



OIL SEPARATOR TANK

Structure : Oil Separator Cover Slab**Project :****Date :****Substation : Rong Kwang****Materials :**

Concrete fc'	210	ksc
Reinforcing Bar SD : 30 SR 24		

Dimension :

Short span	4.00	m
Long span	4.00	m
Thickness	0.20	m
m = S/L =	1.00	
Two Way Slab		

Loading :

Dead Load (Concrete)	480	kg/m ²
Live Load	1000	kg/m ²
Total	1480	kg/m ²

Reinforcement :**Short span**

Coefficient		
C-	0.033	
C+	0.050	
Bending Moment		
M-	781	kg.m
Required As	3.50	cm ² /m
Minimum Reinforcement	4.00	cm ²
DB 12 @ 12.5		cm
Actual As	9.05	cm ²
Use DB12 @ 0.125 m		
M+	1184	kg.m
Required As	5.30	cm ² /m
Minimum Reinforcement	4.00	cm ²
DB 12 @ 15		cm
Actual As	7.92	cm ²
Use DB12 @ 0.15 m		

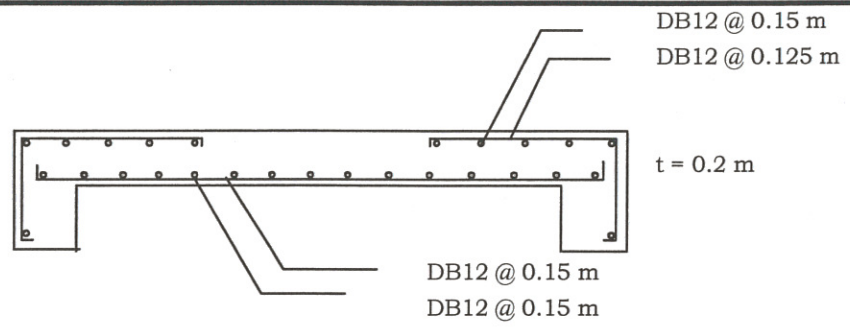
Long Span

Coefficient		
C-	0.033	
C+	0.050	
Bending Moment		
M-	781	kg.m
Required As	3.50	cm ² /m
Minimum Reinforcement	4.00	cm ²
DB 12 @ 15		cm
Actual As 12	7.92	cm ²
Use DB12 @ 0.15 m		
M+	1184	kg.m
Required Depth	9	cm
Actual Depth	17	cm : PASS
M _R	4426	kg.m
Required As	5.30	cm ² /m
Minimum Reinforcement	4.00	cm ²
DB 12 @ 15		cm
Actual As	7.92	cm ²
Use DB12 @ 0.15 m		

RKA/Cover

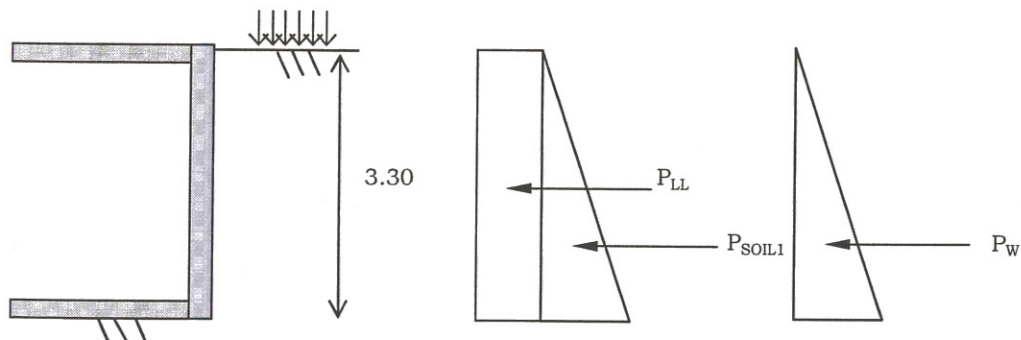

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Slab Section :



Short Span

Structure : Oil Separator
Project :
Substation : Rong Kwang



Soil Pressure and Surcharge

Water Pressure

Live load on ground	1000	kg/m ²
Unit weight of soil	1800	kg/m ³
Depth of Soil behind Wall	3.30	m
Soil pressure = $K_a \cdot \gamma H$	2911	kg/m ²
Live load pressure = $K_a \cdot LL$	490	kg/m ²
Water Pressure	3300	kg/m ²
Maximum Bending Moment in Wall	13940	kg.m/m
Concrete f_c' (Cylinder)	210	ksc
Reinforcing Steel	SD 30 SR 24	

Dead Load

Oil depth 2.3 m	2300	kg/m ²
Concrete $t=0.25$ m	600	kg/m ²
Total	2900	kg/m ²

Lateral Load

Case I :	Oil Pressure	2300	kg/m
Case II:			
Soil pressure = $K_a \cdot \gamma H$	=	1890	kg/m ²
P_{SOI}	=	2835	kg
Live load pressure = $K_a \cdot LL$		175	kg/m ²
P_{LL}	=	525	kg
Total		3360	kg.m

