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	**POWER SUPPLY STATION**	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 vertical and lateral forces, not considering the walls in the model.

Two models for the structure have been constructed:

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

2- For the calculation of the seismic forces.

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. 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Rev	Prepared		No. of	Checked		Reviewed		Superseded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	Rubén Martínez	Jul-02	61	A. MORIOKA	Jul-02			
A								
B								
C								

- DEAD LOAD

Reinforced Concrete Slab

Slab 1 thickness = 0.15 m Weight = 360.00 kg/m²

Slab 2 thickness = 0.12 m Weight = 288.00 kg/m²

Ceiling

The ceiling consists of cement fiber board with aluminium frame.

Weight = 20.00 kg/m²

Floor finish

The floor finish consists of Ceramic Tile

Weight = 60.00 kg/m²

Asphalt protection.

The asphalt protection is used for the roof.

Weight = 15.00 kg/m²

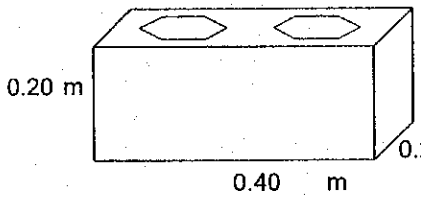
Concrete protection.

The concrete protection is used for the Generator room and roof.

Weight = 48.00 kg/m² th = 0.02 m

Walls

a) Concrete Hollow Block wall, th = 0.20 m



Area of block = 0.08 m²

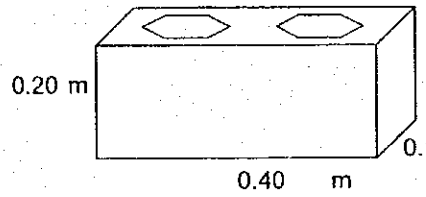
Weight of block = 14.06 kg

Hole filled with concrete = 9.41 kg

23.47 kg

Wall weight = 293.37 kg/m²

b) Concrete Hollow Block wall, th = 0.15 m



Area of block = 0.08 m²

Weight of block = 11.34 kg

Hole filled with concrete = 6.72 kg

18.06 kg

Wall weight = 225.75 kg/m²

Concrete block wall weights

Block	W height (m)	thickness (m)	W weight (kg/m²)	Dist. Weight (kg/m)
20 cm	4.00	0.20	293.37	1173.47
15 cm	4.00	15.00	225.75	902.99

WEIGHTS PER LEVEL

a) Roof

Concrete slab, th=0.12m	288.00
Ceiling	20.00
Asphalt protection	15.00
Concrete protection	48.00

Wd = 371.00 kg/m²

b) First floor, Generator room

Concrete slab, th=0.15m	360.00	Wd =	408.00	kg/m²
Concrete protection	48.00			

c) First floor, other.

Concrete slab, th=0.15m	360.00	Wd =	420.00	kg/m²
Floor finish	60.00			

- LIVE LOAD

		Live load (kg/m²)	
Area	Room	Wm	Wi
Roof	Roof, slope < 5 %	100	50
Machine room	Generator room Transformer room	500	---
Office		250	---

Roof Loads

Roof Area = 398.16 m²

Area of Border Beam = 0.12 m² L = 81.3 m

Roof Dead Load = 171.1 ton

Roof Live load = 39.82 ton

Roof Live load for seismic = 19.91 ton

Load for STAAD :

Total roof load for Seismic Analysis = 191.04 ton

# of Joints = 40

Load per Joint = 4.776 ton/joint

BEAM LOADS

Beams in Axis 1

Tributary area =	9.00	m²	Wdead =	742.0	kg/m
L dist =	4.50	m	Wlive =	200.00	kg/m

Beams in Axis 2

From A to B Axis

Tributary area =	9.00	m²	Wdead =	742.0	kg/m
L dist =	4.50	m	Wlive =	200.00	kg/m

From B to C Axis

Tributary area =	6.50	m²	Wdead =	689.0	kg/m
L dist =	3.50	m	Wlive =	185.71	kg/m

Beams in Axis 3

From A to B Axis

Tributary area =	9.00	m²	Wdead =	742.0	kg/m
L dist =	4.50	m	Wlive =	200.00	kg/m

From B to C Axis

Tributary area =	6.00	m²	Wdead =	636.0	kg/m
L dist =	3.50	m	Wlive =	171.43	kg/m

Beams in Axis 4

From A to B Axis

Tributary area =	9.32	m²	Wdead =	768.4	kg/m
L dist =	4.50	m	Wlive =	207.11	kg/m

From B to C Axis

Tributary area =	6.07	m²	Wdead =	643.4	kg/m
L dist =	3.50	m	Wlive =	173.43	kg/m

Beams in Axis 5

From A to B Axis

Tributary area =	9.64	m²	Wdead =	794.8	kg/m
L dist =	4.50	m	Wlive =	214.22	kg/m

From B to C Axis

Tributary area = 6.14 m² Wdead = 650.8 kg/m
L dist = 3.50 m Wlive = 175.43 kg/m

Beams in Axis 6

From A to B Axis

Tributary area = 9.32 m² Wdead = 768.4 kg/m
L dist = 4.50 m Wlive = 207.11 kg/m

From B to C Axis

Tributary area = 6.57 m² Wdead = 696.4 kg/m
L dist = 3.50 m Wlive = 187.71 kg/m

Beams between Axis 1 & 2

Tributary area = 9.00 m² Wdead = 742.0 kg/m
L dist = 4.50 m Wlive = 200.00 kg/m

Beams between Axis 2 & 3 and Axis 3 & 4

From A to B Axis

Tributary area = 9.00 m² Wdead = 742.0 kg/m
L dist = 4.50 m Wlive = 200.00 kg/m

From B to C Axis

Tributary area = 6.00 m² Wdead = 636.0 kg/m
L dist = 3.50 m Wlive = 171.43 kg/m

Beams between Axis 4 & 5 and Axis 5 & 6

From A to B Axis

Tributary area = 9.64 m² Wdead = 794.8 kg/m
L dist = 4.50 m Wlive = 214.22 kg/m

From B to C Axis

Tributary area = 6.14 m² Wdead = 650.8 kg/m
L dist = 3.50 m Wlive = 175.43 kg/m

Beams in A Axis.

From 1 to 4 Axis

Tributary area =	5.25	m²	Wdead =	649.3	kg/m
L dist =	3.00	m	Wlive =	175.00	kg/m

From 4 to 6 Axis

Tributary area =	6.57	m²	Wdead =	696.4	kg/m
L dist =	3.50	m	Wlive =	187.71	kg/m

Beams in B Axis and between Axis B & C

From 1 to 2 Axis

Tributary area =	5.25	m²	Wdead =	649.3	kg/m
L dist =	3.00	m	Wlive =	175.00	kg/m

From 2 to 4 Axis

Tributary area =	4.50	m²	Wdead =	556.5	kg/m
L dist =	3.00	m	Wlive =	150.00	kg/m

From 4 to 6 Axis

Tributary area =	6.14	m²	Wdead =	759.3	kg/m
L dist =	3.00	m	Wlive =	204.67	kg/m

Beams in C Axis

From 2 to 4 Axis

Tributary area =	5.25	m²	Wdead =	649.3	kg/m
L dist =	3.00	m	Wlive =	175.00	kg/m

From 2 to 4 Axis

Tributary area =	6.57	m²	Wdead =	696.4	kg/m
L dist =	3.50	m	Wlive =	187.71	kg/m

Beams between B & C Axis

From 2 to 4 Axis

Tributary area =	5.25	m²	Wdead =	649.3	kg/m
L dist =	3.00	m	Wlive =	175.00	kg/m

From 2 to 4 Axis

Tributary area =	6.57	m²	Wdead =	696.4	kg/m
L dist =	3.50	m	Wlive =	187.71	kg/m

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, $T = Ct\ hn^{3/4}$

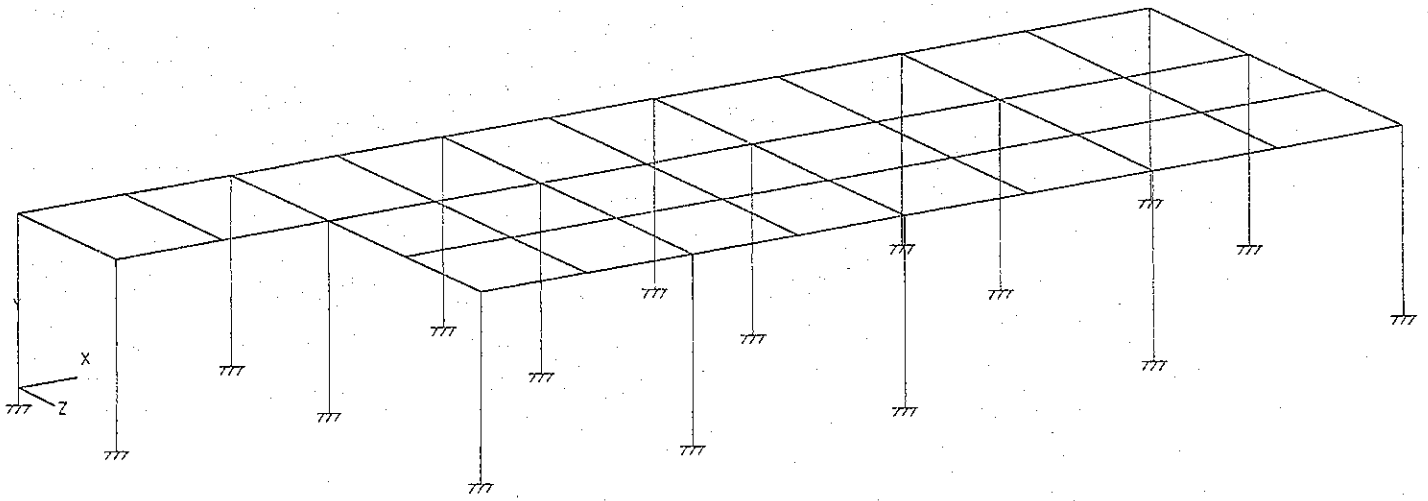
Type of structure coefficient, Ct = 0.073 (For concrete frames system)

The Period of the Sructure and the Cs coefficient is calculated by the structural program (STAAD-III):

SEISMIC FORCE DIRECTION	Period T (sec.)	Coefficient Cs
X-Direction (Strong direction)	0.33	0.201
Z-Direction (Weak direction)	0.32	0.201

STRUCTURE DATA

TYPE = SPACE
NJ = 57
NM = 82
NE = 0
NS = 17
NL = 2
XMAX= 32.0
YMAX= 4.5
ZMAX= 11.5



J=57,M=82

UNIT MET MTO

S T A A D P O S T - P L O T (REV: 21.1W)

DATE: JUL 10, 2002

TITLE: POWER SUPPLY STATION

CALCULATION		
Detailed Design on Port Reactivation Project In La Union Province		
CALC FILE No.:		
CALC INDEX No.:		PAGE 8
	INITIAL	DATE
PREPARED BY	R.M.G.	July/02
CHECKED BY	A.M.	July/02

