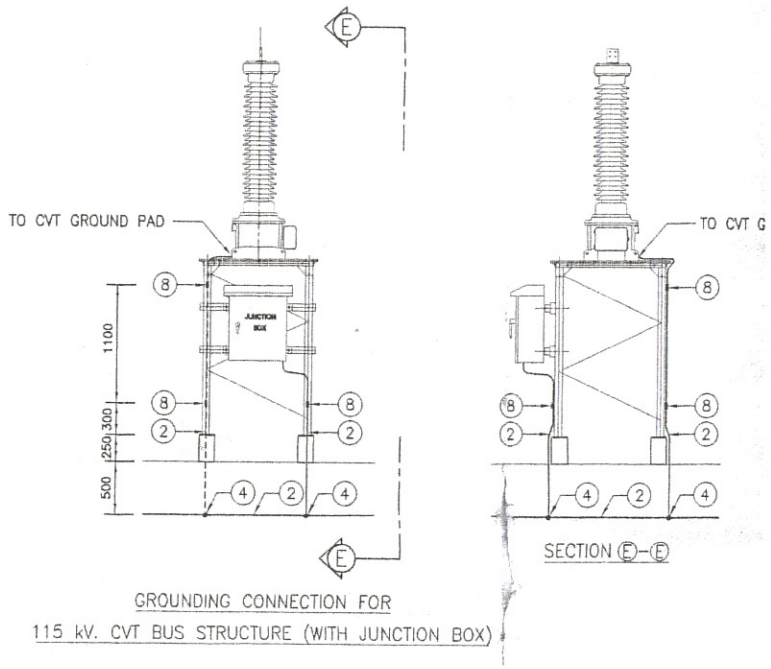
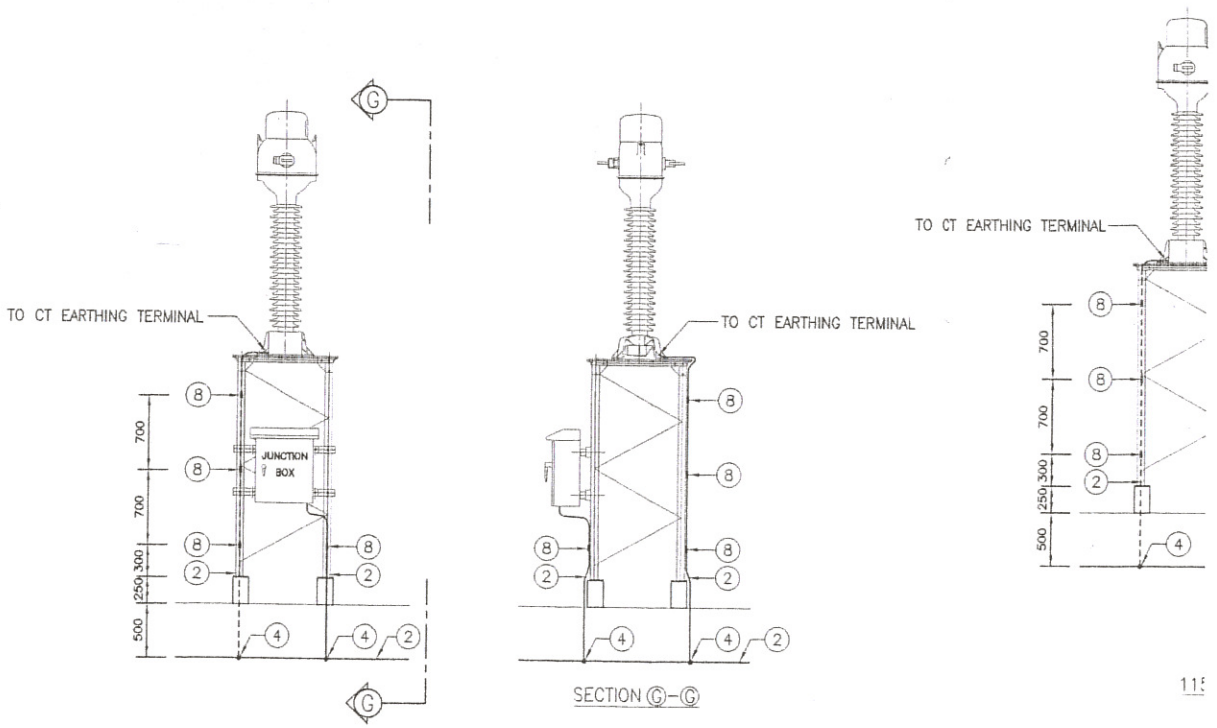


GROUNDING CONNECTION FOR
115 kV. CVT BUS STRUCTURE (WITH JUNCTION BOX)

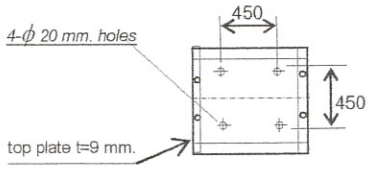


GROUNDING CONNECTION FOR
115 kV. CT STRUCTURE (WITH JUNCTION BOX)

(นายชาย แสงไสว)

SUBJECT : CURRENT TRANSFORMER SUPPORTING STRUCTURE	PAGE

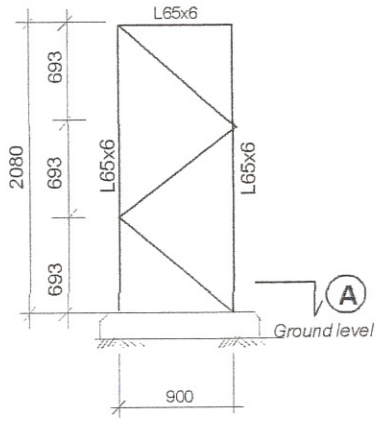
1. STRUCTURAL DESIGN DRAWING

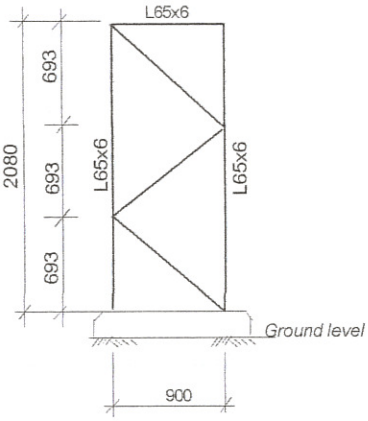


TOP VIEW

NOTES

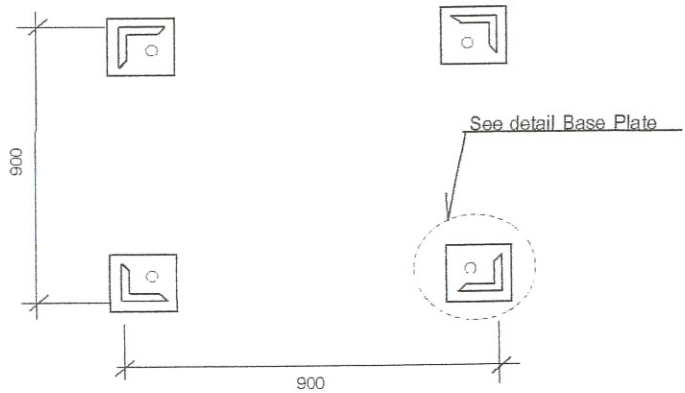
1. BLANK MEMBERS ARE L50x50x4
2. BLANK BOLTS ARE M16-1
3. NO INDICATED BOLT SIZE ARE M16
4. ALL DIMENSION ARE IN MILLIMETERS
5. ALL STRUCTURAL STEEL ARE JIS G3101 SS400
6. ALL BOLTS & NUTS ARE ASTM A394 TYPE 0

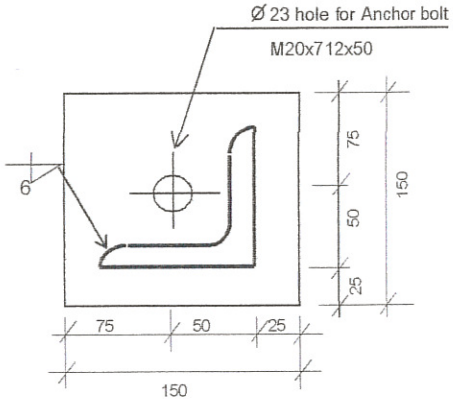




FRONT VIEW

SIDE VIEW





SECTION A-A

BASE PLATE = 15 MM.

