

รายการคำนวณโครงสร้าง
แก้ไขฐานรากเสาปาย
สน.ปตท. ราย บจก.เอ็นแอนด์เอปิโตรเลียม
อ.กาญจนดิษฐ์ จ.สุราษฎร์ธานี (แผน 1)

วิศวกรโครงสร้าง
นายประสาน จิ่งสงวนพรสุข สย. 5499
14/10/2011

1) Design Notes

1.1) Design Standard and References

- a) Ministry of Interior Regulation
 - Control of the Construction of Buildings ACT B.E.2522 and B.E. 2535
- b) American Concrete Institute
 - ACI 318-99 "Building Code Requirement for Reinforced Concrete"
 - ACI 315-99 "Details and Detailing of Concrete Reinforcement"
- c) American Institute of Steel Construction
 - AISC-Ninth Edition "Manual of Steel Construction, Allowable Stress Design"

1.2) Design Loadings

- a) Dead Loads
 - Steel : 7,850 kg/cu.m.
 - Concrete : 2,400 kg/cu.m.
 - Compacted Sand : 2,000 kg/cu.m.

- b) Live Loads
 - Platform : 150 kg/sq.m.

- c) Wind Load

Height of Sign , H (m.)	Wind Pressure (kg/sq.m.)
H <= 10	50
10 < H <= 20	80
20 < H <= 40	120
40 < H <= 80	160
H > 80	200

1.3) Materials Data

a) Concrete

Reinforced Concrete Structure	:	240 ksc (Cyl.)
Lean Concrete	:	150 ksc (Cyl.)

b) Reinforcements.

Reinforcement for reinforced concrete will conform to the following Thai Industrial Standard (TIS)

Mild Steel Round bars , TIS 20 Grade SR-24

(RB6 - RB9) ; fy : 2,400 ksc

Deformed bars , TIS 24 Grade SD-40

(DB12 - DB32) ; fy : 4,000 ksc

c) Cover to Reinforcement

c.1) Concrete cast against and

Permanently exposed to Earth : 75 mm.

c.2) Concrete exposed to earth or weather

- Bar diameter \geq 16 mm. : 50 mm.

- Bar diameter $<$ 16 mm. : 40 mm.

c.3) Concrete not exposed to weather or

in contact with ground

- Slab , Stair , Walls : 20 mm.

- Beam : 30 mm.

- Column : 35 mm.

c.4) Where bundle bars are used or the equivalent bundle

base diameter , which is the greater : 50 mm.