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            ****************************************************
            *                                                  *
            *           S T A A D - III                        *
            *           Revision 21.1W                         *
            *           Proprietary Program of                 *
            *           RESEARCH ENGINEERS, Inc.               *
            *           Date=    MAY 10, 2002                  *
            *                                                  *
            ****************************************************

 1. STAAD SPACE POWER SUPPLY STATION
 2. *DEAD & LIVE FORCES
 3. INPUT WIDTH 72
 4. *FRAMES 2 TO 6
 5. UNIT METER MTON
 6. JOINT COORDINATES
 7. 1 0 0 0 4 18 0 0
 8. 5 25 0 0 6 32 0 0
 9. 7 0 0 4.50 10 18 0 4.50
10. 11 25 0 4.50 12 32 0 4.50
11. 13 6.00 0 11.50 15 18 0 11.50
12. 16 25 0 11.50 17 32 0 11.50
13. 18 0 4.50 0 24 18 4.50 0
14. 25 21.5 4.50 0 28 32 4.50 0
15. 29 0 4.50 4.50 35 18 4.50 4.50
16. 36 21.5 4.50 4.50 39 32 4.50 4.50
17. 40 6.00 4.50 8.00 44 18 4.50 8.00
18. 45 21.5 4.50 8.00 48 32 4.50 8.00
19. 49 6.00 4.50 11.50 53 18 4.50 11.50
20. 54 21.50 4.50 11.50 57 32.00 4.50 11.50
21. MEMBER INCIDENCES
22. *COLUMNS
23. 1 1 18; 2 2 20; 3 3 22; 4 4 24; 5 5 26
24. 6 6 28 7; 8 8 31; 9 9 33; 10 10 35
25. 11 11 37; 12 12 39; 13 13 49; 14 14 51
26. 15 15 53; 16 16 55; 17 17 57
27. *BEAMS
28. 18 18 19 27; 28 29 30 37; 38 40 41 45
29. 46 49 50 53
30. 54 18 29 64; 65 31 40 73; 74 40 49 82
31. MEMBER PROPERTY AMERICAN
32. *COLUMNS
33. 1 TO 17 PRI YD 0.45 ZD 0.45
34. *BEAMS
35. *NUMERIC AXIS BEAMS
36. 54 56 58 60 62 64 PRI YD 0.45 ZD 0.30
37. 65 67 69 71 73 PRI YD 0.45 ZD 0.30
38. 74 76 78 80 82 PRI YD 0.45 ZD 0.30
39. *BEAMS IN LETTER AXIS DIRECTION
40. 18 TO 53 PRI YD 0.40 ZD 0.30
```

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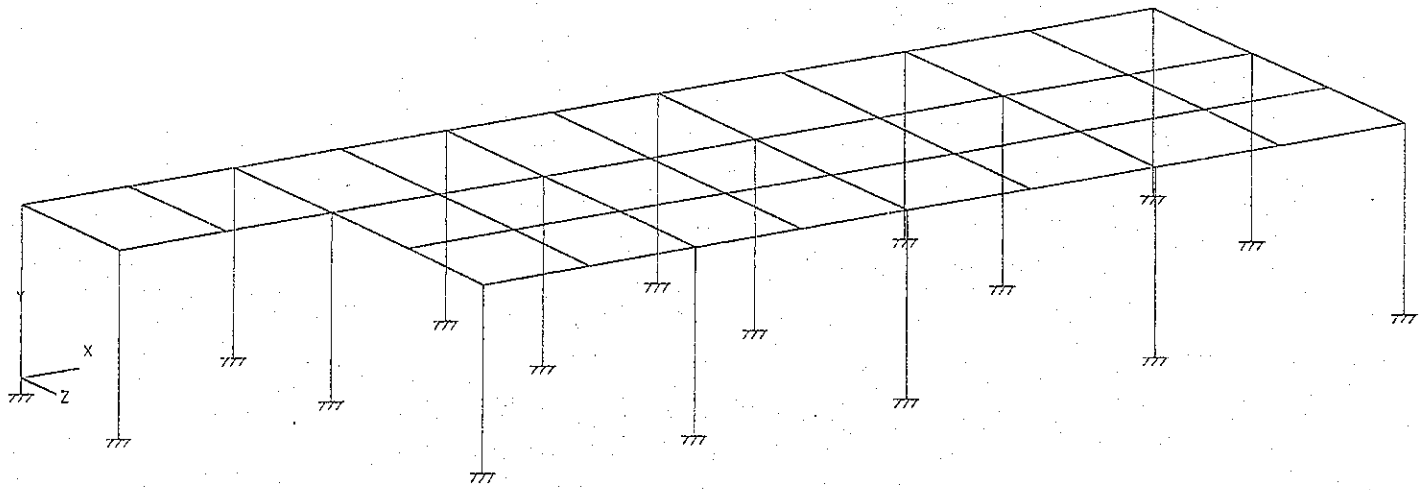
41. *BEAMS BETWEEN NUM. AXIS
42. 55 57 59 61 63 66 68 PRI YD 0.35 ZD 0.25
43. 70 72 75 77 79 81 PRI YD 0.35 ZD 0.25
44. CONSTANT
45. E 2526713. ALL
46. DENSITY CONCRETE ALL
47. SUPPORT
48. 1 TO 17 FIXED
49. LOAD 1 DEAD LOAD
50. SELFWEIGHT Y -1
51. MEMBER LOAD
52. 54 56 58 UNI GY -0.742
53. 65 74 UNI GY -0.689
54. 67 76 UNI GY -0.636
55. 60 64 UNI GY -0.769
56. 69 78 UNI GY -0.644
57. 62 UNI GY -0.795
58. 71 80 UNI GY -0.651
59. 73 82 UNI GY -0.697
60. 55 57 59 UNI GY -0.742
61. 66 75 68 77 UNI GY -0.636
62. 61 63 UNI GY -0.795
63. 70 79 72 81 UNI GY -0.651
64. 18 TO 23 28 29 UNI GY -0.650
65. 24 TO 27 UNI GY -0.697
66. 30 TO 33 UNI GY -0.556
67. 34 TO 37 UNI GY -0.760
68. 38 TO 41 46 TO 49 UNI GY -0.650
69. 42 TO 45 50 TO 53 UNI GY -0.697
70. LOAD 2 LIVE LOAD
71. MEMBER LOAD
72. 54 56 58 UNI GY -0.200
73. 65 74 UNI GY -0.186
74. 67 76 UNI GY -0.172
75. 60 64 UNI GY -0.207
76. 69 78 UNI GY -0.174
77. 62 UNI GY -0.214
78. 71 80 UNI GY -0.176
79. 73 82 UNI GY -0.188
80. 55 57 59 UNI GY -0.200
81. 66 75 68 77 UNI GY -0.172
82. 61 63 UNI GY -0.215
83. 70 79 72 81 UNI GY -0.176
84. 18 TO 23 28 29 UNI GY -0.175
85. 24 TO 27 UNI GY -0.188
86. 30 TO 33 UNI GY -0.150
87. 34 TO 37 UNI GY -0.205
88. 46 TO 49 UNI GY -0.175
89. 50 TO 53 UNI GY -0.188
90. PERFORM ANALYSIS
```

JOINT

STRUCTURE DATA

TYPE = SPACE
NJ = 57
NM = 82
NE = 0
NS = 17
NL = 2
XMAX= 32.0
YMAX= 4.5
ZMAX= 11.5



J=57,M=82

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DATE: JUL 10, 2002

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CHECKED BY	A.M.	JULY/02

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            *                                                *
            *           S T A A D - III                      *
            *           Revision 21.1W                       *
            *           Proprietary Program of               *
            *           RESEARCH ENGINEERS, Inc.             *
            *           Date=    JUL 10, 2002                *
            **************************************************

 1. STAAD SPACE POWER SUPPLY STATION
 2. *SEISMIC FORCES
 3. INPUT WIDTH 72
 4. *FRAMES 2 TO 6
 5. UNIT METER MTON
 6. JOINT COORDINATES
 7. 1 0 0 0 4 18 0 0
 8. 5 25 0 0 6 32 0 0
 9. 7 0 0 4.50 10 18 0 4.50
10. 11 25 0 4.50 12 32 0 4.50
11. 13 6.00 0 11.50 15 18 0 11.50
12. 16 25 0 11.50 17 32 0 11.50
13. 18 0 4.50 0 24 18 4.50 0
14. 25 21.5 4.50 0 28 32 4.50 0
15. 29 0 4.50 4.50 35 18 4.50 4.50
16. 36 21.5 4.50 4.50 39 32 4.50 4.50
17. 40 6.00 4.50 8.00 44 18 4.50 8.00
18. 45 21.5 4.50 8.00 48 32 4.50 8.00
19. 49 6.00 4.50 11.50 53 18 4.50 11.50
20. 54 21.50 4.50 11.50 57 32.00 4.50 11.50
21. MEMBER INCIDENCES
22. *COLUMNS
23. 1 1 18; 2 2 20; 3 3 22; 4 4 24; 5 5 26
24. 6 6 28 7; 8 8 31; 9 9 33; 10 10 35
25. 11 11 37; 12 12 39; 13 13 49; 14 14 51
26. 15 15 53; 16 16 55; 17 17 57
27. *BEAMS
28. 18 18 19 27; 28 29 30 37; 38 40 41 45
29. 46 49 50 53
30. 54 18 29 64; 65 31 40 73; 74 40 49 82
31. MEMBER PROPERTY AMERICAN
32. *COLUMNS
33. 1 TO 17 PRI YD 0.45 ZD 0.45
34. *BEAMS
35. *NUMERIC AXIS BEAMS
36. 54 56 58 60 62 64 PRI YD 0.45 ZD 0.30
37. 65 67 69 71 73 PRI YD 0.45 ZD 0.30
38. 74 76 78 80 82 PRI YD 0.45 ZD 0.30
39. *BEAMS IN LETTER AXIS DIRECTION
40. 18 TO 53 PRI YD 0.40 ZD 0.30
```

```
41. *BEAMS BETWEEN NUM. AXIS
42. 55 57 59 61 63 66 68 PRI YD 0.35 ZD 0.25
43. 70 72 75 77 79 81 PRI YD 0.35 ZD 0.25
44. CONSTANT
45. E 2526713. ALL
46. DENSITY CONCRETE ALL
47. SUPPORT
48. 1 TO 17 FIXED
49. DEFINE UBC LOAD
50. ZONE 0.4 I 1.2 RWX 12 RWZ 12 S 3.00 CT 0.073 TS 0.90
51. SELFWEIGHT
52. JOINT WEIGHT
53. 18 TO 57 WEIGHT 4.776
54. LOAD 1 EQ X
55. UBC LOAD X 1
56. LOAD 2 EQ Z
57. UBC LOAD Z 1
58. PERFORM ANALYSIS PRINT LOAD DATA
```

```
*SEISMIC FORCES

   LOADING     1    EQ X
   -----------

   LOADING     2    EQ Z
   -----------

   ************************************************************
   *                                                          *
   *  CALC/USED PERIOD FOR X  UBC =  0.3312/  0.3312 SEC     *
   *  C, C-ALT =  0.1158 ,  4.4701, LOAD FACTOR = 1.000      *
   *  UBC FACTOR V =  0.2016 X    292.43 =      58.95 MTON    *
   *                                                          *
   ************************************************************

