DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province.	**Project Code**	JC1N004
Section	**BUILDING WORKS**	Calc. File No.	
Sub-Section	**CARGO GATE**	Calc. Index No.	

Subject:

STRUCTURAL DESIGN

Calculation Objective:

The objective of the calculation is to provide a safe structure for the ocupation of the building, by the use of the Republic of El Salvador and American design standards.

References, Calculation Notes and Comments

The Structural Analysis has been made using the program: "STAAD-III rev 21.1W, RESEARCH ENGINEERS, Inc.". The analysis of the structure considers only the concrete frames to resist the lateral forces, not considering the walls in the model.

One model for the structure has been constructed:

1- For the calculation of the Seismic and Dead & Live load.

The Key for the STAAD-III rev 21.1W program is attached for future convinience.

All the design has been made by calculations sheet created for the project in Microsoft Excel, and based in the following bibliography:

1. Building Code Requirements for Structural Concrete (318M-99), American Concrete Institute (ACI).

2. Technical Specification for Seismic Design, Ministry of Public Works, El Salvador, 2001.

3. AISC, American Institute of Steel Construction, ninth Edition, 1989.

4. Technical Specification for Wind Design, Ministry of Public Works, El Salvador, 1997.

5. UBC, Uniform Building Code, Volume 2: Structural Engineering Design Provisions, 1997.

Rev	Prepared		No. of	Checked		Reviewed		Superseded
	by	Date	Pages	by	Date	by	Date	by Calc No.
O	H. WATANABE	Jul-02	43	A. MORIOKA	Jul-02			
A								
B								
C								

gate (cargo,container)

	room	material	thickness	density	(kg/m2) weight	
		metal roof			15	
RF	Roof	purlin			15	
	(metal)	sub-beam			15	
		beam			30	
					75	
2F	office	finish	30		60	
		slab syste	200		345	precast prestress slab,
		ceiling			20	include top concrete t=50
					425	
		finish			20	
2F	Roof	concrete sl	150		360	
		ceiling			20	
					400	
		c pl			30	
2F	Bridge wal	porin			20	
					50	
		finish	30		60	
1F	sidewalk	slab	120	2.4	288	
					348	
1F	office	finish	30		60	
		slab	120	2.4	288	
					348	
1F	Pit	slab	250	2.4	600	
					600	
C.B	t=200mm				293	kg/m2
	t=150mm				226	kg/m2

gate

Floor	Room	Dead Load	Live Load	Total Load	Notes
RF	roof	75	20	95	*
			0	75	
2F	office	425	250	675	*
			180	605	
2F	roof	400	100	500	
			50	450	
2F	bridge wal	50	180	230	
			60	110	
1F	office	348	250	598	
			180	528	
1F	sidewalk	348	350	698	
			150	498	
1F	pit	600	2000	2600	
			1800	2400	

* The selfweight for the Columns & Beams calculated by the MultiFrame structural Analisys Program.

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PROJECT: Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.	Prepared by	H.WATANABE
SECTION: Cargo Gate	Calc. Index No.	Checked by	A.MORIOKA
SUBJECT: Loads	Date July-02	Page	3 / 43

SEISMIC FORCES

$V = Cs\ W$

$Cs = (A\ I\ Co\ /\ R)\ (To\ /\ T)^{2/3}$

Coefficient of Aceleration, A = 0.40

Importance Factor, I = 1.00

Response Modification Factor, R = 12.00

Soil Conditions Factors

Co = 3.00

To = 0.60

Period of the Sructure, $T = Ct\ hn^{3/4}$

Type of structure coefficient, Ct = 0.073

Structure height, hn = 7.85

T = 0.342 seg

Cs = 0.145

X direction

Dead Load

	1	2	3	4	5	6
RF	1.24	4.6	4.3	4.3	4.6	1.24
2F	1.76	10.4	9.1	9.1	10.4	1.76

Live Load

	1	2	3	4	5	6
RF	0.0	0.0				
2F	0.2	2.2	1.7	1.7	2.2	0.2

Each floor weight for seismic

hight		1	2	3	4	5	6
7.85	RF	1.2	4.6	4.3	4.3	4.6	1.2
5.45	2F	1.9	12.6	10.8	10.8	12.6	1.9
wh=		20.2	104.6	92.8	92.8	104.6	20.2

Total weight for seismic

	1	*2*	*3*	*4*	*5*	*6*
RF	1.2	4.6	4.3	4.3	4.6	1.2
2F	3.2	17.2	15.1	15.1	17.2	3.2

Total seismic load

1	*2*	*3*	*4*	*5*	*6*
0.5	2.5	2.2	2.2	2.5	0.5

Each seismic load

	1	*2*	*3*	*4*	*5*	*6*
RF	0.2	0.9	0.8	0.8	0.9	0.2
2F	0.2	1.6	1.4	1.4	1.6	0.2

Reaction of each point

	1	2	3	4	5	6
A	24.1 26.2 **50.3**	23.0 11.3 **34.3**	35.8 3.8 **39.6**	35.8 3.8 **39.6**	38.4 11.8 **50.2**	24.1 26.2 **50.3**
B	24.0 26.0 **50.0**	30.6 30.8 **61.4**	16.5 3.9 **20.4**	25.6 4.2 **29.8**	40.6 32.7 **73.3**	24.1 26.0 **50.1**
C	24.1 26.2 **50.3**	40.6 32.7 **73.3**	25.6 4.2 **29.8**	16.5 3.9 **20.4**	30.6 30.8 **61.4**	24.1 26.2 **50.3**
D	24.1 26.2 **50.3**	38.4 11.8 **50.2**	35.8 3.8 **39.6**	35.8 3.8 **39.6**	23.0 11.3 **34.3**	24.1 26.2 **50.3**

upper line DL
middle line LL
lower line TL=DL+LL

Total dead load = 685.3 ton

Seismic load = 99.62 ton

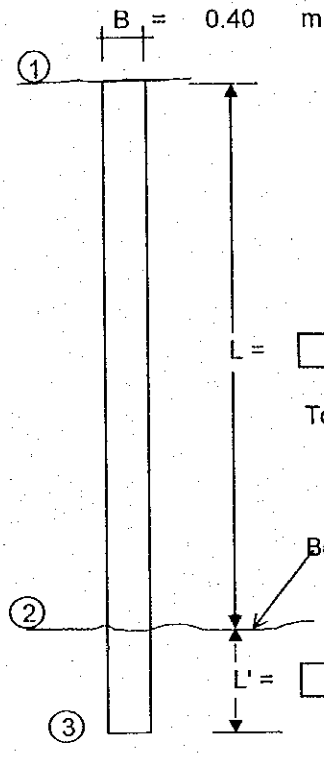
Number of pile

	1	2	3	4	5	6	7	8	9
A	1-45	1-40	1-40	1-40	1-45	1-45			
B	1-45	1-45	1-40	1-40	2-40	1-45			
C	1-45	2-40	1-40	1-40	1-45	1-45			
D	1-45	1-45	1-40	1-40	1-40	1-45			

Pile bearing strength

diameter (cm)	strength (t)
40	46.6
45	65.2
50	71.5

BEARING CAPACITY OF SQUARE DRIVEN CONCRETE PILES



	Properties In Top Soil:		Properties In Bearing Stratum:	
N of hits by SPT =	8	N	30	N
$\phi = \sqrt{12N + 20}$				
Ø =	29.80	°	36.21	°
γ =	1.430	ton/m³	1.840	ton/m³
Nq =	21		50	
δ =	22.35	°	27.16	°
KHc =	1		1	
Factor of safety (F.S.) =	3			

Pressure due to soil:

P1 = 0.00 ton/m³
P2 = 11.44 ton/m³
P3 = 14.72 ton/m³

Qult = Qt + Qf

- Tip Resistance (Qt)

Qp = PtxNqxAt Pt = P3 = 14.72 ton/m²

Pile Area = 0.160 m²

Qp = 117.76 ton

- Friction Capacity (Qf)

Consider Friction ? Y Y/N

Qf = Σ(KHc)xPoxTAN(δ)xS

S1 = 2BLD S1 = 7.20 m² Po1 = (P1 + P2)/2

S2 = 2BL'D S2 = 0.80 m² Po2 = (P2 + P3)/2

Po1 = 5.720 ton/mt² Po2 = 13.080 ton/m² **Qf = 22.30 ton**

Qult = Qt + Qf Qult = 140.06 ton

Qadm = Qult / F.S. **Qadm = 46.69 ton**

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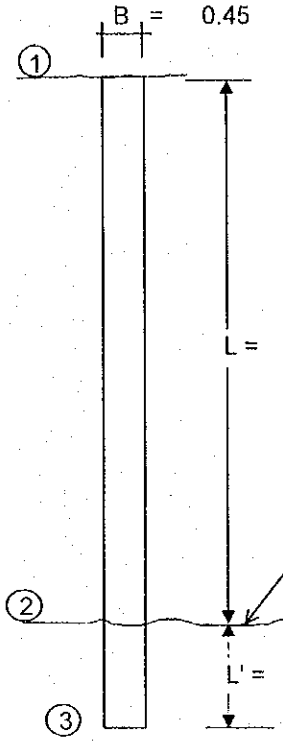
PROJECT: Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.		Prepared by	H.WATANABE
SECTION: Cargo Gate	Calc. Index No.		Checked by	A.MORIOKA
SUBJECT: Pile design	Date	July-02	Page	5 / 43

BEARING CAPACITY OF SQUARE DRIVEN CONCRETE PILES



20xB = 9.00 m

Side dimension = 0.45 m

	Properties In Top Soil:		Properties In Bearing Stratum:	
N of hits by SPT =	8	N	30	N
$\phi = \sqrt{12N + 20}$				
Ø =	29.80	°	38.97	°
γ =	1.430	ton/m³	1.840	ton/m³
Nq =	21		50	
δ =	22.35	°	29.23	°
KHc =	1		1	
Factor of safety (F.S.) =	3			