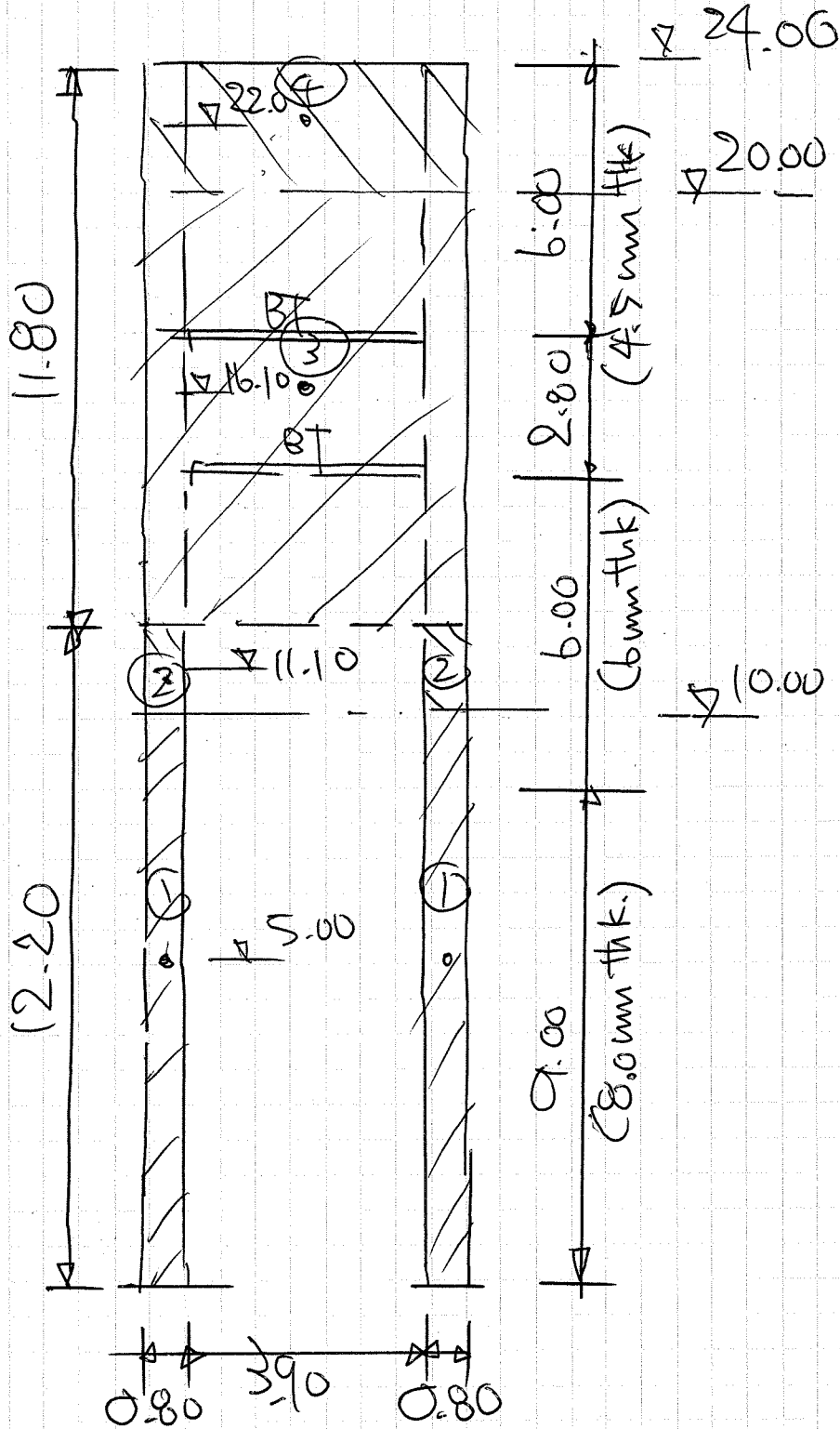
d) Structural Steel

Structural Steel Structure will conform to the following Thai Industrial Standard (TIS)

Minimum Yield Strength , fy : 2,400 ksc

CALCULATION SHEET

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U.U. Jiw.

1) (အိမ်မှု)

$$\begin{aligned}
 \text{အိမ်မှုအလယ်} &= 2\pi \sqrt{\frac{a^2 + b^2}{2}} \\
 &= 2\pi \sqrt{\frac{0.8^2 + 0.5^2}{2}} \\
 &= 4.19
 \end{aligned}$$

$$\text{အိမ်မှုအလယ်} = \frac{4.19}{2} + 1.00 = 3.095 \text{ m.}$$

$$\begin{aligned}
 \text{U.U. အိမ်မှု} &= 2 \left[(3.095 \times 0.008 \times 785 \times 9.0) + \right. \\
 &\quad \left(3.095 \times 0.006 \times 1.0 \times 785 \right) + \\
 &\quad \left. (3.095 \times 0.0045 \times 9.0 \times 785) \right] \\
 &= 2 [1748 + 875 + 983] \\
 &= \underline{7212 \text{ kg}}
 \end{aligned}$$

$$\begin{aligned}
 2) \text{ L-40x40x3} &: 24 \times 3.095 \times 1.83 \\
 &= \underline{133 \text{ kg}}
 \end{aligned}$$

