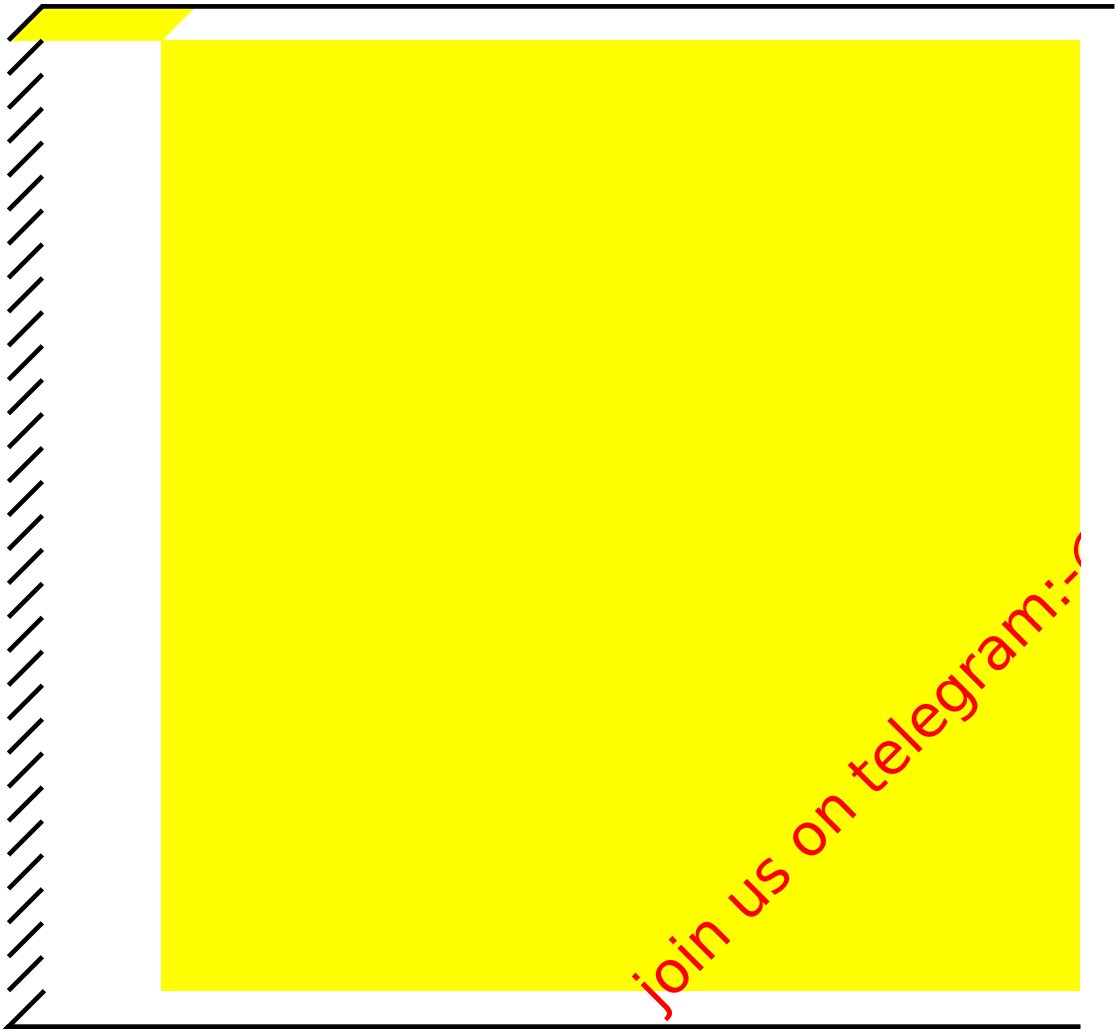
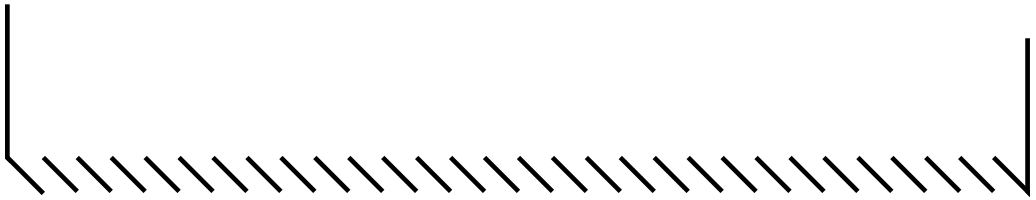
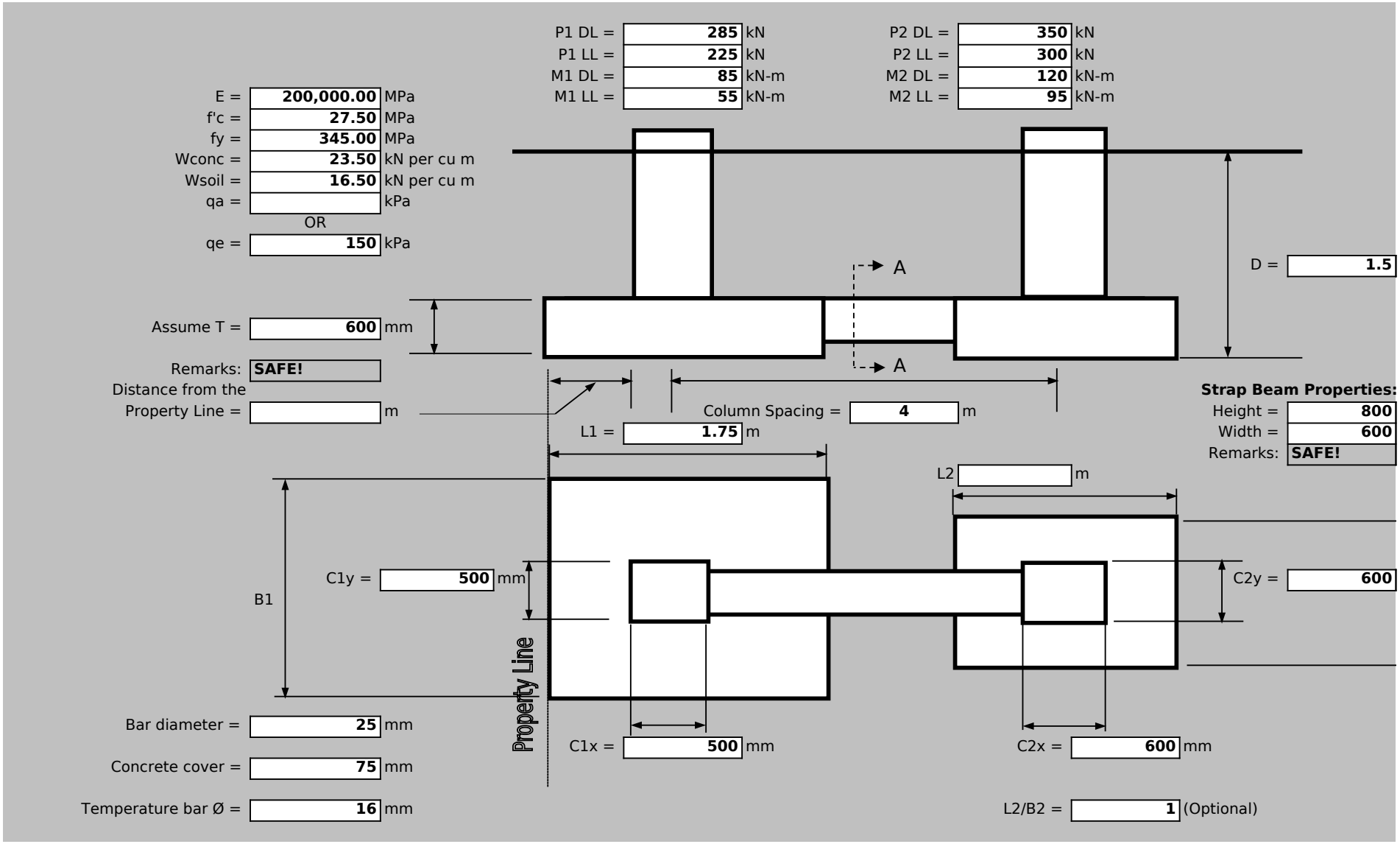
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Design of Combined Strap Footing