   ************************************************************
   *                                                          *
   *  CALC/USED PERIOD FOR Z  UBC =  0.3202/  0.3202 SEC     *
   *  C, C-ALT =  0.1178 ,  4.4701, LOAD FACTOR = 1.000      *
   *  UBC FACTOR V =  0.2016 X    292.43 =      58.95 MTON    *
   *                                                          *
   ************************************************************

    JOINT          LATERAL LOAD (MTON),    LOAD -    1
    -----          --------------          FACTOR -    1.000

      18      FX         1.514
      19      FX         1.316
      20      FX         1.607
      21      FX         1.316
      22      FX         1.607
      23      FX         1.316
      24      FX         1.623
      25      FX         1.347
      26      FX         1.638
      27      FX         1.347
      28      FX         1.530
      29      FX         1.514
      30      FX         1.316
      31      FX         1.730
      32      FX         1.396
      33      FX         1.730
      34      FX         1.396
      35      FX         1.745
      36      FX         1.427
      37      FX         1.761
      38      FX         1.427
      39      FX         1.652
      40      FX         1.366
```

```
     41      FX          1.373
     42      FX          1.459
     43      FX          1.373
     44      FX          1.474
     45      FX          1.404
     46      FX          1.490
     47      FX          1.404
     48      FX          1.381
     49      FX          1.479
     50      FX          1.294
     51      FX          1.572
     52      FX          1.294
     53      FX          1.588
     54      FX          1.325
     55      FX          1.603
     56      FX          1.325
     57      FX          1.495
       *              ----------
       * TOTAL =      58.954 AT LEVEL      4.500 METE
       *
  JOINT          LATERAL LOAD (MTON),    LOAD -    2
  -----          --------------          FACTOR -    1.000
     18      FZ          1.514
     19      FZ          1.316
     20      FZ          1.607
     21      FZ          1.316
     22      FZ          1.607
     23      FZ          1.316
     24      FZ          1.623
     25      FZ          1.347
     26      FZ          1.638
     27      FZ          1.347
     28      FZ          1.530
     29      FZ          1.514
     30      FZ          1.316
     31      FZ          1.730
     32      FZ          1.396
     33      FZ          1.730
     34      FZ          1.396
     35      FZ          1.745
     36      FZ          1.427
     37      FZ          1.761
     38      FZ          1.427
     39      FZ          1.652
     40      FZ          1.366
     41      FZ          1.373
     42      FZ          1.459
     43      FZ          1.373
     44      FZ          1.474
     45      FZ          1.404
     46      FZ          1.490
```