$$\begin{aligned}
 3) \text{ BT-1} &: [-125 = 2 \times 3.90 \times 13.4 = 105 \\
 \text{L-50x50x5} &= 5 \times 1.20 \times 3.77 + \\
 &\quad 5 \times 1.00 \times 3.77 = 42
 \end{aligned}$$

$$2 \times \text{BT-1} = \underline{292 \text{ kg.}}$$

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$$4) \text{ تیر} = 2 \times 3.90 \times 11.8 \times 15 = \underline{1380 \text{ kg}}$$

$$4.1. \text{ تیر} = 7212 + 135 + 292 + 1380 = \underline{9020 \text{ kg}}$$

$$5) \underline{\text{4.4. ستون}} =$$

$$2 [1.00 \times 1.30 \times 1.40 \times 2400] = \underline{8736 \text{ kg}}$$

$$6) \underline{\text{BI}} :$$

$$40 \times 60 \times 2.70 \times 2400 = \underline{2131 \text{ kg}}$$

Wind load

$$① = 2 \times 0.80 \times 9.0 \times 50 = 720 \text{ kg}$$

$$② = 2 \times 0.80 \times 2.2 \times 50 = 176 \text{ "}$$

$$③ = 5.50 \times 7.80 \times 80 = 3432 \text{ "}$$

$$④ = 5.50 \times 4.0 \times 120 = 2640 \text{ "}$$

Moment due to Windload

$$M = 720 \times 9 + 176 \times 11.1 + 3432 \times 16.10 + 2640 \times 22 = \underline{118888 \text{ kg-m}}$$

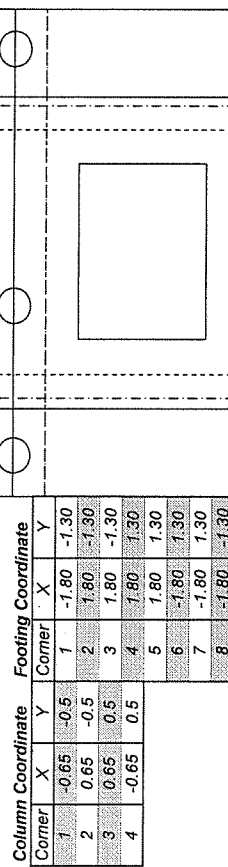
CALCULATION SHEET

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<p><u>Л.Л. 2054577.</u></p> $P = (9,020 + 8,736 + 2,131) / 2 = \frac{9943}{2} \text{ kg}$ $M = 118,900 / 2 = \frac{59450}{2} \text{ kg.m}$		

FOOTING ULTIMATE DESIGN 6F260 (WLx-)
Number of Pile 6

Design Data	X-Dimension	Y-Dimension	Safe Load	Edge Distance	Thickness	Covering	m.	m.	m.	t.	m.	m.	m.
Column Data	1.30	1.00	0.26	0.30	0.60	0.10	240	3000	9.95	0	59.45	13	1.80
Pile Data	1.50	1.00	0.26	0.30	0.60	0.10	ksc.	ksc.	t.	t-m.	t-m.	t.	t.
Material Data	Concrete	Steel	Service Load	Weight of Footing	Average Load Factor								

Pile No.	X-Coordinate			Y-Coordinate			Pile Service Loading						
	Original	Deviate	Existing	SQRT.	Original	Deviate	Existing	SQRT.	P	F	Mx	My	Total
1	-1.50	1.87	-1.00	1.00	-1.00	1.00	1.00	1.00	1	2	0	-9	-5
2	-0.40	-0.40	0.07	-1.00	1.00	2	2	0	-2	0	-2	2	2
3	1.50	1.50	2.67	-1.00	1.00	2	2	0	11	15			
4	-1.50	-1.50	1.87	1.00	1.00	1	2	0	-9	-5			
5	-0.40	-0.40	0.07	1.00	1.00	2	2	0	-2	2			
6	1.50	1.50	2.67	1.00	1.00	2	2	0	11	15			
Sq.	-0.13	0.00	-0.13	0.00	0.00	0.00	0.00	0.00	6.00	10	13	0	23
Total													



