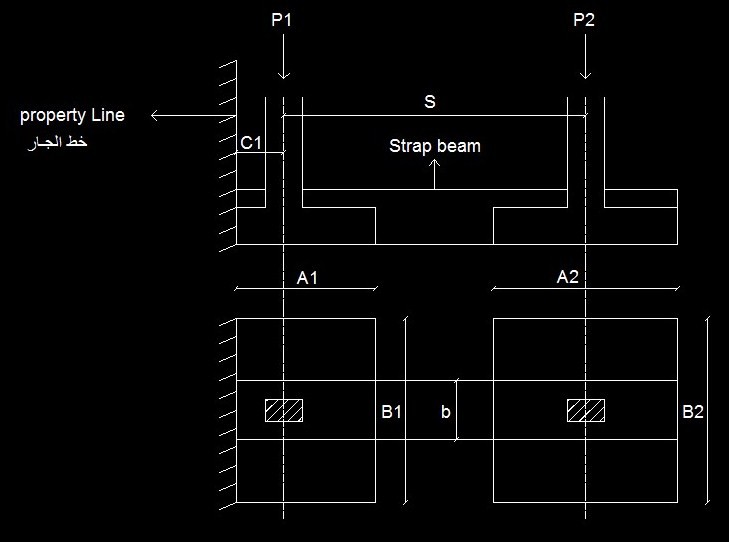
Steps of Design:

1 ) Dimension of Footing:



Pt1 = 1.2\*P1 = …ton

Pt2 = P2 = …ton

حيث أن:

P1 → Working Loads و P2

Take tp.c = 30 cm

Area of Footing (1):

Af1 = = … m2→ A1, B1

*حيث أن:*

*العرض ( البعد الأصغر ) →*A1

*الطول ( البعد الأكبر ) →* B1

Area of Footing (2):

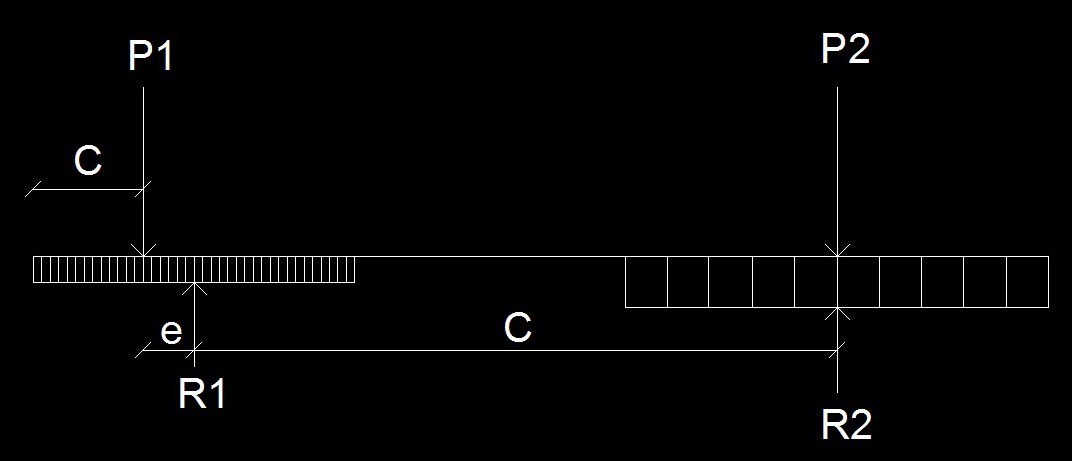
Af2 = = … m2→ A2, B2

*حيث أن:*

*العرض أو الطول حسب وضع العمود →*A2

*العرض أو الطول حسب وضع العمود →* B2

2 ) Determination of eccentricity:



*نلاحظ أن:*

*القاعدة الثانية مرتكزة مع العمود فتكون محصلة إجهاد التربة في نفس مكان تأثير حمل العمود.*

*القاعدة الأولي غير مرتكزة مع العمود ويوجد ترحيل بين* P1 *و* R1 *.*

e = – C1 =… m

C = s – e = … m

3 ) Check Area:

R1u = P1 + P1 \* = … ton

R2 = P2 – P1 \* = … ton

q1 = = … t/m2  qall

q2 = = … t/m2  qall

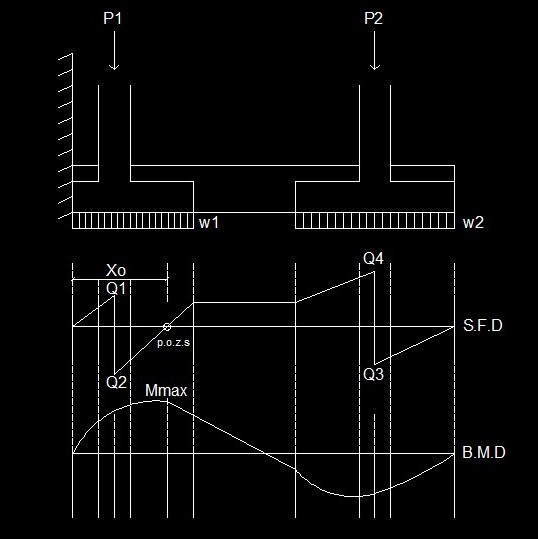
If q1 > qall increase B1

If q2 > qall increase B2

End of Working Loads .