Qult = Qt + Qf

- Tip Resistance (Qt)

Qp = PtxNqxAt Pt = P3 = 16.56 ton/m²

Pile Area = 0.203 m²

Pressure due to soil:

P1 = 0.00 ton/m³
P2 = 12.87 ton/m³
P3 = 16.56 ton/m³

Qp = 167.67 ton

- Friction Capacity (Qf) Consider Friction ? Y Y/N

Qf = Σ(KHc)xPoxTAN(δ)xS

S1 = 2BLD S1 = 8.10 m² Po1 = (P1 + P2)/2

S2 = 2BL'D S2 = 0.90 m² Po2 = (P2 + P3)/2

Po1 = 6.435 ton/mt² Po2 = 14.715 ton/m² **Qf = 28.84 ton**

Qult = Qt + Qf Qult = 196.51 ton

Qadm = Qult / F.S. **Qadm = 65.50 ton**

PILE SEISMIC STRESS

Based on chung equation

mark	size (cm)	length (m)	I (cm4)	kh (kg/cm3)	(cm-1) (cm-1)	L	I 3
P1	14	10	3.20E+03	6.964	0.01262	12.6	0.006
P2	12	10	1.73E+03	7.817	0.01458	14.6	0.005

N of piles	nI 3	Q (t)	Q (t/n)	y0 (cm)	M0 (t m)	Mmax (t m)	lm (m)
14	0.090	58.1	4.2	0.5	1.6	0.3	1.2
12	0.064	41.5	3.5	0.5	1.2	0.2	1.1
Σ=	26	0.154	99.6				

Young's Modulus, E = 3.00E+05 kg/cm2

Seismic force, Q = 99.62 t

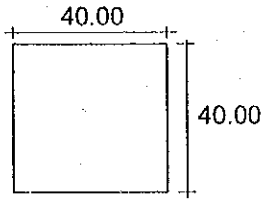
N = 9

E0 = 63

40 x 40		
L (cm)	M (t m)	Q (t)
0	1.6	4.2
-50	0.2	1.8
-100	-0.3	0.4
-150	-0.3	-0.2
-200	-0.2	-0.3
-250	-0.1	-0.2
-300	0.0	-0.1
-350	0.0	0.0
-400	0.0	0.0
-450	0.0	0.0
-500	0.0	0.0
-550	0.0	0.0
-600	0.0	0.0
-650	0.0	0.0
-700	0.0	0.0
-750	0.0	0.0

45 x 45		
L (cm)	M (t m)	Q (t)
0	1.2	3.5
-50	0.0	1.2
-100	-0.2	0.1
-150	-0.2	-0.2
-200	-0.1	-0.2
-250	0.0	-0.1
-300	0.0	0.0
-350	0.0	0.0
-400	0.0	0.0
-450	0.0	0.0
-500	0.0	0.0
-550	0.0	0.0
-600	0.0	0.0
-650	0.0	0.0
-700	0.0	0.0
-750	0.0	0.0

PILE DESIGN



f'c = 350.00 kg/cm²

At release, f'c = 280.00 kg/cm²

Section Area = 1600 cm²

Section Inertia = 213333.33 cm4

- Prestressing Force

Cables.
Uncoated seven wire stress relieved strands. Ultimate Strenght, Fpu = 17,500 kg/cm²
ϕ = 12.7 mm. Area = 92.90 mm.

# of strands to use = 6 Prestressing force, Po = 0.70 Fpu A = 68.28 ton

Allowable stress

At service		At release	
0.4 f'c =	140 kg/cm²	0.4 f'c =	112 kg/cm²

a) Stress at release

Axial Load, Pa = 0.00 ton Excentricity, e = 0.00 cm

Moment, Ma = 0.00 ton-m c = 20.00 cm

(Pa+Po) / A ± (Po e c / I + Ma c / I)

42.68 ± 0.00

Stress 1 = 42.68 kg/cm² < 0.4f'c o.k!!! Stress 2 = 42.68 kg/cm² < 0.4f'c o.k!!!

b) Stress at Service

Axial Load, Pa = 46.60 ton Excentricity, e = 0.00 cm

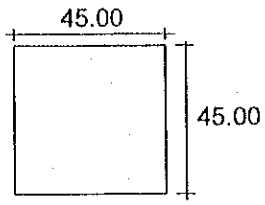
Moment, Ma = 1.64 ton-m Prestress force, Pe = 58.04 cm (15% losses)

(Pa+Pe) / A ± (Pe e c / I + Ma c / I)

65.40 ± 15.42

Stress 1 = 80.82 kg/cm² < 0.4f'c o.k!!! Stress 2 = 49.98 kg/cm² < 0.4f'c o.k!!!

PILE DESIGN



f'c = 350.00 kg/cm²

At release, f'c = 280.00 kg/cm²

Section Area = 2025 cm²

Section Inertia = 341718.8 cm4

- Prestressing Force

Cables.
Uncoated seven wire stress relieved strands. Ultimate Strenght, Fpu = 17,500 kg/cm²
ϕ = 12.7 mm. Area = 92.90 mm.

# of strands to use = 6 Prestressing force, Po = 0.70 Fpu A = 68.28 ton

Allowable stress

At service		At release	
0.4 f'c =	140 kg/cm²	0.4 f'c =	112 kg/cm²

a) Stress at release

Axial Load, Pa = 0.00 ton Excentricity, e = 0.00 cm

Moment, Ma = 0.00 ton-m c = 22.50 cm

(Pa+Po) / A ± (Po e c / I + Ma c / I)

33.72 ± 0.00

Stress 1 = 33.72 kg/cm² < 0.4f'c o.k!!! Stress 2 = 33.72 kg/cm² < 0.4f'c o.k!!!

b) Stress at Service

Axial Load, Pa = 65.50 ton Excentricity, e = 0.00 cm

Moment, Ma = 1.19 ton-m Prestress force, Pe = 58.04 cm (15% losses)

(Pa+Pe) / A ± (Pe e c / I + Ma c / I)

61.01 ± 7.81

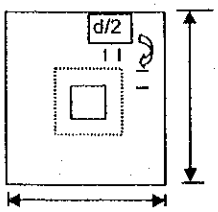
Stress 1 = 68.81 kg/cm² < 0.4f'c o.k!!! Stress 2 = 53.20 kg/cm² < 0.4f'c o.k!!!

FOOTING DESIGN

Design for foundation F-3

a) Punching

For Column



ϕ= 0.85

Dead load PD =	40.60	ton
Live load PL=	32.70	ton
Seismic Ps =	12.18	ton
1.4D + 1.7L =	112.43	ton
0.75(1.4D + 1.7L + 1.87S) =	101.40	ton
Pu=	112.43	ton
d =	66.00	cm
Column width =	45.00	cm
Column base =	45.00	cm
bo=4(c+d)=	444	cm

Th = 80 cm

f'c = 210 kg/cm² (20.59 Mpa)

Concrete shear strength, Vc ACI 11.12

$Vc1 = \phi(1+2/\beta c)\sqrt{f'c}\ bod/6$ = 576.49 ton

βc = 1.000

$Vc2 = \phi(2+\alpha sd/bo)\sqrt{f'c}\ bod/12$ = 249.29 ton

αs = 40

$Vc3 = \phi(1/3)\sqrt{f'c}\ bod$ = 384.33

Vc = 249.29 > 112.43 o.k!!!

For Pile

ϕ= 0.85

Distance from edge = 43.00 cm

βc = 1 αs = 20

Dead load PD =	22.84	ton/pile
Live load PL=	16.35	ton/pile
Carga sismica Ps =	6.09	ton/pile
1.4D + 1.7L =	59.77	ton
0.75(1.4D + 1.7L + 1.87S) =	53.37	ton
Pu=	59.77	ton
d =	33.73	cm
Pile width =	40.00	cm
Pile base =	40.00	cm
bo=4(c+d)=	294.92	cm

$Vc1 = \phi(1+2/\beta c)\sqrt{f'c}\ bod/6$ = 195.70 ton

$Vc2 = \phi(2+\alpha sd/bo)\sqrt{f'c}\ bod/12$ = 232.13 ton

$Vc3 = \phi(1/3)\sqrt{f'c}\ bod$ = 130.47

Vc = 130.47 > 59.77 o.k!!!

b) Shear Reinforcement

Base = 126 cm fy = 4200 kg/cm²

d = 70.00 cm

$Vc = (1/6)\sqrt{f'c}\ bod$ = 68.04 ton

$Vn = Vc + Vs$ $Vs = Vu/\phi - Vc$ $\phi = 0.85$

Vu = 59.77 ton

Vs = 2,274.2 kg

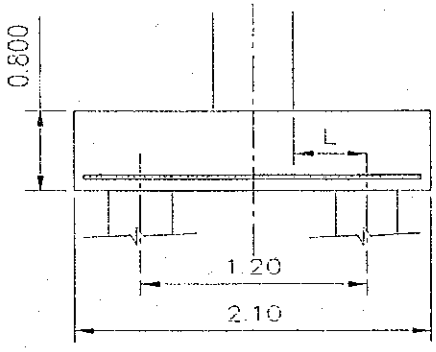
Bar denomination = 4 Bar area = 1.27 cm²

