Load For Analysis And Design

Roof Load Slope = 12.77 degree

1	Covering	=	5.00	kg./m.^{2}	@ p urlin	1.50	=	7.50	kg./m.
2	Self Weigth	=	Software	kg./m.^{2}	@ p urlin	1.50	=	Software	kg./m.
3	Purlin	=	10.00	kg./m.^{2}	@ p urlin	1.50	=	15.00	kg./m.
4	etc. (อื่นๆ)	=	15.00	kg./m.^{2}	@ p urlin	1.50	=	22.50	kg./m.
5	LL	=	30.00	kg./m.^{2}	@ p urlin	1.50	=	45.00	kg./m.

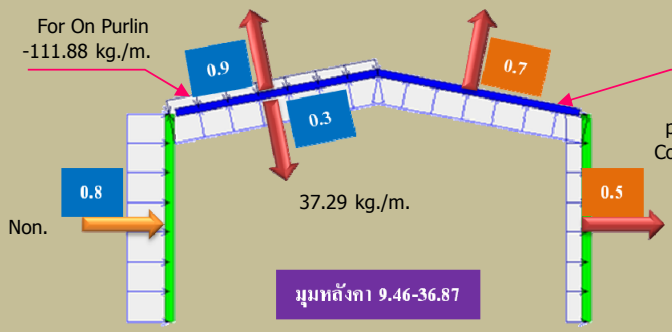
Wind Load UBC-1997

	P	=	$C_eC_gq_sI_w$	kg./m.^{2}
	$V_{10m.}$	=	29.00	m./s. (30 year)

Calculate

H (m.)	C_e Zone C	C_g Windward	C_g Leeward	q_s $0.004826V^2$	I_w	Windward pressure	Leeward pressure	Design pressure	P เฉลี่ย
0-4.57	1.06		0.50	52.60	1.15	0.00	32.06	32.06	34.86
4.57-6.1	1.13		0.50	52.60	1.15	0.00	34.18	34.18	
6.1-7.62	1.19		0.50	52.60	1.15	0.00	35.99	35.99	
7.62-9.14	1.23		0.50	52.60	1.15	0.00	37.20	37.20	
9.14-12.19	1.31	0.30	-0.70	52.60	1.15	23.77	-55.47	-31.70	-33.15
12.19-18.29	1.43	0.30	-0.70	52.60	1.15	25.95	-60.55	-34.60	
9.14-12.19	1.31	-0.90		52.60	1.15	-71.32	0.00	-71.32	
12.19-18.29	1.43	-0.90		52.60	1.15	-77.85	0.00	-77.85	

Show Value For Input in STAAD



When purlin @ = 1.50 m. (c/c)
Colmm @ = 12.00 m. (c/c)

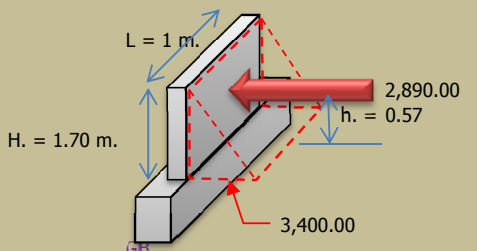
418.29 kg./m. For On Inner Col.
209.15 kg./m. For On Edge Col.

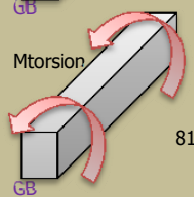
Earth Quake

No. Requirement

Add Load Value For Input In STAAD

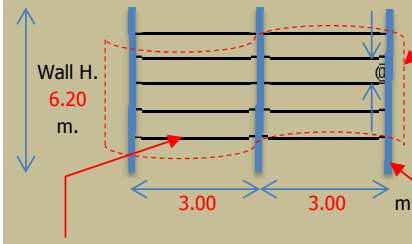
1	Retaining W.	high	3.00	m.	thick	=	0.30	m.	And	Soil H.	=	1.70	m.
	On GB	=	2,160.00	kg./m.						Colmn @	=	12.00	m. (c/c)
2	Wall Metal S.									rh	=	3,400.00	kg./m.^{2}
	On GB	=	651.00	kg./m.	high	=	6.20	m.		Pressure	=	2,890.00	kg.
	On RB	=	315.00	kg./m.	high	=	9.20-6.20	m.		h. From B.	=	0.57	m.
3	Side-End Girts												
	On Beam	=	52.29	kg./m.	From Wind Load								
	On Beam	=	15.00	kg./m.	From Wall Metal S.								
	On Col.	=	104.57	kg./m.	From Wind Load								
	On Col.	=	1,953.00	kg.	From Wall Metal S.								





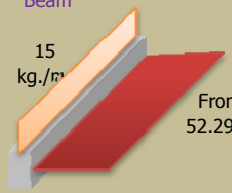
818.83 kg.-m./m.

Detail Side&End Girts For Design

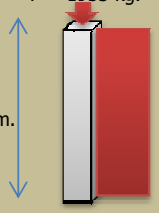


Metal Sheet
@ = 1.50 m.
Metal S. = 5.00 kg./m.^{2}
Beam&Col. = 100.00 kg./m.^{2}
Total Load = 105.00 kg./m.^{2}

Column
P = 1953 kg.

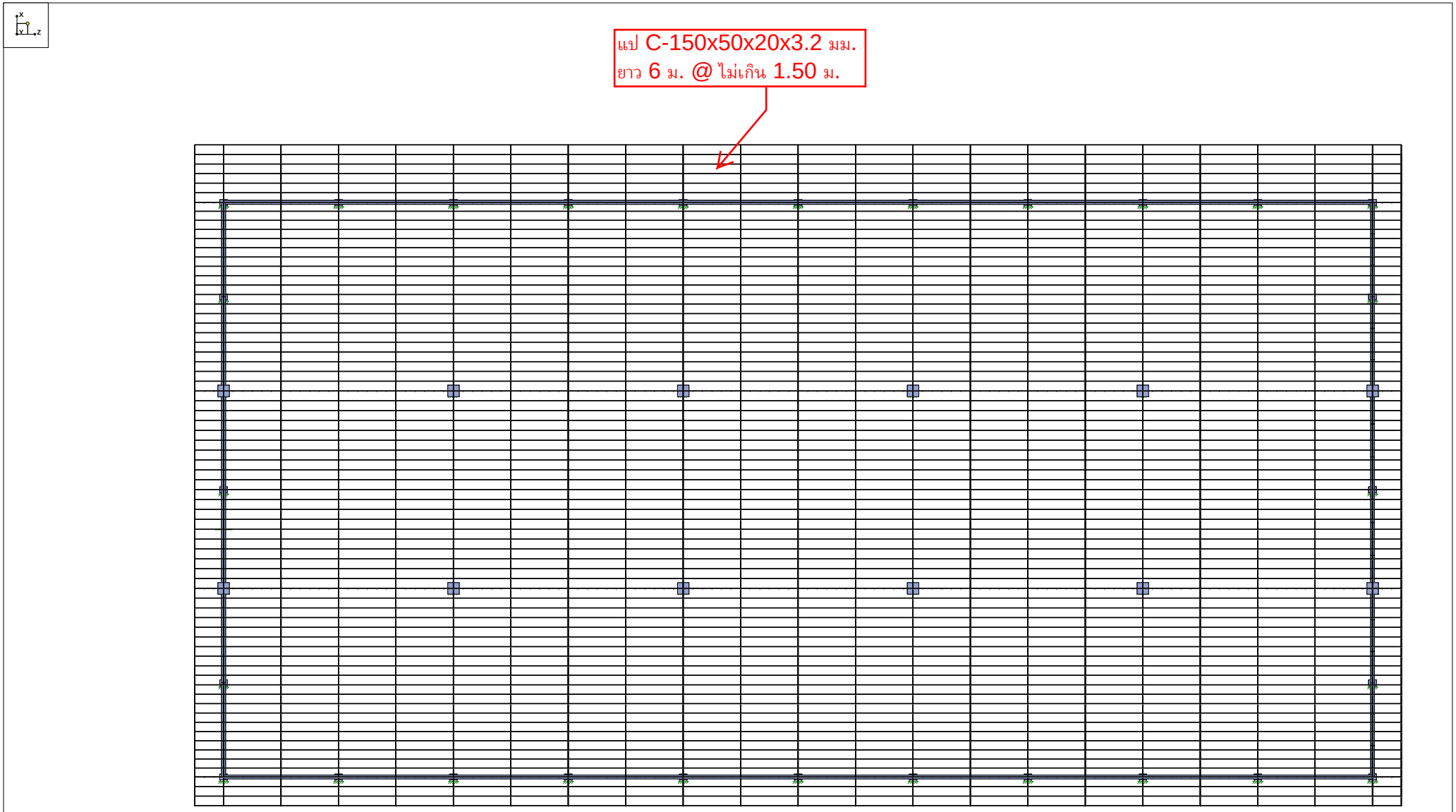


From WL.
52.29 kg./m.



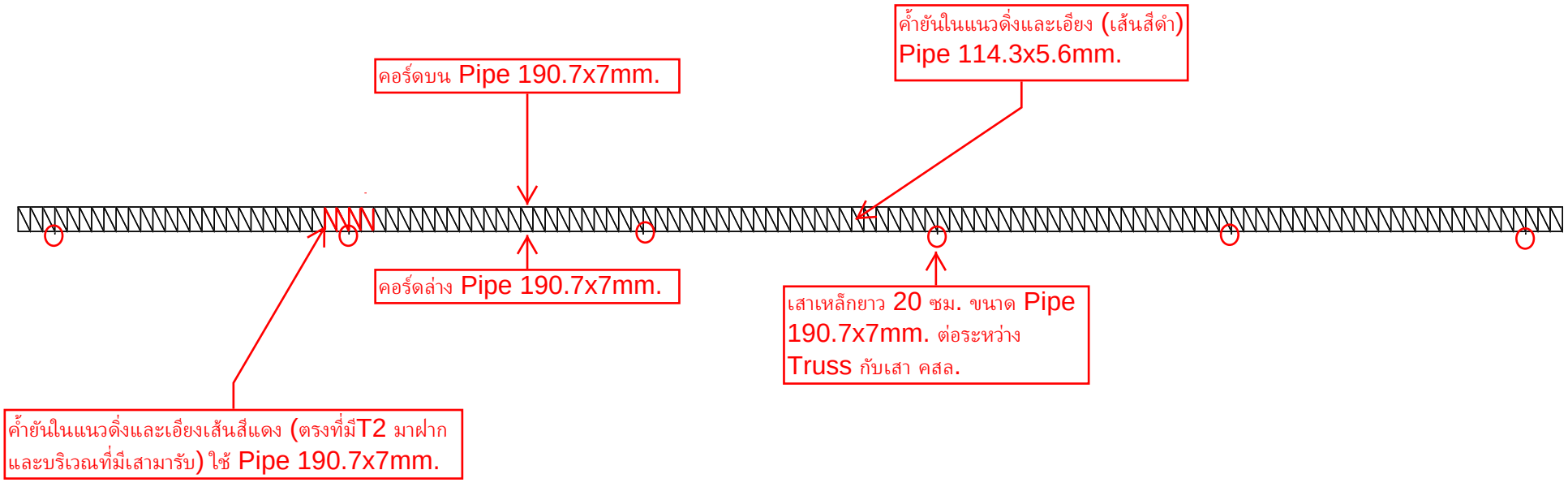
From WL.
104.57 kg./m.