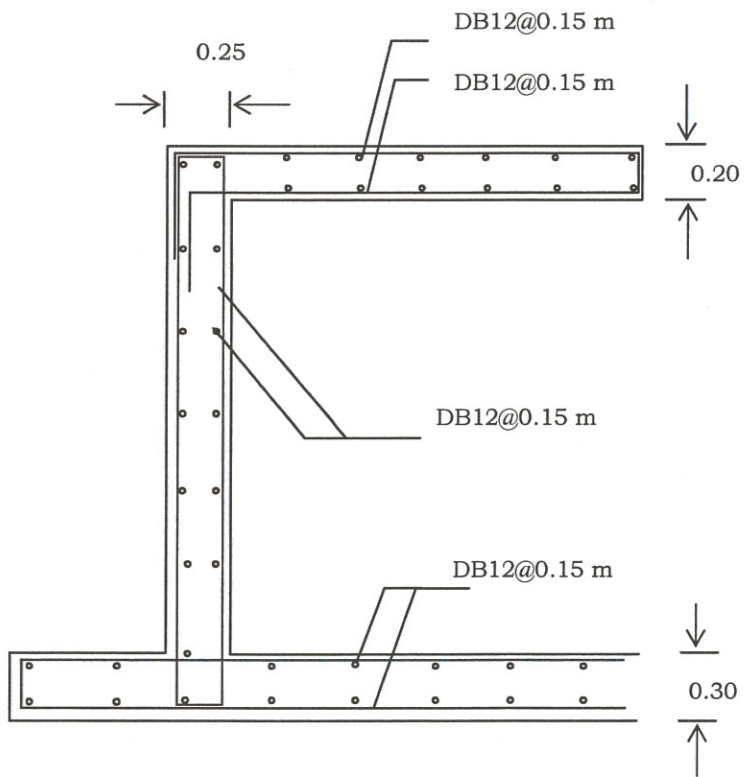
Foundation on Pile

Total Weight	100	Ton
Pile Capacity	9.2	Ton/Pile
Use	11	Piles

Foundation on Ground

Soil Bearing Capacity	12	Ton/sq.m
Total Load(Oil+ Tank)	89	Ton
Required Area of Bottom Slab	7.42	sq.m
Use Foundation Size		

	4.50	x	5.30	=	23.9	sq.m
WALL						
Mmax			3800			kg.m/m
Vmax			8400			kg
Req. d			16			cm
USE d			22			cm
Thickness			25			cm
M _R			7413			kg.m
vc			3.82			ksc
						< 4.49 OK
Req. As			0.00			cm ²
Min As			5.00			cm ²
Min s			66			cm
SLAB						
Mmax			5940			kg.m
Vmax			5940			kg
Req. d			20			cm
USE d			27			cm
M _R			11165			kg.m
Beam Type Shear:						
V			5940			kg
v			2.20			ksc
						< 4.49 OK
Punching Shear:						
V			39875			kg
v			6.48			ksc
						< 8.21 OK
Req. d			24			cm
Drop panel d			24			cm
Thickness			30			cm
Req. As			16.73			cm ²
Min As			6.00			cm ²
Min s			81			cm
<u>Reinforcement</u>						
Use :			DB 12			
As			27.14			cm ²
Req. Spacing			17			cm
use spacing			15			cm
Use:			DB12 @ 0.15 m			
Moment at toe of wall						
			3800			kg.m
Req. As			10.70			cm ²
Use :			DB 12			
As			27.14			cm ²
Req. spacing			17			cm
Spacing			15			cm
Use:			DB12 @ 0.15 m			

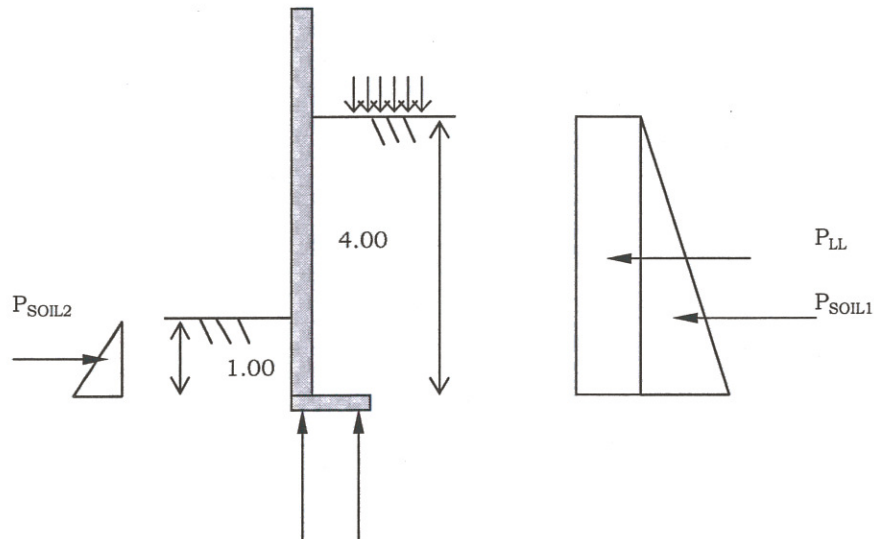


Pile 11 - 0.18x0.18x 3.5 m



FENCE - RETAINING WALL

Structure : Standard Fence Foundation
Project : PEA Substation
Location :
Date :