Total weight of steel structure = 350 kg.. (Approx. and included weight of bolts, plates nut, zinc)

Wind load on steel structure = 1.0x100x1.75

= 175 kg. (Shape factor = 1.75)

2. Detail of equipment

Item no.	Total height (mm.)	Height of equipment (mm.)	Height of steel structure (mm.)	Weight of equipment (kg.)
A4.3	4,480	2400	2,080	600 (APPROX.)

นายชาย แสงไสว)

Weight of equipment = 600 kg.

Wind load on equipment = 2.400x0.5x67 (Approx. diameter equipment = 500 mm.)

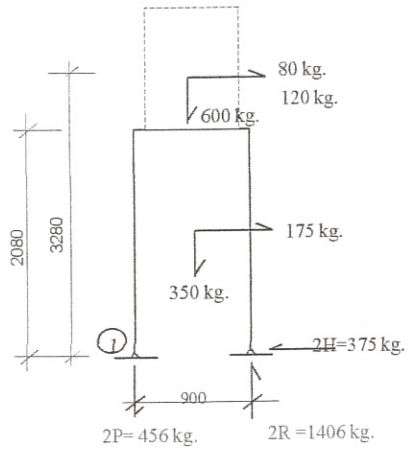
= **80** kg.

Short circuit or dynamic load = 0.2xG

= 0.2x600 = 120 kg.

Center of gravity = 1,200 mm.

3. Analysis and design



LOAD DIAGRAM

$\sum M$ AROUND (1) =0

2Rx0.9= (600+350)x0.9/2+(80+120)x3.280
+175x2.080/2

2R = 1,406 kg.

$\sum Fy = 0$

2P = 1406-350-600

= **456** kg.

$\sum Fx = 0$

2H = 80+120+175

= **375** kg.

Maximum compression in bracing = H/(900/1,136)

= 375/2/(900/1,136)

= **237** kg./bracing

=

Maximum compression in post = R

= 1,406/2

= **703** kg./leg

3.1 Design post

Assume post size L65x6, unit weight =5.91 kg/m, sectional area =7.527 cm^2.,

,radius of gyration Rx = 1.98 cm. Rv = 1.27 cm.

Maximum unsupported length Lv = 133.4 cm.

Maximum compression in post = **703** kg.

KLx/Rx = (1)(138.6)/(1.98) = 70

KLv/Rv = (1)(69.3)/1.27 = 54.57

Cc = $\sqrt{2\pi^2 E/FY}$ = 126.91 > KL/R

Allowable compressive stress

Fa = 1,144 ..... ksc. **(AISC 1.5-1)**

Allowable compressive strength = FaxArea = 1,144x7.5? = 8,611 kg

> **703** kg. **OK.**

So we can use post size L65x65x6

(นายชาย แสงไสว)

3.2 Design bracing

Assume bracing size L50x50x4, unit weight =3.06 kg/m.., sectional area =3.892 cm^2.

,radius of gyration , Rv = 0.983 cm.

Maximum unsupported length . Lv = 112cm.

Maximum compression in bracing = 237 kg.

KLv/Rv = (1)(113.6)/0.983 = 116

Cc = $\sqrt{2\pi^2 E/Fy}$ = 126.91 > KL/R

Allowable compressive stress

Fa = 761 ksc. ..... **(AISC 1.5-1)**

Allowable compressive strength = FaxArea = 761x3.892 = 2962 kg.

> 237 kg. **OK.**

So we can use bracing size L50x50x4

Check bolts connection

Assume use bolt connection size M16-1

Allowable bearing strength (on the contact area) = 0.9x2,500x1.6x0.4

= 1,440 kg. > 237 **OK.**

Allowable shear on bolt = 0.22x5,203xπx$(1.6)^2$/4

= 2,300 kg. > 237 **OK.**

Allowable bearing on bolt = 0.6x5,203x1.6x0.4

= 1,998 kg. > 237 **OK.**

So we can use bolt connection size M16-1

3.3 Design base plate and anchor bolt

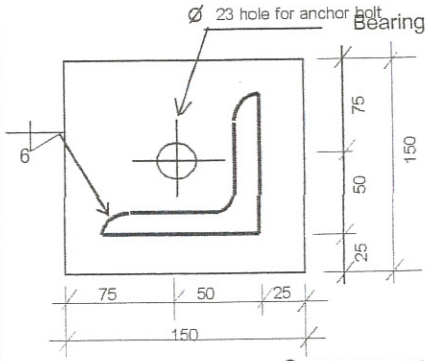
Maximum compression = C = 703 kg./post

Maximum tension = T = 228 kg./post

Allowable bearing stress on concrete fc = 43.75 ksc.

Bearing stress on base plate = 703/(15x15) = 3.12 ksc.

< 43.75 **OK.**



Uniform load on base plate (from tension) = 228/(12.5^2) ksc.

= 1.46 ksc.

Max. bending moment = 0.29x1.46x12.5^2

= 66 kg-cm/cm.

Min. plate thickness = $\sqrt{6x66/(0.75x2500)}$

= 0.46 **cm.**

So we can use base plate 15 mm. Thickness

Assume use anchor bolt size M20x712x50, embeded length = 600 cm.,JIS G3101 SS400 Fu = 4,100 ksc.

Allowable bonding stress = 10 ksc.

Allowable bonding strength = πx2.0x60x10 = 3,768 kg.. > **228** **kg. Ok.**

Allowable tensile strength = 0.33xFuxArea = 0.33x4,100xπx2.0^2/4

= 4,248 kg.. > **228** **kg. Ok.**

So we can use anchor bolt size M20x712x50 per leg.

(นายชาย แสงไสว)

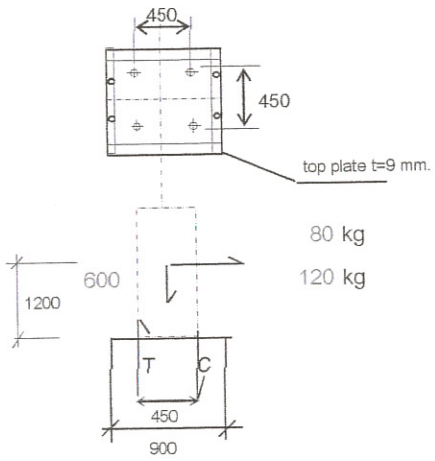
Check welding

Assume use welding 6 mm fillet

Max. horizontal force	=	375/2	= 188	kg.		
Max. tension	=	456/2	= 228	kg.		
Welding length			= 26	cm.		
Shearing stress Fv1			= 188/(26x0.6x0.707)			
			= 17.0	ksc.		
Tensile stress Fv2			= 228/(26x0.6x0.707)			
			= 20.7	ksc.		
Combine shearing stress			$=\sqrt{17^2+20.7^2}$			
			= 26.8	ksc.		
Allowable shearing stress Fv			= 1260	ksc. >	26.8	ksc. **Ok.**

So we can use 6 mm. Fillet weld

3.4 Design top plate and top beam



From load diagram

C	=	(80+120)x1.20/0.45+600/2	kg.
	=	833	kg.
T	=	(80+120)x1.2/0.45-600/2	kg.
	=	233	kg.