A.SERMPUN



FOREST CO., LTD.	DXF IMPORT OF FOREST.DXF	SK - 4
A.SERMPUN		May 4, 2012 at 4:28 PM
2		TPCL 6.0 MW Srilangka4.r3d

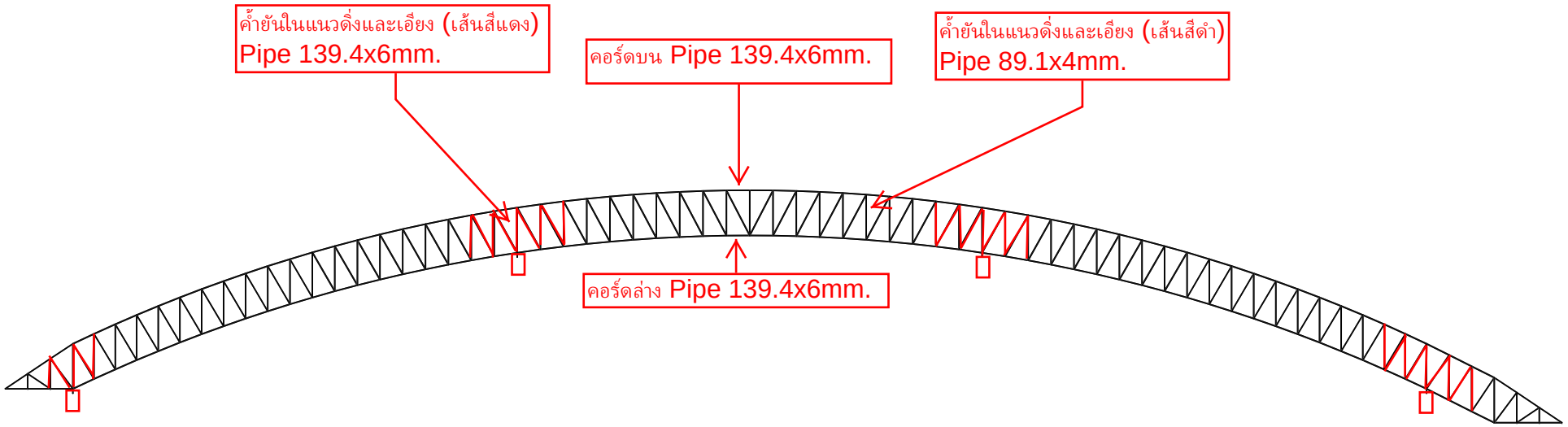
TRUSS T1 ลึก 2 ม.



Gusset Plate หนา 6 mm. ขนาดขาเชื่อม 6 mm. เชื่อมโดยรอบ โดยใช้ลวดเชื่อมเกรด E70-xx

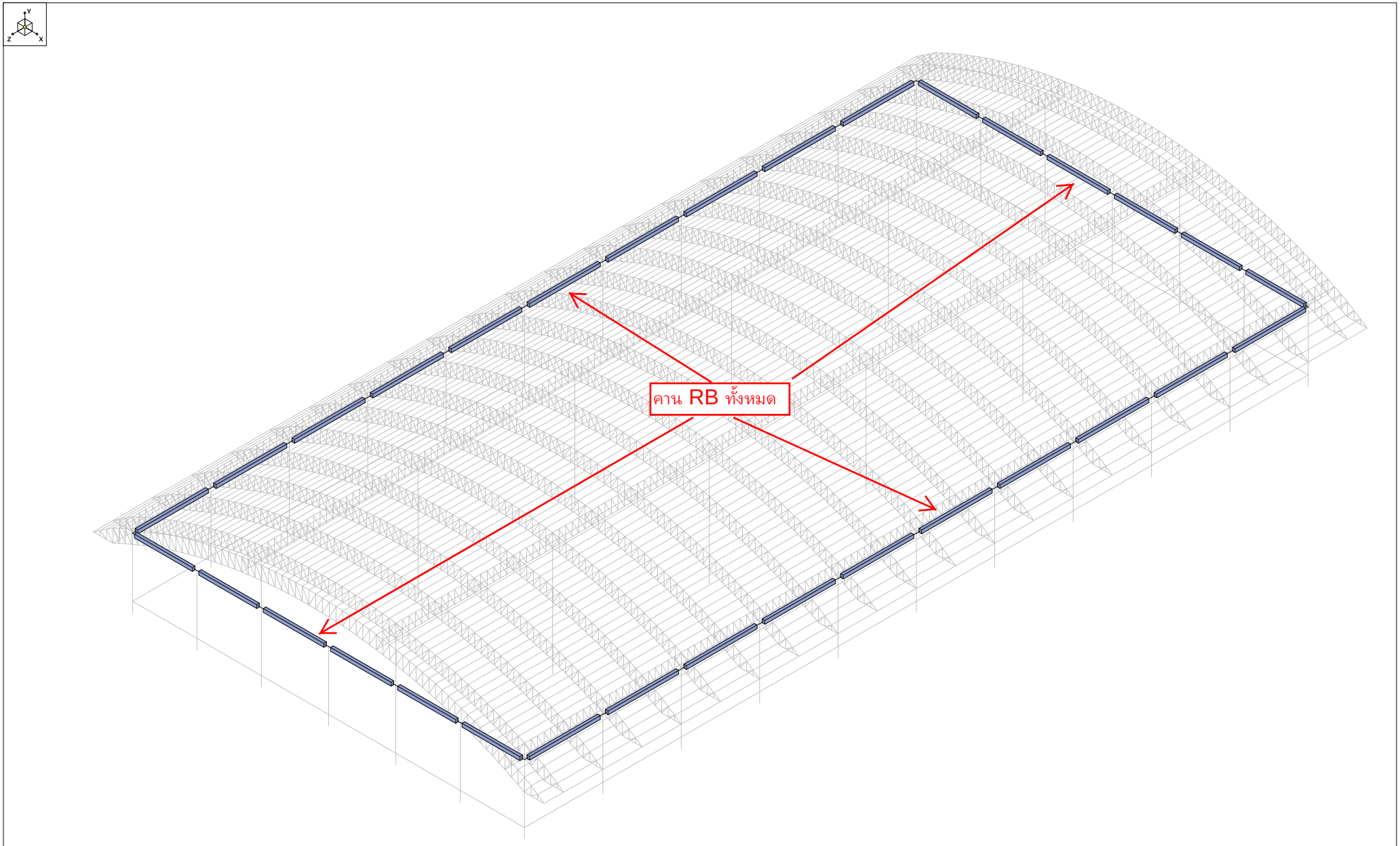
FOREST CO., LTD.	DXF IMPORT OF FOREST.DXF	SK - 3
A.SERMPUN		May 4, 2012 at 4:16 PM
2		TPCL 6.0 MW Srilangka4.r3d

TRUSS T2 ลึก 2 ม.

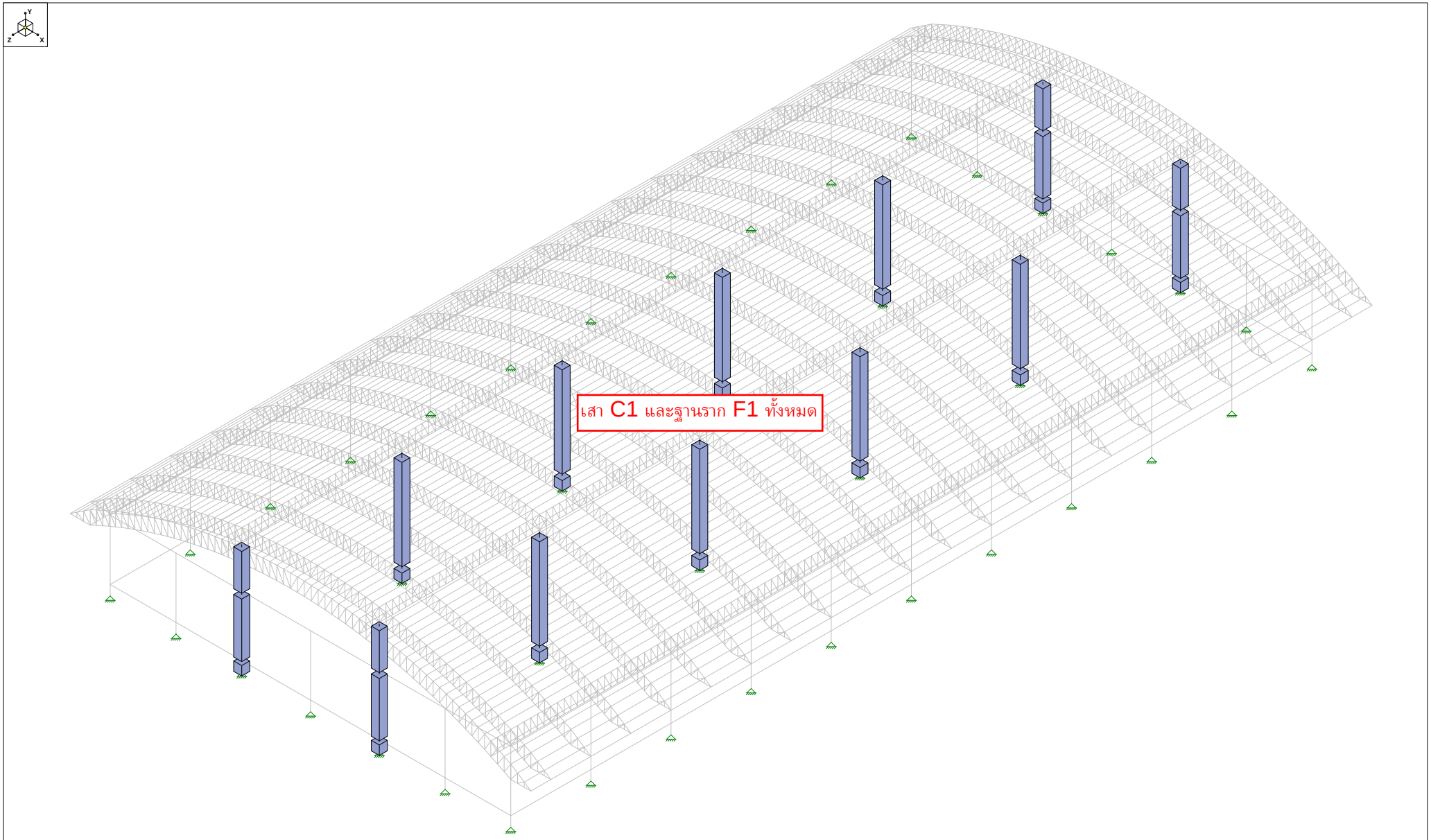


Gusset Plate หนา 6 mm. ขนาดขาเชื่อม 6 mm.
เชื่อมโดยรอบ โดยใช้ลวดเชื่อมเกรด E70-xx