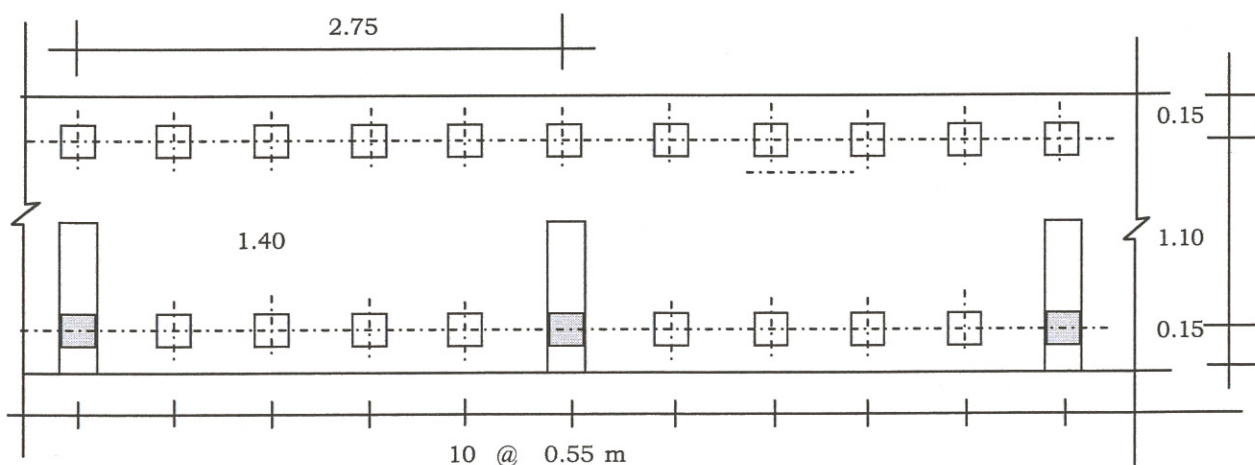


Live load on ground	300	kg/m ²
Unit weight of soil	1800	kg/m ³
Load capacity of wall	300	kg/m ²
Spacing between footing	2.75	m
Width of Footing	2.75	m
Length of Footing	1.75	m
Depth of Soil behind Wall	4.00	m
Pile Friction Capacity	4000	kg/Pile
No. of Pile	10	Pile(s)

Stability of Wall

Overturning Moment

Soil pressure = $K_a \cdot \gamma H$ =	2520	kg/m ²
P_{SOIL1} =	13860	kg
Live load pressure = $K_a \cdot LL$	105	kg/m ²
P_{LL} =	1155	kg
Overturning Moment @ toe of wall	20790	kg.m



	0.20	0.35	0.35	0.20
Concrete f_c' (Cylinder)		210	ksc	
E_c		219110	ksc	
Reinforcing Steel	SD 30			
	SR 24			

Dimensions:

Abutment : b_y	0.20	m
b_x	0.15	m
Piles : $\square$ 0.22 x 0.22 x 4.0 m		
Width / Diameter of Pile	0.22	m

Load:

Bending Moment	8.90	Ton.m
Column Load	0.80	Ton
Weight of Footing	9.24	Ton
Total	10.04	Ton
Maximum Compression	6.56	Ton
Tension	-1.54	Ton
Load Capacity of Pile	4.0	Ton/Pile
Skin Friction Capacity of Pile	3.0	Ton/Pile
Required Number of Piles for Compression	2	Piles
Use	5	Piles
Required Number of Piles for Tension	1	Piles
Use	5	Piles
Maximum Compression on Pile	1.31	Ton/Pile
Maximum Tension on Pile	0.31	Ton/Pile

Depth of Footing:

Mymax	7211	kg.m
Mxmax	7211	kg.m
Required Depth of Footing	13	cm
Use Depth	13	cm
Thickness of Footing	20	cm

Check Shear:

Beam Type Shear

x_1	92.0	cm	
P_1'	0.31	Ton	
V_1	0.92	Ton	
v	0.26	ksc	< v_c PASS
v_c	4.20	ksc	
x_2	-18.0	cm	
P_2'	0.00	Ton	
V_2	0.00	Ton	
v	0.00	ksc	< v_c PASS
v_c	4.20	ksc	

Punching Shear

Punching Shear Perimeter	52.88	cm	
x_1	98.5	cm	
P_1'	0.31	Ton	
Punching Shear Perimeter	52.88	cm	
x_2	-6.5	cm	
P_2'	0.37	Ton	
V	0.74	Ton	
v	1.08	ksc	< v_p PASS
v_p	7.68	ksc	

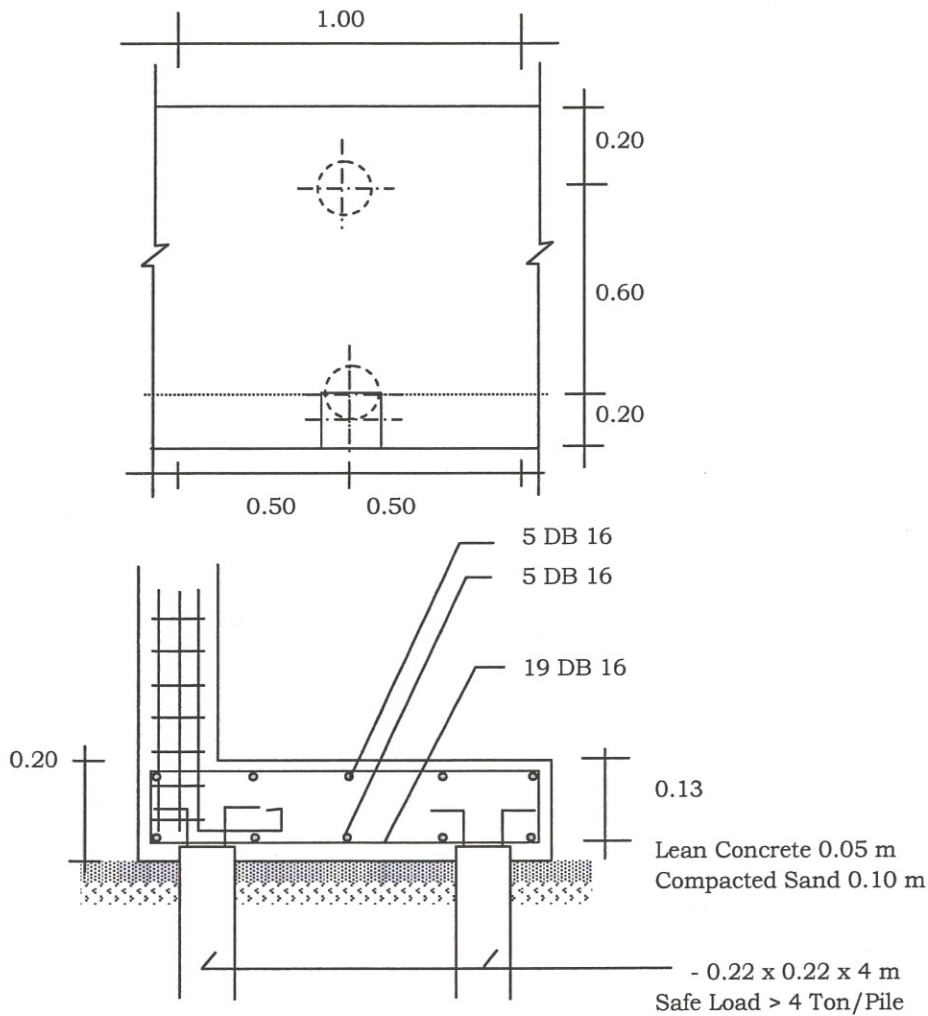
Reinforcement:

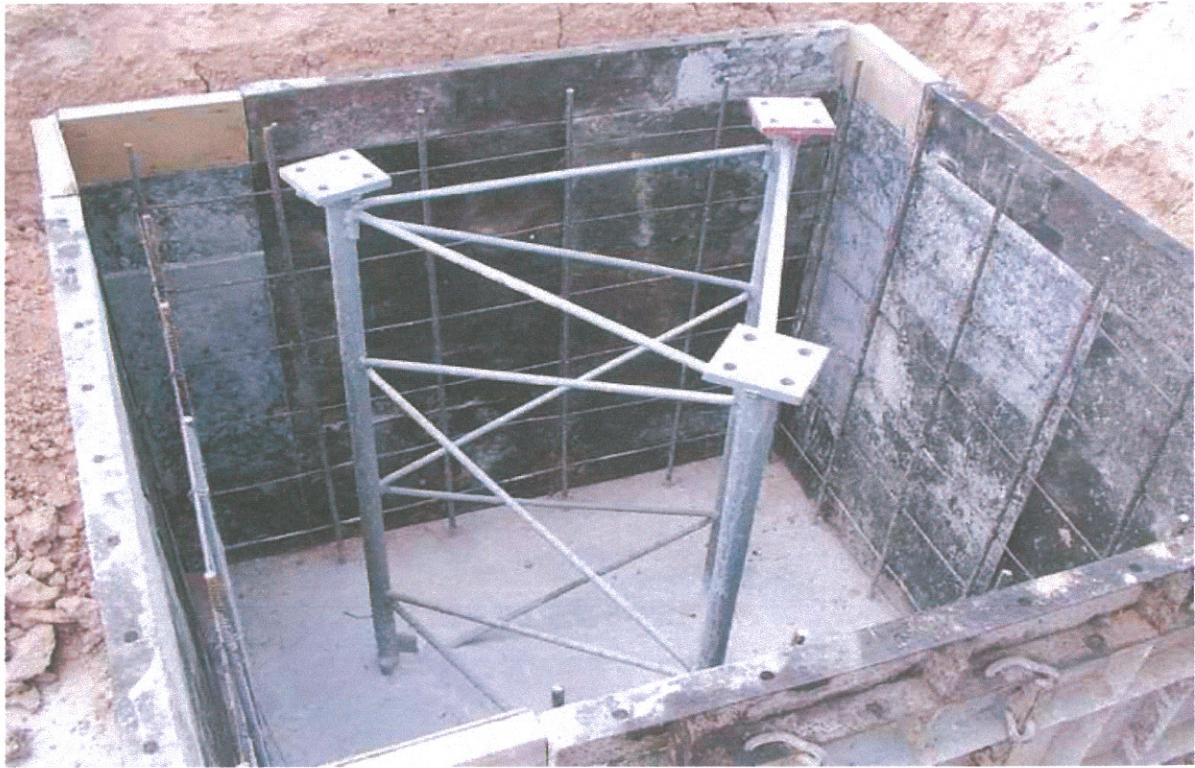
Long Bar

Required Minimum A_s	5.60	cm ²
Required A_s	36.81	cm ²
Allowable Bond Stress	29.3	ksc
Required Perimeter	1.10	cm

Use	19 DB 16		
As	38.20	cm ²	
Total Actual Perimeter	95.50	cm	
Development Length	11.6	cm	
Actual Anchorage Length	125.0	cm	
			> 1.25Ld OK
Short Bar			
Required Minimum As	4.00	cm ² /m	
Required As	36.81	cm ²	
Use	19 DB 16		
Actual As	38.20	cm ²	

Footing Plan and Section:





ANTENNA TOWER FOUNDATION



CABLE TRENCH



HDPE PIPE WITH DUCT BANK

DESIGN CRITERIA**Project :** PEA Substation : Control Building

Kai Bang Ra Chan Substation

Strength of Materials**Concrete**

Compressive strength of 28-days Concrete Cylinders	210	ksc
Elastic modulus	230067	ksc
Shear strength		
-Beam type shear	4.20	ksc
-Punching shear	7.68	ksc

Structural Steel (ASTM A-36)

Elastic modulus	2040000	ksc
Minimum yield strength	2520	ksc
Allowable shear stress	1008	ksc
Allowable tensile stress		
-Pinned end	1134	ksc
-Fixed end	1512	ksc

Reinforcing Steel**Deformed Bars**

Yield strength	4000	ksc
Allowable tensile strength	1700	ksc
Yield strength	3000	ksc
Allowable tensile strength	1500	ksc

Rounded Bars

Yield strength	2400	ksc
Allowable tensile strength	1200	ksc

Live Load

Roof	50	kg/sq.m
Floor		
Capacitor Bank Room	1200	kg/sq.m
Switchgear Room	1200	kg/sq.m
Control Room	1200	kg/sq.m
Battery Room	800	kg/sq.m
Cable Room	600	kg/sq.m
Toilet	300	kg/sq.m
Stair	600	kg/sq.m
Transformer	110	Ton