<Program Created by: Engr. Jeremy E Caballes>



Programmed by : Engr. Jeremy E. Caballes, 17 April 2004, Revised, .

Solve for Location of its Resultant:

P1 =	P1 DL + P2 LL		
P1 =	510.000	kN	
P2 =	P2 DL + P2 LL		
P2 =	650.000	kN	
M1 =	M1 DL + M2 LL		
M1 =	140.000	kN-m	
M2 =	M2 DL + M2 LL		
M2 =	215.000	kN-m	
X1 =	0.250	m	
X2 =	4.250	m	
P =	P1 + P2		
P =	1,160.000	kN	
P(Xc) =	P1(X1) + P2(X2) + M1 +M2		
Xc =	**2.797**	**m**	**X1 ≤ Xc ≤ X2, OK!**
L =	5.300	m	

Determine the Widths:

qe =	qa - qs - qc			
qs =	Wsoil x (D - T)			
qs =	14.850	kPa		
qc =	Wconc x T			
qc =	14.100	kPa		
Therefore: qe =	150.000	kPa		
Thus: A =	(P/qe)(1+6e/L)			
A =	7.733	sq m		
A =	A1 + A2			
P/qe =	A1 + A2			
A2 =	P/qe - A1			
A.Xc =	A1(L1/2) + A2X2			
A.Xc =	A1(L1/2) +(P/qe - A1)X2			
A1 =	3.328	sq m		
L1 B1 =	3.328	sq m		
Since: L1 =	**1.75**	**say**	**1.750**	**m**
Then: B1 =	**1.902**	**say**	**1.910**	**m**
Check: L1/B1 =	0.916	0.75 ≤ L/B ≤ 1.0, OK!		
A2 =	4.405	sq m		
L2 B2 =	4.405			
L2 =	**2.099**	**say**	**2.100**	**m**
B2 =	**2.099**	**say**	**2.100**	**m**
Check: L1/B1 =	1.000			
	0.75 ≤ L/B ≤ 1.0, OK!			
L =	**5.300**	**m**		

Design loads:

Pu1 =	1.4(P1 DL) + 1.7(P1 LL)	
Pu1 =	781.500	kN
Pu2 =	1.4(P2 DL) + 1.7(P2 LL)	
Pu2 =	1,000.000	kN
Pu =	Pu1 + Pu2	
Pu =	1,781.500	kN
Mu1 =	1.4(M1 DL) + 1.7(M1 LL)	
Mu1 =	212.500	kN-m
Mu2 =	1.4(M2 DL) + 1.7(M2 LL)	
Mu2 =	329.500	kN-m
∑M at Ru1 = 0, CW is (+)		
0 =	Pu2(X2 - L1/2) - Pu1(L1/2 - X1) - Ru2(X2 - L1/2) + Mu1 + Mu2	
Ru2 =	1,015.870	kN
Ru1 =	Pu1 + Pu2 - Ru2	
Ru1 =	765.630	kN
qu1 =	Ru1/A1	
=	229.059	kPa
wua =	qu1 x B1	
wu1 =	**437.503**	**kN/m**
qu2 =	Ru2/A2	
=	230.356	kPa
wub =	qu2 x B2	
wu2 =	**483.748**	**kN/m**

		Distance (m)
xa =	X1 - 0.5C1x	xa = 0.000
xb =	X1 + 0.5C1x	xb = 0.500
xc =	L1	xc = 1.750
xd =	L - L2	xd = 3.200
xe =	X2 - 0.5C2x	xe = 3.950
xf =	X2 + 0.5C2x	xf = 4.550

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Check for One-Way or Direct Shear:

d = T - 0.5Ø - cover
= 512.5 mm
d = 0.5125 m

xa = X1 - C1x/2 - d
xb = L1
xc = L - L2
xd = X2 + C2x/2 + d
ye = B1/2 - C1y/2 - d
yf = B2/2 - C2y/2 - d