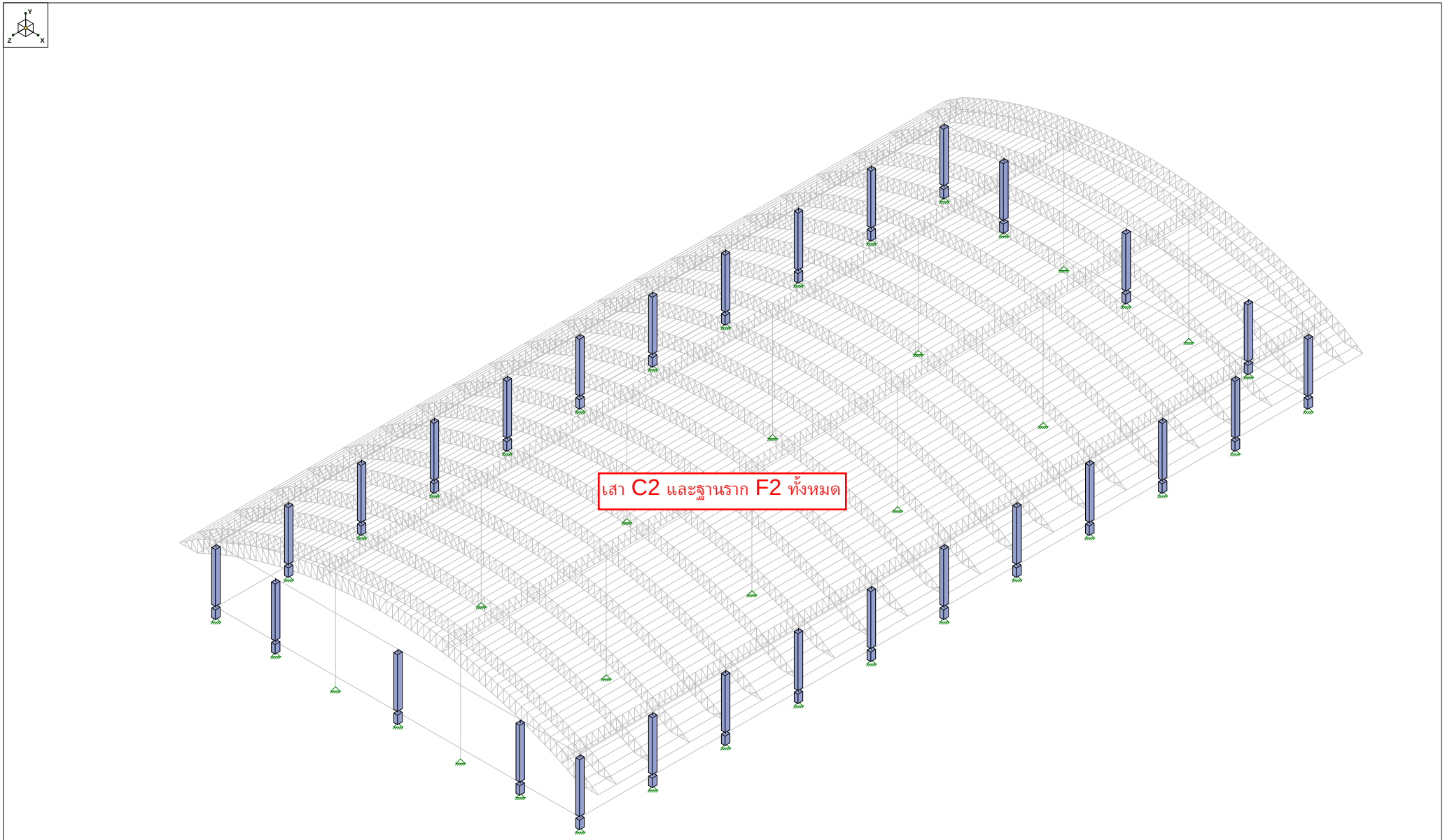
FOREST CO., LTD.	DXF IMPORT OF FOREST.DXF	SK - 2
A.SERMPUN		May 4, 2012 at 4:06 PM
2		TPCL 6.0 MW Srilangka3.R3D



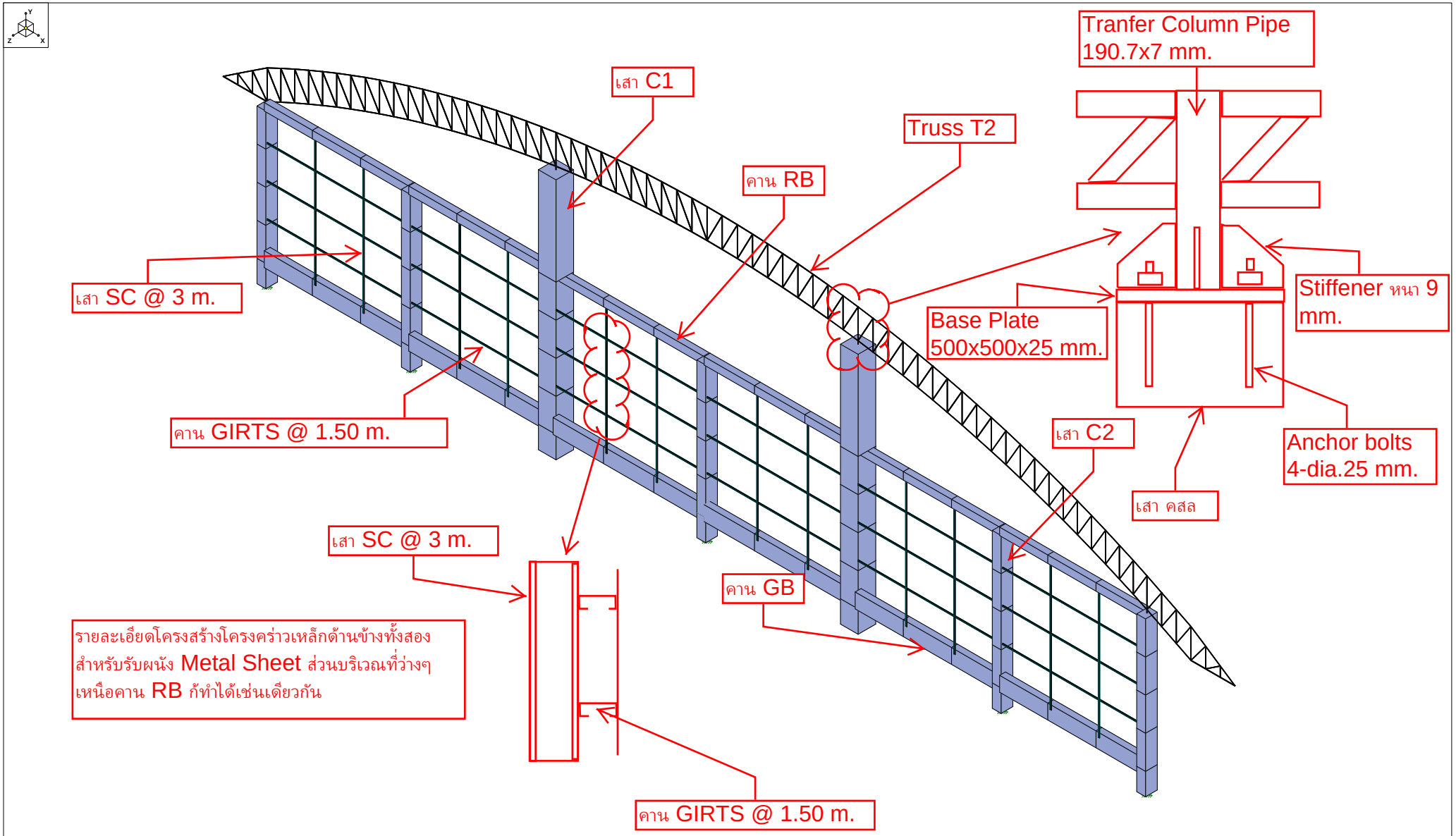
FOREST CO., LTD.	DXF IMPORT OF FOREST.DXF	SK - 2
A.SERMPUN		May 3, 2012 at 5:11 PM
2		TPCL 6.0 MW Srilangka3.R3D



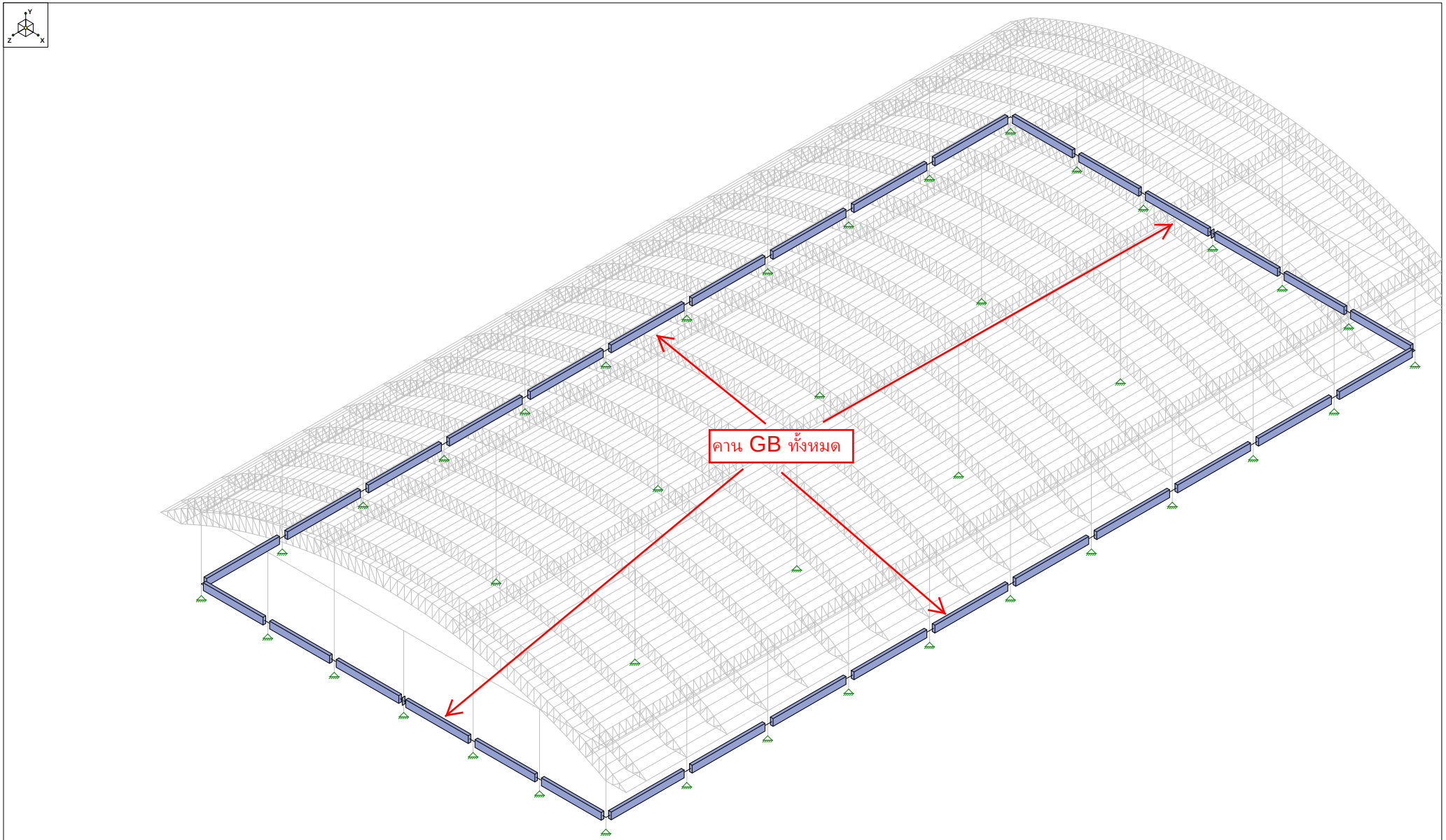
FOREST CO., LTD.	DXF IMPORT OF FOREST.DXF	SK - 3
A.SERMPUN		May 3, 2012 at 5:17 PM
2		TPCL 6.0 MW Srilangka3.R3D