# of legs = 2 Spacing, S_{req} = 327.52 cm

Use 2 legs of N 4 @ 30 cm

c) Reinforcing Steel

fy = 4200 kg/cm²



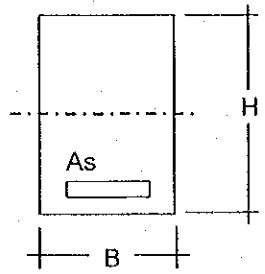
Moment generated by pile reaction

M = Pp x L

L = 0.60 m

M1 = 1.4D + 1.7L = 35.86 ton-m

M2 =0.75(1.4D + 1.7L + 1.87S) = 32.02 ton-m



H = 80.00 cm

b = 126.00 cm

f'c = 280 kg/cm²

fy = 4200 kg/cm²

Force for design: Mu z-z = 35.86 ton-m

d = 62.62 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/\phi = \quad \phi = 0.90$

$294.12\ As^2 - 262999\ As + 3984748.3 = 0$ As = 15.42 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 20.56 cm²

(14/fy) b d = 26.30 cm²

Asmin = 20.56 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 271.90 cm²

As = 20.56 cm² o.k!! As < Amax

Bar denomination, N = 7 Bar Area (Av) = 3.88 cm²

Number of bars = 5.30 Use 6 - N 7

Pitch = 22.25 cm **7 @ 22 cm**

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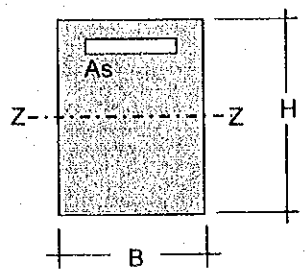
PROJECT: Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.		Prepared by	H.WATANABE
SECTION: Cargo Gate	Calc. Index No.		Checked by	A.MORIOKA
SUBJECT: Foundation beam design	Date	July-02	Page	/6 / 43

FOUNDATION BEAM **FB-1** X-dir

BEAM DESIGN



H = 80.00 cm

b = 40.00 cm

f'c = 210 kg/cm²

fy = 4200 kg/cm²

Forces and Moments, from Structural Analysis (ton , m) :

TYPE OF LOAD	MOMENT Mz-z
Dead Loa	3.93
Live Load	6.91
Seismic x	4.38
Seismic y	0.00

COMBINATION	Mu z-z
C1=1.4 DL+1.7 LL	17.25
.75(1.4DL+1.7LL+1.	19.08
.75(1.4DL+1.7LL+1.	12.94

Force for design: Mu z-z = 19.08 ton-m

d = 72.46 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/f$ f = 0.90

$1235.29\,As^2 304332\,As + 2120000 = 0$ As = 7.18 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 9.57 cm²
(14/fy) b d = 9.66 cm² } Asmin = 9.57 cm²

Asmax : rb = 0.0345 Asmax (0.75rb) = 74.91 cm²

As = 9.57 cm² o.k!! As < Amax

Bar denomination, N = 8 Bar Area (Av) = 5.07 cm²

Number of bars = 1.89 **Use 2 - N8** 4-D25

Minimun Base Required:

Max. bars per layer = 4 Minimum Base = 32.86 cm

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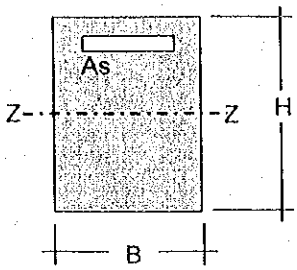
PROJECT: Detailed Design on Port Reactivation Project In La Union Province	Calc. File No.		Prepared by	H.WATANABE
SECTION: Cargo Gate	Calc. Index No.		Checked by	A.MORIOKA
SUBJECT: Foundation beam design	Date	July-02	Page	43 / 43

FOUNDATION BEAM FB-1 Y-dir

BEAM DESIGN



H = 80.00 cm

b = 40.00 cm

f'c = 210 kg/cm²

fy = 4200 kg/cm²

Forces and Moments, from Structural Analysis (ton , m) :

TYPE OF LOAD	MOMENT Mz-z
Dead Loa	11.20
Live Load	13.52
Seismic x	2.39
Seismic y	0.00

COMBINATION	Mu z-z
C1=1.4 DL+1.7 LL	38.66
.75(1.4DL+1.7LL+1.	32.35
.75(1.4DL+1.7LL+1.	29.00

Force for design: Mu z-z = 38.66 ton-m

d = 72.46 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/f \quad f = 0.90$

$1235.29\ As^2 304332 \quad 4295556 = 0$ As = 15.03 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 20.04 cm²
(14/fy) b d = 9.66 cm² } Asmin = 9.66 cm²

Asmax : rb = 0.0345 Asmax (0.75rb) = 74.91 cm²

As = 15.03 cm² o.k!! As < Amax

Bar denomination, N = 8 Bar Area (Av) = 5.07 cm²

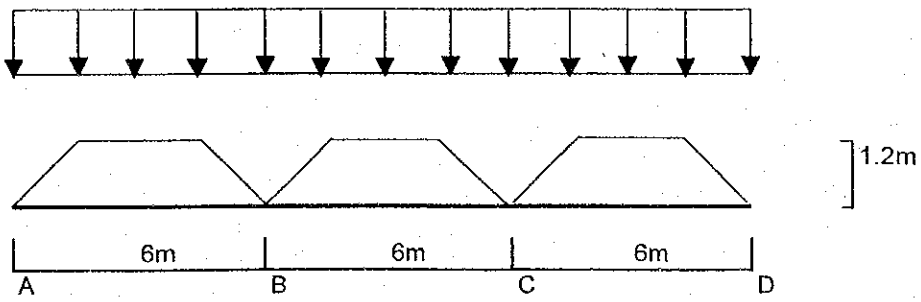
Number of bars = 2.97 **Use 3 - N8** 4-D25

Minimun Base Required:

Max. bars per layer = 4 Minimum Base = 32.86 cm

FB-2

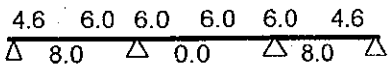
Load Condition



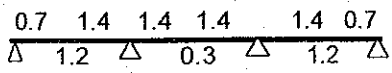
			for trapezoid weight	distribution weight	
DL	0.35t/m2	A/B, C/D	self weight	0.50	t/m
			CB (200)	1.60	t/m
			roof slab	0.48	t/m
				2.58	t/m
		B/C	self weight	0.50	t/m
LL	0.35t/m2				
		A/B, C/D	roof slab	0.12	t/m

Stress Result

DL



LL



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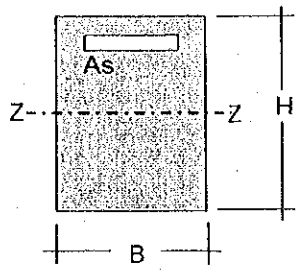
FOUNDATION BEAM FB-2

BEAM DESIGN



H = 65.00 cm

b = 30.00 cm

f'c = 210 kg/cm²

fy = 4200 kg/cm²

Forces and Moments, from Structural Analysis (ton , m) :

TYPE OF LOAD	MOMENT Mz-z
Dead Loa	8.00
Live Load	1.20
Seismic x	0.00
Seismic y	0.00

COMBINATION	Mu z-z
C1=1.4 DL+1.7 LL	13.24
.75(1.4DL+1.7LL+1.	9.93
.75(1.4DL+1.7LL+1.	9.93

Force for design: Mu z-z = 13.24 ton-m

d = 57.46 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/f \quad f = 0.90$

$1647.06\ As^2 41332 \quad 1471111 = 0$ As = 6.37 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 8.50 cm²
(14/fy) b d = 5.75 cm² } Asmin = 5.75 cm²

Asmax : rb = 0.0345 Asmax (0.75rb) = 44.55 cm²

As = 6.37 cm² o.k!! As < Amax

Bar denomination, N = 8 Bar Area (Av) = 5.07 cm²

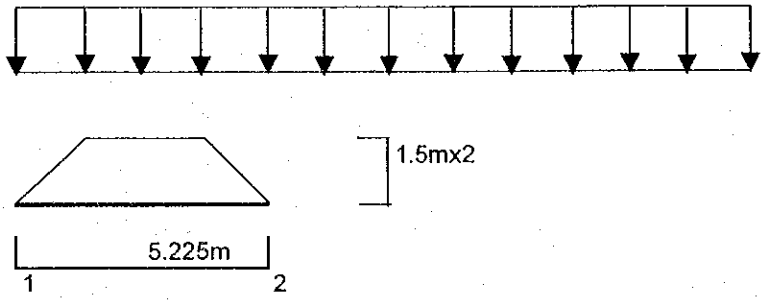
Number of bars = 1.26 **Use 2 - N8** 3-D25

Minimun Base Required:

Max. bars per layer = 3 Minimum Base = 27.78 cm

FB-3

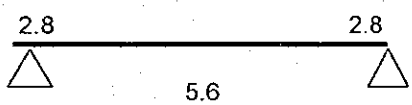
Load Condition



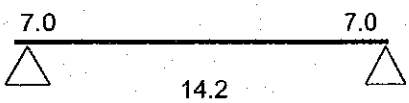
	for trapezoid weight	distribution weight	
DL	0.60t/m2	self weight	0.58 t/m
LL	2.00t/m2		

Stress Result

DL



LL



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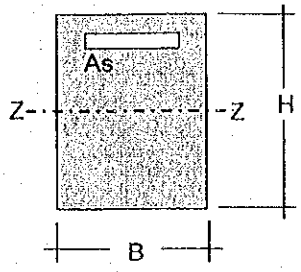
FOUNDATION BEAM FB-1

BEAM DESIGN



H = 80.00 cm

b = 40.00 cm

f'c = 210 kg/cm²

fy = 4200 kg/cm²

Forces and Moments, from Structural Analysis (ton , m) :

TYPE OF LOAD	MOMENT Mz-z
Dead Loa	5.60
Live Load	14.20
Seismic x	0.00
Seismic y	0.00