Ve = qu1 (B1/2 - ye) (L1)
Ve = 57.122 kN
Vf = qu2 (B2/2 - yf) (L2)
Vf = 114.890 kN

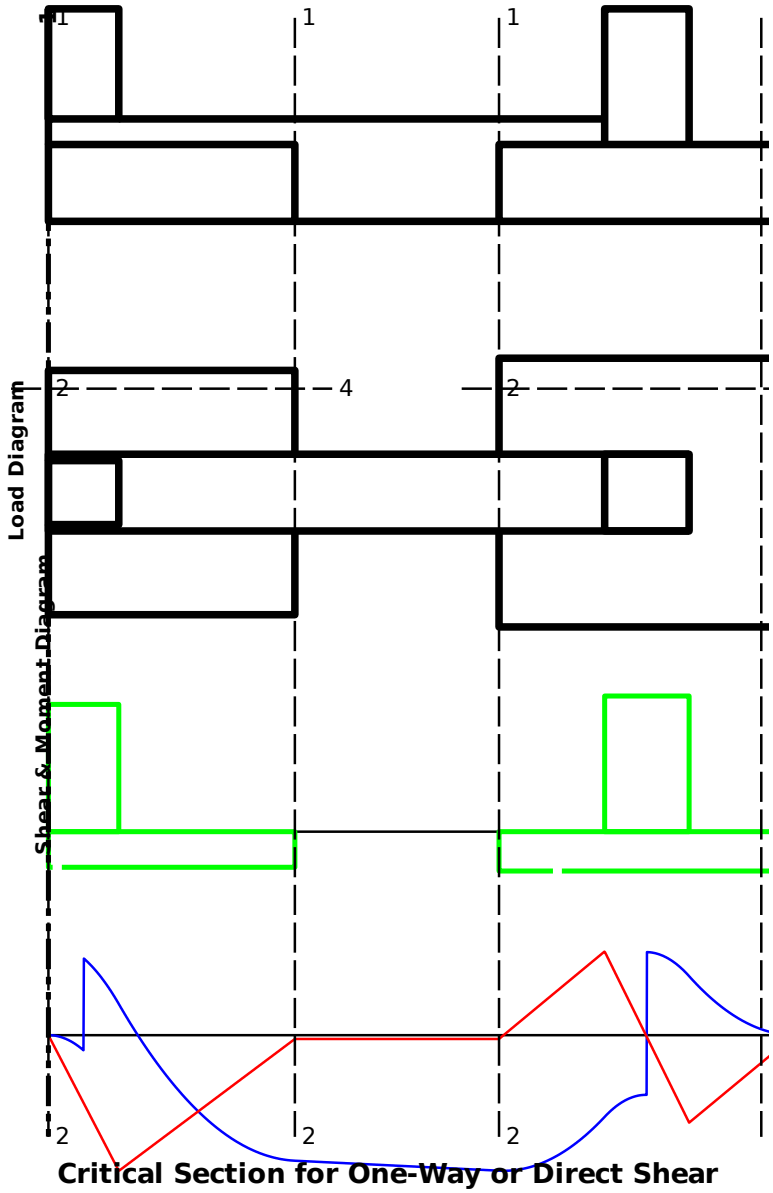
Section:	Longitudinal		Transverse	
	a - a	d - d	e - e	f - f
Distance, x, y, (m)	0.000	5.063	0.813	0.813
Vu (kN)	0.000E+0	-114.890E+0	57.122E+0	114.890E+0
b (mm)	1910	2100	1750	2100
d (mm)	512.5	512.5	512.5	512.5
ØVc = Ø(1/6)√(f'c)bd, (kN)	727.212E+0	799.553E+0	666.294E+0	799.553E+0
Remarks	None	SAFE!	SAFE!	SAFE!

Section:	Strap Beam	
	b - b	c - c
Distance, y (m)	1.750	3.200
Vu (kN)	-15.870E+0	-15.870E+0
b (mm)	600	600
d (mm)	712.5	712.5
ØVc = Ø(1/6)√(f'c)bd, (kN)	317.592E+0	317.592E+0
Remarks	SAFE!	SAFE!