Uniform load on top plate = 833/(90x90/2)

= 0.206 ksc.

Bending monent $M=wl^2/8$ = $0.206X90^2/8$

= 209 *kg.-cm./cm.*

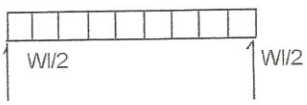
t = $(6x209/(0.75x2500))^{0.5}$

= 0.818 cm.

So we can use top plate 9. mm thickness

Assume beam size L65X6, unit weight =5.91 kg/m., sectional area =7.527 cm^2.,modulus of section

Zx = Zy = 6.26cm^3., moment of inertia Ix = Iy =29.4 cm^4.



Uniform load on beam = ((80+120)x1.2/0.9+600/2)/0.9

= 630 kg/m

MAX. MOMENT = $wl^2/8$ kg-m

= (630+5.91)x0.9^2/8

= 64 kg-m

Bending stress Fb=M/Z= 64x100/6.26 = 1,029 ksc.

Allowable bending stress Fb =0.66Fy = 1650 > 1,029 **ksc. OK.**

allowable deflection =L/360 = 90/360 = 0.25 cm

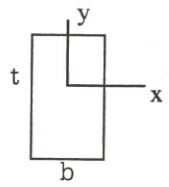
actual aeflection=$5WL^4/384EI$ = $5x(630+5.91)/100x90^4/384EI$

= 0.091292 < 0.25 **OK.**

So we can use beam size L65xX65X6

นายชาย แสงไสว

Structure : CT Column **Project :**
Date : **Location :** Han Ka Substation



Square Section

INPUT:

Material Properties

Concrete fc' (Cylinder)			210	ksc
Reinforcing Steel	SD 30	and SR 24		

Loading

Axial load , P	300	kg
Moment , Mx	0	kg-m
Moment , My	0	kg-m
Reduction Factor	1.00	

Dimension

Length of Column	1.25	m
Section		
Thickness; t	0.15	m
Width; b	0.15	m
Ag	0.02	m^2
% steel , pg	0.020	
Total Steel required , Ast	4.5	cm^2
Input: Ast = *4 DB 12*	4.5	cm^2
h/b	8.3	<15

COMPUTATION: <<Consider as Short Column>>

ex=Mx/P	-	cm
ey=My/P	-	cm
ebx=[0.67pgm + 0.17](t - d')	3.96	cm
eby=[0.67pgm + 0.17](b - d')	3.96	cm
eax=Msx(1/Pa - 1/Po)	0.07	cm
eay=Msy(1/Pa - 1/Po)	0.07	cm
Pa=0.85 Ag (0.25 fc' + fs pg)	6,187	kg
Po=Fa Ag	21,489	kg
Ix=1/12 bt^3 + (2n - 1) Ast $(gt)^2/4$	4,691	cm^4
Iy=1/12 tb^3 + (2n - 1) Ast $(gt)^2/4$	4,691	cm^4
Sx=Ix/cx	626	cm^3
Sy=Iy/cy	626	cm^3
Msx=Fb Sx	591	kg-m

(นายชาย แสงไสว)

Msy=Fb Sy		591	kg-m
Fa=0.34 (1 + pgm) fc'		96	ksc
Fb=0.45 fc'		95	ksc

CHECKING: Computation in case: 1

Case 1: ex<eax , ey<eay : Pure Axial Load

Pa =		15,804	kg
Ast =		(12)	cm^2

Solution: << ***Steel Area Selected : PASS*** >>

Case 2: eax<ex<ebx , eay<ey<eby : Compression Dominant

fa =		-	ksc
fbx =		-	ksc
fby =		-	ksc
$\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}}$ =		-	

Solution: -

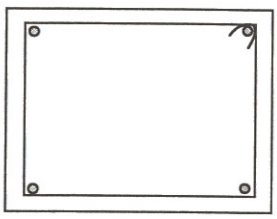
Case 3: ex>ebx , ey>eby : Tension Dominant

Pbx =		-	kg
Pby =		-	kg
Mbx =		-	kg-m
Mby =		-	kg-m
Mox =		-	kg-m
Moy =		-	kg-m
$\frac{M_x}{M_{ox}} + \frac{M_y}{M_{oy}}$ =		-	

Solution: -

STIRRUP:	Stirrup size used (not less than 6 mm)		6	mm
Main steel size used		4 DB-	12	mm
Spacing =	16 times of main steel		19.20	cm
	48 times of stirrup		28.80	cm
	smallest of the size		15.00	cm
Use spacing (not exceed the least spacing)			15	cm

0.15



0.15

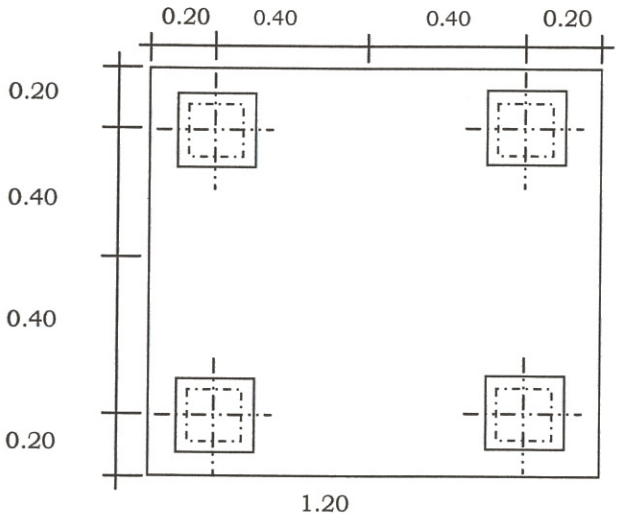
Vertical Bar 4 DB 12

Tie Bar RB 6 @ 0.15m.

