95 + 4.05) / 2 \times 7.95^2 = 2.81 + 1.39 = 4.20$$

$$Q_T = 253 \times 60 / 7.95 + 0.93 \times 4.05 / 7.95 = 1.91 + 0.47 = 2.38$$

$$Q_B = 253 + 0.93 = 2.38 = 1.09$$

$$n_c = 1.09 \times 4.05 = 4.37$$

$$l = 4.05$$

$$W = 120 \times 0.8 \times 1.79 = 460 \text{ kg/m}$$

$$H = 120 = 0.46 \times 4.05^2 / 3 = 0.94$$

$$Q = 0.46 \times 4.05 / 2 = 0.93$$

$$l = 7.95$$

$$W_1 = 650 \text{ kg/m}$$

$$W_2 = 460 \text{ kg/m}$$

$$H = 2.81 \times 0.19 / 0.66 + 0.46 \times 7.95^2 / 3 = 0.82 + 3.63 = 4.45$$

$$Q_T = 1.91 \times 0.19 / 0.66 + 0.66 \times 7.95 / 2 = 0.56 + 1.63 = 2.19$$

$$Q_B = 0.62 \times 0.19 / 0.66 + \dots = 0.18 + 1.63 = 1.81$$

AXIAL FORCE OF COLUMN

	ROOF	WALL	CRANE SIPPER	COLUMN	P
1.1	0.06 x 2.4 x 2.5 1.73	0.50 x 0.90 x 2.50 2.04 0.04 x 2.4 x 2.50 0.34	0.19	0.56	4.06
1.2	0.06 x 4.0 x 2.5 2.45	0.04 x 2.4 x 2.50 0.60 0.40 x 0.90 x 2.50 2.04 x 2.4 x 2.50 4.09	0.70	0.56	4.07
1.3	0.06 x 2.4 x 2.5 1.73	0.04 x 2.4 x 2.50 0.64 0.40 x 0.90 x 2.50 2.45	0.19	0.56	2.61
1.4	0.06 x 4.0 x 2.5 2.45	0.04 x 2.4 x 2.50 0.64 0.40 x 0.90 x 2.50 2.45	0.70	0.56	3.96
1.5	0.06 x 4.0 x 2.5 2.45		0.70	0.56	3.96
1.6	0.06 x 4.0 x 2.5 2.45			0.70	1.02
1.7	0.06 x 4.0 x 2.5 2.45			0.70	1.67

HORIZONTAL LOADEARTHQUAKE LOAD

ROOF	$0.06 \times 64.7 \times 16.94$	65.25
	$0.06 \times 56.64 \times 7.03$	23.97
WALL	$0.44 \times (79.46 \times 3.55 + 40 \times 1.95)$	70.90
	$0.04 \times (115.7 \times 7.56 + 52.7 \times 1.95)$	30.54
CRANE GIRDER	0.04×1245	9.96
COLUMN	$0.07 \times 33 \times 90$	2.07
	$0.05 \times 12 \times 20$	1.20