Vc = (1/6)√(f'c)bd
= 373.638152161 kN > Vu = -15.87 kN
Stirrups are not Required!

Using: d = 10 mm
S = Smax = d/2
= 256.25 mm

Use: S = 256.250 mm



Critical Section for One-Way or Direct Shear

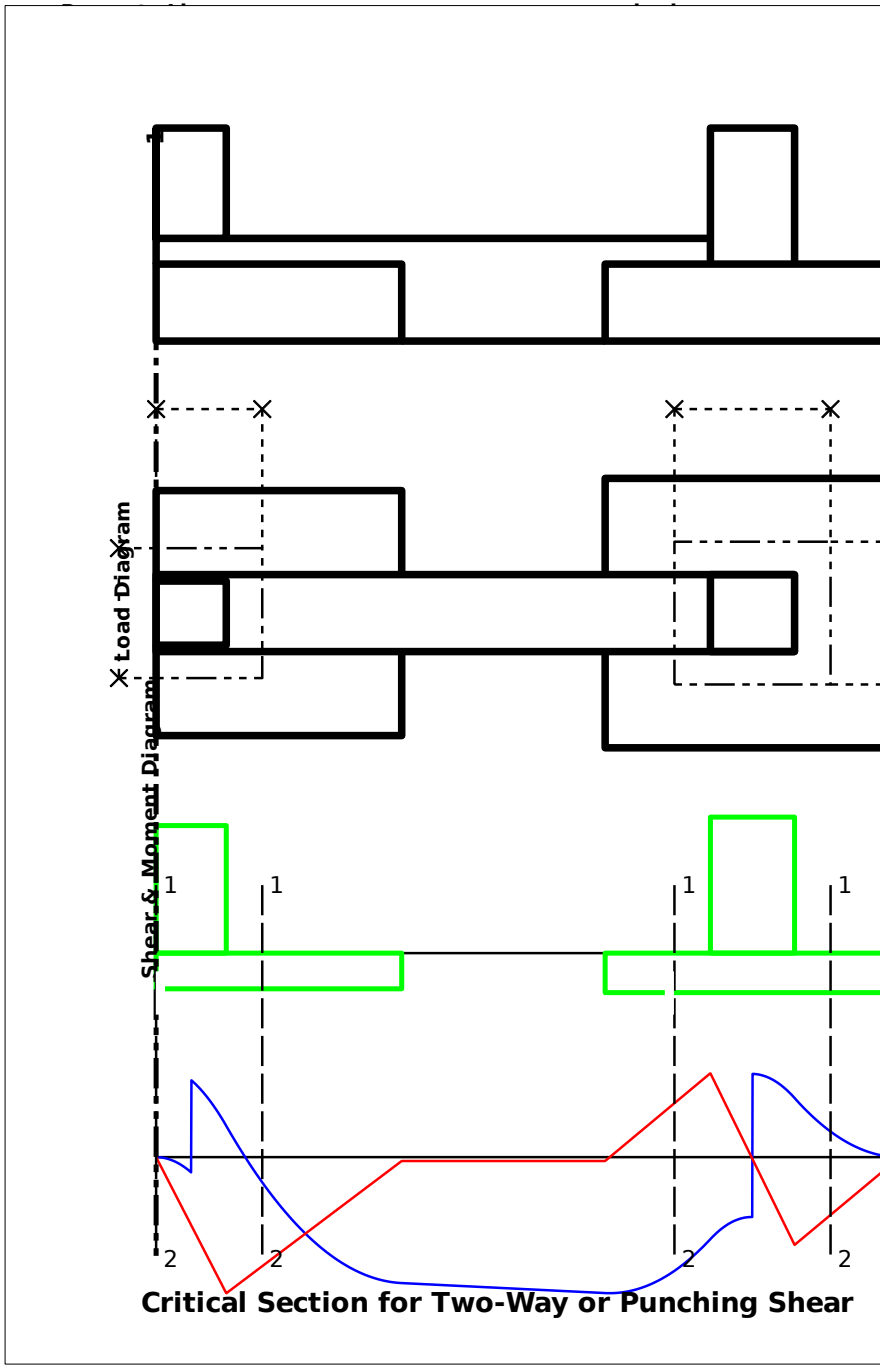
Check for Two-Way or Punching Shear:

(a) Exterior Column:

xa =	X1-C1x/2-d/2		xa =	0.000	m
xb =	X1+C1x/2+d/2		xb =	0.756	m
x1 =	0.756	m			
y1 =	1.013	m			
Vu =	Pu1 - qu1(x1)(y1)				
Vu =	529.201	kN			
bo =	2.525	m			
ØVc =	Ø(1/3)√(f'c)bod				
ØVc =	1,922.734	kN	**SAFE!**		

(b) Interior Column:

Xc =	X2-C2x/2-d/2		Xc =	3.694	m
Xd =	X2+C2x/2+d/2		Xd =	4.806	m
x2 =	1.112	m			
y2 =	1.112	m			
Vu =	Pu2 - qu2(x2)(y2)				
Vu =	714.898	kN			
bo =	4.450	m			
ØVc =	Ø(1/3)√(f'c)bod				
ØVc =	3,388.581	kN	**SAFE!**		



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Design of Reinforcement:

d = T - 0.5Ø - cover
= 512.500 mm Footing
= 712.500 mm Strap

$\rho_{min} = \frac{4\sqrt{f`c}}{fy}$ or $\rho_{min} = \frac{1.4}{fy}$

= 0.00380 = 0.00406
Use ρ_{min} = 0.00406

Ab = $\pi d^2 / 4$
= 490.874 sq mm

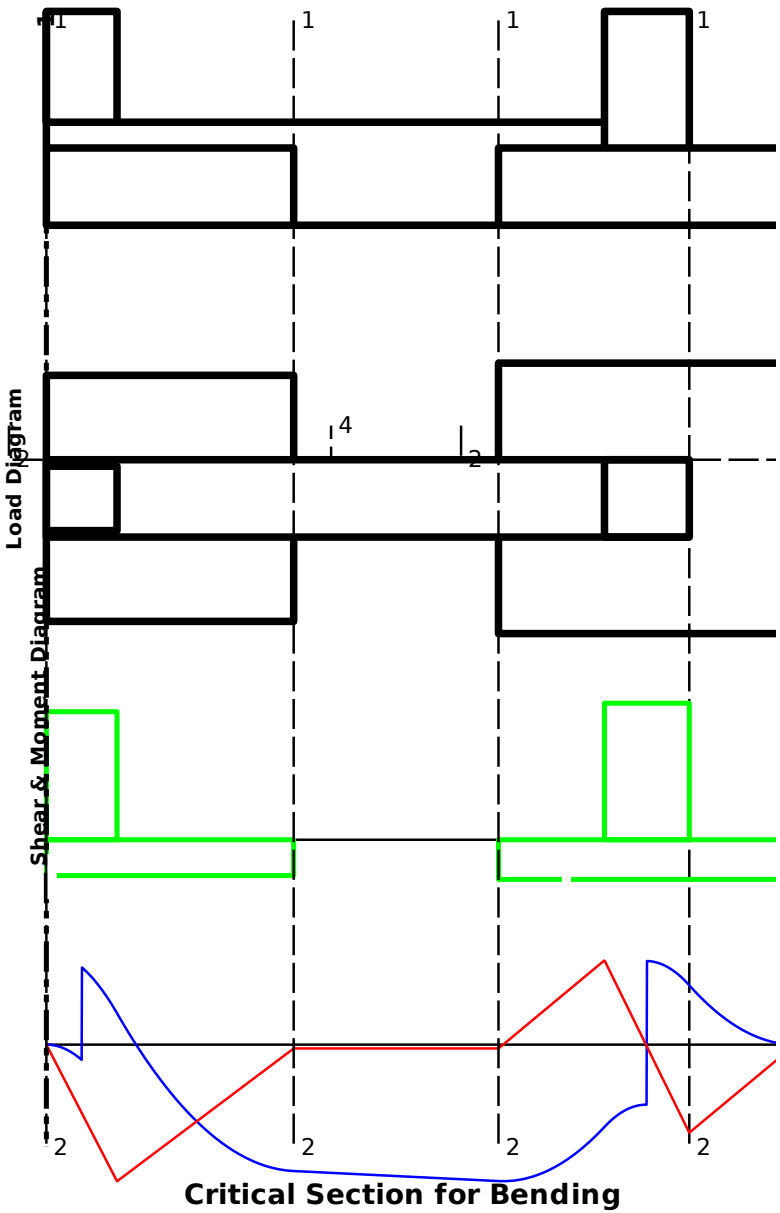
Section	Longitudinal			
	a	**b**	**c**	**d**
Mu =	0.000E+0	289.824E+6	312.836E+6	136.054E+6
b =	1,910.000	600.000	600.000	2,100.000
d =	512.500	712.500	712.500	512.500
Rn =	0.00000	1.05723	1.14118	0.27407
act p =	0.00000	0.00314	0.00339	0.00080
Use: p =	0.00406	0.00406	0.00406	0.00406
As =	3,972.246	1,734.783	1,734.783	4,367.391
n =	**9**	**4**	**4**	**9**
Soc =	**219.000**	**149.000**	**149.000**	**243.000**
Scl =	194.000	124.000	124.000	218.000
Location =	**None**	**Top**	**Top**	**Bottom**