COMBINATION	Mu z-z
C1=1.4 DL+1.7 LL	31.98
.75(1.4DL+1.7LL+1.	23.99
.75(1.4DL+1.7LL+1.	23.99

Force for design: Mu z-z = 31.98 ton-m

d = 72.46 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/f \quad f = 0.90$

$1235.29\ As^2 304332 \quad 3553333 = 0$ As = 12.29 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 16.39 cm²
(14/fy) b d = 9.66 cm² } Asmin = 9.66 cm²

Asmax : rb = 0.0345 Asmax (0.75rb) = 74.91 cm²

As = 12.29 cm² o.k!! As < Amax

Bar denomination, N = 8 Bar Area (Av) = 5.07 cm²

Number of bars = 2.43 **Use 3 - N8** 4-D25

Minimun Base Required:

Max. bars per layer = 4 Minimum Base = 32.86 cm

PROJECT: Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.		Prepared by H.WATANABE
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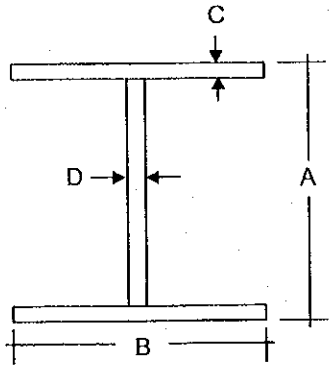
Roof Beam **B1**



Beam type = **W10X22**

A = 10.17 in

B = 5.75 in

C = 0.36 in

D = 0.240 in

Area = 6.490 in²

Yc = 5.085 in

I = 118.00 in4

S = 23.21 in³

Pd = 0.70 ton

PL = 0.30 ton

PS = 0.10 ton

Md = 0.70 ton-m

ML = 0.20 ton-m

MS = 0.20 ton-m

/A(d+L) 23.88

(d+L+s) 19.70

+ L/S = 236.67

d+L/S= 216.95

Fy = 36 ksi

260.56 kg/cm²

0.6 Fy = 1512.00 kg/cm² **o.k.!!**

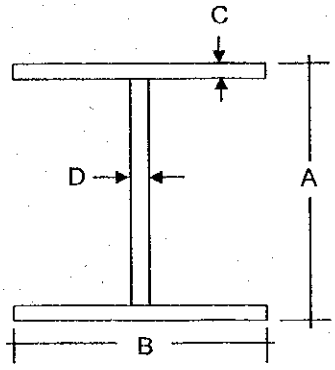
- Shear

Max. Shear = 700.0 kg

Fv = V / (h tw) = 44.45 kg/cm²

0.4 Fy = 1008.00 kg/cm² **o.k.!!**

Roof Beam **B2**



Beam type = **W12X40**

A = 11.94 in

B = 8.01 in

C = 0.52 in

D = 0.300 in

Area = 11.800 in²

Yc = 5.970 in

I = 310.00 in4

S = 51.93 in³

Pd = 1.00 ton

PL = 0.30 ton

PS = 0.10 ton

Md = 1.80 ton-m from analysis

ML = 0.20 ton-m

MS = 0.00 ton-m

/A(d+L) 17.08

(d+L+s) 13.79

+ L/S = 235.04

d+L/S= 176.28

Fy = 36 ksi

252.12 kg/cm²

0.6 Fy = 1512.00 kg/cm² **o.k.!!**

- Shear

Max. Shear = 900.0 kg

Fv = V / (h tw) = 38.94 kg/cm²

0.4 Fy = 1008.00 kg/cm² **o.k.!!**

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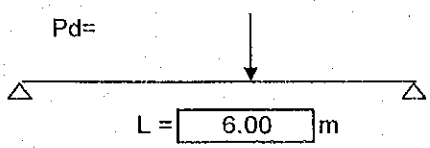
Roof Beam B3

DL= 45 kg/m2
LL= 20 kg/m2
LLd= 0 kg/m2

Pd=

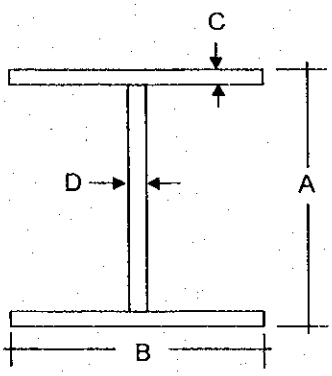


L = 6.00 m

Tributary Width = 3.88 m

Pd= 523.8 kg
Wd =selfw. = 27.00 kg/m

PL= 232.8 kg
PLd= 0 kg



Beam type = W8x18

A = 8.14 in

B = 5.25 in

C = 0.33 in

D = 0.230 in

Area = 5.260 in²

I = 61.90 in4

Yc = 4.070 in

S = 15.21 in³

Fy = 36 ksi

Md = 0.91 ton-m

ML = 0.35 ton-m

Md / S = 364.00
ML / S = 140.11
} 504.12 kg/cm²

0.6 Fy = 1512.00 kg/cm² **o.k.!!**

- Shear

Max. Shear = 459.3 kg

Fv = V / (h tw) = 38.03 kg/cm²

0.4 Fy = 1008.00 kg/cm² **o.k.!!**

- Deflection

d admi.= L/360 = 1.67 cm

E = 2.0E+10 kg/m²

d dead = 0.54 cm
d Total = 0.54 cm o.k!!
d live = 0.00 cm

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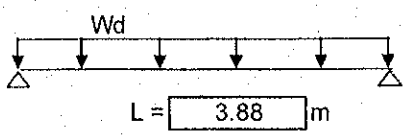
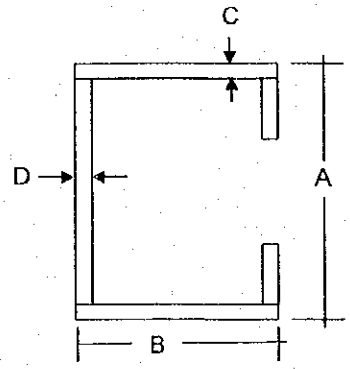
Roof Beam B4

DL= 30 kg/m2
LL= 20 kg/m2
LLd= 0 kg/m2
Tributary Width = 3.00 m



Wd1 = 90.0 kg/m
Wd2 =selfw. = 8.00 kg/m
Wd = 98.00 kg/m

WL = 60.0 kg/m



Beam type = C4x5.4

A = 4 in
B = 1.584 in
C = 0.296 in
D = 0.184 in

Area = 1.590 in²
Yc = 2.000 in
Fy = 36 ksi

I = 3.85 in4
S = 1.93 in³
Md = 0.18 ton-m
ML = 0.11 ton-m

Md / S = 584.61
ML / S = 357.93
942.54 kg/cm²
0.6 Fy = 1512.00 kg/cm² **o.k.!!**

- Shear

Max. Shear = 306.5 kg
Fv = V / (h tw) = 64.55 kg/cm²
0.4 Fy = 1008.00 kg/cm² **o.k.!!**

- Deflection

d admi.= L/360 = 1.08 cm
E = 2.0E+10 kg/m²
d dead = 0.88 cm
d Total = 0.88 cm o.k!!
d live = 0.00 cm

Polin

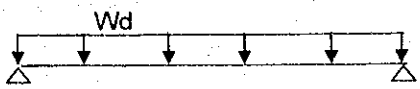
Tributary Width = 1.00 m

Dead Load = 20 kg/m²

Live load = 20 kg/m²

Wd = 20.0 kg/m

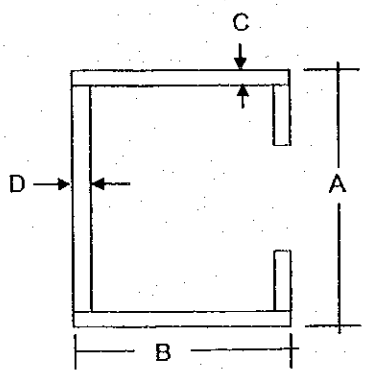
WL = 20.0 kg/m



L = 3.00 m

Wd1 = 20.0 kg/m
Wd2 = selfweight. = 2.70 kg/m
Wd = 22.70 kg/m

WL = 20.0 kg/m



Beam type = C4x3/64

A = 4 in

B = 2 in

C = 0.0469 in

D = 0.0469 in

Area = 0.406 in²

I = 1.06 in4

Yc = 2.000 in

S = 0.53 in³

Fy = 36 ksi

Md = 0.03 ton-m

ML = 0.02 ton-m

Md / S = 294.04

ML / S = 259.06

553.10 kg/cm²

0.6 Fy = 1512.00 kg/cm² **o.k.!!**

- Deflection

d admi.= L/360 = 0.83 cm

E = 2.0E+10 kg/m²

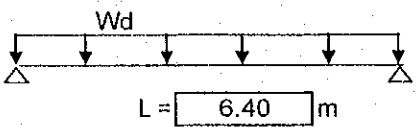
d dead = 0.27 cm

d live = 0.23

d Total = 0.50 cm o.k!!