```
47      FZ          1.404
48      FZ          1.381
49      FZ          1.479
50      FZ          1.294
51      FZ          1.572
52      FZ          1.294
53      FZ          1.588
54      FZ          1.325
55      FZ          1.603
56      FZ          1.325
57      FZ          1.495
  *          -----------
  * TOTAL =      58.954 AT LEVEL      4.500 METE
  *
```

VERTICAL LOADS

	Roof (ton)		First Floor (ton)		
Axis	Dead Load	Live Load	Area (m²)	Dead	Live
1-A	8.22	1.15	6.75	2.84	3.38
2-A	11.81	1.89	13.50	5.67	6.75
3-A	10.91	1.76	13.50	5.67	6.75
4-A	11.76	1.95	14.63	6.14	7.31
5-A	12.82	2.19	15.75	6.62	7.88
6-A	8.11	1.20	7.88	3.31	3.94
1-B	8.10	1.14	6.75	2.84	3.38
2-B	19.94	3.05	24.00	10.08	12.00
3-B	23.07	3.27	34.50	14.49	17.25
4-B	24.54	3.56	35.65	14.97	17.83
5-B	27.21	4.03	21.00	8.82	10.50
6-B	16.79	2.45	18.00	7.56	9.00
2~3-B'	0.00	0.00	0.00	0.00	0.00
3~4-B'	0.00	0.00	0.00	0.00	0.00
2-C	10.52	1.34	10.50	4.41	5.25
3-C	16.67	2.22	21.00	8.82	10.50
4-C	17.19	2.30	21.70	9.11	10.85
5-C	19.04	2.57	12.25	5.15	6.13
6-C	11.40	1.48	6.13	2.57	3.06

Wd = 420.0 kg/m²

Wl = 500.0 kg/m²

	ton				
Axis	Walls	Footing	Total	Pile Bearing Capacity	
1-A	6.16	2.03	23.77	80.00	o.k!!!
2-A	9.68	2.03	37.83	80.00	o.k!!!
3-A	7.04	2.03	34.16	80.00	o.k!!!
4-A	7.63	2.03	36.83	80.00	o.k!!!
5-A	8.21	2.03	39.75	80.00	o.k!!!
6-A	4.11	2.03	22.69	80.00	o.k!!!
1-B	5.77	2.03	23.25	80.00	o.k!!!
2-B	10.27	2.03	57.37	80.00	o.k!!!
3-B	0.00	2.03	60.11	80.00	o.k!!!
4-B	6.75	2.03	69.68	80.00	o.k!!!
5-B	0.00	2.03	52.59	80.00	o.k!!!
6-B	6.75	2.03	44.58	80.00	o.k!!!
2~3-B'	0.00	2.03	2.03	80.00	o.k!!!
3~4-B'	0.00	2.03	2.03	80.00	o.k!!!
2-C	7.63	2.03	31.18	80.00	o.k!!!
3-C	7.04	2.03	47.28	80.00	o.k!!!
4-C	11.73	2.03	53.22	80.00	o.k!!!
5-C	8.21	2.03	43.13	80.00	o.k!!!
6-C	8.21	2.03	28.76	80.00	o.k!!!

SUPPORT REACTIONS -UNIT MTON METE STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	1.10	8.22	0.57	0.87	-0.03	-1.64
	2	0.21	1.15	0.11	0.16	0.00	-0.32
2	1	-0.10	11.81	0.57	1.10	-0.03	0.13
	2	-0.02	1.89	0.11	0.19	0.00	0.03
3	1	0.01	10.91	0.51	1.11	-0.01	-0.05
	2	0.00	1.76	0.10	0.19	0.00	-0.01
4	1	0.37	11.76	0.54	1.19	0.00	-0.61
	2	0.08	1.95	0.11	0.20	0.00	-0.12
5	1	0.19	12.82	0.55	1.20	0.01	-0.36
	2	0.03	2.19	0.11	0.20	0.00	-0.07
6	1	-1.47	8.11	0.50	1.03	0.02	2.07
	2	-0.29	1.20	0.10	0.17	0.00	0.42
7	1	1.05	8.10	-0.50	-0.70	-0.02	-1.55
	2	0.21	1.14	-0.10	-0.14	0.00	-0.31
8	1	0.47	19.94	1.09	1.87	-0.01	-0.71
	2	0.05	3.05	0.11	0.19	0.00	-0.07
9	1	-0.07	23.07	1.89	3.16	0.00	0.07
	2	-0.01	3.27	0.17	0.29	0.00	0.01
10	1	0.54	24.54	2.00	3.35	0.00	-0.86
	2	0.10	3.56	0.17	0.29	0.00	-0.16
11	1	0.27	27.21	2.21	3.67	0.00	-0.50
	2	0.04	4.03	0.19	0.32	0.00	-0.08
12	1	-2.35	16.79	1.33	2.27	0.00	3.35
	2	-0.40	2.45	0.14	0.23	0.00	0.57
13	1	1.29	10.52	-1.66	-2.18	-0.02	-1.93
	2	0.21	1.34	-0.22	-0.30	0.00	-0.31
14	1	-0.15	16.67	-2.46	-3.26	-0.01	0.19
	2	-0.02	2.22	-0.28	-0.38	0.00	0.03

SUPPORT REACTIONS -UNIT MTON METE STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
15	1	0.38	17.19	-2.55	-3.36	-0.01	-0.61
	2	0.06	2.30	-0.28	-0.38	0.00	-0.10
16	1	0.23	19.04	-2.82	-3.75	0.01	-0.42
	2	0.04	2.57	-0.31	-0.42	0.00	-0.07
17	1	-1.76	11.40	-1.77	-2.31	0.02	2.50
	2	-0.28	1.48	-0.23	-0.30	0.00	0.40

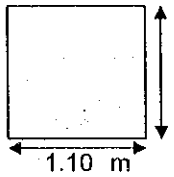
SUPPORT REACTIONS -UNIT MTON METE STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	-2.46	-1.25	-0.14	-0.37	-0.13	7.51
	2	-0.08	-1.88	-2.30	-6.20	0.37	0.17
2	1	-3.28	0.21	0.01	0.02	-0.08	8.73
	2	-0.04	-2.38	-3.30	-8.96	0.15	0.10
3	1	-3.21	-0.05	0.00	0.00	-0.07	8.62
	2	-0.04	-2.63	-3.68	-10.00	0.05	0.09
4	1	-3.13	0.25	0.01	0.03	-0.07	8.51
	2	-0.03	-2.69	-3.78	-10.26	0.05	0.07
5	1	-3.12	-0.13	0.01	0.03	-0.08	8.50
	2	-0.02	-2.66	-3.73	-10.15	-0.05	0.05
6	1	-2.35	0.92	0.05	0.16	-0.10	7.36
	2	0.03	-2.09	-2.93	-8.02	-0.37	-0.03
7	1	-3.05	-1.27	-0.14	-0.37	-0.15	9.23
	2	0.08	1.88	-2.32	-6.23	0.37	-0.16
8	1	-4.09	0.09	-0.03	-0.05	-0.32	10.79
	2	0.02	1.26	-4.08	-10.11	0.08	-0.07
9	1	-4.07	0.02	0.02	0.02	-0.30	10.78
	2	0.04	1.31	-4.58	-11.34	0.03	-0.09
10	1	-3.99	0.30	0.02	0.04	-0.30	10.67
	2	0.03	1.35	-4.70	-11.64	0.03	-0.08
11	1	-4.00	-0.25	-0.01	0.00	-0.32	10.69
	2	0.03	1.33	-4.64	-11.51	-0.03	-0.08
12	1	-3.11	1.20	0.12	0.25	-0.42	9.38
	2	0.01	1.06	-3.68	-9.15	-0.20	-0.05
13	1	-3.35	-1.54	0.06	0.10	0.37	9.89
	2	0.02	1.12	-2.81	-8.24	0.24	-0.04
14	1	-4.31	0.25	-0.01	-0.02	0.25	11.33
	2	0.00	1.32	-3.25	-9.38	0.04	0.00

SUPPORT REACTIONS -UNIT MTON METE STRUCTURE TYPE = SPACE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
15	1	-4.12	0.29	0.00	0.02	0.25	11.04
	2	-0.01	1.34	-3.33	-9.63	0.04	0.02
16	1	-4.13	-0.25	0.03	0.06	0.26	11.06
	2	-0.01	1.33	-3.30	-9.54	-0.05	0.04
17	1	-3.20	1.22	0.00	0.06	0.38	9.68
	2	-0.04	1.03	-2.55	-7.49	-0.33	0.09

Design for foundation F-1



Thickness, h = 70 cm

d = 53.10 cm

Clear cover = 5.00 cm

- Shrinkage and temperature reinforcement, ACI 7.12.

Minimun Gross area ratio = 0.180% Total area of steel = 13.86 cm²

Area by layer = As/2 = 6.93 cm²

Bar denomination, N = 4 Bar Area (Av) = 1.27 cm²

Number of bars = 5.47 Use 6 - N 4

Pitch = 19.24 cm **6 - N 4 @ 19 cm**

Minimum spacing for ties, ACI 11.5.4.

S1 = d/2 = 26.55 cm

S2 = 60.00 cm

Use S = 25.00 cm

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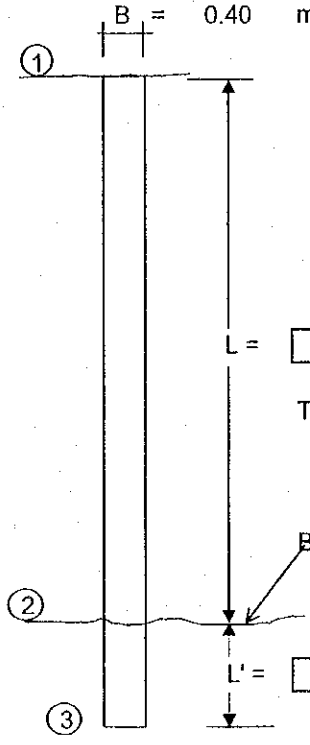
PROJECT: Detailed Design on Port Reactivation Project In La Union Province	Calc. File No.		Prepared by	R.Martinez
SECTION: Power Supply Station	Calc. Index No.		Checked by	A.MORIOKA
SUBJECT: Pile design	Date	July-02	Page 53	/ 61

BEARING CAPACITY OF SQUARE DRIVEN CONCRETE PILES



	Properties In Top Soil:		Properties In Bearing Stratum:	
N of hits by SPT =	8	N	50	N
$\phi = \sqrt{12N + 20}$				
Ø =	29.80	°	42.39	°
γ =	1.430	ton/m³	1.840	ton/m³
Nq =	21		145	
δ =	22.35	°	31.79	°
KHc =	1		1	
Factor of safety (F.S.) =	3			

Pressure due to soil:

Qult = Qt + Qf

- Tip Resistance (Qt)

P1 = 0.00 ton/m³
P2 = 8.58 ton/m³
P3 = 10.42 ton/m³

Qp = PtxNqxAt Pt = P3 = 10.42 ton/m²

Pile Area = 0.160 m² **Qp = 241.79 ton**

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

Qf = Σ(KHc)xPoxTAN(δ)xS

S1 = 2BLD S1 = 4.80 m² Po1 = (P1 + P2)/2

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

Po1 = 4.292 ton/mt² Po2 = 9.502 ton/m² **Qf = 0.00 ton**

Qult = Qt + Qf Qult = 241.79 ton

Qadm = Qult / F.S. **Qadm = 80.60 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	40	7	2.13E+05	3.169	0.00472	3.3	0.022
P2	45	7	3.42E+05	2.901	0.00422	3.0	0.026

N of piles	nI 3	Q (t)	Q (t/n)	y0 (cm)	M0 (t m)	Mmax (t m)	lm (m)
17	0.381	58.6	3.4	0.1	3.7	0.8	3.3
0	0.000	0.0	0.0	0.0	0.0	0.0	3.7
Σ=	17	0.381	58.6				

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

Seismic force, Q = 58.6 t

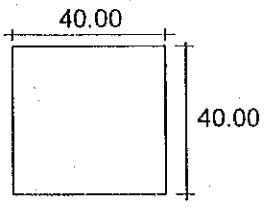
N = 9

E0 = 63

40 x 40		
L (cm)	M (t m)	Q (t)
0	3.7	3.4
-50	2.1	2.6
-100	1.0	1.9
-150	0.2	1.3
-200	-0.3	0.8
-250	-0.6	0.4
-300	-0.7	0.1
-350	-0.8	-0.1
-400	-0.7	-0.2
-450	-0.6	-0.2
-500	-0.5	-0.2
-550	-0.4	-0.2
-600	-0.3	-0.2
-650	-0.2	-0.2
-700	-0.1	-0.1
-750	-0.1	-0.1

45 x 45		
L (cm)	M (t m)	Q (t)
0	0.0	0.0
-50	0.0	0.0
-100	0.0	0.0
-150	0.0	0.0
-200	0.0	0.0
-250	0.0	0.0
-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 = 213333.3 cm4

- Prestressing Force

Cables.