Section	Transverse	
	e	**f**
Mu =	164.756E+6	244.897E+6
b =	1,750.000	2,100.000
d =	512.500	512.500
Rn =	0.39826	0.49333
act p =	0.00116	0.00145
Use: p =	0.00406	0.00406
As =	3,639.493	4,367.391
n =	**8**	**9**
Soc =	**228.000**	**243.000**
Scl =	203.000	218.000
Location =	**Bottom**	**Bottom**

ye = ½b of Strap m
yf = ½b of Strap m
yg = 0.300 m
yh = 0.300 m

Temperature/Shrinkage Reinforcement: Ø = 16 mm

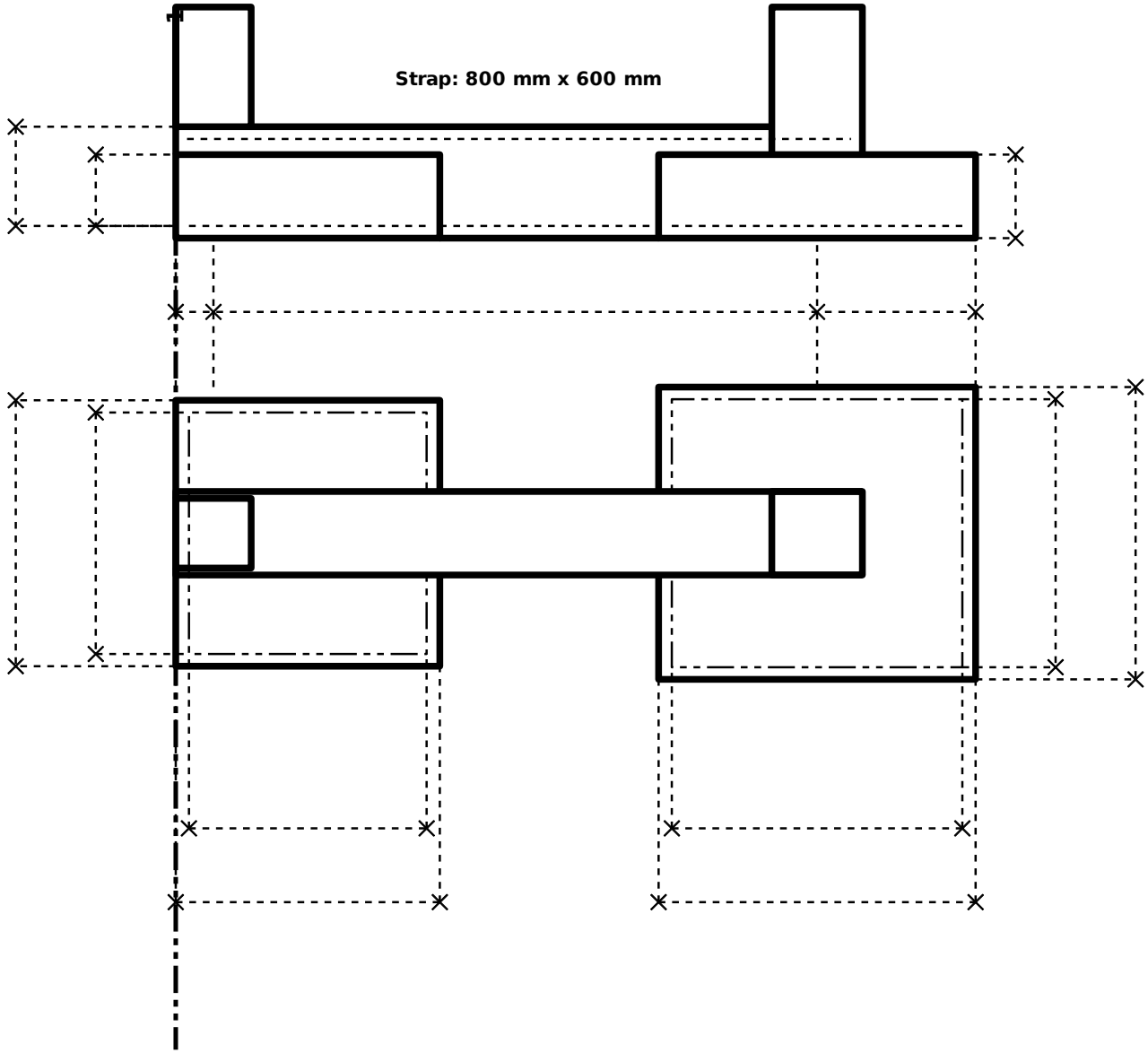
Ast = 0.002bh consider: b = 1000 mm
Ast = 1,200.000 sq mm