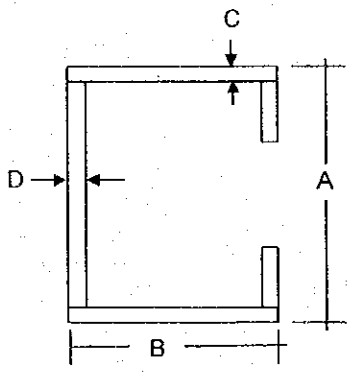
2nd Beam B11

DL= 30 kg/m2
LL= 180 kg/m2
LLd= 60 kg/m2
Tributary Width = 0.50 m



Wd1 = 15.0 kg/m
Wd2 =selfw. = 38.00 kg/m
Wd = 53.00 kg/m

WL = 90.0 kg/m



Beam type = **C10x25**

A = 10 in
B = 2.886 in
C = 0.436 in
D = 0.526 in

Area = 7.350 in²
Yc = 5.000 in
Fy = 36 ksi

I = 144.00 in4
S = 24.10 in³
Md = 0.27 ton-m
ML = 0.46 ton-m

Md / S = 68.71
ML / S = 116.68
185.39 kg/cm²
0.6 Fy = 1512.00 kg/cm² **o.k.!!**

- Shear

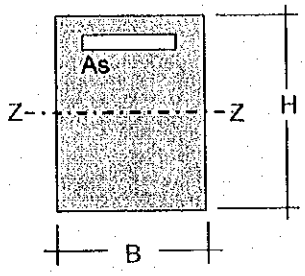
Max. Shear = 457.6 kg
Fv = V / (h tw) = 13.48 kg/cm²
0.4 Fy = 1008.00 kg/cm² **o.k.!!**

- Deflection

d admi.= L/360 = 1.78 cm
E = 2.0E+10 kg/m²
d dead = 0.09 cm
d Total = 0.15 cm o.k!!
d live = 0.05 cm

RF BEAM B-5

BEAM DESIGN



H = 65.00 cm

b = 30.00 cm

f'c = 280 kg/cm²

fy = 4200 kg/cm²

Forces and Moments, from Structural Analysis (ton , m) :

TYPE OF LOAD	MOMENT Mz-z
Dead Load	0.66
Live Load	0.12
Seismic x	1.82
Seismic y	0.00

COMBINATION	Mu z-z
C1=1.4 DL+1.7 LL	1.13
.75(1.4DL+1.7LL+1.	3.40
.75(1.4DL+1.7LL+1.	0.85

Force for design: Mu z-z = 3.40 ton-m

d = 57.46 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/f = \quad f = 0.90$

$1235.29\,As^2 - 241332\,As + 377777.78 = 0$ As = 1.58 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 2.10 cm²
(14/fy) b d = 5.75 cm²

Asmin = 2.10 cm²

Asmax : rb = 0.0459 Asmax (0.75rb) = 59.40 cm²

As = 2.10 cm² o.k!! As < Amax

Bar denomination, N = 8 Bar Area (Av) = 5.07 cm²

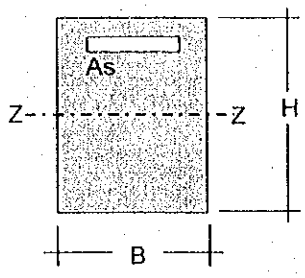
Number of bars = 0.42 **Use 1 - N8** 3-D25

Minimun Base Required:

Max. bars per layer = 3 Minimum Base = 27.78 cm

2nd Beam **B-10**

BEAM DESIGN



H = 65.00 cm

b = 30.00 cm

f'c = 280 kg/cm²

fy = 4200 kg/cm²

Forces and Moments, from Structural Analysis (ton , m) :

TYPE OF LOAD	MOMENT Mz-z
Dead Load	4.30
Live Load	1.50
Seismic x	8.10
Seismic y	0.00

COMBINATION	Mu z-z
C1=1.4 DL+1.7 LL	8.57
.75(1.4DL+1.7LL+1.	17.79
.75(1.4DL+1.7LL+1.	6.43

Force for design: Mu z-z = 17.80 ton-m

d = 57.46 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/f = \quad f = 0.90$

$1235.29\ As^2\ 241332\ \ 1977777.8 = 0$ As = 8.57 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 11.43 cm²
(14/fy) b d = 5.75 cm² } Asmin = 5.75 cm²

Asmax : rb = 0.0459 Asmax (0.75rb) = 59.40 cm²

As = 8.57 cm² o.k!! As < Amax

Bar denomination, N = 8 Bar Area (Av) = 5.07 cm²

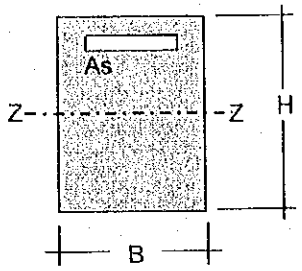
Number of bars = 1.69 **Use 2 - N8** 4-D25

Minimun Base Required:

Max. bars per layer = 3 Minimum Base = 27.78 cm

Canti Beam **CB-10**

BEAM DESIGN



H = 30.00 cm

b = 30.00 cm

f'c = 280 kg/cm²

fy = 4200 kg/cm²

Forces and Moments, from Structural Analysis (ton , m) :

TYPE OF LOAD	MOMENT Mz-z
Dead Load	0.39
Live Load	0.75
Seismic x	0.00
Seismic y	0.00

COMBINATION	Mu z-z
C1=1.4 DL+1.7 LL	1.82
.75(1.4DL+1.7LL+1.	1.37
.75(1.4DL+1.7LL+1.	1.37

Force for design: Mu z-z = 1.82 ton-m

d = 22.46 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/f = \quad f = 0.90$

$1235.29\ As^2 - 94332\ As + 202222.22 = 0$ As = 2.21 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 2.94 cm²
(14/fy) b d = 2.25 cm² } Asmin = 2.25 cm²

Asmax : rb = 0.0459 Asmax (0.75rb) = 23.22 cm²

As = 2.25 cm² o.k!! As < Amax

Bar denomination, N = 8 Bar Area (Av) = 5.07 cm²

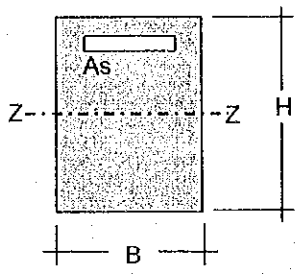
Number of bars = 0.44 **Use 1 - N8** 2-D25

Minimun Base Required:

Max. bars per layer = 3 Minimum Base = 27.78 cm

2nd Beam B-11

BEAM DESIGN



H = 40.00 cm

b = 30.00 cm

f'c = 280 kg/cm²

fy = 4200 kg/cm²

Forces and Moments, from Structural Analysis (ton , m) :

TYPE OF LOAD	MOMENT Mz-z
Dead Load	1.30
Live Load	0.60
Seismic x	1.60
Seismic y	0.00

COMBINATION	Mu z-z
C1=1.4 DL+1.7 LL	2.84
.75(1.4DL+1.7LL+1.	4.37
.75(1.4DL+1.7LL+1.	2.13

Force for design: Mu z-z = 4.37 ton-m

d = 32.46 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/f = \quad f = 0.90$

$1235.29\ As^2 - 136332\ As + 485555.56 = 0$ As = 3.68 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 4.91 cm²
(14/fy) b d = 3.25 cm² } Asmin = 3.25 cm²

Asmax : rb = 0.0459 Asmax (0.75rb) = 33.56 cm²

As = 3.68 cm² o.k!! As < Amax

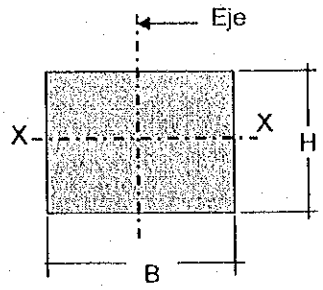
Bar denomination, N = 8 Bar Area (Av) = 5.07 cm²

Number of bars = 0.73 **Use 1 - N8** 3-D25

Minimun Base Required:

Max. bars per layer = 3 Minimum Base = 27.78 cm

Column **C1**



H = 0.40 m

B = 0.40 m

f 'c = 280 kg/cm²

fy = 4200 kg/cm²

Area = 1,600 cm²

Inertia Z = 2.1E+05 cm^4

Inertia Y = 2.1E+05 cm^4

Forces and Moments

From Structural Analisis (ton , m) :

TYPE O LOAD	AXIAL	MOMENT		SHEAR	
	P	Mz-z	Mx-x	Vx	Vz
Dead Load	3.06	1.46	1.00	0.19	0.10
Live Load	0.89	0.66	1.60	0.13	0.20
Seismic Loa	0.00	1.82	0.00	0.29	0.00
Seismic Loa	0.00	0.00	5.30	0.00	0.70

COMBINATI	Pu	Mu z-z	Mu x-x	Vu x	Vu z
C1	5.80	3.17	4.12	0.49	0.48
C2	4.35	6.13	---	0.93	---
C3	4.35	---	10.94	---	1.41

Forces for design.

Pu z = 4.35 ton Pu x = 4.35 ton

Mu x-x = 10.94 ton-m Mu z-z = 6.13 ton-m

Vu z = 0.93 ton Vu x = 1.41 ton

C1 = 1.4 DL + 1.7 LL

C2 = 0.75(1.4DL + 1.7LL + 1.87SLy)

C3 = 0.75(1.4DL + 1.7LL + 1.87SLz)

Ortogonal Combination

MX = 100%EQX + 30%EQZ MZ = 100%EQZ + 30%EQX

$Mx = Mx + Mz(H/B)(\frac{1-b}{\beta})$ b = 0.65 $MZ = Mz + Mx(B/H)(\frac{1-b}{\beta})$ b = 0.65

Slenderness.

iF klu/r > 22 Consider Slenderness .

k = 2.0 lu = 15.7 m r = (Inercia/Area)^½

Y Direction

r = 0.115 m klu/r = 271.932 > 22 Consider slenderness

Z Direction

r = 0.115 m klu/r = 271.932 > 22 Consider slenderness

Slenderness

Mc = dbMb + dsMs

db = cm/(1 - Pu/fPc) cm = 1.0

Pc = p²EI / (klu)² E = 2526713 ton/m²

Pu = Axial Force = 5.80 ton

X Dir. :		Z Dir. :	
Inertia =	0.0021 m²	Inertia =	0.0021 m²
Pc =	53.96 ton	Pc =	53.96 ton
db =	1.130	db =	1.130