Wind Load

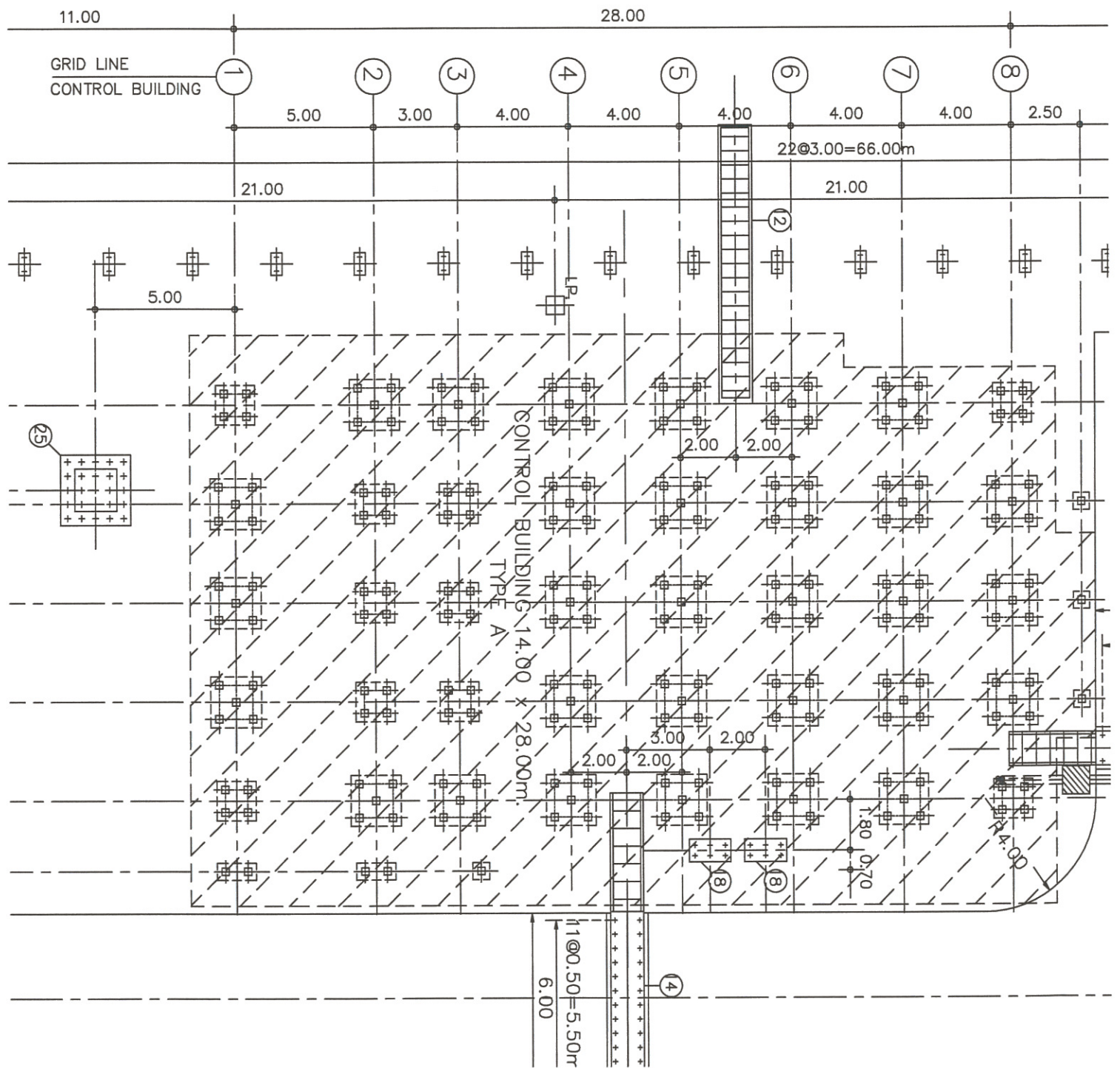
H = 10 - 20 m	80	kg/sq.m
H = 0 - 10 m	50	kg/sq.m

Dead Load

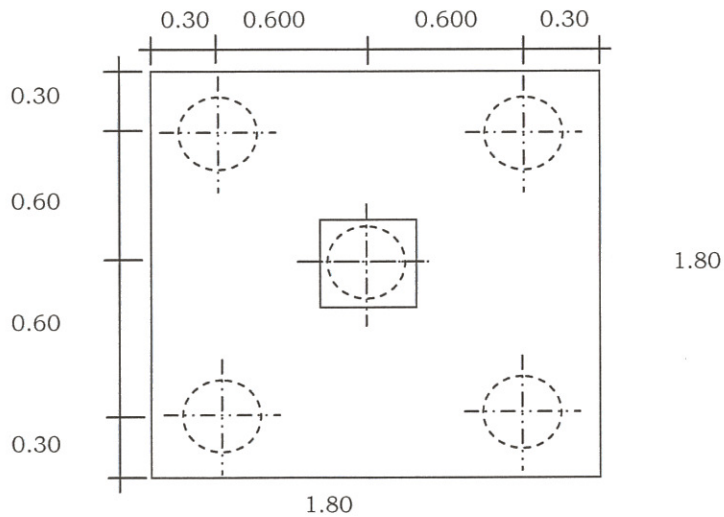
Concrete	2400	kg/cu.m
Steel	7860	kg/cu.m
Ceiling	20	kg/sq.m
Brick Wall (Full Size)	360	kg/sq.m
Brick Wall (Half Size)	180	kg/sq.m
Concrete Block Wall	120	kg/sq.m
Light Weight Concrete Wall	85	kg/sq.m