FOREST CO., LTD.	DXF IMPORT OF FOREST.DXF	SK - 4
A.SERMPUN		May 3, 2012 at 5:49 PM
2		TPCL 6.0 MW Srilangka3.R3D



FOREST CO., LTD.	DXF IMPORT OF FOREST.DXF	SK - 1
A.SERMPUN		May 4, 2012 at 11:30 AM
2		TPCL 6.0 MW Srilangka3.R3D



FOREST CO., LTD.	DXF IMPORT OF FOREST.DXF	SK - 1
A.SERMPUN		May 3, 2012 at 5:06 PM
2		TPCL 6.0 MW Srilangka3.R3D

NeoSteelDesign v.5

Project	: Power Plant 6.0 MW Srilangka	**Engineer**	: A.SERMPUN
Location	: Srilangka	**Date**	: 3-พ.ค.-2012
Owner	: FOREST CO., LTD.	**Time**	: 10:37:33 AM

Design For Axially Tension Members : T1-Diagonal&Web

[I.Datas For Design]

1.1.Type Of Joints	1	Welding
1.2.Use Strength Of Welding	0.4*fy	
1.3.Size Of Welding	4.00	mm.
1.4.Length Of Member	2.20	m.
1.5.Design Load	27,255	kg.
1.6.Use Value Of k	1	(Normal = 1)

[II.Properties Of Steel For Design]

2.1.Use Steel Grade	Fe-24	
2.2.Modulus Of Elastic.	2,040,000	ksc.
2.3.Yield Strength	2,400	ksc.
2.4.Ultimate Strength	4,100	ksc.
2.5.All. Tensile Stress	1,440	ksc.
2.6.Use Allowable KL/r	240	For Main.

[III.Result Of Calculate]

3.1.Req. Min. Area(A_g)	18.92	$cm.^2$
3.2.Req. Min. Area(A_n)	13.29	$cm.^2$
3.3.Req. Min. Area(A_e)	1*[13.29]	$cm.^2$
3.4.Required $r_{min.}$	0.73	cm.

[IV.Select Type & Section Of Steel]

4.1.Type Of Section	1	Pipe
4.2.Trial Section No.	25	O
4.3.Size Of Diameter	114.30	mm.
4.4.Thick. Web(t , t_w)	5.60	mm.
4.5.Thick. Flange(t_f)		mm.
4.6.Section Area(A_s)	19.12	$cm.^2$
4.7.Weight Of Section	15.00	kg./m.
4.8.Sect. Modulus(S_{x-x})	49.60	$cm.^3$
4.9.Moment Of In.(I_{x-x})	283.00	$cm.^4$
4.10.Rad. Of Gyr.($r_{min.}$)	3.85	cm.

[V.Recheck Design Section]

5.1.Net Area To Req.	13.29	$cm.^2$
5.2.Status Of Sect. Area	: This Section OK.!	
5.3.Load Resist By Sect.	27,533	kg. OK.!
5.4.Safty Load	1.01	times
5.5.Actual Stress	1,425.47	ksc. OK.!
5.6.Selenderness Ratio	57.14 < 240	OK.!

O - 114.3 * 5.6 mm.(น้ำหนัก = 15 kg./m.)

Select To Use Section : O - 114.3 * 5.6 mm.(น้ำหนัก = 15 kg./m.)

NeoSteelDesign v.5

Project	: Power Plant 6.0 MW Srilangka	**Engineer**	: A.SERMPUN
Location	: Srilangka	**Date**	: 3-พ.ค.-2012
Owner	: FOREST CO., LTD.	**Time**	: 10:40:09 AM

Design For Axially Tension Members : T1-Upper&Lower

[I.Datas For Design]

1.1.Type Of Joints	1	Welding
1.2.Use Strength Of Welding	0.4*fy	
1.3.Size Of Welding	4.00	mm.
1.4.Length Of Member	1.20	m.
1.5.Design Load	55,441	kg.
1.6.Use Value Of k	1	(Normal = 1)

[II.Properties Of Steel For Design]

2.1.Use Steel Grade	Fe-24	
2.2.Modulus Of Elastic.	2,040,000	ksc.
2.3.Yield Strength	2,400	ksc.
2.4.Ultimate Strength	4,100	ksc.
2.5.All. Tensile Stress	1,440	ksc.
2.6.Use Allowable KL/r	240	For Main.

[III.Result Of Calculate]

3.1.Req. Min. Area(A_g)	38.5	$cm.^2$
3.2.Req. Min. Area(A_n)	27.04	$cm.^2$
3.3.Req. Min. Area(A_e)	1*[27.04]	$cm.^2$
3.4.Required $r_{min.}$	0.40	cm.

[IV.Select Type & Section Of Steel]

4.1.Type Of Section	1	Pipe
4.2.Trial Section No.	37	O
4.3.Size Of Diameter	190.70	mm.
4.4.Thick. Web(t , t_w)	7.00	mm.
4.5.Thick. Flange(t_f)		mm.
4.6.Section Area(A_s)	40.40	$cm.^2$
4.7.Weight Of Section	31.70	kg./m.
4.8.Sect. Modulus(S_{x-x})	179.00	$cm.^3$
4.9.Moment Of In.(I_{x-x})	1,710.00	$cm.^4$
4.10.Rad. Of Gyr.($r_{min.}$)	6.50	cm.

[V.Recheck Design Section]

5.1.Net Area To Req.	27.04	$cm.^2$
5.2.Status Of Sect. Area	: This Section OK.!	
5.3.Load Resist By Sect.	58,176	kg. OK.!
5.4.Safty Load	1.05	times
5.5.Actual Stress	1,372.30	ksc. OK.!
5.6.Selenderness Ratio	18.46 < 240	OK.!

O - 190.7 * 7 mm.(น้ำหนัก = 31.7 kg./m.)

Select To Use Section : O - 190.7 * 7 mm.(น้ำหนัก = 31.7 kg./m.)

NeoSteelDesign v.5

Project	: Power Plant 6.0 MW Srilangka	**Engineer**	: A.SERMPUN
Location	: Srilangka	**Date**	: 3-พ.ค.-2012
Owner	: FOREST CO., LTD.	**Time**	: 10:33:52 AM

Design For Axially Tension Members : T2-Diagonal&Web

[I.Datas For Design]

1.1.Type Of Joints	1	Welding
1.2.Use Strength Of Welding	0.4*fy	
1.3.Size Of Welding	4.00	mm.
1.4.Length Of Member	1.20	m.
1.5.Design Load	13,177	kg.
1.6.Use Value Of k	1	(Normal = 1)

[II.Properties Of Steel For Design]

2.1.Use Steel Grade	Fe-24	
2.2.Modulus Of Elastic.	2,040,000	ksc.
2.3.Yield Strength	2,400	ksc.
2.4.Ultimate Strength	4,100	ksc.
2.5.All. Tensile Stress	1,440	ksc.
2.6.Use Allowable KL/r	240	For Main.

[III.Result Of Calculate]

3.1.Req. Min. Area(A_g)	9.15	$cm.^2$
3.2.Req. Min. Area(A_n)	6.42	$cm.^2$
3.3.Req. Min. Area(A_e)	1*[6.42]	$cm.^2$
3.4.Required $r_{min.}$	0.40	cm.

[IV.Select Type & Section Of Steel]

4.1.Type Of Section	1	Pipe
4.2.Trial Section No.	18	O
4.3.Size Of Diameter	89.10	mm.
4.4.Thick. Web(t , t_w)	4.00	mm.
4.5.Thick. Flange(t_f)		mm.
4.6.Section Area(A_s)	10.69	$cm.^2$
4.7.Weight Of Section	8.39	kg./m.
4.8.Sect. Modulus(S_{x-x})	21.80	$cm.^3$
4.9.Moment Of In.(I_{x-x})	97.00	$cm.^4$
4.10.Rad. Of Gyr.($r_{min.}$)	3.01	cm.

[V.Recheck Design Section]

5.1.Net Area To Req.	6.42	$cm.^2$
5.2.Status Of Sect. Area	: This Section OK.!	
5.3.Load Resist By Sect.	15,394	kg. OK.!
5.4.Safty Load	1.17	times
5.5.Actual Stress	1,232.65	ksc. OK.!
5.6.Selenderness Ratio	39.87 < 240	OK.!

O - 89.1 * 4 mm.(น้ำหนัก = 8.39 kg./m.)

Select To Use Section : O - 89.1 * 4 mm.(น้ำหนัก = 8.39 kg./m.)

NeoSteelDesign v.5

Project	: Power Plant 6.0 MW Srilangka	**Engineer**	: A.SERMPUN
Location	: Srilangka	**Date**	: 3-พ.ค.-2012
Owner	: FOREST CO., LTD.	**Time**	: 10:31:50 AM

Design For Axially Compression Members : T2-Upper&Lower

[I.Datas For Design]

1.1.Design Load(P)	28,584	kg.
1.2.Length(L_{x-x})	2.20	m.
1.3.Length(L_{y-y})	2.20	m.
1.4.Max. Length	2.20	m.
1.5.Min. Value Of k	0.65	[fixed-fixed]
1.6.Use Value Of k	1.00	

[II.Properties Of Steel For Design]

2.1.Use Steel Grade	Fe-24	
2.2.Modulus Of Elastic.	2,040,000	ksc.
2.3.Yield Strength	2,400	ksc.
2.4.Ultimate Strength	4,100	ksc.
2.5.All. Comp. Stress	1,440	ksc.
2.6.Use Allowable KL/r	200	For Main.