Uncoated seven wire stress relieved strands. Ultimate Strenght, Fpu = 17,500.0 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 = 80.60 ton Excentricity, e = 0.00 cm

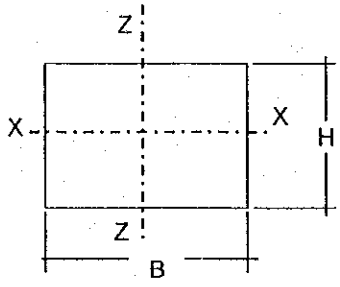
Moment, Ma = 3.65 ton-m Prestress force, Pe = 58.04 cm (15% losses)

(Pa+Pe) / A ± (Pe e c / I + Ma c / I)

86.65 ± 34.25

Stress 1 = 120.90 kg/cm² < 0.4f'c o.k!!! Stress 2 = 52.40 kg/cm² < 0.4f'c o.k!!!

COLUMN DESIGN (5-A)



H = 0.45 m

B = 0.45 m

f 'c = 280 kg/cm²

fy = 4200 kg/cm²

Area = 2,025 cm²

Inertia z = 341,719 cm^4

Inertia y = 341,719 cm^4

Forces and Moments

From Structural Analisis (ton , m) :

TYPE OF LOAD	AXIAL	MOMENT		SHEAR	
	P	Mz-z	Mx-x	Vx	Vz
Dead Load	12.03	0.30	2.70	0.17	2.03
Live Load	2.59	0.07	0.41	0.03	0.31
Seismic Load x	0.32	10.81	0.10	4.20	0.04
Seismic Load z	1.35	0.10	9.67	0.05	3.34

COMB.	Pu	Mu z-z	Mu x-x	Vu x	Vu z
C1	21.25	0.54	4.48	0.29	3.37
C2	15.46	17.80	---	6.89	---
C3	16.90	---	19.41	---	8.19

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)

Forces for design.

Pu z = 16.90 ton

Pu x = 15.46 ton

Mu x-x = 19.41 ton-m

Mu z-z = 17.80 ton-m

Vu z = 6.89 ton

Vu x = 8.19 ton

Ortogonal Combination

Mx = 100%EQX + 30%EQZ Mz = 100%EQZ + 30%EQX

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

Slenderness.

iF klu/r > 22 Consider Slenderness .

k = 2.0 lu = 4.02 m r = (Inetia/Area)^½

Y Direction
r = 0.130 m klu/r = 61.892 > 22 Consider slenderness

Z Direction
r = 0.130 m klu/r = 61.892 > 22 Consider slenderness

Slenderness

Mc = δbMb + δsMs

δb = cm/(1 - Pu/ϕPc) cm = 1.0

Pc = π²EI / (klu)² E = 2526713 ton/m²

Pu = Axial Force = 21.25 ton

X Dir. :		Z Dir. :	
Inertia =	0.0034 m²	Inertia =	0.0034 m²
Pc =	1318.30 ton	Pc =	1318.30 ton
δb =	1.017	δb =	1.019

Mu x-x = 18.10 ton-m

Mu z-z = 19.77 ton-m

- Design by flexure and Axial load

Z Direction : $\phi = 0.70$

Gross Area (Ag) =	0.20	m²	=	313.91	in²
h =	0.45	m	=	17.72	in
P =	15.46	ton	=	34.08	kips
M =	18.10	ton-m	=	1571.20	kips-in

Pu/Ag = 0.11 Mu/Agh = 0.28

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

ρ = [1.1] % As = Ag x ρ = 22.28 cm²

Bar denomination = [7] Bar area = 3.88 cm²

Quantity of bars = 5.74

Use 6 N 7

X Direction : $\phi = 0.7$

Gross Area (Ag) =	0.20	m²	=	313.91	in²
h =	0.45	m	=	17.72	in
P =	16.90	ton	=	37.26	kips
M =	19.77	ton	=	1716.32	kips-in

Pu/Ag = 0.12 Mu/Agh = 0.31

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

ρ ? [1.25] % As = Ag x ρ = 25.31 cm²

Bar Denomination = [7] Bar area = 3.88 cm²

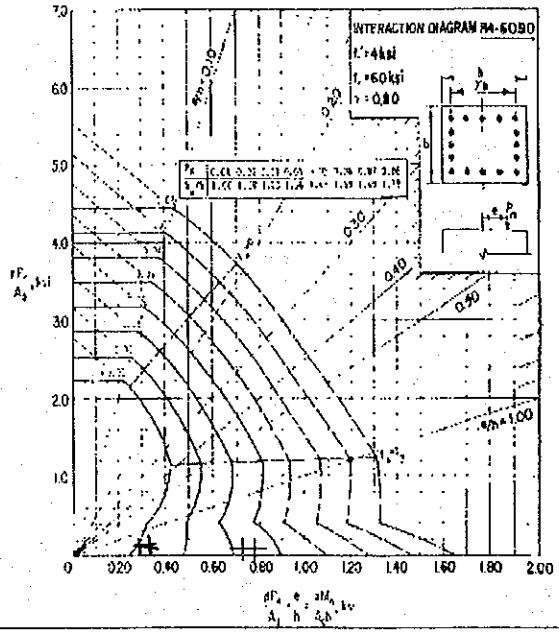
Quantity of bars = 6.52

Use 8 N 7

PROJECT: Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.		Prepared by	R.Martinez
SECTION: Power Supply Station	Calc. Index No.		Checked by	A.MORIOKA
SUBJECT: Column design	Date	July-02	Page	29/61

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

columns



SHEAR DESIGN.

X Direction :

bw = 450.00 mm

d = 388.89 mm

fy = 4200 kg/cm²
411.90 Mpa

f 'c = 280 kg/cm²
27.46 Mpa

Shear Strenght provided by concrete.

$Vc = (\sqrt{f'c} / 6)\ bw\ d$

Vc = 152,839.5 Newton
15,584.7 kg

$Vc = (1+Nu/14Ag)\ (\sqrt{f'c} / 6)\ bw$

Nu = 15.46 ton
151,596 Newton

Vc = 161,012.2 Newton
16,418.1 kg

Vc = 15,584.73 kg

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

Vu = 6.89 ton $\quad$ Vs = (7,478.7) kg

$Vs = Av\ fy\ d / s$; $Sreq = Av\ fy\ d / Vs$

Bar denomination = 3 $\quad$ Bar area = 0.71 cm²

# of legs = 2

Spacing, S_{req} = -31.12 cm

Max. spacing of shear reinforcement.

d/2 = 19.44 cm
60 mm = 60 cm
} S_2 = 19.44 cm

$(1/3)(\sqrt{f'c}/6)\ bw\ d$ = 50946.49 Newton
5,194.9 kg > Vs, o.k.

S_2 = 19.44 cm

Minimun Shear Reinforcement

$Av = (1/3)\ bw\ S / fy$

$S_3 = 3\ Av\ fy / bw$

S_3 = 39.13 cm

Use 2 legs of N 3 @ 19 cm

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PROJECT: Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.		Prepared by	R.Martinez
SECTION: Power Supply Station	Calc. Index No.		Checked by	A.MORIOKA
SUBJECT: Column design	Date	July-02	Page	3 / 16 /

Z Direction :

fy = 4200 kg/cm² = 411.90 Mpa

bw = 450.00 mm

d = 388.89 mm

f 'c = 280.00 kg/cm² = 27.46 Mpa

Shear Strenght provided by concrete.

$Vc = (\sqrt{f'c} / 6)\ bw\ d$

Vc = 152,839.5 Newton = 15,584.7 kg

$Vc = (1+Nu/14Ag)\ (\sqrt{f'c} / 6)\ bw$

Nu = 16.90 ton = 165,763 Newton

Vc = 161,776.0 Newton = 16,496.0 kg

} Vc = 15,584.73 kg

Vn = Vc + Vs Vs = Vu/ϕ - Vc ' ϕ = 0.85

Vu = 8.19 ton Vs = (5,954.4) kg

Vs = Av fy d / s ; Sreq = Av fy d / Vs

Bar denomination = 3 Bar area = 0.71 cm²

# of legs = 2 Spacing, S_{req} = -39.09 cm

Max. spacing of shear reinforcement.

d/2 = 19.44 cm

60 mm = 60 cm

} S_2 = 19.44 cm

$(1/3)(\sqrt{f'c} / 6)\ bw\ d$ = 50946.49 Newton = 5,194.9 kg > Vs, o.k.

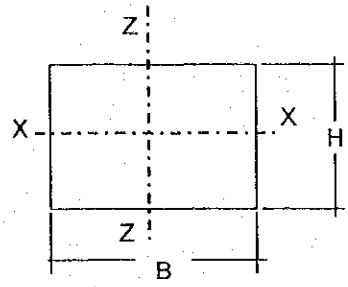
S_2 = 19.44 cm

Minimun Shear Reinforcement

Av = (1/3) bw S / fy S_3 = 3 Av fy / bw S_3 = 39.13 cm

Use 2 legs of N 3 @ 19 cm

COLUMN DESIGN (4-B)



H = 0.45 m

B = 0.45 m

f 'c = 280 kg/cm²

fy = 4200 kg/cm²

Area = 2,025 cm²

Inertia z = 341,719 cm^4

Inertia Y = 341,719 cm^4

Forces and Moments

From Structural Analisis (ton , m) :

TYPE OF LOAD	AXIAL	MOMENT		SHEAR	
	P	Mz-z	Mx-x	Vx	Vz
Dead Load	15.89	0.60	2.36	0.38	1.40
Live Load	3.56	0.14	0.29	0.10	0.17
Seismic Load x	0.32	10.35	0.05	4.02	0.02
Seismic Load z	1.38	0.09	11.85	0.04	4.79

COMB.	Pu	Mu z-z	Mu x-x	Vu x	Vu z
C1	28.30	1.08	3.80	0.70	2.25
C2	20.41	18.05	---	7.26	---
C3	21.89	---	21.83	---	9.33

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)

Forces for design.

Pu z = 21.89 ton

Pu x = 20.41 ton

Mu x-x = 21.83 ton-m

Mu z-z = 18.05 ton-m

Vu z = 7.26 ton

Vu x = 9.33 ton

Ortogonal Combination

Mx = 100%EQX + 30%EQZ Mz = 100%EQZ + 30%EQX

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

Slenderness.

iF klu/r > 22 Consider Slenderness .

k = 2.0 lu = 4.02 m r = (Inetia/Area)^½

Y Direction
r = 0.130 m klu/r = 61.892 > 22 Consider slenderness

Z Direction
r = 0.130 m klu/r = 61.892 > 22 Consider slenderness

Slenderness

Mc = δbMb + δsMs

δb = cm/(1 - Pu/ϕPc) cm = 1.0

Pc = π²EI / (klu)² E = 2526713 ton/m²

Pu = Axial Force = 28.30 ton

X Dir. :		Z Dir. :	
Inertia =	0.0034 m²	Inertia =	0.0034 m²
Pc =	1318.30 ton	Pc =	1318.30 ton
δb =	1.023	δb =	1.024

Mu x-x = 18.46 ton-m

Mu z-z = 22.36 ton-m

- Design by flexure and Axial load

Z Direction : $\phi = 0.70$

Gross Area (Ag) =	0.20	m²	=	313.91	in²
h =	0.45	m	=	17.72	in
P =	20.41	ton	=	44.99	kips
M =	18.46	ton-m	=	1601.90	kips-in

Pu/Ag = 0.14 **Mu/Agh = 0.29**

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

ρ = 1.1 % As =Ag x ρ = 22.28 cm²

Bar denomination = 7 Bar area = 3.88 cm²

Quantity of bars = 5.74

Use 6 N 7

X Direction : $\phi = 0.7$

Gross Area (Ag) =	0.20	m²	=	313.91	in²
h =	0.45	m	=	17.72	in
P =	21.89	ton	=	48.25	kips
M =	22.36	ton	=	1941.17	kips-in

Pu/Ag = 0.15 **Mu/Agh = 0.35**

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

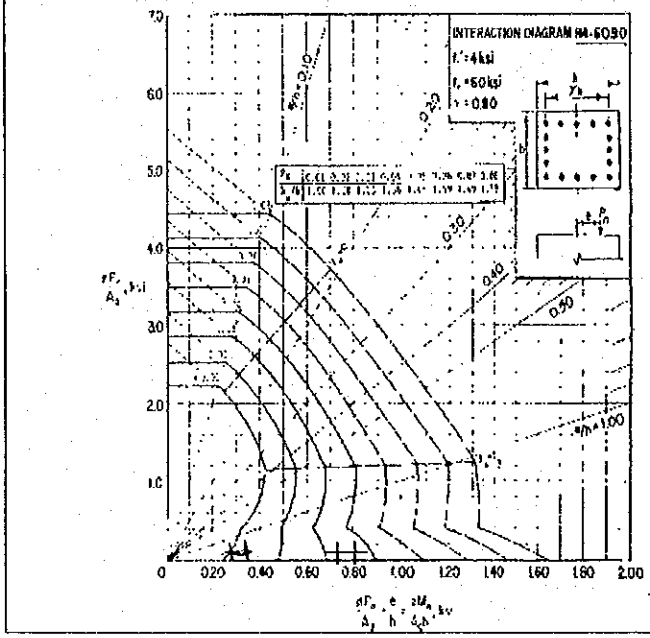
ρ ? 1.4 % As = Ag x ρ = 28.35 cm²

Bar Denomination = 7 Bar area = 3.88 cm²

Quantity of bars = 7.31

Use 8 N 7

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



SHEAR DESIGN.

X Direction :

bw = 450.00 mm

d = 388.89 mm

fy = 4200 kg/cm²
411.90 Mpa

f 'c = 280 kg/cm²
27.46 Mpa

Shear Strenght provided by concrete.

$Vc = (\sqrt{f'c} / 6)\ bw\ d$