(นายชาย แสงไสว)

HKASF/ct c

Structure : Current Transformer Foundation
Project : PEA Nakorn Thai Substation
Location : Han Ka Substation
Date :



Dimension :

Abutment :	bx		0.15	m
	by		0.15	m
	Depth		1.50	m
Piles :	SQ 0.15 x 0.15 x 3.0 m			
	Width / Diameter of Piles		0.15	m

Materials Properties :

Concrete :	fc'	(28-day concrete cylinder)	210	ksc
Reinforcing Steels :	SD 30	and SR 24		
				Ton/m^3

Load :

Column Load	0.30	Ton
Bending Moment	0.00	Ton.m
Horizontal Force	0.00	Ton
Weight of Footing	0.20	Ton
Total	0.50	Ton
Number of Piles	4	Piles
Each Pile Carry Load	0.13	Ton
Compression 1	0.08	Ton : PASS
Compression 2	0.08	Ton

Depth of Footing:

Mmax	120	kg.m
Required Depth of Footing	3	cm
Use Depth	8	cm
Thickness of Footing	15	cm

Check Overturning:

Overturning Moment	0.00	Ton.m
Resisting Moment		
Soil Weight Above Footing	1.56	Ton.m
Footing Weight	0.21	Ton.m
Pile Friction	4.80	Ton.m
Compression Load	0.12	Ton.m
Total Resisting Moment	6.68	Ton.m

CT/HKASF

(นายชาย แสงไสว)

Msy=Fb Sy		591	kg-m
Fa=0.34 (1 + pgm) fc'		96	ksc
Fb=0.45 fc'		95	ksc

CHECKING: Computation in case: 1

Case 1: ex<eax , ey<eay : Pure Axial Load

Pa =		15,804	kg
Ast =		(12)	cm^2

Solution: << ***Steel Area Selected : PASS*** >>

Case 2: eax<ex<ebx , eay<ey<eby : Compression Dominant

fa =		-	ksc
fbx =		-	ksc
fby =		-	ksc
$\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}}$ =		-	

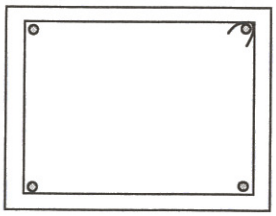
Solution: -

Case 3: ex>ebx , ey>eby : Tension Dominant

Pbx =		-	kg
Pby =		-	kg
Mbx =		-	kg-m
Mby =		-	kg-m
Mox =		-	kg-m
Moy =		-	kg-m
$\frac{M_x}{M_{ox}} + \frac{M_y}{M_{oy}}$ =		-	

Solution: -

STIRRUP:	Stirrup size used (not less than 6 mm)		6	mm
Main steel size used		4 DB-	12	mm
Spacing =	16 times of main steel		19.20	cm
	48 times of stirrup		28.80	cm
	smallest of the size		15.00	cm
Use spacing (not exceed the least spacing)			15	cm



Vertical Bar 4 DB 12

Tie Bar RB 6 @ 0.15m.

นายชาย แสงไสว)

Check Shear:

Beam Type Shear

x	7.0	cm	
P'	0.1	Ton	
V	0.1	Ton	
v	0.11	ksc	< vc : PASS
v_C	4.20	ksc	

Punching Shear

Width of footing at distance d/2 from face of column	23.00	m	
x_1	11.0	cm	
P_1'	0.1	Ton	
V	0.3	Ton	
v	0.35	ksc	< vp : PASS
v_P	7.68	ksc	

Reinforcement:

Long Bar

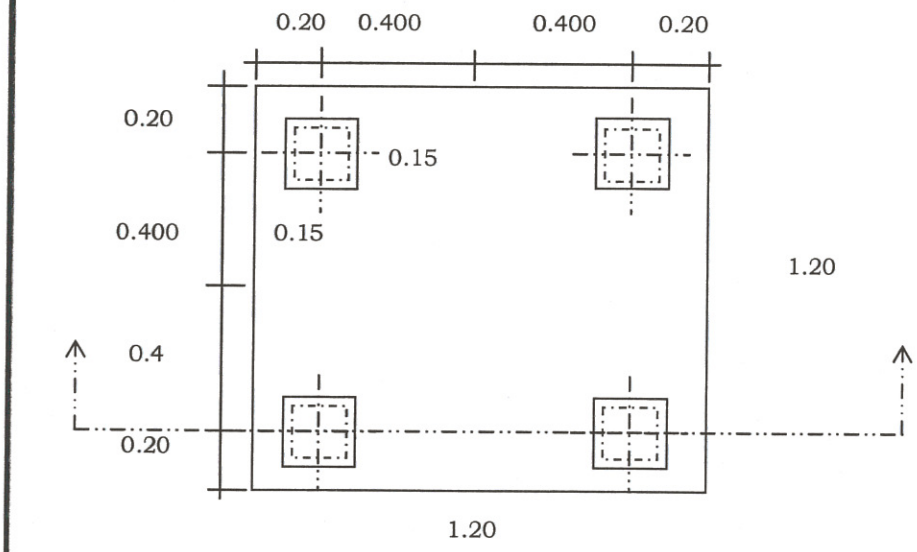
Min. As	3.60	cm^2	
Req. As	1.14	cm^2	
Allowable Bond Stress	35.20	ksc	
Required Perimeter	0.60	cm	
Use RB 9 @ 0.15			
As	3.82	cm^2	
Total Actual Perimeter	16.96	cm	
Spacing	15.00	cm	
Development Length	4.8	cm	
Actual Anchorage Length	45.5	cm	
		> 1.25Ld : PASS	

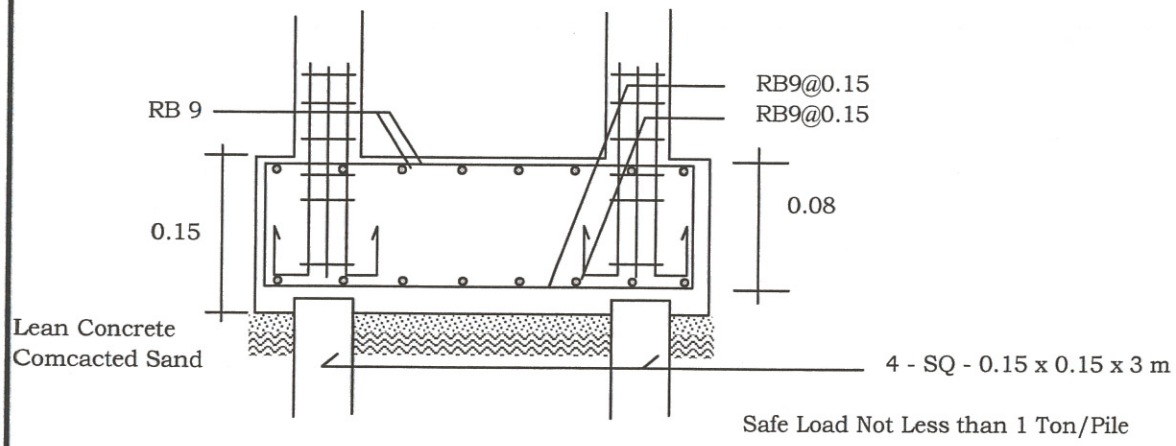
Short Bar

Min As	3.60	cm^2	
Req. As	1.14	cm^2	
Allowable Bond Stress	35.20	ksc	
Required Perimeter	0.60	cm	
Use RB 9 @ 0.15			
As	3.82	cm^2	
Total Actual Perimeter	16.96	cm	
Spacing	15.00	cm	
Development Length	4.8	cm	
Actual Anchorage Length	45.5	cm	
		> 1.25Ld : PASS	

(นายชาย แสงไสย)

Footing Plan and Section:





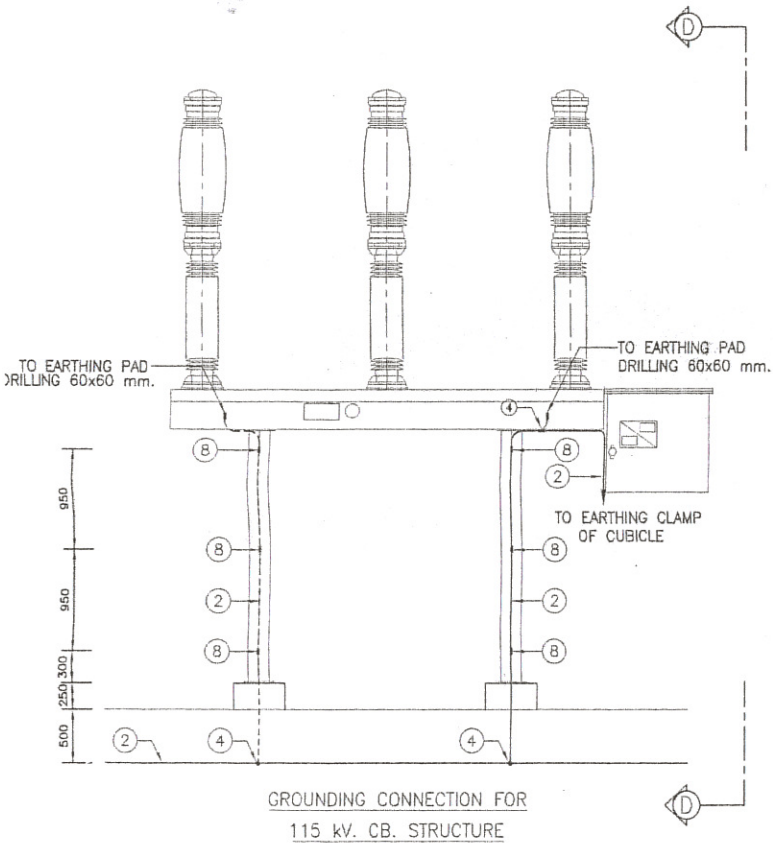
Safe Load Not Less than 1 Ton/Pile

CT/HKASF

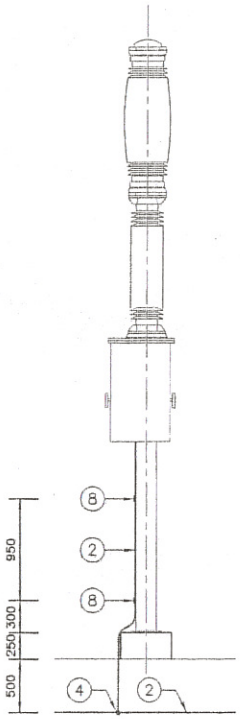
(นายชาย แสงไสว)


DISCONNECTING SWITCH SUPPORT
CIRCUIT BRAEAKER SUPPORT
20 7 2006


BUS POLE SUPPORT
20 7 2006



GROUNDING CONNECTION FOR
115 kV. CB. STRUCTURE

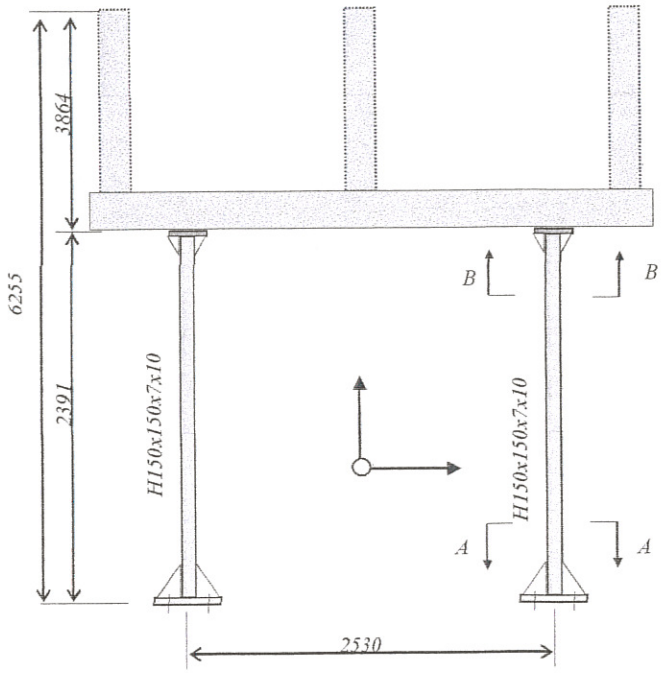


SECTION Ⓓ–Ⓓ

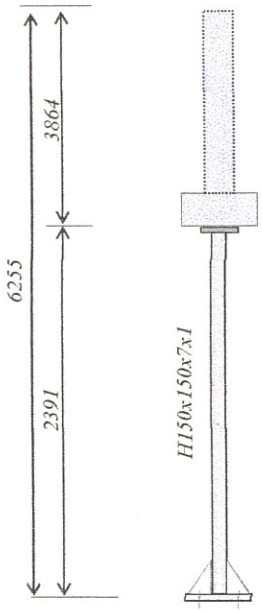
(นายชาย แสงไสว)

SUBJECT : 115 kV. CIRCUIT BREAKER SUPPORTING STRUCTURE	PAGE

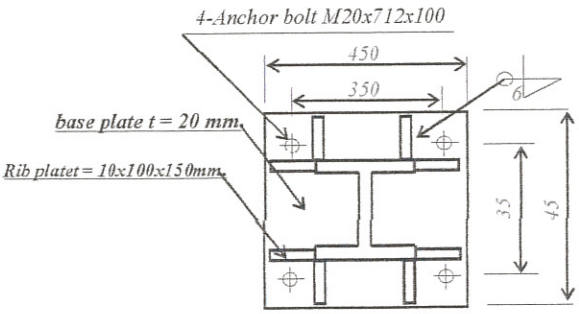
1. Structural design drawing



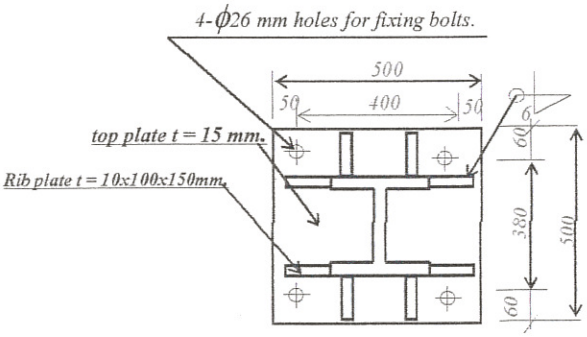
Front view



Side view



Section A



Section B

Total weight of steel structure	=	500	kg.
Wind load on steel structure	=	72	kg.
Wind load on steel equipment	=	3x67x3.864x0.3+100x3.94x0.46	kg
	=	958	(app. Diameter= 300 mm.)
Center of gravity of equipment	=	1932	kg.

2. Detail of equipment

Item no.	Total height (mm.)	Height of equipment (mm.)	Height of steel structure (mm.)	Weight of Equipment (kg.)
A1.2	6255	3864	2391	1200

(นายชาย แสงไสว)

SUBJECT : 115 kV. CIRCUIT BREAKER SUPPORTING STRUCTURE	PAGE

3. Loading data

(Loads per 2 column)

	Fx (kg.)	Fy (kg.)	Fz (kg.)	Arm (m.)	Mx (kg-m)	My (kg-m)
1. Weight of equipment			1200			
2. Dynamic conductor tension due to short circuit		300		6.255	1877	
3. Vertical forces due to switching operations			2400			
4. *Horizontal forces due to switching operations*	200			2.391		478.2
5. Weight of structure including weight of junction box			500			
6. Wind load on steel structure		72		1.196	86	
7. Wind load on equipment		958		4.323	4141	
S Center of gravity (wind- Y) **max.**	**200**	**1330**	**4100**		**6103**	**478**

Wind assumptions : 100 km/m^2

Z Axis is positive downward.