[III.Result Of Calculate]

3.1.Req. Min. Area	19.85	$cm.^2$
3.2.Value Of (λ)$_c$	129.53	****
3.3.Value Of (λ)$_{(kL/r)}$	46.41	OK.!

3.5.Allowable Compressive Stress : F_a

1.)Inelastic Range : $\lambda_{(kl/r)} \subset \lambda_c$

F_{ai} = 1,251.01 ksc.

2.)Elastic Range : $\lambda_{(kl/r)} \supset \lambda_c$

F_{ae} = 0.00 ksc.

<<--- Member Will To Fail By Yield --->>

O - 139.4*6 mm.(น้ำหนัก = 19.8 kg./m.)

[IV.Select Type & Section Of Steel]

4.1.Type Of Section	1	Pipe
4.2.Trial Section No.	29	O
4.3.Size Of Diameter	139.40	mm.
4.4.Thick. Web(t , tw)	6.00	mm.
4.5.Thick. Flange(tf)	6.00	mm.
4.6.Section Area(As)	25.22	cm.2
4.7.Weight Of Section	19.80	kg./m.
4.8.Sect. Modulus(Sx-x)	80.90	cm.3
4.9.Moment Of In.(Ix-x)	566.00	cm.4
4.10.Rad. Of Gyr.(rmin.)	4.74	cm.

[V.Recheck Design Section]

5.1.Status Of Sect. Area	: This Section OK.!		5.4.Actual Stress	1,133.39	ksc. OK.!
5.2.Load Resist By Sect.	31,551	kg. OK.!	5.5.Slenderness Ratio	46.41	< 200 OK.!
5.3.Safty Load	1.10	times	**O - 139.4*6 mm.(น้ำหนัก = 19.8 kg./m.)**		

Select To Use Section : O - 139.4*6 mm.(น้ำหนัก = 19.8 kg./m.)

NeoSteelDesign v.5

Project	: Power Plant 6.0 MW Sr.langka	**Engineer**	: A.SERMPUN
Location	: Srilangka	**Date**	: 3-พ.ค.-2012
Owner	: FOREST CO., LTD.	**Time**	: 10:20:09 AM

Design For Flexible Members [Purlin] : Purlin

[I.Datas For Design]

1.1.Type Of Sag Rod	1	
1.2.Not To Use Sag Rod For This Member		
1.3.Span Length(L.)	6.00	m.
1.4.Range Of Purlin(@)	1.50	m.
1.5.Slope Of Roof(θ)	12.77	degree
1.6.Weight Of Tiles	5.00	kg./m.^{2}
1.7.Live Load(LL.)	30.00	kg./m.^{2}
1.8.Wind Load(WL.)	50.00	kg./m.^{2}
1.9.Use Self Weight	5.00	kg./m.

[III.Result Of Calculate]

3.1.Load On Purlin(W_t)	57.50	kg./m.
3.2.Unif. Load Of W_x	12.71	kg./m.
3.3.Unif. Load Of W_y	56.08	kg./m.
3.4.Moment Of M_x	252.35	kg.-m.
3.5.Moment Of M_y	57.19	kg.-m.
3.6.Deflextion(Δ /IE)	9.46E+10	kg.-cm.^{3}
3.7.Req. Sect. Modulus	17.52	cm.^{3}

[Recheck Allowable Stress On Section]

1.Actual Bending Stress	1,373.07	OK.!
2.Actual Deflextion	1.66	cm. OK.!(L/360)
3.Actual Self Weight	6.76	kg./m. OK.!
4.Actual Sect. Modulus	37.40	OK.!

[Reaction Transfer To Support]

1.Min. Reaction(R_y)	172.50	kg.

[II.Properties Of Steel For Design]

2.1.Use Steel Grade	Fe-24	
2.2.Modulus Of Elastic.	2,040,000	ksc.
2.3.Yield Strength	2,400	ksc.
2.4.Ultimate Strength	4,100	ksc.
2.5.All. Bend. Stress	1,440	ksc.
2.6.All. Deflextion= L /	360	

[IV.Select Type & Section Of Steel]

4.1.Required $S_{max.}$	17.52	cm.^{3}
4.2.Type Of Section	2	Lip. Chan.
4.3.Trial Section No.	8	C
4.4.Size Of Section	150*50*20	mm.
4.5.Thick. Web(t , t_w)	3.20	mm.
4.6.Thick. Flange(t_f)	3.20	mm.
4.7.Section Area(A_s)	8.61	cm.^{2}
4.8.Weight Of Section	6.76	kg./m.
4.9.Sect. Modulus(S_{x-x})	37.40	cm.^{3}
4.10.M. Of In.(I_{x-x})	280.00	cm.^{4}
4.11.Rad. Of Gyr.($r_{min.}$)	1.81	cm.

C - 150*50*20*3.2 mm.(น้ำหนัก = 6.76 kg./m.)

Minimum Size Of Sag Rod(AISC.)

1.Required $r_{min.}$	*****	cm.
2.Req. Minimum(ϕ)	*****	mm.

Select To Use Section : C - 150*50*20*3.2 mm.(น้ำหนัก = 6.76 kg./m.)

Project : Power Plant 6.0 MW Srilangka | **Engineer** : A.SERMPUN

Location : Srilangka | **Date** : 3-พ.ค.-2012

Owner : FOREST CO., LTD. | **Time** : 3:51:30 PM

Design For Beam - Column Members : SC

[I.Datas For Design]

1.1.Point Load(P_c)	1,953	kg.
1.2.Moment(M_{x-x})	503	kg.-m.
1.3.Moment(M_{y-y})		kg.-m.
1.4.Max. Length	6.20	m.
1.5.Min. Value Of k	0.65	[fixed-fixed]
1.6.Use Value Of k	1.00	

[II.Properties Of Steel For Design]

2.1.Use Steel Grade	Fe-24	
2.2.Modulus Of Elastic.	2,040,000	ksc.
2.3.Yield Strength	2,400	ksc.
2.4.Ultimate Strength	4,100	ksc.
2.5.All. Comp. Stress	1,440	ksc.
2.6.Use Allowable KL/r	200	For Main.

[III.Result Of Calculate]

3.1.Req. Min. Area	1.36	$cm.^2$
3.2.Value Of (λ)$_c$	129.53	****
3.3.Value Of (λ)$_{(kL/r)}$	171.75	OK.!

3.5.Allowable Compressive Stress : F_a

1.)Inelastic Range : $\lambda_{(kl/r)} \subset \lambda_c$

F_{ai} = 0.00 ksc.

2.)Elastic Range : $\lambda_{(kl/r)} \supset \lambda_c$

F_{ae} = 356.13 ksc.

<<--- Member Will To Fail By Buckling --->>

WF - 200*150*6*9 mm.(น้ำหนัก = 30.6 kg./m.)

[IV.Select Type & Section Of Steel]

4.1.Type Of Section	7	WF-Beam
4.2.Trial Section No.	12	WF
4.3.Size Of Section	200*150	mm.
4.4.Thick. Web(t , t_w)	6.00	mm.
4.5.Thick. Flange(t_f)	9.00	mm.
4.6.Section Area(A_s)	39.01	$cm.^2$
4.7.Weight Of Section	30.60	kg./m.
4.8.Sect. Modulus(S_{x-x})	277.00	$cm.^3$
4.9.Moment Of In.(I_{x-x})	2,690.00	$cm.^4$
4.10.Rad. Of Gyr.($r_{min.}$)	3.61	cm.

[V.Recheck Design Section]

5.1.Status Of Sect. Area	: This Section OK.!			
5.2.Load Resist By Sect.	13,893	kg. OK.!		
5.3.Interaction Stress	0.27	ksc. OK.!		
5.4.Slenderness Ratio	171.75	< 200 OK.!		

$f_a/F_a + fb_x/Fb_x + fb_y/Fb_y$ = 0.27 < 1.00

WF - 200*150*6*9 mm.(น้ำหนัก = 30.6 kg./m.)

Select To Use Section : WF - 200*150*6*9 mm.(น้ำหนัก = 30.6 kg./m.)

Mahanakorn University of Technology
Civil Eng. Department
Bangkok Thailand

Project : 6 MW. Power Plant: SAHAGREEN FOREST CO., LTD.: SRILANKA
Des. By : A.SERMPUN **Chk. By :** **Sheet :**
Title : Doubly Beam (Torsion) **File :** RB **Date :** 3/05/2012

Design of Doubly Reinforced Beam (Bending, Shear and Torsion) - USD Method ACI 318-99 ,E . I .T1008-38 [Metric Unit]

A. Material Properties :

Concrete

Comp. Strength (fc')	240	ksc.
Unit Weigth ,(w_c)	2400	kg/m^3
Elas. Modulus (Ec)	245952	ksc.

Steel

Yeild Strength(main) (fy)	4000	ksc.
Yeild Strength(strir.) (fvy)	2400	ksc.
Elas. Modulus (Es)	2040000	ksc.

B. Design Parameters :

ACI318-10.2.7

β_1 : 0.850 ; ϕ_b : 0.9 ; ϕ_v, ϕ_t : 0.85

C. Dimension and Reinforcing Bar Arrangement :

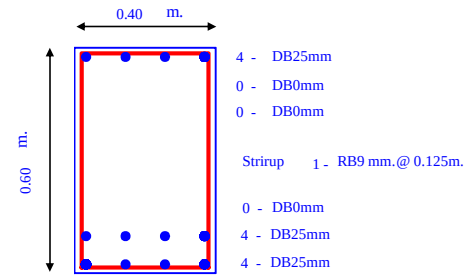
Width (bw)	0.40	m.
Depth (h)	0.60	m.
Length (L)	12.00	m.
Covering, cov	0.025	m.
Spacer	0.03	m.
Eff. Depth, d	0.526	m.
Dist.Comp face to Bar C.G.d'	0.05	m.

Bar Side	Layer	Reinf. Bar	As (cm^2)
Comp.	No.1	4 - DB25mm	19.63
	No.2		
	No.3		
Tension	No.3		39.27
	No.2	4 - DB25mm	
	No.1	4 - DB25mm	
Design as Doubly Reinf			OK

D. Loading :

0.034

Factor Moment, Mu	63443.00	kg-m
Factor Shear. Load, Vu	31036.53	kg
Factor Tor. Load, Tu	0.00	kg-m
Support Type :	One End Continuous	



E. Flexural Reinforcement Design :

ACI318-10.3 and 10.5

Mode of Failure : **Tension Failure**

ρ - ρ'	≥	0.85*fc'β$_1$/fy*d'/d*[6120/(6120-fy)]
0.00933	<	0.01106

Comp.Reinf. Not Yeild., fs'<fy fs' = 3606.82 ksc.