Beam Shear	X1		X2		Y1		Y2		Length	Deep Beam	X1	Y1	X2	Y2	Length
	X-Negative	X-Positive	X-Negative	X-Positive	X-Negative	X-Positive	X-Negative	X-Positive							
X-Negative	-1.15	-1.30	-1.15	1.30	2.60	2.60	-1.08	-1.30	1.30	2.60	-1.08	-1.30	1.30	2.60	2.60
X-Positive	1.15	-1.30	1.15	1.30	2.60	2.60	1.08	-1.30	1.08	1.30	1.08	-1.30	1.08	1.30	2.60
Y-Negative	-1.80	-1.00	-1.80	-1.00	3.60	3.60	-1.80	-0.75	1.80	-0.75	1.80	-0.75	1.80	-0.75	3.60
Y-Positive	-1.80	1.00	-1.80	1.00	3.60	3.60	-1.80	0.75	1.80	0.75	1.80	0.75	1.80	0.75	3.60
Punching	X1	Y1	X2	Y2	Length	Moment	X1	Y1	X2	Y2	Length	Y2	Length		
X-Negative	-0.90	-1.30	-0.90	1.30	2.60	3.60	-0.65	-1.30	-0.65	1.30	2.60	2.60	2.60		
X-Positive	0.90	-1.30	0.90	1.30	2.60	3.60	0.65	-1.30	0.65	1.30	2.60	2.60	2.60		
Y-Negative	-1.80	-0.75	-1.80	-0.75	3.60	3.60	-1.80	-0.50	1.80	-0.50	3.60	3.60	3.60		
Y-Positive	-1.80	0.75	-1.80	0.75	3.60	3.60	-1.80	0.50	1.80	0.50	3.60	3.60	3.60		

Ultimate Shear and Shear Stress at Critical Section

Pile No.	Beam Shear			Deep Beam Shear			Punching Shear		
	X-Neg	X-Pos	Y	X-Neg	X-Pos	Y	X-Neg	X-Pos	Y
1	-9	0	0	-9	0	0	-9	0	0
2	0	0	2	0	0	4	0	0	4
3	0	26	13	0	26	26	0	26	26
4	-9	0	0	-9	0	0	-9	0	0
5	0	0	0	0	0	0	0	0	0
6	0	26	0	0	26	0	26	0	26
Shear	-18	34	-3	-18	34	12	-18	34	12
Moment									
Factor	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Length	2.60	2.60	3.60	2.60	2.60	3.60	2.60	2.60	3.60
Depth	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Stress	-1.42	2.65	-0.78	-1.42	2.65	0.86	-1.42	2.65	0.86
Allow		6.98		17.45	17.45	17.45	17.45	17.45	17.45

Ultimate Moment and Reinforcement at Critical Section

Pile Number	X-Negative			X-Positive			Y-Negative			Y-Positive		
	a	V	M	a	V	M	a	V	M	a	V	M
1	0.85	-9	-8	-2.15	0	0	0.50	-9	-5	-1.50	0	0
2	-0.25	0	0	-1.05	0	0	0.50	4	2	-1.50	0	0
3	-2.15	0	0	0.85	26	22	0.50	26	13	-1.50	0	0
4	0.85	-9	-8	-2.15	0	0	-1.50	0	0	0.50	-9	-5
5	-0.25	0	0	-1.05	0	0	-1.50	0	0	0.50	4	2
6	-2.15	0	0	0.85	26	22	-1.50	0	0	0.50	26	13
Moment												
Length	2.60			2.60			45		11			11
Depth	0.50			0.50			3.60		0.50			0.50
As(Req.)				11.7			33.9		7.8			7.8
MinAs(Beam)				60.7			60.7		84.0			84.0
MinAs(Stab)				28.08			28.08		38.88			38.88
Conc. Moment				401			401		555			555