n = 5.968 say **6**
Soc = 200.000 mm
Scl = 184.000 mm **> 25 mm OK!**
Ext Footing:Le = **1.135** m **5**
Int Footing:Le = **1.325** m **6**



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Reinforcement Details of Combined Strap Footing

By: Engr. Jeremy E. Caballes



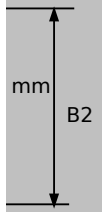
Given:

m

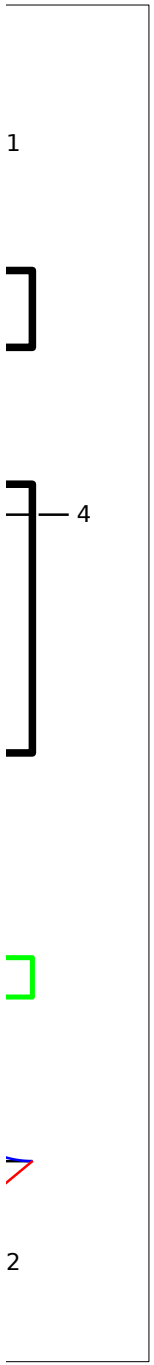
Section A-A

mm

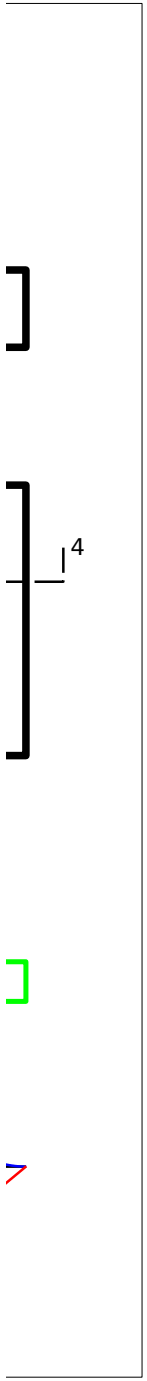
mm



11 Nov 2005


1
4
2

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