Vc = 152,839.5 Newton
15,584.7 kg

$Vc = (1+Nu/14Ag)\ (\sqrt{f'c} / 6)\ bw$

Nu = 20.41 ton
200,118 Newton

Vc = 163,628.1 Newton
16,684.8 kg

Vc = 15,584.73 kg

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

$Vu =$ 7.26 ton $\quad Vs =$ (7,042.4) kg

$Vs = Av\ fy\ d / s$; $Sreq = Av\ fy\ d / Vs$

Bar denomination = 3

# of legs = 2

Bar area = 0.71 cm²

Spacing, S_{req} = -33.05 cm

Max. spacing of shear reinforcement.

d/2 = 19.44 cm

60 mm = 60 cm

S_2 = 19.44 cm

$(1/3)(\sqrt{f'c}/6)\ bw\ d$ = 50946.49 Newton

5,194.9 kg > Vs, o.k.

S_2 = 19.44 cm

Minimun Shear Reinforcement

$Av = (1/3)\ bw\ S / fy$

$S_3 = 3\ Av\ fy / bw$

S_3 = 39.13 cm

Use 2 legs of N 3 @ 19 cm

Z Direction :

fy = 4200 kg/cm²
411.90 Mpa

bw = 450.00 mm

d = 388.89 mm

f 'c = 280.00 kg/cm²
27.46 Mpa

Shear Strenght provided by concrete.

$Vc = (\sqrt{f'c} / 6)\ bw\ d$

Vc = 152,839.5 Newton
15,584.7 kg

$Vc = (1+Nu/14Ag)\ (\sqrt{f'c} / 6)\ bw$

Nu = 21.89 ton
214,656 Newton

Vc = 164,411.9 Newton
16,764.8 kg

} Vc = 15,584.73 kg

Vn = Vc + Vs Vs = Vu/ϕ - Vc ϕ = 0.85

Vu = 9.33 ton Vs = (4,610.3) kg

Vs = Av fy d / s ; Sreq = Av fy d / Vs

Bar denomination = 3 Bar area = 0.71 cm²

# of legs = 2 Spacing, S_{req} = -50.49 cm

Max. spacing of shear reinforcement.

d/2 = 19.44 cm
60 mm = 60 cm
} S_2 = 19.44 cm

$(1/3)\ (\sqrt{f'c} / 6)\ bw\ d$ = 50946.49 Newton
5,194.9 kg > Vs, o.k.

S_2 = 19.44 cm

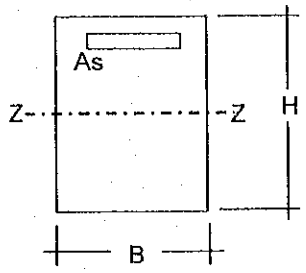
Minimun Shear Reinforcement

Av = (1/3) bw S / fy S_3 = 3 Av fy / bw S_3 = 39.13 cm

Use 2 legs of N 3 @ 19 cm

FOUNDATION BEAM DESIGN (FB-1)

Outer End



H = 60.00 cm

b = 35.00 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	7.06
Live Load	6.12
Seismic Load x	0.10
Seismic Load z	11.85

COMBINATION	Mu z-z
C1	20.29
C2	15.36
C3	31.84

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)

Force for design: Mu z-z = 31.84 ton-m

d = 52.62 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/\phi = 0$ $\phi = 0.90$

$1058.8As^2 - 220999\ As + 3537291.7 = 0$ As = 17.47 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 23.29 cm²
(14/fy) b d = 6.14 cm²
} Asmin = 6.14 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 63.47 cm²

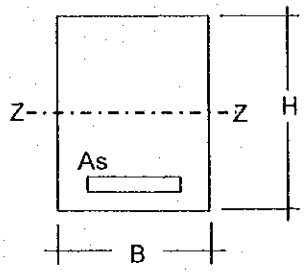
As = 17.47 cm² o.k!! As < Amax

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

Number of bars = 4.50 **Use 5 - N 7**

FOUNDATION BEAM DESIGN (FB-1)

Center



H = 60.00 cm

b = 35.00 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	3.58
Live Load	3.06
Seismic Load x	0.60
Seismic Load z	1.50

COMBINATION	Mu z-z
C1	10.21
C2	8.50
C3	9.76

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)

Force for design: Mu z-z = 10.21 ton-m

d = 52.78 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$1058.8As^2 - 221666\,As + 1134888.9 = 0$ As = 5.25 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 7.00 cm²
(14/fy) b d = 6.16 cm²
} Asmin = 6.16 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 63.66 cm²

As = 6.16 cm² o.k!! As < Amax

Bar denomination, N = 6 Bar Area (Av) = 2.85 cm²

Number of bars = 2.16 **Use 3 - N 6**

b) Shear Reinforcement

Base = 35.00 cm fy = 4200 kg/cm² (411.89)

d = 52.62 cm f'c = 280 kg/cm² (27.46 Mpa)

$Vc = (1/6)\sqrt{f'c}\ bod$ = 16.41 ton

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

TYPE OF LOAD	SHEAR Vy
Dead Load	6.05
Live Load	5.25
Seismic Load x	4.37
Seismic Load z	0.01

COMBINATION	Vy
C1	17.40
C2	19.18
C3	13.06

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)

Force for design: Vu = 19.18 ton

Vs = 6,153.0 kg

Bar denomination = 3 Bar area = 0.71 cm²

# of legs = 2 Spacing, S_{req} = 51.19 cm

Max. spacing of shear reinforcement.

d/2 = 26.31 cm
30 mm = 30 cm
} S_2 = 26.31 cm

$(1/3)(\sqrt{f'c}/6)\ bw\ d$ = 1027227 Newton
104,744 kg > Vs, o.k.

S_2 = 26.31 cm

Minimun Shear Reinforcement

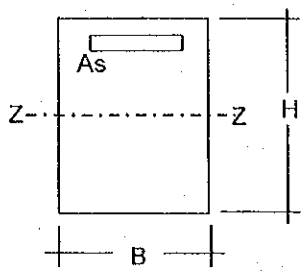
$Av = (1/3)\ bw\ S / fy$ $S_3 = 3\ Av\ fy / bw$ S_3 = 5031.4 cm

Use 2 legs of N 3 @ 26 cm

PROJECT: Detailed Design on Port Reactivation Project in La Union Province	Calc. File No.		Prepared by	R.Martinez
SECTION: Power Supply Station	Calc. Index No.		Checked by	A.MORIOKA
SUBJECT: Foundation beam design	Date	July-02	Page	61 / 161

FOUNDATION BEAM DESIGN (FB-2)

Outer End



H = 60.00 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	4.97
Live Load	4.50
Seismic Load x	0.10
Seismic Load z	11.05

COMBINATION	Mu z-z
C1	14.61
C2	11.10
C3	26.45

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)

Force for design: Mu z-z = 26.45 ton-m

d = 52.62 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/\phi = 0$ $\phi = 0.90$

$1235.3As^2 - 220999\ As + 2939291.7 = 0$ As = 14.47 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 19.29 cm²
(14/fy) b d = 5.26 cm² } Asmin = 5.26 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 54.40 cm²

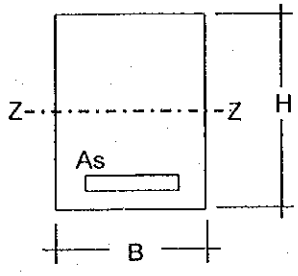
As = 14.47 cm² o.k!! As < Amax

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

Number of bars = 3.73 **Use 4 - N 7**

FOUNDATION BEAM DESIGN (FB-2)

Center



H = 60.00 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	2.48
Live Load	2.26
Seismic Load x	1.40
Seismic Load z	0.10

COMBINATION	Mu z-z
C1	7.31
C2	7.45
C3	5.63

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)

Force for design: Mu z-z = 7.45 ton-m

d = 52.62 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$1235.3As^2 - 220999\,As + 827666.67 = 0$ As = 3.83 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 5.10 cm²
(14/fy) b d = 5.26 cm² } Asmin = 5.10 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 54.40 cm²

As = 5.10 cm² o.k!! As < Amax

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

Number of bars = 1.32 **Use 2 - N 7**

b) Shear Reinforcement

Base = 30.00 cm

d = 52.62 cm

fy = 4200 kg/cm² (411.89)

f'c = 280 kg/cm² (27.46 Mpa)

$Vc = (1/6)\sqrt{f'c}\ bod$ = 14.06 ton

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

TYPE OF LOAD	SHEAR Vy
Dead Load	4.97
Live Load	4.50
Seismic Load x	0.05
Seismic Load z	4.79

COMBINATION	Vy
C1	14.61
C2	11.03
C3	17.67

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)

Force for design: Vu = 17.67 ton

Vs = 6,730.6 kg

Bar denomination = 3 Bar area = 0.71 cm²

# of legs = 2 Spacing, S_{req} = 46.79 cm

Max. spacing of shear reinforcement.

d/2 = 26.31 cm

30 mm = 30 cm

S_2 = 26.31 cm

$(1/3)(\sqrt{f'c}/6)\ bw\ d$ = 880480.1 Newton

89,781 kg > Vs, o.k.

S_2 = 26.31 cm

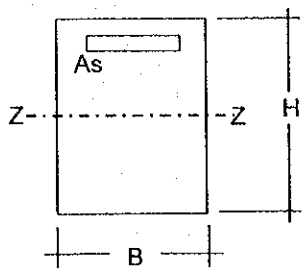
Minimun Shear Reinforcement

$Av = (1/3)\ bw\ S / fy$ $S_3 = 3\ Av\ fy / bw$ S_3 = 5870.0 cm

Use 2 legs of N 3 @ 26 cm

ROOF BEAM DESIGN (B-1)

Column End



H = 45.00 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	8.07
Live Load	1.29
Seismic Load x	0.05
Seismic Load z	5.04

COMBINATION	Mu z-z
C1	13.49
C2	10.19
C3	17.19

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)

Force for design: Mu z-z = 17.19 ton-m

d = 37.62 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$1235.3As^2 - 157999\,As + 1909650 = 0$ As = 13.51 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 18.02 cm²
(14/fy) b d = 3.76 cm²

Asmin = 3.76 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 38.89 cm²

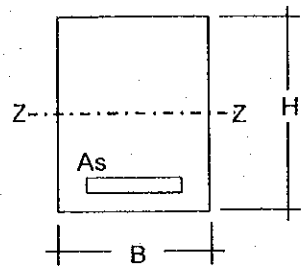