4. Design column, base plate , anchor bolts and check welding

Assume use column size H150x150x7x10,area = 40.14m^2 , rx =6.39 ry= 3.75 cm, Zx = 219 Zy = 75.1 cm3

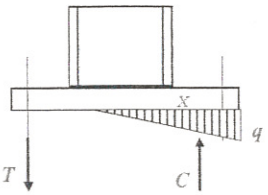
Base plate 450X450 mm^2

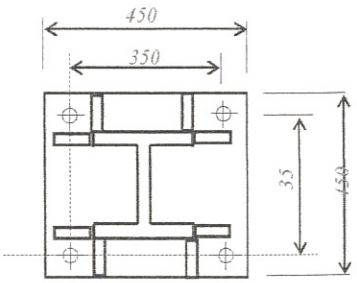
Mx = **3052** kg.-m/column

My = **239** kg.-m/column

V = **2050** kg./column

H = **665** kg./column





Kl/r = 2.0x239/3.75 = 127.47 > Cc = $(2(\pi)^2 E/FY)^{0.5}$ = 126.91

Fa = **646** ksc.

fa = 2050/40.14 = 51 ksc.

fa/Fa = 51/646 = 0.079 < 0.15

According to AISC specification for checking of combined axial force and bending moment

fa/Fa + fbx/Fbx + fby/Fby < 1.00 **(AISC 1.6-2)**

0.079 + 3052x100/219+239x100/75.1 = 0.86

0.66x2,500x1.333 < 1.00 **OK.**

ALLOWABLE BEARING STRESS OF CONCRETE

fc= 0.25fc' = 0.25x175 = 43.75

qx = V/A+M/S = 2050/(45x45)+3052x100x6/(45x45^2) = 21.1 **OK.**

qy = 160x100x6/(45x45^2) = 1.57

q1+q2 = 22.67 < 43.75 ksc. **OK.**

Σ moment around 1-1 = 0

Cy(40-X/3) = My

0.5x1.57x45xX(40-X/3) = 239x100

-11.78X^2+1413X = 23900

11.78X^2-1413X+23900 = 0

Xy = 20.4 cm.

Ty = Cy

= 0.5x1.57x45x20.4

= **1441** kg.

Σ moment around 2-2 = 0

Cx(40-X/3) = Vx17.5+Mx

0.5x21.1x45X(40-X/3) = 2050x17.5+3052x100

-158X^2+18990X = 341,075

158X^2-18990X+341075 = 0

Xx = 22.0 cm.

Tx = Cx-V

= 0.5x21.1x45x22-2050

= **8395** kg.

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Maximum tension on anchor bolt = 1441/2+8395/2

= **4918** kg./bolt

Maximum unifrom load on base plate = 4918/(15x15)

= 21.9 ksc.

Maximum bending moment = $0.29x21.9x15^2$

= 1426 kg-cm/cm.

Minimum thickness of base plate = $(1426x6/(0.75x2400x1.33))^{0.5}$

= 1.89 cm.

Assume use ancho bolt size M20x712x100, Embeded length = 60 cm., JIS G3101 SS400 Fu = 4,100 ksc.

Allowable bonding stress = 10x1.333 KSC

Allowable bonding strength = πx2.0x60x10x1.333

= 5,023 KG./bolt > 4,918 kg. **OK**

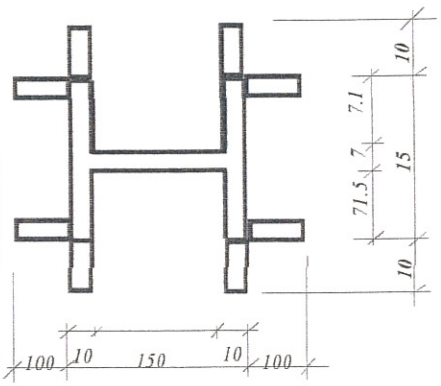
Allowable tensile strength = 0.33xFuxAREAx1.333

= $0.33x4,100x\pi x(2.0)^2/4x1.333$

= 5,663 KG./bolt > 4,918 kg. **OK**

So we can use column size H150x150x7x10, base plate 450x450x20^t and 4-M20x712x100 anchor bolts.

Check welding



Assume use 6 mm. weld

Ix = $2x35x1x7.5^2+2x35x6.5^2+2x1/12x13^3+$

= $8x(1/12x1x10^3+1x10x12.5^2)$

= 20428 $cm.^4/cm$

Iy = $4x1/12x35^3+2x1x13x0.35^2+4x10x7.5^2+4x10x6.3^2$

= 18132 $cm.^4/cm$

fv1 = 3052x100x17.5/(20428x0.6x0.707)

= 616 ksc.

fv2 = 239x100x17.5/(18132x0.6x0.707)

= 54 ksc.

ALLOWABLE SHEARING STRESS fv = 1,260 KSC

TOTAL HORIZ. FORCE = 665 KG. TOTAL WELDING LENGTH = 104 cm.

SHEARING STRESS fv3 = 665/104x0.6x0.707 = 15.07 ksc.

COMBINED SHEARING STRESS = $\sqrt{(616+54)^2+(15.07)^2}$ = 670 < 1,260 ksc. **Ok.**

So we can use 6.0 mm. Fillet weld

Design top plate (load on 2 top plate)

	Fx (kg.)	Fy (kg.)	Fz (kg.)	Arm (m.)	Mx (kg-m)	My (kg-m)
1. Weight of equipment			1200			
2. Dynamic conductor tension due to short circuit		300		3.864	1159	
3. Wind load on equipment		958		1.932	1851	

Maximum moment on top plate = (1159+1851)/2 = 1505 kg-m

Maximum load on top plate = 1200/2 = 600 kg.

Maximum compression on tension

= 1505/0.38-600/2 = 3661 kg.

uniform load = 3661/(2/17.5^2) = 5.98 ksc.

Maximum bending moment on plate = 0.29x5.98x17.5^2 = 531 kg-cm/cm.

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minimum thickness of top plate = $(531x6/(0.75x2500x1.333))^{0.5}$

= 1.13 cm.

So we can use top plate 15 mm. Thickness

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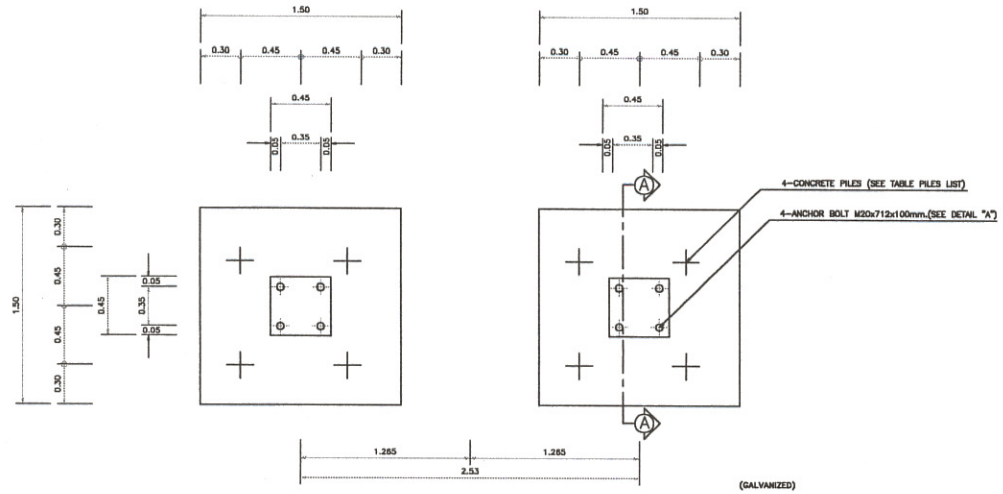
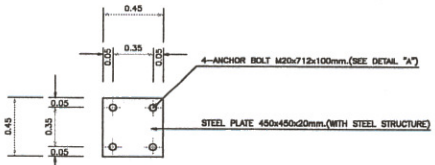
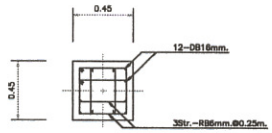