$\rho_b = 0.85\beta1*(fc'/fy)[6120/(6120+fy)]$ = 0.02622

Check ρ max = 0.75ρ_b+ρ' = 0.02784

ρ min = max[14/fy,(fc')0.5/(4*fy)] = 0.00350

USE ρ = 0.01866 **OK**

a = [(Asfy-As'fs')/(0.85*fc'b)] = 10.57 cm.

Check ϕMn > Mu

ϕbMn = ϕb[(Asfy-As'fs')(d-a/2) + As'fs'(d-d') = 67294.33 kg-m.

Check F.S. = ϕbMn/Mu = **1.06** **OK**

F. Shear Reinforcement Design :

ACI318-11.3 and 11.5

USE 1 - RB9 mm. @ 0.125m. For Closed Stirrup Asv =πr^2 1.27 cm^2 (2 legs)

Check For Vu = 31036.53 kg.

ϕ_vVc = ϕ_v*0.53*(fc')^0.5*bw*d	14,684.06	kg :	1.1*ϕ_v*(fc')$^{0.5}$*bw*d	27705.77	kg
Vu -ϕVc	16352.47	kg :	2.1*ϕ_v(fc')$^{0.5}$*bw*d	58182.12	kg
ϕ_vVc/2	7342.03	kg :			

Check Dimensioning of Cross-Section

2.1*ϕv(fc')$^{0.5}$*bw*d = 58182.1247 kg > Vu -ϕVc 16352.47 kg. **OK**

F.1 Shear Reinf. Requirement ϕ_vVc/2 < Vu > ϕ_vVc **Required.** **Case2** **Control**

Case2 Vu > 0.85*Vc ; Vu-0.85Vc < 1.1*0.85*(fc')^0.50*bw*d

Check Max. Spacing(m),smax = min[Av*0.85*fv*d/(Vu-0.85Vc),0.25*d,0.30]= 0.132 > 0.125 **OK**

G. Torsion Reinforcement Design :

ACI318-99 - Section 11.6.1

Torsion Effect can be neglected if Tu < 0.13*ϕ(fc')$^{0.5}$(b^{2}h)

Tu = 0.00 kg-m < 0.13*ϕ(fc')$^{0.5}$(b^{2}h) = 1643.38 kg-m **OK**

H. Serviceability :

H.1 Deflection Control

Support Type :	One End Continuous	:
Allow.Min. Depth, L/18.5 (m.)	0.649	:
Depth > Allow.Min. Depth	**OK**	:
Use fs = 0.6*fy for crack width control :		

H.2 Crack Width Control

s = 95000/fs - 2.5cc	341	mm.
Max. s = 300(252/fs)	321	< s (mm.)
Control s = Max.(s,Max.s)	321	mm.
Check actual s (mm) > sallow.	116.67	**OK**

--- END OF CALCULATION ---

Mahanakorn University of Technology	**Project :**	6 MW. Power Plant: SAHAGREEN FOREST CO., LTD.: SRILANKA	
Civil Eng. Department	**Des. By :** A.SERMPUN	**Chk. By :**	**Sheet :**
Bangkok Thailand	**Title :** Doubly Beam (Torsion)	**File :** GB	**Date :** 3/05/2012

Design of Doubly Reinforced Beam (Bending, Shear and Torsion) - USD Method ACI 318-99 ,E . I .T1008-38 **[Metric Unit]**

A. Material Properties :

Concrete			Steel		
Comp. Strength (fc')	240	ksc.	Yeild Strength(main) (fy)	4000	ksc.
Unit Weigth ,(w_c)	2400	kg/m^3	Yeild Strength(strir.) (fvy)	2400	ksc.
Elas. Modulus (Ec)	245952	ksc.	Elas. Modulus (Es)	2040000	ksc.

B. Design Parameters : ACI318-10.2.7

β_1 : 0.850 ; ϕ_b : 0.9 ; ϕ_v, ϕ_t : 0.85

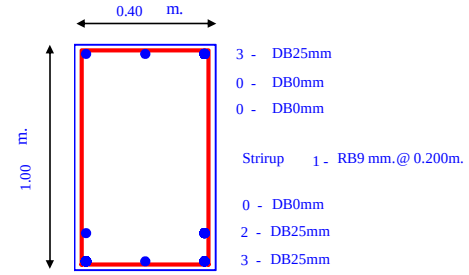
C. Dimension and Reinforcing Bar Arrangement :

Width (bw)	0.40	m.
Depth (h)	1.00	m.
Length (L)	12.00	m.
Covering, cov	0.025	m.
Spacer	0.03	m.
Eff. Depth, d	0.932	m.
Dist.Comp face to Bar C.G.d'	0.05	m.

Bar Side	Layer	Reinf. Bar	As (cm^2)
Comp.	No.1	3 - DB25mm	14.73
	No.2		
	No.3		
Tension	No.3		24.54
	No.2	2 - DB25mm	
	No.1	3 - DB25mm	
Design as Singly. Reinf.			OK

D. Loading : 0.034

Factor Moment, Mu	68233.21	kg-m
Factor Shear. Load, Vu	32835.78	kg
Factor Tor. Load, Tu	0.00	kg-m
Support Type :	One End Continuous	



E. Flexural Reinforcement Design : ACI318-10.3 and 10.5

Mode of Failure : **Tension Failure**

ρ - ρ'		0.85*fc'β_1/fy*d'/d*[6120/(6120-fy)]
0.00263	<	0.00625

Comp.Reinf. Not Yeild., fs'<fy fs' = 1093.64 ksc.

$\rho_b = 0.85\beta1*(fc'/fy)[6120/(6120+fy)]$ 0.02622

Check ρ max = 0.75ρ_b+ρ' 0.02334

ρ min = max[14/fy,(fc')0.5/(4*fy)] 0.00350

USE ρ = 0.00659 **OK**

a = [(Asfy-As'fs')/(0.85*fc'b)] 10.06 cm.

Check ϕMn > Mu

ϕbMn = ϕb[(Asfy-As'fs')(d-a/2) + As'fs'(d-d') 77916.43 kg-m.

Check F.S. = ϕbMn/Mu **1.14** **OK**

F. Shear Reinforcement Design : ACI318-11.3 and 11.5

USE 1 - RB9 mm. @ 0.200m. For Closed Stirrup Asv =πr^2 1.27 cm^2 (2 legs)

Check For Vu = 32835.78 kg.

$\phi_v Vc = \phi_v*0.53*(fc')^{0.5}*bw*d$ 26,004.19 kg : $1.1*\phi_v*(fc')^{0.5}*bw*d$ 49064.50 kg

Vu -ϕVc 6831.59 kg : $2.1*\phi_v(fc')^{0.5}*bw*d$ 103035.45 kg

$\phi_v Vc/2$ 13002.09 kg :

Check Dimensioning of Cross-Section

2.1*ϕv(fc')$^{0.5}$*bw*d = 103035.4547 kg > Vu -ϕVc 6831.59 kg. **OK**

F.1 Shear Reinf. Requirement $\phi_v Vc/2$ < Vu > $\phi_v Vc$ **Required.** **Case2** **Control**

Case2 Vu > 0.85*Vc ; Vu-0.85Vc < 1.1*0.85*(fc')^0.50*bw*d

Check Max. Spacing(m),smax = min[Av*0.85*fv*d/(Vu-0.85Vc),0.25*d,0.30]= 0.233 > 0.200 **OK**

G. Torsion Reinforcement Design : ACI318-99 - Section 11.6.1

Torsion Effect can be neglected if Tu < 0.13*ϕ(fc')$^{0.5}$(b^{2}h)

Tu = 0.00 kg-m < 0.13*ϕ(fc')$^{0.5}$(b^{2}h) = 2738.97 kg-m **OK**

H. Serviceability :

H.1 Deflection Control

Support Type :	One End Continuous	:
Allow.Min. Depth, L/18.5 (m.)	0.649	:
Depth > Allow.Min. Depth	**OK**	:
Use fs = 0.6*fy for crack width control :		

H.2 Crack Width Control

s = 95000/fs - 2.5cc	341	mm.
Max. s = 300(252/fs)	321	< s (mm.)
Control s = Max.(s,Max.s)	321	mm.
Check actual s (mm) > sallow.	175.00	**OK**

--- END OF CALCULATION ---

Mahanakorn University of Technology Civil Engineering Department Bangkok Thailand	Project : 6 MW. Power Plant: SAHAGREEN FOREST CO., LTD.: SRILANKA Des. By : A.SERMPUI Chk. By : Sheet 1/1 Title : Square File : C1 Date : 3/5/2012

Design of Square Column - USD Method ACI318-99 ,E . I .T1008-38 **[Metric Unit]**

A. Material Properties :

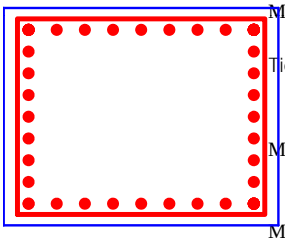
Concrete			Steel		
Comp. Strength (fc')	240	ksc.	Yeild Strength(main) (fy)	4000	ksc.
Unit Weigth ,(w_c)	2400	kg/m^3	Yeild Strength(strir.) (fvy)	2400	ksc.
Elas. Modulus (Ec)	245952	ksc.	Elas. Modulus (Es)	2040000	ksc.

B. Design Parameters :

β_1 : 0.85 ; ϕ : 0.70 εc : 0.003 εs : 0.00196

C. Dimension and Reinforcing Bar Arrangement :

Width (b)	1.200	m.
Depth (h)	1.200	m.
Length (L)	15.030	m.
Covering, cov	0.025	m.
e_x	0.000	m.
e_y	0.000	m.
e_{min}	0.240	m.
Ast	179.558	cm^2
Ag	1.4400	m^2
ρ_t = Ast/bh : (ACI 10.9.1)	0.0125	**OK**



Main Bar 9 - DB28mm
Tie 4 - RB 6mm. @ 288 mm.
Main Bar 14 - DB25mm
Main Bar 9 - DB28mm

D. Loading :

Pu	162.76	T.
Mu	0.00	T.
Pnx=Pu/ϕ	232.51	T.
Mnx=Pn*ey or Mu/0.9	0.00	T-m.
Pny=Pu/ϕ	232.51	T.
Mny=Pn*ex or Mu/0.9	0.00	T-m.

E. Axial Force : (ACI 10.3.5.1;10-1)

Pn-max	3619	T.
0.80 *Pn-max	2895	T.

F. Zero Tention : (ACI 10.3.5.1;10-1)

P0tx	2877	T.	P0ty	2877	T.
M0tx	413	T-m.	M0ty	413	T-m.
etx	0.143	m.	ety	0.143	m.