 199.64

$$Q_E = 199.64 \times 0.1 = 19.96$$

WIND PRESSURE

$$0.17 \times 1.2 \times 15.34 \times 0.0/2 = 12.52$$

$$0.12 \times 1.2 \times 3.27 \times 40/2 = 1.17$$

$$\uparrow Q_w = 13.65$$

$$0.17 \times 1.2 \times 62.47 \times 0.0/2 = 50.97$$

$$0.12 \times 0.4 \times 62.47 \times 40/2 = 6.00$$

$$\uparrow Q_w = 56.97$$

$$0.17 \times 1.2 \times 62.47 \times 0.0/2 = 50.97$$

$$0.12 \times 1.2 \times 62.47 \times 40/2 = 12.00$$

$$\downarrow Q_w = 62.97$$

P-7 STIFFNESS RATIO

COLUMN CA CD H-400 x 300 x 8 x 13

$$I_x = 23702 \quad I_y = 1740$$

CB H-300 x 300 x 8 x 12

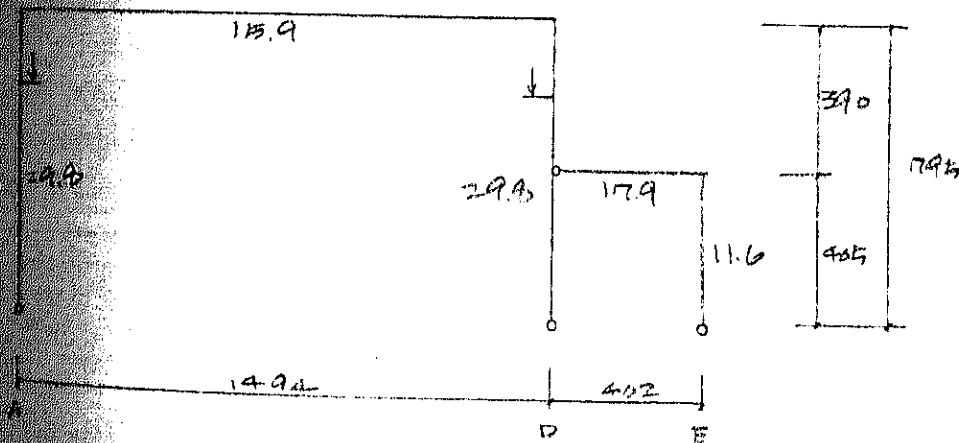
$$I_x = 9730 \quad I_y = 1600$$

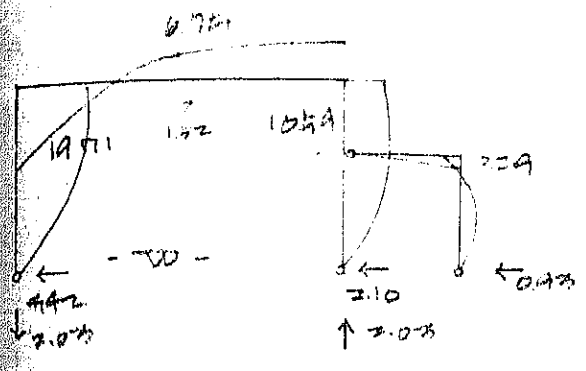
BEAM CF1 H-400 x 300 x 8 x 13

$$I_x = 23702$$

CF2 H-300 x 150 x 6.5 x 9

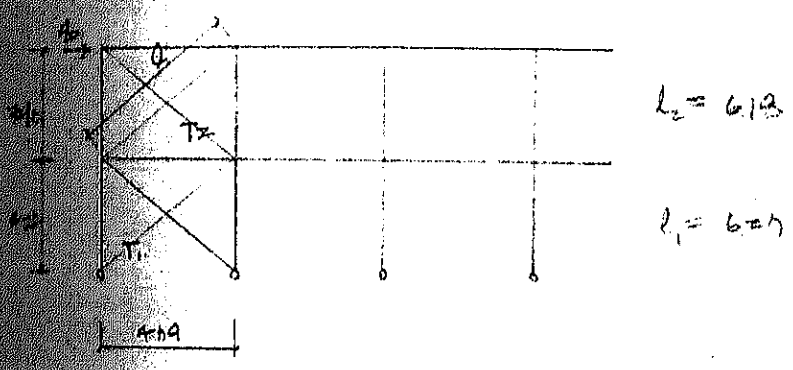
$$I_x = 7210$$





RIDGE DIRECTION

BRACE $q = 19.96 / 4 = 4.99$



$$T_2 = 4.99 \times 6.13 / 4.44 = 6.84$$

$$C_2 = 4.99 \times 3.10 / 4.44 = 4.06$$

$$T_1 = 4.99 \times 6.27 / 4.44 = 6.93$$

$$C_1 = 4.99 \times 4.05 / 4.44 = 4.32$$

DESIGN OF SECTION

1. BEAM

FIXD	M_{LE}	M_C	M_{RE}	Q
L	-2.97	+5.27	+2.97	1.07
C	+0.06	+2.06	-0.06	0
W	+14.71	-6.75	+12.54	1.52
S	+16.73	-1.64	+12.56	2.44