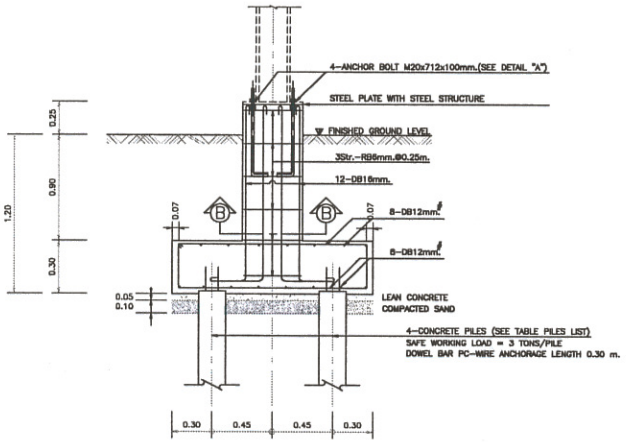
FOUNDATION PLAN
SCALE 1:20



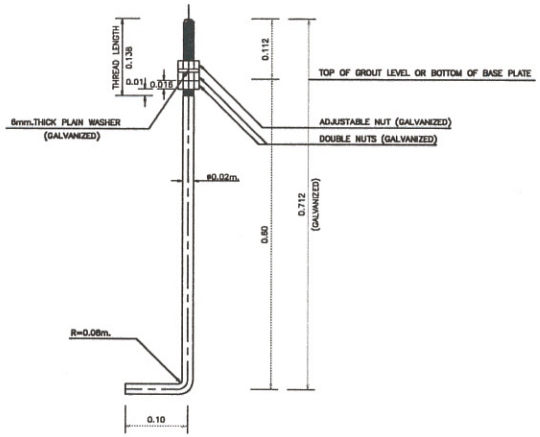
BOLT SETTING
SCALE 1:20



SECTION Ⓑ – Ⓑ
SCALE 1:20



SECTION Ⓐ – Ⓐ
SCALE 1:20



DETAIL "A"
SCALE NTS.

ANCHOR BOLT M20x712x100

TABLE

LIST OF CIRCUIT BREAKER FOUNDATION	
KHU KHAN	□-0.18x0.18x4.00m.
BORABU	□-0.18x0.18x3.00m.
PRASAT	□-0.18x0.18x3.00m.
NANG RONG	□-0.18x0.18x3.00m.

NOTES:

1. ALL DIMENSTION ARE IN METER, EXCEPT OTHERWISE SHOW.
2. THE STRENGTH OF CONCRETE IS NOT LESS THAN 210 KSC. (AFTER 28 DAYS AGING, CYLINDER TEST)
3. ANCHOR BOLTS SHALL BE GAVALNIZED TYPE GRADE ASTM.A307
4. THE REINFORCEMENT BAR FOR ROUND BAR CONFIRM TO REQUIREMENT OF TIS.20 (NOT LESS THAN 2,400 KSC.) AND FOR DEFORMED BAR CONFIRM TO REQUIREMENT OF TIS.24 (NOT LESS THAN 3,000 KSC.)

REV.	DATE	DESCRIPTION	REF.
1	12-10-05	REVISED AS PEA'S COMMENT	MYI.5302.6/18924
0	05-10-05	FIRST ISSUE	

POSITION	NAME	SIGNATURE	DATE
DRAWN	WEERA K.		12-10-05
CIVIL ENGINEER.	PRATEEP K. วศ. 38603		
PROJECT ENGINEER.	SONGCHAI T. วศ. 12024		
PROJECT MANAGER.	SURAPOL M. วศ. 455		

OWNER: PROVINCIAL ELECTRICITY AUTHORITY
200 NGAMWONGWAN ROAD, CHATUCHAK, BANGKOK 10900, THAILAND

PROJECT: TSD.7.1.P-3.2/2548

CONTRACTOR: PICNIC CORPORATION PUBLIC COMPANY LIMITED
805 SRINAKHARIN RD.,SUANLUANG, SUANLUANG DISTRICT BANGKOK 10250 TEL. 0-2721-3800 FAX. 0-2721-3501

SUBSTATION: KHU KHAN, BORABU, PRASAT, NANG RONG

TITLE: 115 kV. CIRCUIT BREAKER SUPPORT FOUNDATION

SCALE: 1:20 NTS.

DWG. STATUS: FOR CONSTRUCTION

DWG. SIZE: A1

DWG.NO: STD-SWY-A-001

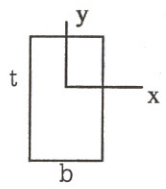
SHEET 1 OF 1

REV. 1

DISK\FILE NAME :

Structure : Circuit Breaker Column **Project :**

Date : **Location :** Han Ka Substation



Square Section

INPUT:

Material Properties

Concrete fc' (Cylinder)			210	ksc
Reinforcing Steel	SD 30	and SR 24		

Loading

Axial load , P	1,400	kg
Moment , Mx	0	kg-m
Moment , My	0	kg-m
Reduction Factor	1.00	

Dimension

Length of Column	1.15	m
Section		
Thickness; t	0.55	m
Width; b	0.55	m
Ag	0.30	m^2
% steel , pg	0.008	
Total Steel required , Ast	24.1	cm^2
Input: Ast = *12 DB 16*	24.1	cm^2
h/b	2.1	<15

COMPUTATION: <<Consider as Short Column>>

ex=Mx/P	-	cm
ey=My/P	-	cm
ebx=[0.67pgm + 0.17](t - d')	12.99	cm
eby=[0.67pgm + 0.17](b - d')	12.99	cm
eax=Msx(1/Pa - 1/Po)	0.78	cm
eay=Msy(1/Pa - 1/Po)	0.78	cm
Pa=0.85 Ag (0.25 fc' + fs pg)	36,453	kg
Po=Fa Ag	244,929	kg
$Ix=1/12\ bt^3 + (2n - 1)\ Ast\ (gt)^2/4$	966,886	cm^4
$Iy=1/12\ tb^3 + (2n - 1)\ Ast\ (gt)^2/4$	966,886	cm^4
Sx=Ix/cx	35,160	cm^3
Sy=Iy/cy	35,160	cm^3
Msx=Fb Sx	33,226	kg-m

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Msy=Fb Sy		33,226	kg-m
Fa=0.34 (1 + pgm) fc'		81	ksc
Fb=0.45 fc'		95	ksc

CHECKING: Computation in case: 1

Case 1: ex<eax , ey<eay : Pure Axial Load

Pa =		165,744	kg
Ast =		(129)	cm^2

Solution: << ***Steel Area Selected : PASS*** >>

Case 2: eax<ex<ebx , eay<ey<eby : Compression Dominant

fa =		-	ksc
fbx =		-	ksc
fby =		-	ksc
$\frac{f_a}{F_a} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}}$ =		-	

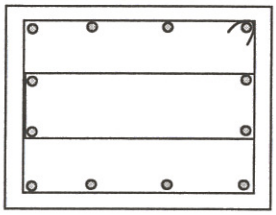
Solution: -

Case 3: ex>ebx , ey>eby : Tension Dominant

Pbx =		-	kg
Pby =		-	kg
Mbx =		-	kg-m
Mby =		-	kg-m
Mox =		-	kg-m
Moy =		-	kg-m
$\frac{M_x}{M_{ox}} + \frac{M_y}{M_{oy}}$ =		-	

Solution: -

STIRRUP:	Stirrup size used (not less than 6 mm)		6	mm
Main steel size used		12 DB-	16	mm
Spacing =	16 times of main steel		25.60	cm
	48 times of stirrup		28.80	cm
	smallest of the size		55.00	cm
Use spacing (not exceed the least spacing)			25	cm



Vertical Bar 12 DB 16

Tie Bar 2RB 6 @ 0.25m.