As = 13.51 cm² o.k!! As < Amax

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

Number of bars = 3.48 **Use 4 - N 7**

ROOF BEAM DESIGN (B-1)

Center (between B & C Axis)



H = 45.00 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	7.97
Live Load	1.06
Seismic Load x	0.14
Seismic Load z	0.58

COMBINATION	Mu z-z
C1	12.96
C2	9.92
C3	10.53

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)

Force for design: Mu z-z = 12.96 ton-m

d = 37.62 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$1235.3As^2 - 157999\,As + 1440000 = 0$ As = 9.88 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 13.17 cm²
(14/fy) b d = 3.76 cm²

Asmin = 3.76 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 38.89 cm²

As = 9.88 cm² o.k!! As < Amax

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

Number of bars = 2.55 **Use 3 - N 7**

b) Shear Reinforcement

Base = 30.00 cm fy = 4200 kg/cm² (411.89)

d = 37.62 cm f'c = 280 kg/cm² (27.46 Mpa)

$Vc = (1/6)\sqrt{f'c}\ bod$ = 10.05 ton

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

TYPE OF LOAD	SHEAR Vy
Dead Load	5.72
Live Load	0.98
Seismic Load x	0.10
Seismic Load z	1.22

COMBINATION	Vy
C1	9.67
C2	7.40
C3	8.97

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)

Force for design: Vu = 9.67 ton

Vs = 1,327.6 kg

Bar denomination = 3 Bar area = 0.71 cm²

# of legs = 2 Spacing, S_{req} = 169.61 cm

Max. spacing of shear reinforcement.

d/2 = 18.81 cm
30 mm = 30 cm
} S_2 = 18.81 cm

$(1/3)(\sqrt{f'c}/6)\ bw\ d$ = 629482.1 Newton
64,187 kg > Vs, o.k.

S_2 = 18.81 cm

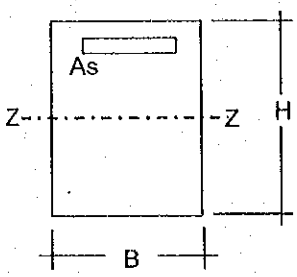
Minimun Shear Reinforcement

$Av = (1/3)\ bw\ S / fy$ $S_3 = 3\ Av\ fy / bw$ S_3 = 5870.0 cm

Use 2 legs of N 3 @ 18 cm

ROOF BEAM DESIGN (B-2)

End



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	7.39
Live Load	1.83
Seismic Load x	3.35
Seismic Load z	0.15

COMBINATION	Mu z-z
C1	13.46
C2	14.79
C3	10.30

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)

Force for design: Mu z-z = 14.79 ton-m

d = 32.62 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/\phi = 0$ $\phi = 0.90$

$1235.3As^2 - 136999\ As + 1643458.3 = 0$ As = 13.68 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 18.25 cm²
(14/fy) b d = 3.26 cm² } Asmin = 3.26 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 33.72 cm²

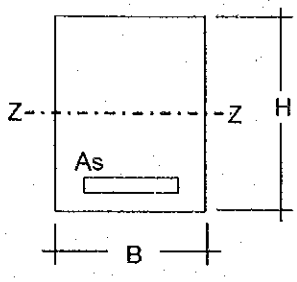
As = 13.68 cm² o.k!! As < Amax

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

Number of bars = 3.53 **Use 4 - N 7**

ROOF BEAM DESIGN (B-2)

Center



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	5.58
Live Load	1.39
Seismic Load x	0.08
Seismic Load z	0.27

COMBINATION	Mu z-z
C1	10.18
C2	7.74
C3	8.01

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)

Force for design: Mu z-z = 10.18 ton-m

d = 32.62 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/\phi = 0$ $\phi = 0.90$

$1235.3As^2 - 136999\ As + 1130555.6 = 0$ As = 8.98 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 11.97 cm²
(14/fy) b d = 3.26 cm²

Asmin = 3.26 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 33.72 cm²

As = 8.98 cm² o.k!! As < Amax

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

Number of bars = 2.31 **Use 3 - N 7**

b) Shear Reinforcement

Base = 30.00 cm

d = 32.62 cm

fy = 4200 kg/cm²
411.89

f'c = 280 kg/cm²
27.46 Mpa

$Vc = (1/6)\sqrt{f'c}\ bod =$ 8.72 ton

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

TYPE OF LOAD	SHEAR Vy
Dead Load	5.04
Live Load	1.24
Seismic Load x	1.07
Seismic Load z	0.05

COMBINATION	Vy
C1	9.16
C2	8.37
C3	6.94

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)

Force for design: Vu = 9.16 ton

Vs = 2,063.8 kg

Bar denomination = 3 Bar area = 0.71 cm²

# of legs = 2 Spacing, S_{req} = 94.60 cm

Max. spacing of shear reinforcement.

d/2 = 16.31 cm
30 mm = 30 cm
} S_2 = 16.31 cm

$(1/3)(\sqrt{f'c}/6)\ bw\ d =$ 545816.1 Newton
55,656 kg > Vs, o.k.

S_2 = 16.31 cm

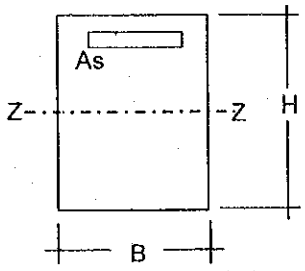
Minimun Shear Reinforcement

$Av = (1/3)\ bw\ S / fy$ $S_3 = 3\ Av\ fy / bw$ S_3 = 5870.0 cm

Use 2 legs of N 3 @ 16 cm

ROOF BEAM DESIGN (B-3)

End



H = 35.00 cm

b = 25.00 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	4.01
Live Load	0.57
Seismic Load x	0.78
Seismic Load z	0.10

COMBINATION	Mu z-z
C1	6.58
C2	6.03
C3	5.08

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)

Force for design: Mu z-z = 6.58 ton-m

d = 27.78 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\ As^2 - fyd\ As + Mu/\phi = 0$ $\phi = 0.90$

$1482.4As^2 - 116666\ As + 731444.44 = 0$ As = 6.87 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 9.16 cm²
(14/fy) b d = 2.31 cm² } Asmin = 2.31 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 23.93 cm²

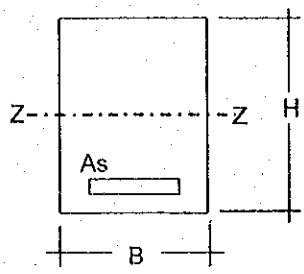
As = 6.87 cm² o.k!! As < Amax

Bar denomination, N = 6 Bar Area (Av) = 2.85 cm²

Number of bars = 2.41 **Use 3 - N 6**

ROOF BEAM DESIGN (B-3)

Center



H = 35.00 cm

b = 25.00 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	3.03
Live Load	0.62
Seismic Load x	0.36
Seismic Load z	0.03

COMBINATION	Mu z-z
C1	5.30
C2	4.48
C3	4.01

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)

Force for design: Mu z-z = 5.30 ton-m

d = 27.94 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$1482.4As^2 - 117332\,As + 588444.44 = 0$ As = 5.38 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 7.17 cm²
(14/fy) b d = 2.33 cm² } Asmin = 2.33 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 24.07 cm²

As = 5.38 cm² o.k!! As < Amax

Bar denomination, N = 5 Bar Area (Av) = 1.98 cm²

Number of bars = 2.72 **Use 3 - N 5**

b) Shear Reinforcement

Base = 25.00 cm fy = 4200 kg/cm² (411.89)

d = 28.25 cm f'c = 280 kg/cm² (27.46 Mpa)

$Vc = (1/6)\sqrt{f'c}\ bod$ = 6.29 ton

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

TYPE OF LOAD	SHEAR Vy
Dead Load	3.20
Live Load	0.34
Seismic Load x	0.25
Seismic Load z	0.05

COMBINATION	Vy
C1	5.06
C2	4.14
C3	3.86

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)

Force for design: Vu = 5.06 ton

Vs = (341.8) kg

Bar denomination = 3 Bar area = 0.71 cm²

# of legs = 2 Spacing, S_{req} = -494.84 cm

Max. spacing of shear reinforcement.

d/2 = 14.13 cm
30 mm = 30 cm
} S_2 = 14.13 cm

(1/3) ($\sqrt{f'c}$ / 6) bw d = 393979.7 Newton
40,173 kg > Vs, o.k.

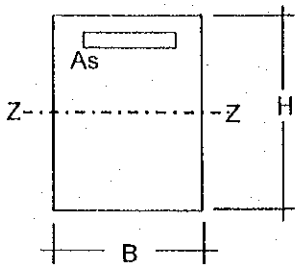
S_2 = 14.13 cm

Minimun Shear Reinforcement

$Av = (1/3)\ bw\ S / fy$ $S_3 = 3\ Av\ fy / bw$ S_3 = 7044.0 cm

Use 2 legs of N 3 @ 14 cm

CANTILEVER BEAM DESIGN (CB-1)



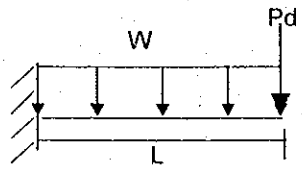
H = 35.00 cm f'c = 280 kg/cm²

b = 20.00 cm fy = 4200 kg/cm²

L = 1.00 m Width = 7.00 m

Wd = 371.00 kg/m² Wd = 2597.00 kg/m

Wl = 100.00 kg/m² Wd = 700.00 kg/m



Additional load, Pd = 1612.8 kg
(from edge beam)

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

TYPE OF LOAD	MOMENT Mz-z
Dead Load	3.00
Live Load	0.35

Force for design:

Mu z-z = 4.79 ton-m
C1 = 1.4 DL + 1.7 LL

d = 27.78 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$1852.9As^2 - 116666\,As + 532046.67 = 0$ As = 4.95 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 6.60 cm²
(14/fy) b d = 1.85 cm²
Asmin = 1.85 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 19.15 cm²

As = 4.95 cm² o.k!! As < Amax