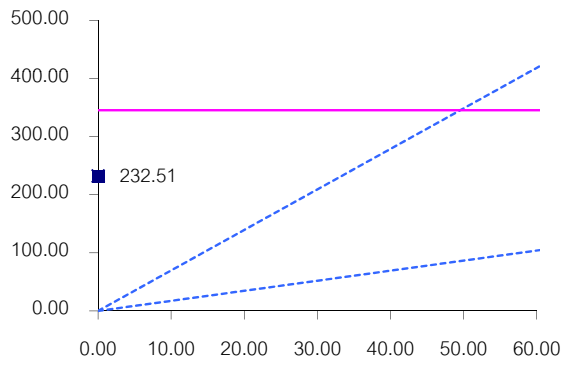
G. Balance : (ACI 10.3.5.1;10-1)

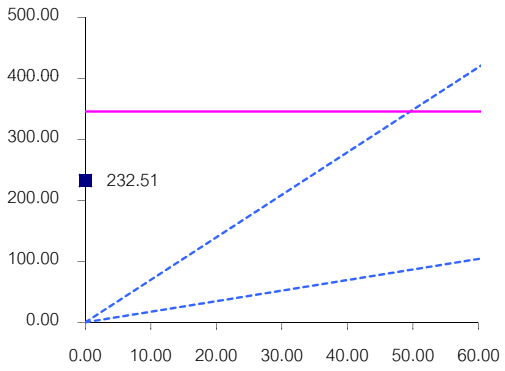
Pbx	1453	T.	Pby	1453	T.
Mbx	839	T-m.	Mby	839	T-m.
ebx	0.577	m.	eby	0.577	m.

H. Peal Binding : (ACI 10.3.5.1;10-1)

Mo	366	T-m.	Mo	366	T-m.
e0x	0.101	m.	e0y	0.101	m.

0.10*fc'*Ag : (ACI 9.3.2.2) 346 T.





Mahanakorn University of Technology Civil Engineering Department Bangkok Thailand	Project : 6 MW. Power Plant: SAHAGREEN FOREST CO., LTD.: SRILANKA Des. By : A.SERMPUI Chk. By : Sheet 1/1 Title : Square File : C2 Date : 3/5/2012

Design of Square Column - USD Method ACI318-99 ,E . I .T1008-38 **[Metric Unit]**

A. Material Properties :

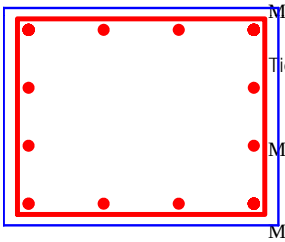
Concrete			Steel		
Comp. Strength (fc')	240	ksc.	Yeild Strength(main) (fy)	4000	ksc.
Unit Weigth ,(w_c)	2400	kg/m^3	Yeild Strength(strir.) (fvy)	2400	ksc.
Elas. Modulus (Ec)	245952	ksc.	Elas. Modulus (Es)	2040000	ksc.

B. Design Parameters :

β_1 : 0.85 ; ϕ : 0.70 εc : 0.003 εs : 0.00196

C. Dimension and Reinforcing Bar Arrangement :

Width (b)	0.600	m.
Depth (h)	0.800	m.
Length (L)	9.000	m.
Covering, cov	0.025	m.
e_x	0.000	m.
e_y	0.000	m.
e_{min}	0.160	m.
Ast	68.895	cm^2
Ag	0.4800	m^2
ρ_t = Ast/bh : (ACI 10.9.1)	0.0144	**OK**



Main Bar	4 -	DB28mm
Tie	4 -	RB 6mm.
	@	288 mm.
Main Bar	4 -	DB25mm
Main Bar	4 -	DB28mm

D. Loading :

Pu	101.71	T.
Mu	0.00	T.
Pnx=Pu/ϕ	145.30	T.
Mnx=Pn*ey or Mu/0.9	0.00	T-m.
Pny=Pu/ϕ	145.30	T.
Mny=Pn*ex or Mu/0.9	0.00	T-m.

E. Axial Force : (ACI 10.3.5.1;10-1)

Pn-max	1241	T.
0.80 *Pn-max	993	T.

F. Zero Tention : (ACI 10.3.5.1;10-1)

P0tx	982	T.	P0ty	986	T.
M0tx	95	T-m.	M0ty	69	T-m.
etx	0.096	m.	ety	0.070	m.

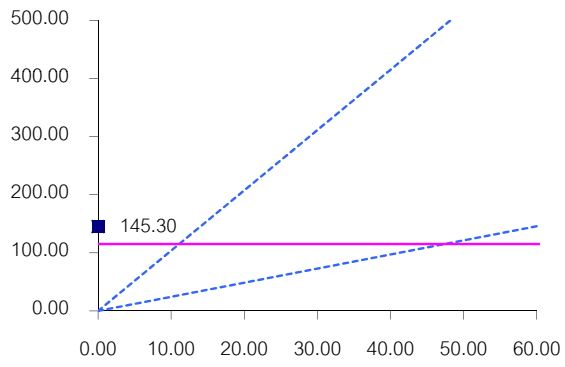
G. Balance : (ACI 10.3.5.1;10-1)

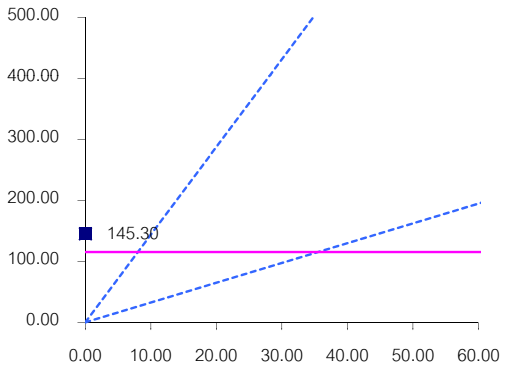
Pbx	475	T.	Pby	466	T.
Mbx	196	T-m.	Mby	144	T-m.
ebx	0.412	m.	eby	0.308	m.

H. Peal Binding : (ACI 10.3.5.1;10-1)

Mo	82	T-m.	Mo	81	T-m.
e0x	0.066	m.	e0y	0.065	m.

0.10*fc'*Ag : (ACI 9.3.2.2) 115 T.





Mahanakorn University of Technology
Civil Eng. Department
Bangkok Thailand

Project : 6 MW. Power Plant: SAHAGREEN FOREST CO., LTD.: SRILANKA
Des. By : A.SERMPUN **Chk. By :** ENG 2 **Sheet :** 1/1
Title : Footing on Soil Bearing **File :** F1 **Date :** 3/5/2012

Design Footing on Soil Bearing - USD Method ACI318-99 , EIT 1008 - 38 [Metric Unit]

A. Material Properties : ACI318-8.5.2

Concrete			Steel		
Comp. Strength (fc')	240	ksc.	Yeild Strength (fy)	4000	ksc.
Unit Weigth ,(w_c)	2400	kg/m^3			

B. Design Parameters : ACI318-10.2.7

β_1 : 0.850 ; ϕ_b : 0.9 ; ϕ_v 0.85 ; Covering 5 cm.

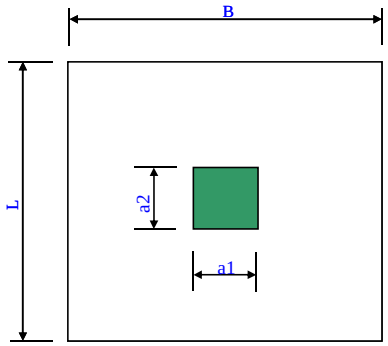
C. Footing and Soil Capacity

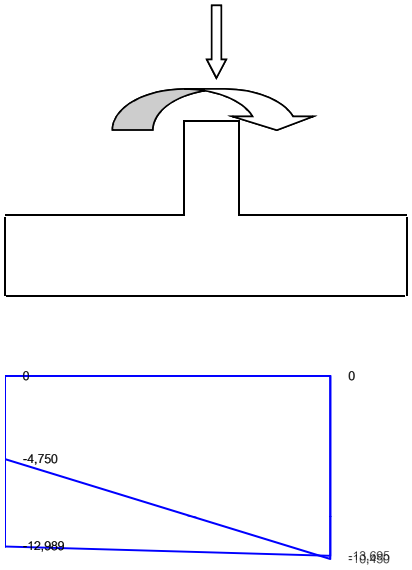
Soil			Footing				
Bearing Capacity	10.00	Ton/m^2	Colume Siz	a 1	=	1.20	m.
factor load	1.40			a 2	=	1.20	m.
Ultimate Bearing Capacity	14.00	Ton/m^2	Footing size	B	=	3.75	m.
				L	=	3.75	m.

D. Loading ACI318-15.2.1 and 15.2.2

Dead Load	=	105.15	Tons.	Moment Dead Load	=	1	Ton.-m
Live Load	=	23.77	Tons.	Moment Live Load	=	1	Ton.- m
Total Load	=	187.619	Tons.	MomentTotal Load	=	3.1	Ton.- m

CHECK Total Load and Moment **OK**





E. Q. eff

Q.eff minimum	=	12989.08	kg/m^2.	
Q.eff maxzimum	=	13694.51	kg/m^2.	
Q.eff at Border Column	=	13454.66	kg/m^2.	

F. Bending moment ACI318-15.4.1

Mu		=	41497.81	kg-m.			
Assume.	ρ min = 14/fy	=	0.0035				
Ru.=ρfy(1-0.59ρ(fy/fc	Ru	=	13.52	ksc.			
Mu=ϕRubd^2	d.eff.	=	30.20	cm.			
	d.	=	95.00	cm.	Thickness	=	1.00 m.