15-DB16(+)
10-DB25(B)
15-DB16(+DB)

FOOTING ULTIMATE DESIGN 6F260 (WLx-)
Number of Pile 6

FOOTING ULTIMATE DESIGN 6F260 (WLx+) 6
Number of Pile 6

Design Data

Column Data	X-Dimension	Y-Dimension	Safe Load	Edge Distance	Thickness	Covering	m.	m.	m.	t.	m.	m.	ksc.	ksc.	t.	t-m.	t-m.	t.		
Concrete	1.30	1.00	0.26	0.30	0.60	0.10	1.30	1.00	0.26	0.30	0.60	0.10	240	3000	9.95	0	59.45	13	1.80	
Steel																				
Service Load																				
Weight of Footing																				
Average Load Factor																				

Pile Coordinate and Loading

Pile No.	X-Coordinate			Y-Coordinate			Pile Service Loading						
	Original	Deviate	Existing	SQRT.	Original	Deviate	Existing	SQRT.	P	F	Mx	My	Total
1	-1.50	0.40	0.40	2.67	-1.00	1.00	1.00	1.00	2	2	0	-11	-6
2	0.40	1.50	1.50	1.87	-1.00	1.00	1.00	1.00	1	2	0	9	13
3	1.50	-1.50	-1.50	2.67	1.00	1.00	1.00	1.00	2	2	0	-11	-6
4	-1.50	0.40	0.40	2.67	1.00	1.00	1.00	1.00	2	2	0	9	13
5	0.40	1.50	1.50	1.87	1.00	1.00	1.00	1.00	1	2	0	9	13
6	1.50	-1.50	-1.50	2.67	1.00	1.00	1.00	1.00	2	2	0	-11	-6
cg. 0.13 0.00 0.13 0.00 0.00 0.00 0.00 0.00 6.00 10 13 0 0 23													
Total													

Column Coordinate

Corner	X		Y		Footing Coordinate	
	X	Y	X	Y	X	Y
1	-0.65	-0.5	1	-1.80	-1.30	-1.30
2	0.65	-0.5	2	1.80	-1.30	-1.30
3	0.65	0.5	3	1.80	1.30	1.30
4	-0.65	0.5	4	-1.80	1.30	1.30
5			5	1.80	1.30	1.30
6			6	-1.80	1.30	1.30
7			7	-1.80	1.30	1.30
8			8	-1.80	-1.30	-1.30

Critical Section Line Coordinate

Beam Shear	X1		Y1		X2		Y2		Length	Deep Beam	X1	Y1	X2	Y2	Length
	X	Y	X	Y	X	Y	X	Y							
X-Negative	-1.15	-1.30	-1.15	1.30	-1.30	-1.30	-1.30	-1.30	2.60	X-Negative	-1.08	-1.30	-1.08	-1.30	2.60
X-Positive	1.15	-1.30	1.15	1.30	1.08	-1.30	1.08	1.30	2.60	X-Positive	1.08	-1.30	1.08	1.30	2.60
Y-Negative	-1.80	-1.00	-1.80	-1.00	-1.80	-0.75	-1.80	-0.75	3.60	Y-Negative	-1.80	-0.75	-1.80	-0.75	3.60
Y-Positive	-1.80	1.00	-1.80	1.00	-1.80	0.75	-1.80	0.75	3.60	Y-Positive	-1.80	0.75	-1.80	0.75	3.60
Punching										Moment					
X-Negative	-0.90	-1.30	-0.90	1.30	-0.65	-1.30	-0.65	1.30	2.60	X-Negative	-0.65	-1.30	-0.65	1.30	2.60
X-Positive	0.90	-1.30	0.90	1.30	0.65	-1.30	0.65	1.30	2.60	X-Positive	0.65	-1.30	0.65	1.30	2.60
Y-Negative	-1.80	-0.75	-1.80	-0.75	-1.80	-0.50	-1.80	-0.50	3.60	Y-Negative	-1.80	-0.50	-1.80	-0.50	3.60
Y-Positive	-1.80	0.75	-1.80	0.75	-1.80	0.50	-1.80	0.50	3.60	Y-Positive	-1.80	0.50	-1.80	0.50	3.60