CONTROL ROOM BUILDING



Structure : Footing F1
Project :
Location : Kai Bang Ra Chan Substation



Dimension :

Abutment :	bx	0.30	m
	by	0.30	m
Piles :	I	0.26 x 0.26 x 8.0 m	

Materials Properties :

Concrete :	fc'	(28-day concrete cylinder)	210	ksc
Reinforcing Steels :	SD 30 and SR 24			

Load :

Column Load	48.00	Ton	
Bending Moment	0.50	Ton.m	
Horizontal Force		Ton	
Weight of Footing	2.72	Ton	
Total	51.14	Ton	
Load Capacity of Pile	11.0	Ton/Pile	
Number of Piles	5	Piles	
Each Pile Carry Load	10.23	Ton	: PASS

Depth of Footing:

Mmax	9205	kg.m	
Required Depth of Footing	22	cm	
Use Depth	28	cm	
Thickness of Footing	35	cm	

Check Shear:

Beam Type Shear

V	7.5	Ton	
v	1.49	ksc	< vc : PASS
vc	4.20	ksc	

Punching Shear

V	34.1	Ton	
v	5.25	ksc	< vp : PASS
vp	7.68	ksc	

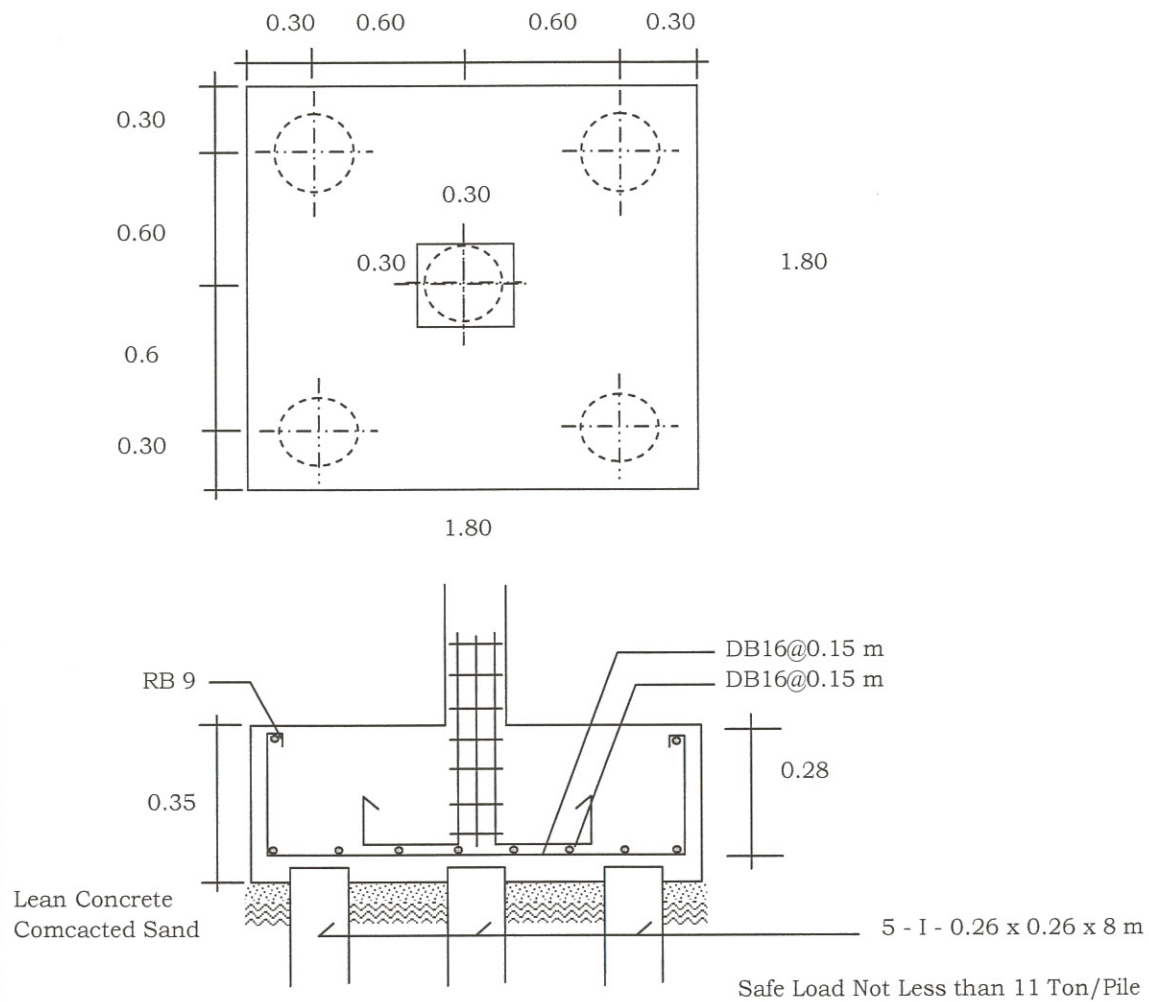
Reinforcement:

Long Bar

Min. As	12.60	cm ²	
Req. As	24.89	cm ²	
Allowable Bond Stress	29.25	ksc	
Required Perimeter	28.36	cm	
Use	DB 16 @ 0.150		
As	26.14	cm ²	
Total Actual Perimeter	65.35	cm	
Spacing	15.00	cm	

Development Length	10.3	cm
Actual Anchorage Length	93.0	cm
		> 1.25Ld : PASS
Short Bar		
Min As	12.60	cm ²
Req. As	24.89	cm ²
Allowable Bond Stress	29.25	ksc
Required Perimeter	28.36	cm
Use	DB 16 @ 0.150	
As	26.14	cm ²
Total Actual Perimeter	65.35	cm
Spacing	15.00	cm
Development Length	10.3	cm
Actual Anchorage Length	93.0	cm
		> 1.25Ld : PASS