H. Check Shearing at Critical section ACI318-15.4.2

Vu=Qnet*x	Qnet	=	13633.37	kg/m^2.	
	Vu	=	16652.92489	kg.	
Vc=0.53ϕ(fc')^0.5bd	Vc	=	248631.0071	kg.	OK

G. Check Punching Shear ACI R 318-15.4.2 and 15.5.2

	X1	=	215.000	cm.
	bo	=	860	cm.
	Qnet	=	13341.79556	kg/m^2.
Vu		=	125946.55	kg.
Vc=0.27ϕ(2+(4/Bc))(fc')^0.5bod		=	1742856.45	kg.
or Vc=1.06ϕ(fc')^0.5bod		=	1140387.55	kg.
Vc		=	1140387.55	kg. OK

Mahanakorn University of Technology	**Project :**	6 MW. Power Plant: SAHAGREEN FOREST CO., LTD.: SRILANKA	
Civil Eng. Department	**Des. By :** A.SERMPUN	**Chk. By :** ENG 2	**Sheet :** 1/2
Bangkok Thailand	**Title :** Footing on Soil Bearing	**File :** F1	**Date :** 3/5/2012

Design Footing on Soil Bearing - USD Method ACI318-99 , EIT 1008 - 38 **[Metric Unit]**

I. Reinforcement Design ACI318-10.3 and 10.5

About X-X Axis

Mu	=	41500.25	kg-m.	
m = fy/(0.85*fc')	=	19.6078		
Ru = Mu/ϕbd^2	=	1.36	$cm^{2.}$	
ρreq'd = (1/m)[1-(1-(2m*Rn/fy))$^{0.5}$]	=	0.0007		
ρb = 0.85β1*(fc'/fy)[6120/(6120+fy)]	=	0.0262		
Asreq'd=(0.85fc'/fy).b.d.(1-(1-(2/0.85fc') Mu/($\phi_b$bd^2))$^{0.50}$))		12.15	cm^2	
Check ρ max = 0.75ρb	=	0.0197		
ρ min = max(14/fy,(fc')$^{0.5}$/(4*fy))		0.00350		
USE	=	0.0017	**OK**	

Select

Layer	Reinf. Bar	As (cm^2)	
No. 12	DB25mm	58.9	**OK**

J. Reinforcement Design

About Y-Y Axis

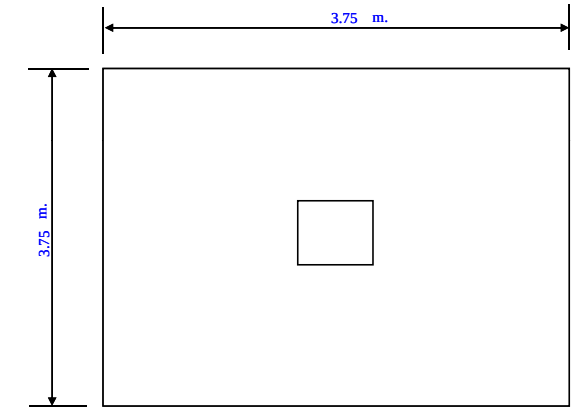
Mu	=	41500.25	Tons-m.	
m=fy/(0.85*fc')	=	19.6078		
Ru =Mu/ϕbd^2	=	1.36	$cm^{2.}$	
ρreq'd =(1/m)[1-(1-(2m*Rn/fy))$^{0.5}$]	=	0.0007		
ρb = 0.85β1*(fc'/fy)[6120/(6120+fy)]	=	0.0262		
Asreq'd=(0.85fc'/fy).b.d.(1-(1-(2/0.85fc') Mu/($\phi_b$bd^2))$^{0.50}$))		12.15	cm^2	
Check ρ max = 0.75ρb	=	0.0197		
ρ min = max(14/fy,(fc')$^{0.5}$/(4*fy))		0.00350		
USE	=	0.0017		

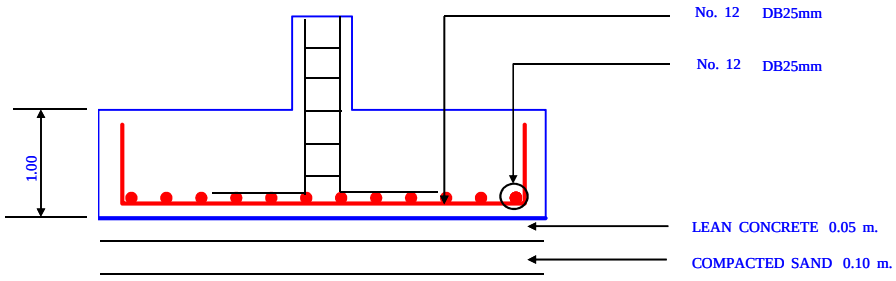
Select

Layer	Reinf. Bar	As (cm^2)	
No. 12	DB25mm	58.9	**OK**

K. Check Bonding ACI318-15.6.2

B							
l_{db} of	Reinf. Bar	=	(0.06*Ab*fy)/(fc')$^{0.5}$	=	76.05	cm.	OK
L							
l_{db} of	DB25mm	=	(0.06*Ab*fy)/(fc')$^{0.5}$	=	76.05	cm.	OK





Mahanakorn University of Technology
Civil Eng. Department
Bangkok Thailand

Project : 6 MW. Power Plant: SAHAGREEN FOREST CO., LTD.: SRILANKA
Des. By : A.SERMPUN **Chk. By :** ENG 2 **Sheet :** 1/1
Title : Footing on Soil Bearing **File :** F2 **Date :** 3/5/2012

Design Footing on Soil Bearing - USD Method ACI318-99 , EIT 1008 - 38 [Metric Unit]

A. Material Properties : ACI318-8.5.2

Concrete			Steel		
Comp. Strength (fc')	240	ksc.	Yeild Strength (fy)	4000	ksc.
Unit Weigth ,(w_c)	2400	kg/m^3			

B. Design Parameters : ACI318-10.2.7

β_1 : 0.850 ; ϕ_b : 0.9 ; ϕ_v 0.85 ; Covering 5 cm.

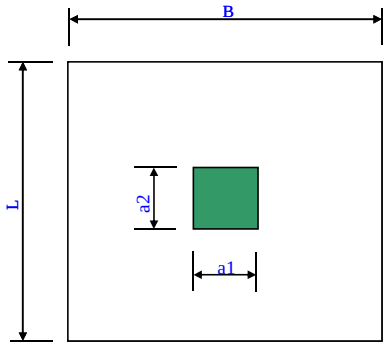
C. Footing and Soil Capacity

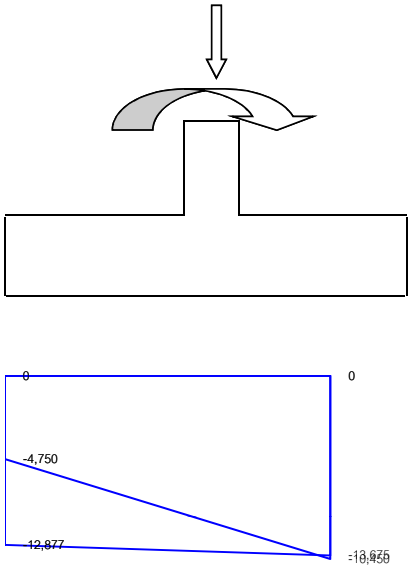
Soil			Footing				
Bearing Capacity	10.00	Ton/m^2	Colume Siz	a 1	=	0.80	m.
factor load	1.40			a 2	=	0.60	m.
Ultimate Bearing Capacity	14.00	Ton/m^2	Footing size	B	=	3.60	m.
				L	=	3.60	m.

D. Loading ACI318-15.2.1 and 15.2.2

Dead Load	=	112.31	Tons.	Moment Dead Load	=	1	Ton.-m
Live Load	=	8.72	Tons.	Moment Live Load	=	1	Ton.- m
Total Load	=	172.058	Tons.	MomentTotal Load	=	3.1	Ton.- m

CHECK Total Load and Moment **OK**





E. Q. eff

Q.eff minimum	=	12877.42	kg/m^2.
Q.eff maxzimum	=	13674.74	kg/m^2.
Q.eff at Border Column	=	13364.67	kg/m^2.

F. Bending moment ACI318-15.4.1

Mu		=	47879.85	kg-m.			
Assume.	ρ min = 14/fy	=	0.0035				
Ru.=ρfy(1-0.59ρ(fy/fc	Ru	=	13.52	ksc.			
Mu=ϕRubd^2	d.eff.	=	33.10	cm.			
	d.	=	75.00	cm.	Thickness	=	0.80 m.

H. Check Shearing at Critical section ACI318-15.4.2

Vu=Qnet*x	Qnet	=	13530.78	kg/m^2.	
	Vu	=	31830.46322	kg.	
Vc=0.53ϕ(fc')^0.5bd	Vc	=	188436.1317	kg.	OK

G. Check Punching Shear ACI R 318-15.4.2 and 15.5.2

	X1	=	155.000	cm.
	bo	=	620	cm.
	Qnet	=	13276.08025	kg/m^2.
Vu		=	140162.22	kg.
Vc=0.27ϕ(2+(4/Bc))(fc')^0.5bod		=	991956.24	kg.
or Vc=1.06ϕ(fc')^0.5bod		=	649057.79	kg.
Vc		=	649057.79	kg. OK

Mahanakorn University of Technology	**Project :**	6 MW. Power Plant: SAHAGREEN FOREST CO., LTD.: SRILANKA	
Civil Eng. Department	**Des. By :** A.SERMPUN	**Chk. By :** ENG 2	**Sheet :** 1/2
Bangkok Thailand	**Title :** Footing on Soil Bearing	**File :** F2	**Date :** 3/5/2012

Design Footing on Soil Bearing - USD Method ACI318-99 , EIT 1008 - 38 **[Metric Unit]**

I. Reinforcement Design ACI318-10.3 and 10.5

About X-X Axis

Mu	=	47883.50	kg-m.	
m = fy/(0.85*fc')	=	19.6078		
Ru = Mu/ϕbd^2	=	2.63	$cm^{2.}$	
ρreq'd = (1/m)[1-(1-(2m*Rn/fy))$^{0.5}$]	=	0.0013		
ρb = 0.85β1*(fc'/fy)[6120/(6120+fy)]	=	0.0262		
Asreq'd=(0.85fc'/fy).b.d.(1-(1-(2/0.85fc') Mu/($\phi_b$bd^2))$^{0.50}$))		17.87	cm^2	
Check ρ max = 0.75ρb	=	0.0197		
ρ min = max(14/fy,(fc')$^{0.5}$/(4*fy))		0.00350		
USE	=	0.0022	**OK**	

Select

Layer	Reinf. Bar	As (cm^2)	
No. 12	DB25mm	58.9	**OK**

J. Reinforcement Design

About Y-Y Axis

Mu	=	54968.30	Tons-m.	
m=fy/(0.85*fc')	=	19.6078		
Ru =Mu/ϕbd^2	=	3.02	$cm^{2.}$	
ρreq'd =(1/m)[1-(1-(2m*Rn/fy))$^{0.5}$]	=	0.0015		
ρb = 0.85β1*(fc'/fy)[6120/(6120+fy)]	=	0.0262		
Asreq'd=(0.85fc'/fy).b.d.(1-(1-(2/0.85fc') Mu/($\phi_b$bd^2))$^{0.50}$))		20.54	cm^2	
Check ρ max = 0.75ρb	=	0.0197		
ρ min = max(14/fy,(fc')$^{0.5}$/(4*fy))		0.00350		
USE	=	0.0022		

Select

Layer	Reinf. Bar	As (cm^2)	
No. 12	DB25mm	58.9	**OK**

K. Check Bonding ACI318-15.6.2

B

l_{db} of Reinf. Bar = (0.06*Ab*fy)/(fc')$^{0.5}$ = 76.05 cm. OK

L

l_{db} of DB25mm = (0.06*Ab*fy)/(fc')$^{0.5}$ = 76.05 cm. OK