Ultimate Shear and Stress at Critical Section

Pile No.	Beam Shear			Deep Beam Shear			Punching Shear		
	X-Neg	X-Pos	Y	X-Neg	X-Pos	Y	X-Neg	X-Pos	Y
1	-12	-12	-12	-12	-12	-12	-12	-12	-12
2	0	0	5	0	0	0	0	0	10
3	0	23	11	0	23	11	0	23	0
4	-12	-12	-12	-12	-12	-12	-12	-12	-12
5	0	0	0	0	0	0	0	0	10
6	0	23	0	11	0	23	0	23	0
Shear -23 22 -7 -7 -23 22 10 10 23 10 10 10 42									
Moment 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50 2.50									
Length 2.60 2.60 3.60 3.60 2.60 2.60 3.60 3.60 2.60 2.60 3.60 3.60 6.60									
Depth 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50									
Stress -1.77 1.70 1.70 -0.37 -0.37 -1.77 1.70 0.53 -1.77 1.70 0.53 0.53 1.28									
Allow 6.98 17.45 17.45 17.45 17.45 17.45 17.45 17.45 17.45 17.45 17.45 17.45 13.96									

Ultimate Moment and Reinforcement at Critical Section

Pile Number	X-Negative			X-Positive			Y-Negative			Y-Positive		
	a	V	M	a	V	M	a	V	M	a	V	M
1	0.85	-12	-10	-2.15	0	0	0.50	-12	-6	-1.50	0	0
2	-1.05	0	0	-0.25	0	0	0.50	10	5	-1.50	0	0
3	-2.15	0	0	0.85	23	19	0.50	23	11	-1.50	0	0
4	0.85	-12	-10	-2.15	0	0	-1.50	0	0	0.50	-12	-6
5	-1.05	0	0	-0.25	0	0	-1.50	0	0	0.50	10	5
6	-2.15	0	0	0.85	23	19	-1.50	0	0	0.50	23	11
Moment 2.60 2.60 3.60 3.60 2.60 2.60 3.60 3.60 2.60 2.60 3.60 3.60 11												
Length 2.60 2.60 3.60 3.60 2.60 2.60 3.60 3.60 2.60 2.60 3.60 3.60 11												
Depth 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50												
As(Req.) 14.6 28.9 28.9 7.8 7.8 84.0 84.0 7.8 7.8 84.0 84.0 7.8												
MinAs(Beam) 60.7 60.7 60.7 84.0 84.0 84.0 84.0 84.0 84.0 84.0 84.0 84.0 84.0												
MinAs(Slab) 28.08 28.08 28.08 38.88 38.88 38.88 38.88 38.88 38.88 38.88 38.88 38.88 38.88												
Conc. Moment 401 401 401 555 555 555 555 555 555 555 555 555 555												

15-DB16(A)
10-DB25(B)
15-DB16(T&B)

CALCULATION SHEET

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Pile Bearing Capacity (in Sand)

Driven Pile I-0.26 x 0.26 x 8.00 m

Bearing Capacity

$$Q_e = 0.26 \times 0.26 \times 400$$
$$= 27^t$$

Skin-friction Capacity

$$Q_f = 4(0.26) \times 8.00 \times 2.0$$
$$= 38.4^t$$

$$Q_u = 27 + 38.4$$
$$= 65.4^t$$

$$Q_{ALL} \text{ (Comp)} = \frac{65.4}{2.9} = 22.55^t > 18^t \text{ OK.}$$

$$Q_{ALL} \text{ (tens)} = \frac{38.4}{2.9} = 13.24^t > 6^t \text{ OK.}$$