Footing Plan and Section:



Structure :		Footing F2		Project :	
Date :		28-11-05		Location : Kai Bang Ra Chan Substation	

Use DB 12 @ 0.125

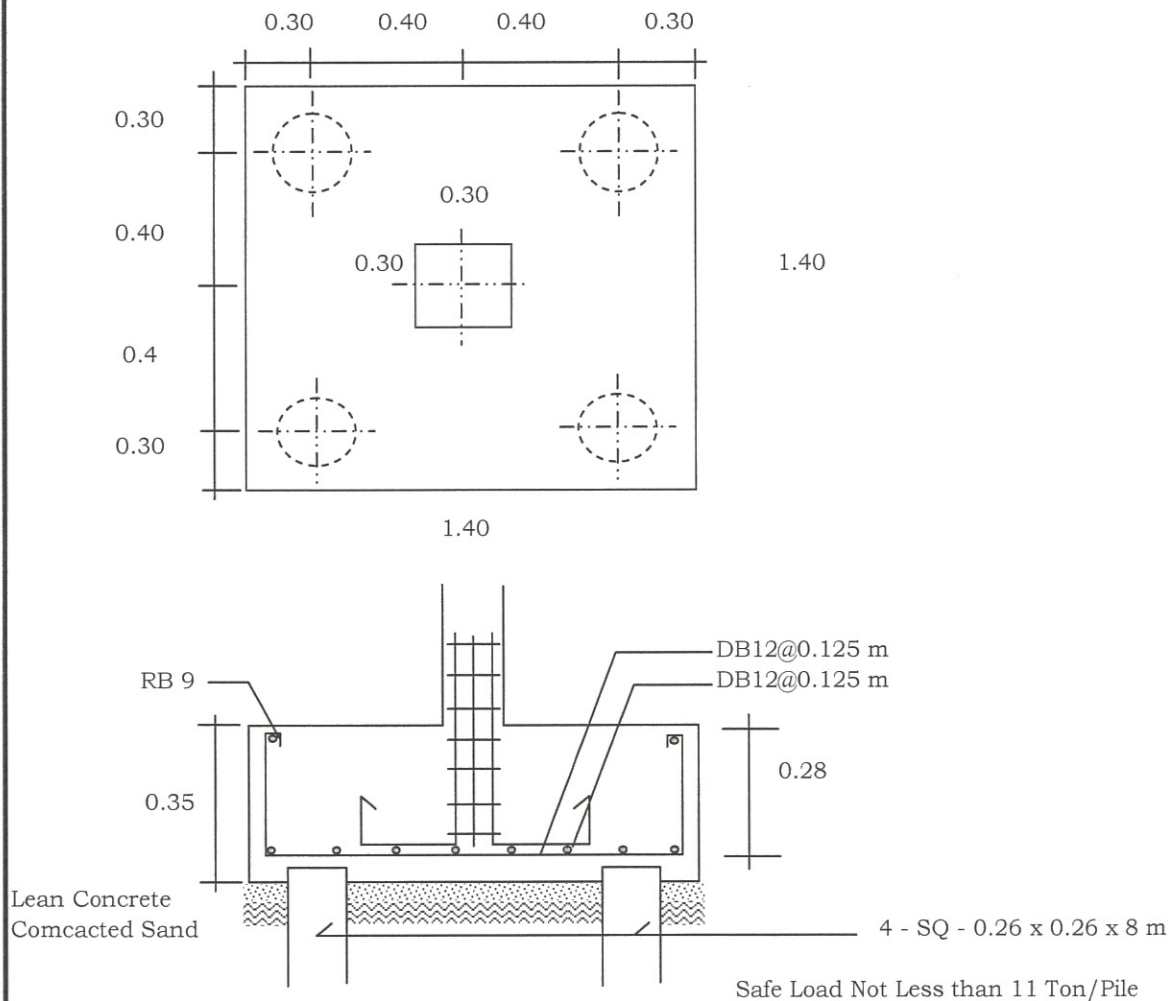
As	12.44	cm ²
Total Actual Perimeter	41.47	cm
Spacing	14.00	cm
Development Length	6.4	cm
Actual Anchorage Length	93.0	cm
> 1.25Ld : PASS		

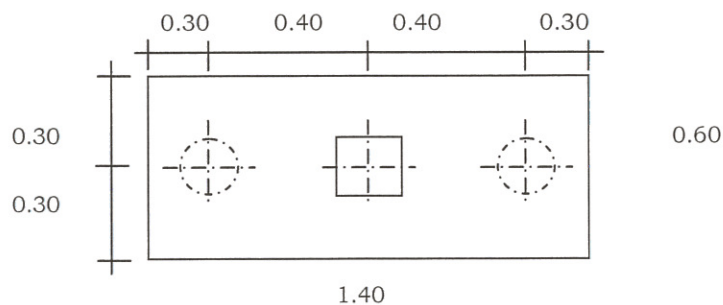
Short Bar

Min As	9.80	cm ²
Req. As	12.18	cm ²
Allowable Bond Stress	35.20	ksc
Required Perimeter	20.76	cm
Use DB 12 @ 0.125		

As	12.44	cm ²
Total Actual Perimeter	41.47	cm
Spacing	14.00	cm
Development Length	6.4	cm
Actual Anchorage Length	93.0	cm
> 1.25Ld : PASS		

Footing Plan and Section:



Structure : Footing F3**Project :****Date : 28-11-05****Location : Kai Bang Ra Chan Substation****Dimension :**

<u>Abutment :</u>	bx	0.15	m
	by	0.15	m
<u>Piles :</u>	SQ 0.26 x 0.26 x 8.0 m		
	Width / Diameter of Piles	0.26	m
	Load Capacity of Pile	11	Ton/Pile