$$H = 400 \times 200 \times 8 \times 13$$

$$l_b = 14.94 / 4 = 3.74$$

$$f_b = 400 / 200 \times 40 / 20 = 1.56$$

$$m_b = 16.73 / 1190 = 1.31 < 1.56 \times 1.5 = 2.34$$

2. COLUMN

CD	P	M	Q
L	9.07	+2.95	0.25
C	3.53	0.21	0
W	2.03	14.71	4.42
S	9.63	16.73	4.05

$$H = 400 \times 200 \times 8 \times 13$$

$$l_{bx} = 7.47 \quad l_{by} = 4.05$$

$$\lambda = 405 / 454 = 0.892 \quad f_c = 1.00$$

$$f_b = 400 / 200 \times 40 / 20 = 1.44$$

$$m_b = 9.63 / 1012 = 0.114$$

$$m_b = 16.73 / 1190 = 1.41$$

$$0.114 / 1.00 + 1.41 / 1.44 = 0.114 + 0.976 = 1.090 < 1.5$$

$$P 12 \quad 45 \times 25$$

$$\sigma_c = 7.600 / 46 \times 10^3 = 64 \text{ kg/cm}^2$$

$$m = 6.8 \times 10^5 / 4 = 624$$

$$t = \sqrt{6 \times 624 / 64} = 1.41 \rightarrow \text{B12-19}$$

AB-4-B19

CS	P	R	G
L	1.64	0	0
M	0.07	0.94	0.93
S	1.07	0.94	0.93

$$H = 200 < 2000 \rightarrow \times 12$$

$$\lambda = 405 / 400 = 33 \quad f_c = 1.07$$

$$f_b = 900 / 405 \times 20 / 20 \times 1.3 = 2.67 \rightarrow 1.60$$

$$\sigma_c = 1.71 / 625 = 0.027$$

$$\sigma_b = 94 / 402 = 0.234$$

$$0.027 / 1.07 + 0.234 / 1.60 = 0.025 + 0.146 = 0.171 < 1.5$$

$$\text{B12-25} \times 25$$

$$\sigma_c = 1620 / 25 \times 10^3 = 2.6$$

$$m = 2.6 \times 10^5 / 2 = 205$$

$$t = \sqrt{6 \times 205 / 1600} = 0.87 \rightarrow \text{B12-16}$$

AB-4-1216

PAGE

$$T = 6.53$$

$$A = 657 / 2.12 = 2.12$$

$$L = 65 \times 65 \times 6 \quad \text{HTB-K16}$$

$$A_N = 4.74 > A$$

TIE BEAM

$35 \cdot 90$

$i = 72.6$

$l = 479$

$w = 0.76 + 0.49 \times 35 = 2.44 \text{ T/m}$

$0.76 + 0.49 \times 1.2 + 0.29 = 1.43$

$C = 2.44 \times 479^2 / 12 = 4.17$

2.7

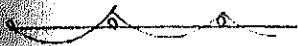
$R_0 = \dots / 4 = 7.0$

4.1

$R = \dots \times 479 / 2 = 5.8$

3.7

PGAW



$R_0 = 1.2C = 5.0$

$R_0C = R_0 - 0.6C = 2.5$

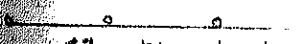
$A_0 = 5.0 / 0.776 \times 2.0 = 3.2$

$2 - 0.19$

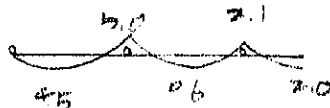
$A_0C = 2.5 / \dots = 1.7$

$3 - 0.19$

PGAW



0.49 0.49 0.49 0.49
 -2.0 +2.0 -2.0 +2.0
 +1.9 -2.4 0 0
 +1.2
 +1.1 -0.3 -0.6 -0.6



$A_0 = 5.0 / 0.776 \times 2.0 = 3.4$

$2 - 0.19$

$A_0C = 4.5 / \dots = 3.1$

$2 - 0.19$

TIE BEAM

$w = 0.76 + 0.49 \times 35 = 2.20 \text{ P = 4.47}$

$i = 5.85$

$l = 320$

$C = 2.20 \times 320^2 / 12 + 4.47 \times 320 \times 5.85 \times 2 / 4 = 12.2$

0.6

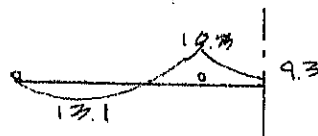
$R_0 = \dots / 4 = 12.3$

1.0

$R = 2.20 \times 320 \times 5.85 / 2 + 4.47 \times 320 = 10.9$

1.2

0.49 0.49
 0.49 0.49
 +1.02 -0.6
 -1.9 -0.7



$q = 10900 / 776 = 14 = 10.0$

$q_c = 17.1 / 0.726 \times 2.0 = 9.0 \quad 4-D14$

$q_B = 10.7 / \quad \quad = 7.1 \quad 3-D14$

$q_c = 9.7 / \quad \quad = 6.4 \quad 3-D14$

5. FOOTINGS

	P	WALL	TIE BEAM	CRAN	IP	n	l x l'
1	406	1.94 x 2.94 4.23 0.59 x 2.9 1.42	4.10	3.13	14.6	1	90 x 90
2	407	0.59 x 4.8 2.83	3.65	3.53	14.1	2	90 x 210
3	407	1.44 x 2.94 4.23	3.45		12.2	1	90 x 90
4	411	1.44 x 2.94 4.23 1.68 x 2.4 4.03	4.10	3.13	24.1	2	90 x 210
5	412	1.68 x 2.4 4.03	5.17	3.53	20.9	2	"
6	416		5.17	3.53	10.5	2	"
7	142	0.59 x 2.4 1.42 1.44 x 2.0 2.88	3.34		9.5	1	90 x 90
8	164	0.59 x 4.8 2.83	5.17		9.6	1	"

$\frac{1}{2} \times 30.4 = 15.2$

$15.2 - 0.9 \times 0.9 \times 0.6 \times 2.4 = 1.2$

$15.2 - 1.2 = 14.0$

308×1 90×90 $D = 60$ $\rho = 46.3$
 $n = 4 - D16$

308×1 90×210

$P_{02} = 15.6$
 $W_P = -20$ } 136

$Q = 442$ $h = \frac{H}{150}$

$M = 442 \times 150 = 663^{T-H}$



$P_B = 26 \times \frac{1}{60} = 1.20$

$\sigma_P = 136 / 2 = 663 / 120$

$= 63 \pm 5.5 = 12.3 \text{ } \sigma_L 1.8$

$\sigma_B = 12.3^T$

$M = 12.3 \times 1.20 \frac{1}{2} = 7.4^{T-H}$

$P_B = 12.3 \times 10^3 / 46.3 = 267 < 275$

$Q = 12.3 \times 10^3 / 46.3 \times 1.8 = 11.4$

$A = 7.4 / 3063 \times 2.2 = 5.3$

$L_0 = 241 / 2 = 121$

$M = 12.1 \times 1 = 12.1$

$Q = 12.1 \times 10^3 / 46.3 \times 1.8 = 17.4$

$A = 17.4 / 3063 \times 2.2 = 7.9$ } 5-D16