Mu x-x = 6.92 ton-m

Mu z-z = 12.36 ton-m

- Design by flexure and Axial load

Z Direction : f = 0.70

Gross Area (Ag) =	0.16	m²	=	248.02	in²
h =	0.40	m	=	15.75	in
P =	4.35	ton	=	9.59	kips
M =	6.92	ton-m	=	601.08	kips-in

Pu/Ag = 0.04 Mu/Agh = 0.15

From the Load-Moment strength interaction diagram R4-60.90, the ρ value is:

r = [1] % As = Ag x r = 16.00 cm²

ar denomination = [8] Bar area = 5.07 cm²

Quantity of bars = 3.16

Use 4 N 8

X Direction : f = 0.7

Area Gruesa (Ag) =	0.16	m²	=	248.02	in²
h =	0.40	m	=	15.75	in
P =	4.35	ton	=	9.59	kips
M =	12.36	ton	=	1072.68	kips-in

Pu/Ag = 0.04 Mu/Agh = 0.27

From the Load-Moment strength interaction diagram R4-60.90, the ρ value is:

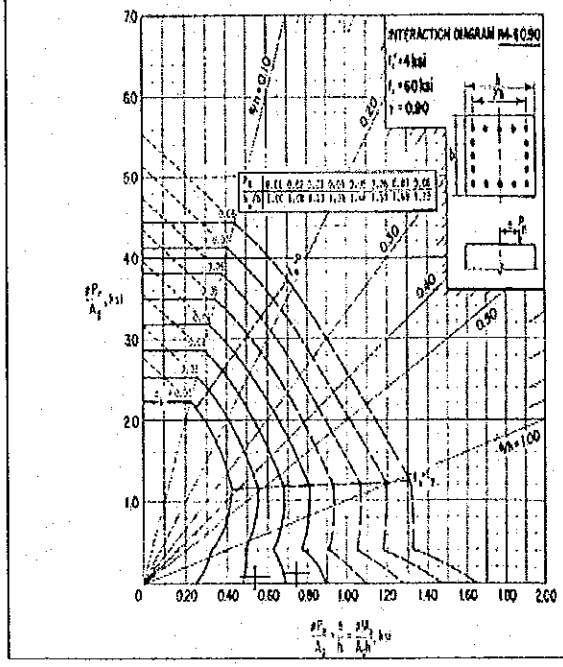
r ? [1] % As = Ag x r = 16.00 cm²

de varilla = [8] Bar area = 5.07 cm²

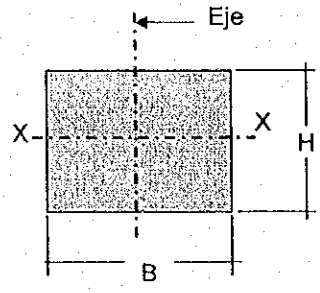
Quantity of bars = 3.16

Use 4 N 8

COLUMNS 7.4.4—Load-moment strength interaction diagram for R4-60.90 columns



Column **C2**



H = 0.45 m

B = 0.45 m

f 'c = 280 kg/cm²

fy = 4200 kg/cm²

Area = 2,025 cm²

Inertia Z = 3.4E+05 cm^4

Inertia Y = 3.4E+05 cm^4

Forces and Moments

From Structural Analisis (ton , m) :

TYPE O LOAD	AXIAL P	MOMENT Mz-z	MOMENT Mx-x	SHEAR Vx	SHEAR Vz
Dead Load	14.50	0.80	1.10	0.20	0.40
Live Load	3.10	0.60	0.00	0.20	0.00
Seismic Loa	5.40	7.60	0.00	2.70	0.00
Seismic Loa	2.60	0.00	6.90	0.00	2.40

COMBINATI	Pu	Mu z-z	Mu x-x	Vu x	Vu z
C1	25.57	2.14	1.54	0.62	0.56
C2	26.75	13.83	---	4.80	---
C3	22.82	---	12.55	---	4.40

Forces for design.

Pu z = 22.82 ton Pu x = 26.75 ton

Mu x-x = 12.55 ton-m Mu z-z = 13.83 ton-m

Vu z = 4.80 ton Vu x = 4.40 ton

C1 = 1.4 DL + 1.7 LL
C2 = 0.75(1.4DL + 1.7LL + 1.87SLy)
C3 = 0.75(1.4DL + 1.7LL + 1.87SLz)

Ortogonal Combination

MX = 100%EQX + 30%EQZ MZ = 100%EQZ + 30%EQX

$Mx = Mx + Mz(H/B)(\frac{1-b}{\beta})$ b = 0.65 $MZ = Mz + Mx(B/H)(\frac{1-b}{\beta})$ b = 0.65

Slenderness.

iF klu/r > 22 Consider Slenderness .

k = 1.0 lu = 5.45 m r = (Inercia/Area)^½

Y Direction

r = 0.130 m klu/r = 83.908 > 22 Consider slenderness

Z Direction

r = 0.130 m klu/r = 83.908 > 22 Consider slenderness

Slenderness

Mc = dbMb + dsMs

db = cm/(1 - Pu/fPc) cm = 1.0

$Pc = \pi^2 EI / (klu)^2$ E = 2526713 ton/m²

Pu = Axial Force = 26.75 ton

X Dir. :		Z Dir. :	
Inertia =	0.0034 m²	Inertia =	0.0034 m²
Pc =	717.25 ton	Pc =	717.25 ton
db =	1.056	db =	1.048

Mu x-x = 14.61 ton-m

Mu z-z = 13.15 ton-m

- Design by flexure and Axial load

Z Direction : f = 0.70

Gross Area (Ag) = 0.20 m² = 313.91 in²

h = 0.45 m = 17.72 in

P = 26.75 ton = 58.98 kips

M = 14.61 ton-m = 1267.75 kips-in

Pu/Ag = 0.19 Mu/Agh = 0.23

From the Load-Moment strength interaction diagram R4-60.90, the ρ value is:

r = 1 % As =Ag x r = 20.25 cm²

ar denomination = 8 Bar area = 5.07 cm²

Quantity of bars = 4.00

Use 4 N 8

X Direction : f = 0.7

Gross Area (Ag) = 0.20 m² = 313.91 in²

h = 0.45 m = 17.72 in

P = 22.82 ton = 50.32 kips

M = 13.15 ton = 1141.59 kips-in

Pu/Ag = 0.16 Mu/Agh = 0.21

From the Load-Moment strength interaction diagram R4-60.90, the ρ value is:

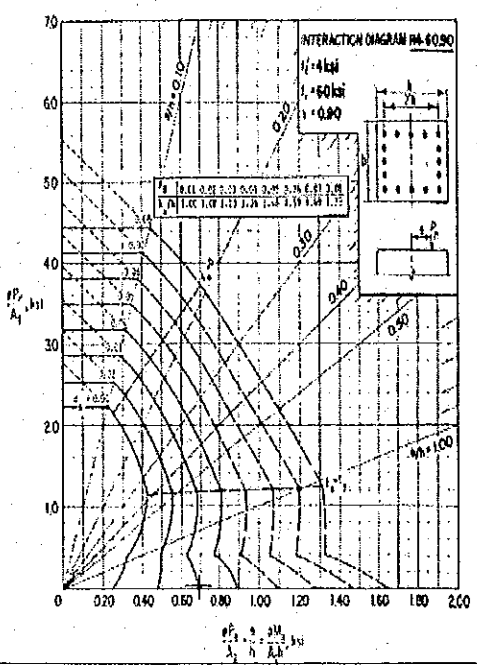
r ? 1 % As = Ag x r = 20.25 cm²

ar Denomination = 8 Bar area = 5.07 cm²

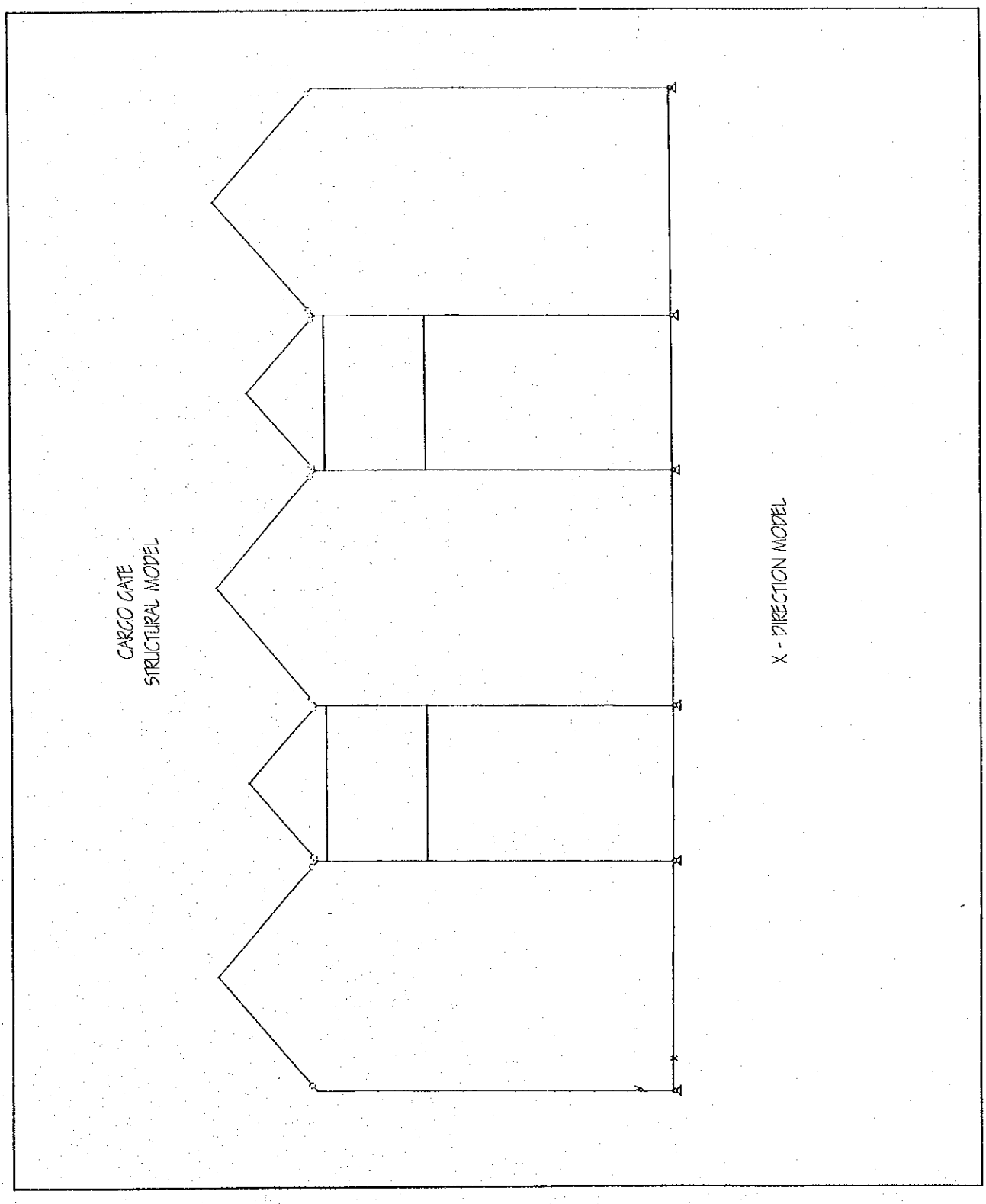
Quantity of bars = 4.00

Use 4 N 8

COLUMNS 7.4.4—Load-moment strength interaction diagram for R4-60.90 columns



PROJECT: Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.		Prepared by	H.WATANABE
SECTION: Cargo Gate	Calc. Index No.		Checked by	A.MORIOKA
SUBJECT: Structural Input	Date	July-02	Page 40	/ 43



Cargo Gate

Model X- direction

Node Coordinate

Node No.	x (m)	y (m)	z (m)
1	0	0	0
2	5.225	0	0
3	8.775	0	0
4	14.2	0	0
5	17.75	0	0
6	22.975	0	0
7	0	5.45	0
8	5.225	5.45	0
9	8.775	5.45	0
10	14.2	5.45	0
11	17.75	5.45	0
12	22.975	5.45	0
13	0	6.55	0
14	5.225	6.55	0
15	8.775	6.55	0
16	14.2	6.55	0
17	17.75	6.55	0
18	22.975	6.55	0
19	0	7.85	0
20	5.225	7.85	0
21	8.775	7.85	0
22	14.2	7.85	0
23	17.75	7.85	0
24	22.975	7.85	0
25	2.612	10.05	0
26	7	9.35	0
27	11.488	10.05	0
28	15.975	9.35	0
29	20.362	10.05	0
30	5.225	7.65	0
31	8.775	7.65	0
32	14.2	7.65	0
33	17.75	7.65	0

Element data

Member No.	node 1	node 2	length (m)
1	1	2	5.225
2	2	3	3.55
3	3	4	5.425
4	4	5	3.55
5	5	6	5.225
6	1	7	5.45
7	2	8	5.45
8	3	9	5.45
9	4	10	5.45
10	5	11	5.45
11	6	12	5.45
12	7	13	1.1
13	8	14	1.1
14	9	15	1.1
15	10	16	1.1
16	11	17	1.1
17	12	18	1.1
18	13	19	1.3
19	14	30	1.1
20	15	31	1.1
21	16	32	1.1
22	17	33	1.1
23	18	24	1.3
24	19	25	3.415
25	25	20	3.415
26	20	26	2.324
27	26	21	2.324
28	21	27	3.493
29	27	22	3.493
30	22	28	2.324
31	28	23	2.324
32	23	29	3.415
33	29	24	3.415
34	8	9	3.55
35	10	11	3.55
36	30	20	0.2
37	31	21	0.2
38	32	22	0.2
39	33	23	0.2
40	30	31	3.55
41	32	33	3.55

Section

Member	group	section	direction
1	Custom1	bd-40x80	0
2	Custom1	bd-40x80	0
3	Custom1	bd-40x80	0
4	Custom1	bd-40x80	0
5	Custom1	bd-40x80	0
6	Custom1	bd-40x40	0
7	Custom1	bd-45x45	0
8	Custom1	bd-45x45	0
9	Custom1	bd-45x45	0
10	Custom1	bd-45x45	0
11	Custom1	bd-40x40	0
12	Custom1	bd-40x40	0
13	Custom1	bd-45x45	0
14	Custom1	bd-45x45	0
15	Custom1	bd-45x45	0
16	Custom1	bd-45x45	0
17	Custom1	bd-40x40	0
18	Custom1	bd-35x35	0
19	Custom1	bd-45x45	0
20	Custom1	bd-45x45	0
21	Custom1	bd-45x45	0
22	Custom1	bd-45x45	0
23	Custom1	bd-35x35	0
24	W	W10x22	0
25	W	W10x22	0
26	W	W10x22	0
27	W	W10x22	0
28	W	W10x22	0
29	W	W10x22	0
30	W	W10x22	0
31	W	W10x22	0
32	W	W10x22	0
33	W	W10x22	0
34	Custom1	bd-30x65	0
35	Custom1	bd-30x65	0
36	Custom1	bd-45x45	0
37	Custom1	bd-45x45	0
38	Custom1	bd-45x45	0
39	Custom1	bd-45x45	0
40	Custom1	bd-30x65	0
41	Custom1	bd-30x65	0

REACTION

DL

Node	Rx	Ry	Rz	Mx	My	Mz
1	0.186	14.531	0	0	0	0
2	0.149	30.986	0	0	0	0
3	0.182	25.004	0	0	0	0
4	-0.182	25.004	0	0	0	0
5	-0.149	30.986	0	0	0	0
6	-0.186	14.531	0	0	0	0

LL

Node	Rx	Ry	Rz	Mx	My	Mz
1	0.129	9.214	0	0	0	0
2	-0.099	17.956	0	0	0	0
3	0.189	4.136	0	0	0	0
4	-0.19	4.021	0	0	0	0
5	0.1	17.841	0	0	0	0
6	-0.129	9.214	0	0	0	0

SL

Node	Rx	Ry	Rz	Mx	My	Mz
1	-0.293	-0.818	0	0	0	0
2	-2.399	-6.344	0	0	0	0
3	-2.408	6.183	0	0	0	0
4	-2.408	-6.183	0	0	0	0
5	-2.399	6.344	0	0	0	0
6	-0.293	0.818	0	0	0	0

DESIGN CALCULATION COVER SHEET

Project	Detailed Design on Port Reactivation Project in La Union Province.	**Project Code**	JC1N004
Section	**BUILDING WORKS**	Calc. File No.	
Sub-Section	**CARGO GATE**	Calc. Index No.	

Subject:

STRUCTURAL DESIGN FOR SPREAD FOUNDATIONS

Calculation Objective:

The objective of the calculation is to provide a safe structure for the ocupation of the building, by the use of the Republic of El Salvador and American design standards.

References, Calculation Notes and Comments

The Structural Analysis has been made using the program: "STAAD-III rev 21.1W, RESEARCH ENGINEERS, Inc.". The analysis of the structure considers only the concrete frames to resist the lateral forces, not considering the walls in the model.

One model for the structure has been constructed:

1- For the calculation of the Seismic and Dead & Live load.

The Key for the STAAD-III rev 21.1W program is attached for future convinience.

All the design has been made by calculations sheet created for the project in Microsoft Excel, and based in the following bibliography:

1. Building Code Requirements for Structural Concrete (318M-99), American Concrete Institute (ACI).

2. Technical Specification for Seismic Design, Ministry of Public Works, El Salvador, 2001.

3. AISC, American Institute of Steel Construction, ninth Edition, 1989.

4. Technical Specification for Wind Design, Ministry of Public Works, El Salvador, 1997.

5. UBC, Uniform Building Code, Volume 2: Structural Engineering Design Provisions, 1997.

Rev	Prepared		No. of	Checked		Reviewed		Superseded
	by	Date	Pages	by	Date	by	Date	by Calc No.
O	R.MARTINEZ	Aug-02	7	A. MORIOKA	Aug-02		14 Aug 02	
A								
B								
C								

NIPPON KOEI CO.,LTD.

PROJECT: Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.		Prepared by	H.WATANABE
SECTION: Cargo Gate	Calc. Index No.		Checked by	A.MORIOKA
SUBJECT: Vertical reactions	Date	July-02	Page	1 / 7

Reaction of each point

	1	2	3	4	5	6
A	24.1 26.2 **50.3**	23.0 11.3 **34.3**	35.8 3.8 **39.6**	35.8 3.8 **39.6**	38.4 11.8 **50.2**	24.1 26.2 **50.3**
B	24.0 26.0 **50.0**	30.6 30.8 **61.4**	16.5 3.9 **20.4**	25.6 4.2 **29.8**	40.6 32.7 **73.3**	24.1 26.0 **50.1**
C	24.1 26.2 **50.3**	40.6 32.7 **73.3**	25.6 4.2 **29.8**	16.5 3.9 **20.4**	30.6 30.8 **61.4**	24.1 26.2 **50.3**
D	24.1 26.2 **50.3**	38.4 11.8 **50.2**	35.8 3.8 **39.6**	35.8 3.8 **39.6**	23.0 11.3 **34.3**	24.1 26.2 **50.3**

upper line DL
middle line LL
lower line TL=DL+LL

Total dead load = 685.3 ton

Seismic load = 99.62 ton

NIPPON KOEI CO.,LTD.