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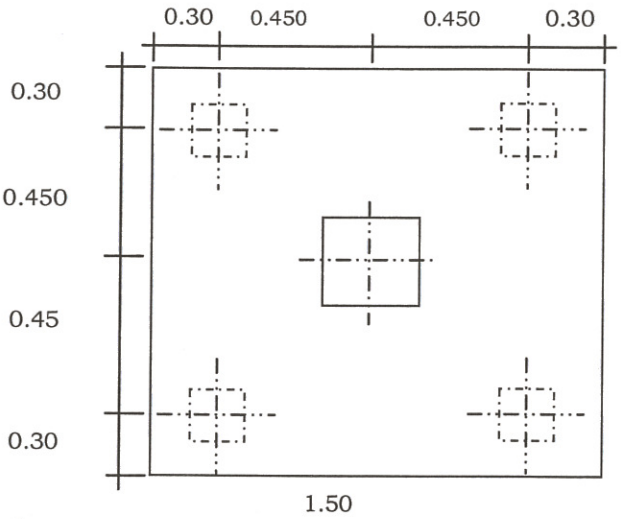
Structure : Circuit Breaker Foundation
Project : PEA Substations
Location : Han Ka Substation
Date :



Dimension :

Abutment :	bx	0.55	m
	by	0.55	m
	Depth	1.20	m
Piles :	SQ 0.15 x 0.15 x 3.0 m		
	Width / Diameter of Piles	0.15	m

Materials Properties :

Concrete :	fc' (28-day concrete cylinder)	210	ksc
Reinforcing Steels :	SD 30 and SR 24		
			Ton/m^3

Load :

Column Load		1.40	Ton
Bending Moment		0.00	Ton.m
Horizontal Force		0.00	Ton
Weight of Footing		0.41	Ton
Total		1.81	Ton
Number of Piles		4	Piles
Compression 1		0.35	Ton : PASS
Compression 2		0.35	Ton

Depth of Footing:

Mmax	123	kg.m
Required Depth of Footing	3	cm
Use Depth	23	cm
Thickness of Footing	30	cm

Check Overturning:

Overturning Moment	0.00	Ton.m
Resisting Moment		
Soil Weight Above Footing	3.65	Ton.m
Footing Weight	1.22	Ton.m
Pile Friction	5.40	Ton.m
Compression Load	0.63	Ton.m
Total Resisting Moment	10.89	Ton.m

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Check Shear:

Beam Type Shear

x	-28.0	cm	
P'	0.0	Ton	
V	0.0	Ton	
v	0.00	ksc	< vc : PASS
v_C	4.20	ksc	

Punching Shear

Width of footing at distance d/2 from face of column	78.00	m	
x_1	-16.5	cm	
P_1'	0.0	Ton	
V	0.0	Ton	
v	0.00	ksc	< vp : PASS
v_P	7.68	ksc	

Reinforcement:

Long Bar

Min. As	9.00	cm^2
Req. As	0.40	cm^2
Allowable Bond Stress	35.20	ksc
Required Perimeter	0.98	cm
Use DB 12 @ 0.20		m
As	9.05	cm^2
Total Actual Perimeter	30.16	cm
Spacing	21.43	cm
Development Length	6.4	cm
Actual Anchorage Length	60.5	cm
		> 1.25Ld : PASS

Short Bar

Min As	9.00	cm^2
Req. As	0.40	cm^2
Allowable Bond Stress	35.20	ksc
Required Perimeter	0.98	cm
Use DB 12 @ 0.20		
As	9.05	cm^2
Total Actual Perimeter	30.16	cm
Spacing	21.43	cm
Development Length	6.4	cm
Actual Anchorage Length	60.5	cm
		> 1.25Ld : PASS

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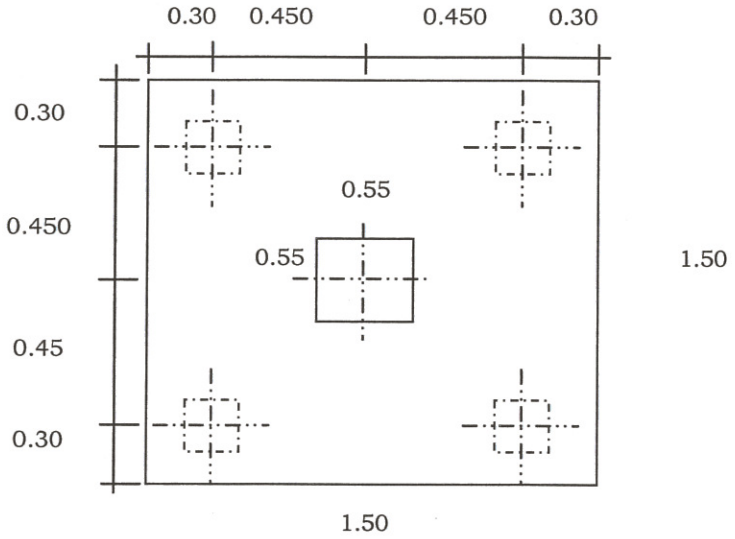
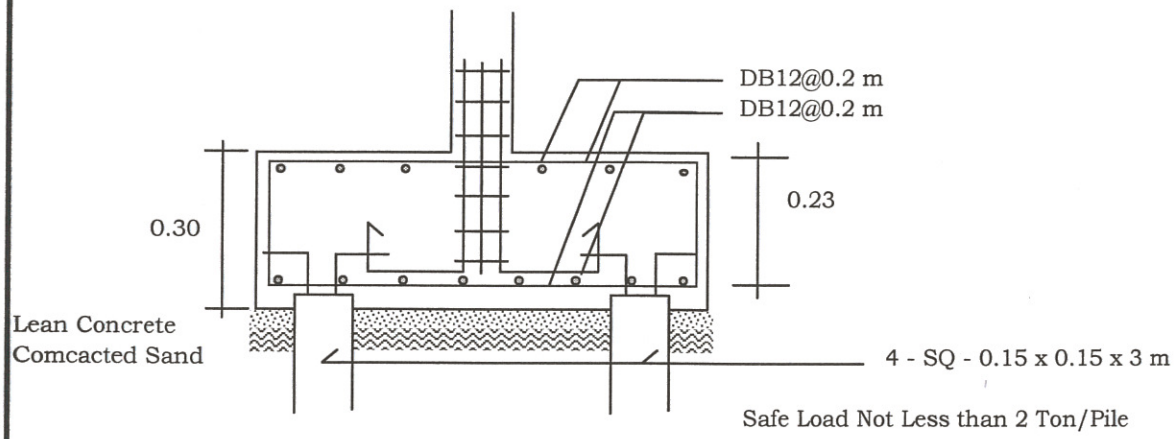
Footing Plan and Section:





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