Materials Properties :

Concrete : f_c' (28-day concrete cylinder)	210	ksc
E_c	230067	ksc
Reinforcing Steel : SD 30 SR 24		
E_s	2040000	ksc

Load :

Bending Moment	0.50	Ton.m
Column Load	20.0	Ton
Weight of Footing	0.65	Ton
Total	20.6	Ton
Compression	10.9	Ton
Tension	9.7	Ton
Number of Piles	2	Piles
Each Pile Carry Load	10.9	Ton : PASS

Depth of Footing:

Maximum Bending Moment	3559	kg.m
Required Depth of Footing	21	cm
Use Depth	33	cm
Thickness of Footing	40	cm

Check Shear:**Beam Type Shear**

x	-0.5	cm
P'	5.3	Ton
V	5.3	Ton
v	2.67	ksc < v_c : PASS
v_c	4.20	ksc

Punching Shear

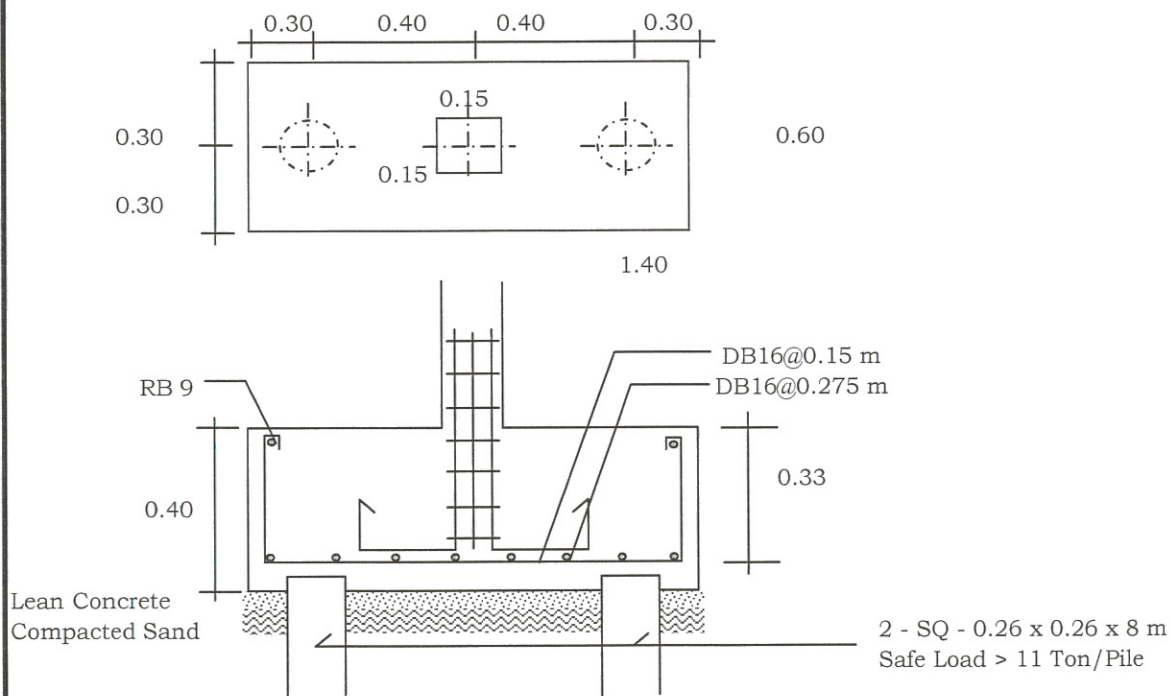
Width of footing at distance $d/2$ from face of column	0.60	m
x_1	16.0	cm
P_1'	10.9	Ton
V	21.9	Ton
v	6.38	ksc < v_p : PASS
v_p	7.68	ksc

Reinforcement:**Long Bar**

Min. As	4.80	cm ²
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Req. As	8.16	cm ²
Allowable Bond Stress	29.25	ksc
Required Perimeter	12.88	cm
Use DB 16 @ 0.150		
As	10.05	cm ²
Total Actual Perimeter	25.13	cm
Spacing	15.00	cm
Development Length	10.3	cm
Actual Anchorage Length	103.0	cm
		> 1.25Ld : PASS
Short Bar		
Min As	11.20	cm ²
Allowable Bond Stress	29.25	ksc
Required Perimeter	12.88	cm
Use DB 16 @ 0.275		
As	12.06	cm ²
Total Actual Perimeter	30.16	cm
Spacing	28.00	cm
Development Length	10.3	cm
Actual Anchorage Length	63.0	cm
		> 1.25Ld : PASS

Footing Plan and Section:



Structure : FOOTING F4

Project :

Location : Kai Bang Ra Chan Substation

Date :

Loading :

Column Load 10.0 Ton

Materials Properties :

Concrete : f_c' (28-day concrete cylinder) 210 ksc

Reinforcing Steels SD 30 SR 24

Footing Dimension :

Pile SQ 0.26 x 0.26 x 8.0 m

Load Capacity of Pile 11.0 Ton/Pile : **PASS**

No. of pile 1 Pile

Req. width of footing 55 cm

use: 60 cm

Depth of Footing 30 cm

Thickness of Footing 60 cm

Reinforcing Steel :

As min 7.20 cm^2

Allowable Bond Stress 24.6 ksc

Required Perimeter 7.7 cm

use: DB 12 @ 0.100

Total Actual Area of Steel 7.92 cm^2

Total Actual Perimeter 26.39 cm

Spacing 10.00 cm

Development Length 18.3 cm

Actual Anchorage Length 55.0 cm

> 1.25Ld PASS

Footing Plan and Section :