Bar denomination, N = 6 Bar Area (Av) = 2.85 cm²

Number of bars = 1.74 **Use 2 - N 6**

b) Shear Reinforcement

Base = 20.00 cm

d = 27.78 cm

fy = 4200 kg/cm² (411.89)

f'c = 280 kg/cm² (27.46 Mpa)

$Vc = (1/6)\sqrt{f'c}\ bod$ = 4.95 ton

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

TYPE OF LOAD	SHEAR Vy
Dead Load	4.21
Live Load	0.70

COMBINATION	Vy
C1	7.08

C1 = 1.4 DL + 1.7 LL

Force for design: Vu = 7.08 ton

Vs = 3,384.8 kg

Bar denomination = 3 Bar area = 0.71 cm²

# of legs = 2 Spacing, S_{req} = 49.12 cm

Max. spacing of shear reinforcement.

d/2 = 13.89 cm

30 mm = 30 cm

S_2 = 13.89 cm

$(1/3)(\sqrt{f'c}/6)\ bw\ d$ = 309871 Newton

31,597 kg > Vs, o.k.

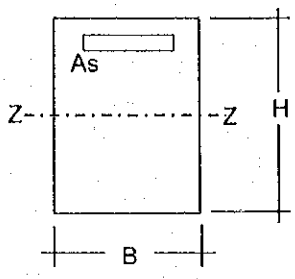
S_2 = 13.89 cm

Minimun Shear Reinforcement

$Av = (1/3)\ bw\ S / fy$ $S_3 = 3\ Av\ fy / bw$ S_3 = 8805.0 cm

Use 2 legs of N 3 @ 13 cm

EDGE BEAM DESIGN (B-4)



H = 60.00 cm f'c = 280 kg/cm²

b = 20.00 cm fy = 4200 kg/cm²

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

TYPE OF LOAD	MOMENT Mz-z
Dead Load	1.41
Live Load	0.10

Force for design:

Mu z-z = 2.15 ton-m

C1 = 1.4 DL + 1.7 LL

d = 52.94 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$1852.9As^2 - 222332\,As + 238408.89 = 0$ As = 1.08 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 1.44 cm²

(14/fy) b d = 3.53 cm² Asmin = 3.53 cm²

Asmax : ρb = 0.0459 Asmax (0.75ρb) = 36.49 cm²

As = 3.53 cm² o.k!! As < Amax

Bar denomination, N = 5 Bar Area (Av) = 1.98 cm²

Number of bars = 1.78 **Use 2 - N 5**

b) Shear Reinforcement

Base = 20.00 cm fy = 4200 kg/cm² (411.89)

d = 52.94 cm f'c = 280 kg/cm² (27.46 Mpa)

$Vc = (1/6)\sqrt{f'c}\ bod$ = 9.43 ton

Vn = Vc + Vs Vs = Vu/ϕ - Vc ϕ = 0.85

TYPE OF LOAD	SHEAR Vy
Dead Load	1.21
Live Load	0.12

COMBINATION	Vy
C1	1.90

C1 = 1.4 DL + 1.7 LL

Force for design: Vu = 1.90 ton

Vs = (7,197.3) kg

Bar denomination = 3 Bar area = 0.71 cm²

# of legs = 2 Spacing, S_{req} = -44.02 cm

Max. spacing of shear reinforcement.

d/2 = 26.47 cm
30 mm = 30 cm
} S_2 = 26.47 cm

(1/3) $(\sqrt{f'c}/6)$ bw d = 590528.6 Newton
60,215 kg > Vs, o.k.

S_2 = 26.47 cm

Minimun Shear Reinforcement

Av = (1/3) bw S / fy S_3 = 3 Av fy / bw S_3 = 8805.0 cm

Use 2 legs of N 3 @ 26 cm

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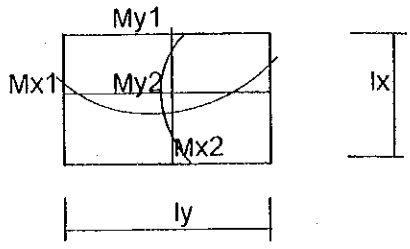
PROJECT: Detailed Design on Port Reactivation Project in La Union Provin	Calc. File No.		Prepared by	H.WATANABE
SECTION: Power Supply Station	Calc. Index No.		Checked by	A.MORIOKA
SUBJECT: Slab design	Date	July-02	Page	57 / 61

Slab S2 for roof



lx= 3.5 m

ly= 4.5 m

ly/lx= 1.3

t= 12 cm

coefficient of bend (thioretical result fix end)

Mx1/(w lx²) =	0.070
Mx2/(w lx²) =	0.040
My1/(w lx²) =	0.056
My2/(w lx²) =	0.028

d= 7.35 cm
fc= 280 kg/cm2
fy= 4200 kg/cm2

wDL= 0.443 t/m2
wLL= 0.020 t/m2

DL		LL	
Mx1=	0.38 tm/m	Mx1=	0.02 tm/m
Mx2=	0.22 tm/m	Mx2=	0.01 tm/m
My1=	0.30 tm/m	My1=	0.01 tm/m
My2=	0.15 tm/m	My2=	0.01 tm/m

1.4DL+1.7LL			fy2/1.7bfc'	fyd	Mu/f		
Mx1=	0.56	tm/m	370.6	30870	62331	As=	2.07 cm²/m
Mx2=	0.32	tm/m	370.6	30870	35618	As=	1.17 cm²/m
My1=	0.45	tm/m	370.6	30870	49865	As=	1.65 cm²/m
My2=	0.22	tm/m	370.6	30870	24932	As=	0.82 cm²/m

	Short Span			Long Span		
	Use Ba	Area cm2	Pitch cm	Use Bar	Area cm2	Pitch cm
End	3	0.71	34.4	3	0.71	43.2
Center	3	0.71	60.9	3	0.71	87.4

Thickne (mm)	Location	Shorter Side (Direction)				Longer Side (Direction)			
		Edge Strip		Middle Strip		Edge Strip		Middle Strip	
		End	Center	End	Center	End	Center	End	Center
S2	Top	D10-@200			-	D10-@250			-
120	Bottom	D10-@200				D10-@250			

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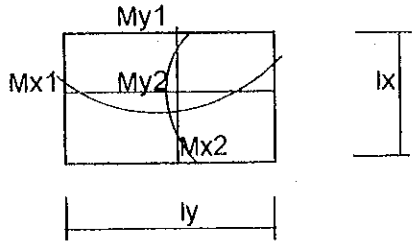
SUBJECT: Slab design	Date	July-02	Page	58 / 61

Slab S1 for 1st floor



lx= 3.5 m

ly= 4.5 m

ly/lx= 1.3

t= 15 cm

coefficient of bend (thioretical result fix end)

Mx1/(w lx²) =	0.070
Mx2/(w lx²) =	0.040
My1/(w lx²) =	0.056
My2/(w lx²) =	0.028

d= 10.35 cm
fc= 210 kg/cm2
fy= 4200 kg/cm2

wDL= 0.450 t/m2
wLL= 0.500 t/m2

DL		LL	
Mx1=	0.39 tm/m	Mx1=	0.43 tm/m
Mx2=	0.22 tm/m	Mx2=	0.25 tm/m
My1=	0.31 tm/m	My1=	0.34 tm/m
My2=	0.15 tm/m	My2=	0.17 tm/m

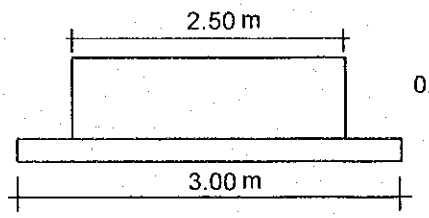
1.4DL+1.7LL			fy2/1.7bfc'	fyd	Mu/f		
Mx1=	1.27	tm/m	494.1	43470	141011	As=	3.37 cm²/m
Mx2=	0.73	tm/m	494.1	43470	80578	As=	1.89 cm²/m
My1=	1.02	tm/m	494.1	43470	112809	As=	2.68 cm²/m
My2=	0.51	tm/m	494.1	43470	56404	As=	1.32 cm²/m

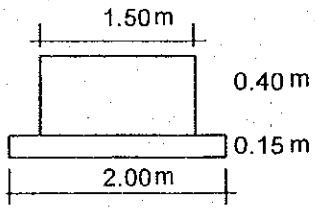
	Short Span			Long Span		
	Use Ba	Area cm2	Pitch cm	Use Bar	Area cm2	Pitch cm
End	3.4	0.99	29.3	3.4	0.99	37.0
Center	3	0.71	37.6	3	0.71	54.1

Thickne (mm)	Location	Shorter Side (Direction)				Longer Side (Direction)			
		Edge Strip		Middle Strip		Edge Strip		Middle Strip	
		End	Center	End	Center	End	Center	End	Center
S1	Top	D10,D13-@200			-	D10,D13-@250			-
150	Bottom	D10-@200				D10-@250			

FOUNDATION DESIGN

a) Transformer foundation





Foundation Weight = 5.76 ton

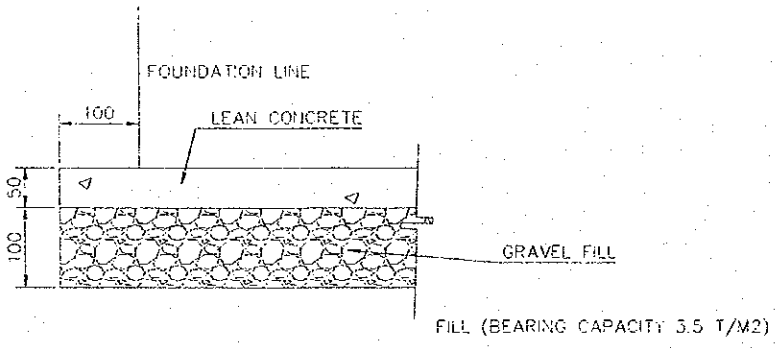
Area of contact = 6.00 m²

Generator Weight = 15.00 ton

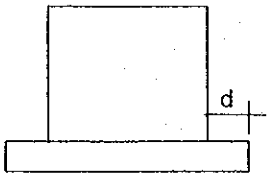
Soil Pressure = 3.46 ton/m²

Total weigth = 20.76 ton

Provide a 3.50 ton/m² underneath foundation



Reinforcement



d = 0.50 m

Pressure = 3.46 ton/m²

M = 0.433 ton-m

H = 15.00 cm f'c = 210 kg/cm²

b = 100.00 cm fy = 4200 kg/cm²

Force for design: Mu = 1.3xM = 0.56 ton-m

d = 7.94 cm Clear cover = 5.00 cm

$fy^2/1.7bf'c\,As^2 - fyd\,As + Mu/\phi = 0$ $\phi = 0.90$

$494.1\,As^2 - 33332\,As + 62472.222 = 0$ As = 1.93 cm²

Asmin = (4/3)Asreq :

(4/3)Asreq = 2.57 cm²
(14/fy) b d = 2.65 cm² } Asmin = 2.65 cm²

Asmax : ρb = 0.0345 Asmax (0.75ρb) = 20.51 cm²

As = 2.65 cm² o.k!! As < Amax

Bar denomination, N = 5 Bar Area (Av) = 1.98 cm²

Number of bars = 1.34 **Use 2 - N 5** **N5 @ 25 cm**

- Shrinkage and temperature reinforcement, ACI 7.12.

d = 53.73 cm Clear cover = 5.00 cm

Minimun Gross area ratio = 0.180% Total area of steel = 18 cm²
Area by layer = As/2 = 9 cm²

Bar denomination, N = 4 Bar Area (Av) = 1.27 cm²

Number of bars = 7.10 Use 8 - N 4 Pitch = 33.74 cm

Minimum spacing for ties, ACI 11.5.4.

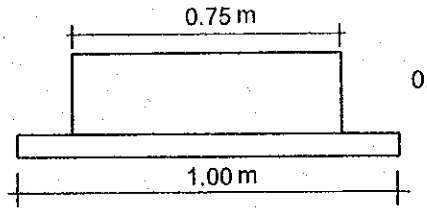
S1 = d/2 = 26.87 cm

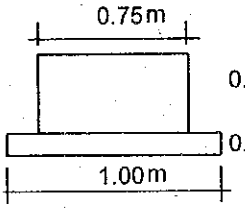
S2 = 60.00 cm

Use S = 25.00 cm

N 4 @ 25 cm

b) Electric foundation type-A





Foundation Weight = 1.54 ton

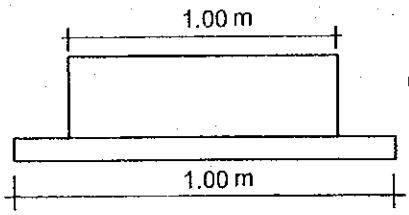
Area of contact = 1.00 m²

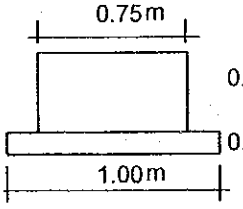
Equipment Weight = 1.50 ton

Soil Pressure = 3.04 ton/m²

Total weigth = 3.04 ton

c) Electric foundation type-B





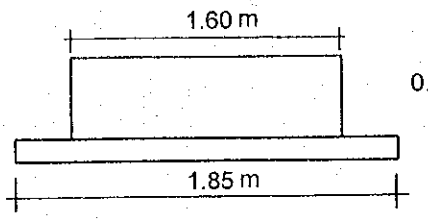
Foundation Weight = 1.91 ton

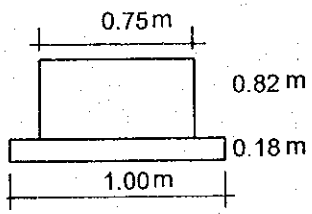
Area of contact = 1.00 m²

Equipment Weight = 1.50 ton Soil Pressure = 3.41 ton/m²

Total weigth = 3.41 ton

d) Electric foundation type-C





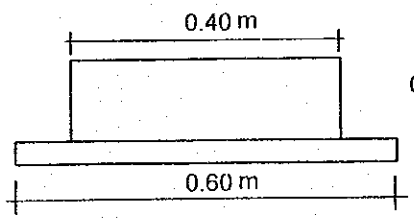
Foundation Weight = 3.16 ton

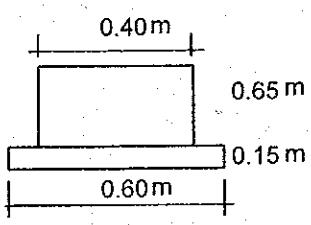
Area of contact = 1.85 m²

Equipment Weight = 3.00 ton Soil Pressure = 3.33 ton/m²

Total weigth = 6.16 ton

e) Electric foundation type-D



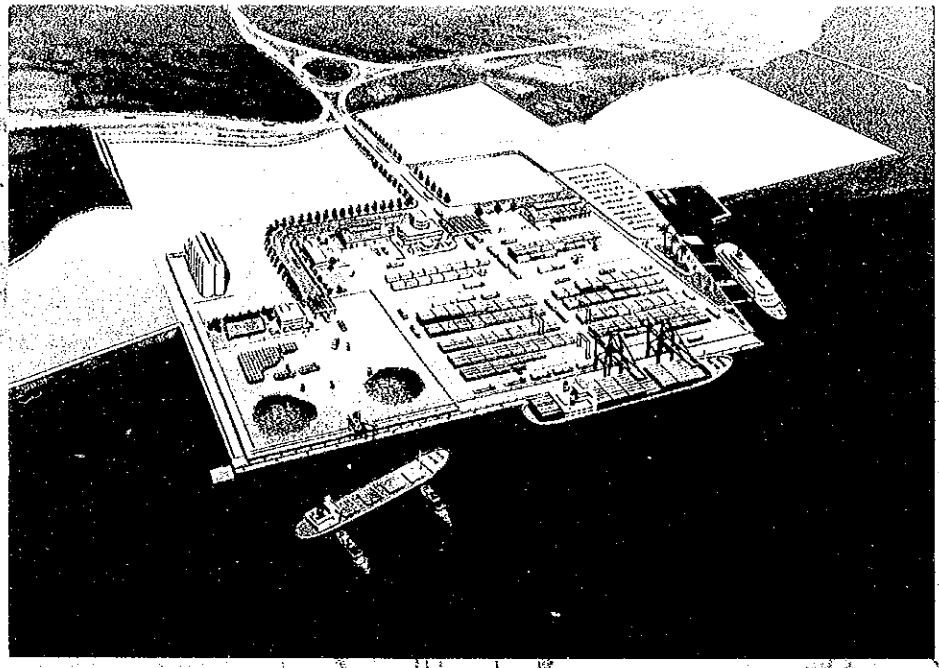


Foundation Weight = 0.38 ton

Area of contact = 0.36 m²

Equipment Weight = 0.40 ton Soil Pressure = 2.16 ton/m²

Total weigth = 0.78 ton



JICA