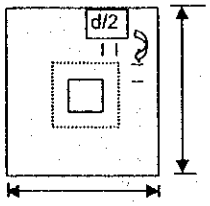
PROJECT: Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.		Prepared by	R.Martinez
SECTION: Cargo Gate	Calc. Index No.		Checked by	A. Morioka
SUBJECT: Spread Foundation design	Date	Aug-02	Page	7 / 7

FOOTING DESIGN

Design for foundation F-1

a) Punching

For Column



1.70 m

1.70 m

ϕ= 0.85

Dead load PD =	35.80	ton
Live load PL=	3.80	ton
Seismic PS =	17.90	ton
1.4D + 1.7L =	56.58	ton
0.75(1.4D + 1.7L + 1.87S) =	67.54	ton
Pu=	67.54	ton
d =	46.23	cm
Column width =	40.00	cm
Column base =	40.00	cm
bo=4(c+d)=	344.92	cm

Th = 55 cm

f'c = 210 kg/cm²
20.59 Mpa

Concrete shear strength, Vc ACI 11.12

$Vc1 = \phi(1+2/\beta c)\sqrt{f'c}\ bod/6$ = 313.70 ton

βc = 1.000

$Vc2 = \phi(2+\alpha sd/bo)\sqrt{f'c}\ bod/12$ = 132.60 ton

αs = 40

$Vc3 = \phi(1/3)\sqrt{f'c}\ bod$ = 209.13

Vc = 132.60 > 67.54 o.k!!!

b) Foundation Size

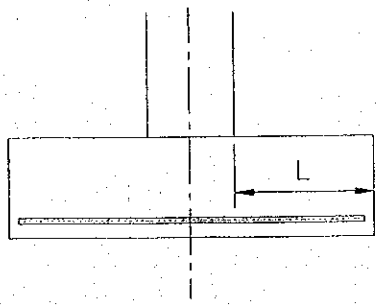
Soil Capacity = 20 ton/m² P = 54.27 ton

Square Foundation, Size = 1.65 m, ok!

Soil reaction = 18.78 ton/m²

c) Reinforcing Steel

fy = 4200 kg/cm²



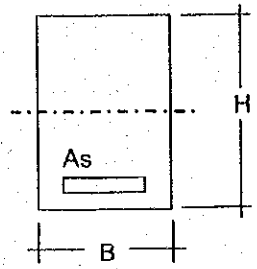
Moment generated by pile reaction

M = [(B-Bcolumn)/2]² x Soil reaction / 2

L = 0.65 m

M1 = 1.4D + 1.7L = 5.17 ton-m

M2 =0.75(1.4D + 1.7L + 1.87S) = 8.06 ton-m



H = 55.00 cm

b = 40.00 cm

f'c = 280 kg/cm²

fy = 4200 kg/cm²

Force for design: Mu z-z = 8.06 ton-m

d = 46.23 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = \phi = 0.90$

$926.47\,As^2 - 194166\,As + 895339.39 = 0$ As = 4.72 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 6.29 cm²

(14/fy) b d = 6.16 cm²

Asmin = 6.16 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 63.73 cm²

As = 6.16 cm² o.k!! As < Amax

Bar denomination, N = 7 Bar Area (Av) = 3.88 cm²

Number of bars = 1.59 Use 2 - N 7

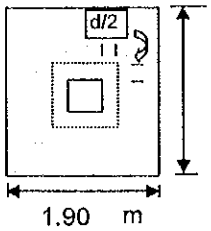
Pitch = 25.24 cm **7 @ 25 cm**

FOOTING DESIGN

Design for foundation F-2

a) Punching

For Column



ϕ= 0.85

Dead load PD =	38.40	ton
Live load PL=	11.80	ton
Seismic Ps =	19.20	ton
1.4D + 1.7L =	73.82	ton
0.75(1.4D + 1.7L + 1.87S) =	82.29	ton
Pu=	82.29	ton
d =	46.23	cm
Column width =	40.00	cm
Column base =	40.00	cm
bo=4(c+d)=	344.92	cm

Th = 55 cm

f'c = 210 kg/cm² (20.59 Mpa)

Concrete shear strength, Vc ACI 11.12

$Vc1 = \phi(1+2/\beta c)\sqrt{f'c}\ bod/6 =$ 313.70 ton

βc = 1.000

$Vc2 = \phi(2+\alpha sd/bo)\sqrt{f'c}\ bod/12 =$ 132.60 ton

αs = 40

$Vc3 = \phi(1/3)\sqrt{f'c}\ bod =$ 209.13

Vc = 132.60 > 82.29 o.k!!!

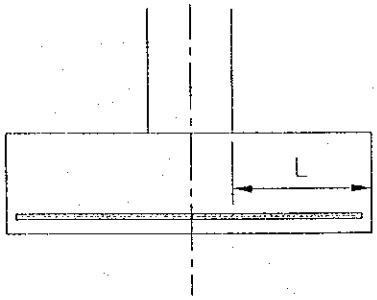
b) Foundation Size

Soil Capacity = 20 ton/m² P = 68.71 ton

Square Foundation, Size = 1.85 m, ok!

Soil reaction = 19.03 ton/m²

c) Reinforcing Steel



fy = 4200 kg/cm²

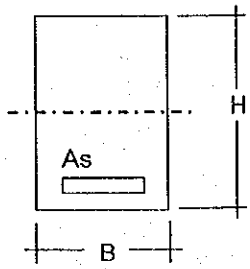
Moment generated by pile reaction

M = [(B-Bcolumn)/2]² x Soil reaction / 2

L = 0.75 m

M1 = 1.4D + 1.7L = 7.19 ton-m

M2 =0.75(1.4D + 1.7L + 1.87S) = 10.41 ton-m



H = 55.00 cm

b = 40.00 cm

f'c = 280 kg/cm²

fy = 4200 kg/cm²

Force for design: Mu z-z = 10.41 ton-m

d = 46.23 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = \quad \phi = 0.90$

$926.47\,As^2 - 194166\,As + 1156785.1 = 0$ As = 6.14 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 8.18 cm²

(14/fy) b d = 6.16 cm²

Asmin = 6.16 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 63.73 cm²

As = 6.16 cm² o.k!! As < Amax

Bar denomination, N = 7 Bar Area (Av) = 3.88 cm²

Number of bars = 1.59 Use 2 - N7

Pitch = 25.24 cm **7 @ 25 cm**

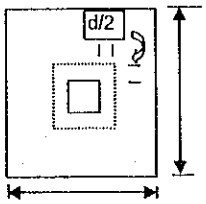
PROJECT: Detailed Design on Port Reactivation Project In La Union Province	Calc. File No.		Prepared by	R.Martinez
SECTION: Cargo Gate	Calc. Index No.		Checked by	A. Morioka
SUBJECT: Spread Foundation design	Date	Aug-02	Page	6 17

FOOTING DESIGN

Design for foundation F-3

a) Punching

For Column



ϕ= 0.85

Dead load PD =	40.60	ton
Live load PL=	32.70	ton
Seismic PS =	20.30	ton
1.4D + 1.7L =	112.43	ton
0.75(1.4D + 1.7L + 1.87S) =	112.79	ton
Pu=	112.79	ton
d =	46.23	cm
Column width =	45.00	cm
Column base =	45.00	cm
bo=4(c+d)=	364.92	cm

Th = 55 cm

f'c = 210 kg/cm² = 20.59 Mpa

Concrete shear strength, Vc ACI 11.12

$Vc1 = \phi(1+2/\beta c)\sqrt{f'c}\ bod/6$ = 331.89 ton

βc = 1.000

$Vc2 = \phi(2+\alpha sd/bo)\sqrt{f'c}\ bod/12$ = 138.66 ton

αs = 40

$Vc3 = \phi(1/3)\sqrt{f'c}\ bod$ = 221.26

Vc = 138.66 > 112.79 o.k!!!

b) Foundation Size

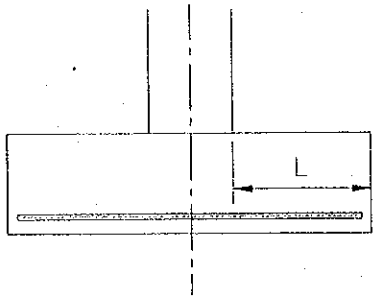
Soil Capacity = 20 ton/m² P = 99.98 ton

Square Foundation, Size = 2.24 m, ok!

Soil reaction = 19.75 ton/m²

c) Reinforcing Steel

fy = 4200 kg/cm²



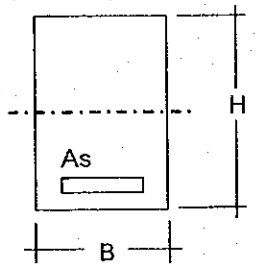
Moment generated by pile reaction

M = [(B-Bcolumn)/2]² x Soil reaction / 2

L = 0.90 m

M1 = 1.4D + 1.7L = 11.24 ton-m

M2 =0.75(1.4D + 1.7L + 1.87S) = 14.53 ton-m



H = 55.00 cm

b = 45.00 cm

f'c = 280 kg/cm²

fy = 4200 kg/cm²

Force for design: Mu z-z = 14.53 ton-m

d = 46.23 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/\phi = \quad \phi = 0.90$

$823.53\ As^2\ 194166\ As\ 1614024.2 = 0$ As = 8.63 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 11.50 cm²

(14/fy) b d = 6.93 cm² } Asmin = 6.93 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 71.69 cm²

As = 8.63 cm² o.k!! As < Amax

Bar denomination, N = 8 Bar Area (Av) = 5.07 cm²

Number of bars = 1.70 Use 2 - N8

Pitch = 29.92 cm **8 @ 29.5 cm**