4 ) Design of Strap Beam:

Calculation of Moment and Shear for Strap Beam:



P1u = 1.5 P1 = … ton

P2u = 1.5 P2 = … ton

R1u = 1.5 R1 = … ton

R2u = 1.5 R2 = … ton

W1 = = … t/m'

W2 = = … t/m'

Point of Zero Shear

At distance Xo

Xo = = … m

Mmax = P1u ( Xo – C1 ) – W1 \* ( ) = … mt

d = c1 = … cm

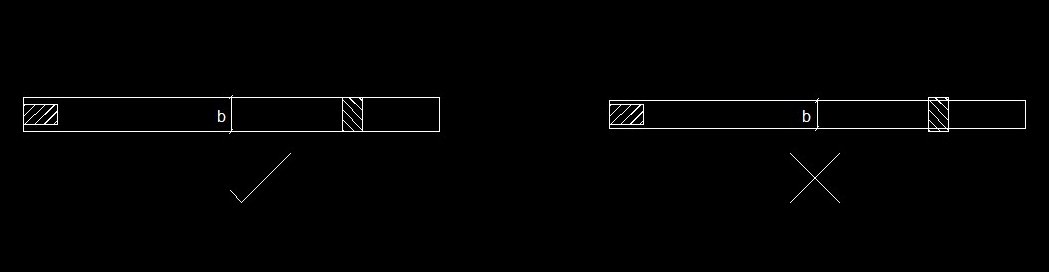
حيث أن:

c1 = 4 → beam

عرض strap beam b →

b = 40 → 80 cm

ولا تقل عن بعد العمود في اتجاه strap beam



5 ) Check Shear:

Q1 = W1 \* C1 = … t

Q2 = Q1 – P1u = … t

Q3 = W2 \* = … t

Q4 = Q3 – P2u = … t

Qsh1 = Q1 or Q2 – W1 \*( + )= … ton

حيث أن:

Take the bigger of Q1 or Q2

*طول العمود* a→

*عرض العمود* b→

*حسب اتجاه العمود* →

Qsh2 = Q3or Q4 – W2 \*( + )= … ton

حيث أن:

Take the bigger of Q3 or Q4

*طول العمود* a→

*عرض العمود* b→

*حسب اتجاه العمود* →

qsh = = … kg/cm2

حيث أن:

Take the bigger of Qsh1 or Qsh2

*عرض* strap beamb→

qcu = 0.75\* (for beam ) = … kg/cm2

حيث أن:

Ϫc = 1.5

If qcu > qsh  ok ( use min stirrups 5y8/m')

If qcu < qsh  ( use min stirrups 7y10/m')

t = d + cover

cover =(5 to 10 cm)

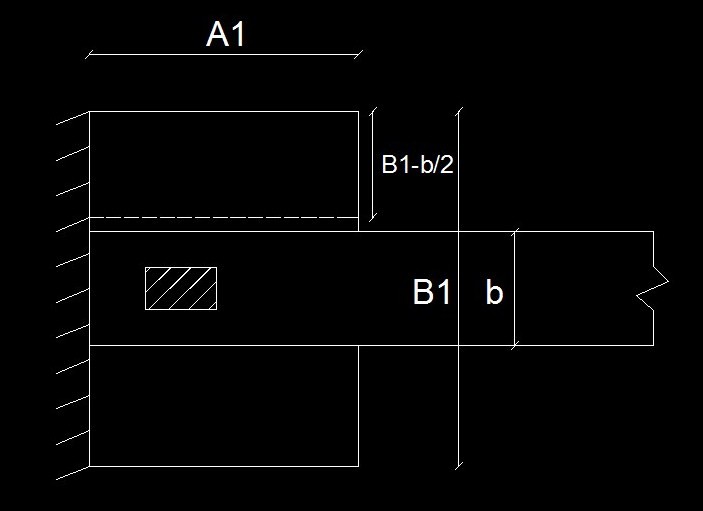
Reinforcement of the Strap beam:

As top = = … cm2

AS bott = 20 % As top = … cm2

6 ) Design of Footing:

Footing 1 (F1 ):



qu1 = = … t/m2

M1 = qu1 \* = … mt

d1 = c1 = … cm

حيث أن:

B = 100 cm , c1 = 5 for Footing

Check Shear:

Qsh = qu1 \*( + )= … ton

qsh = = … kg/cm2

*حيث أن:*

B = 100 cm

qcu = 0.4\* = … kg/cm2

If qcu > qsh  ok safe

If qcu < qsh  un safe increase depth

Take d = Qsh / (qcu \* B) = … cm

t = d + cover

cover =(5 to 10 cm)

Reinforcement of the footing (1):

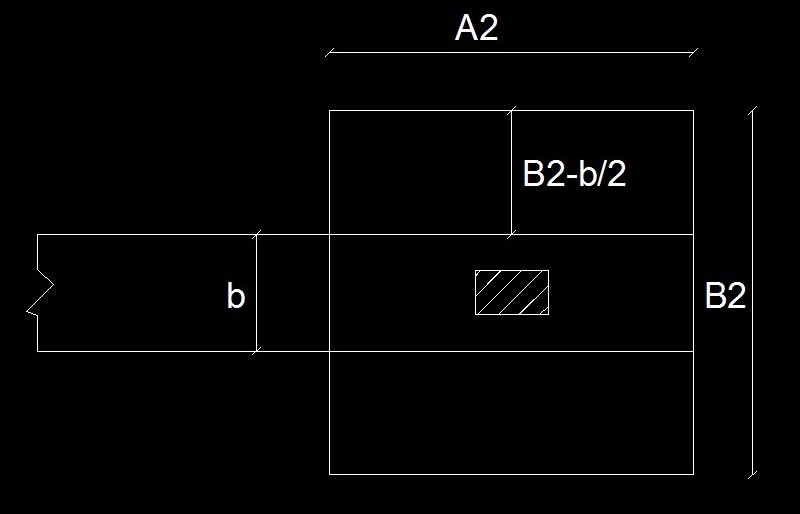
As1 = = … cm2 /m'

As min = 5y12/m' = … cm2 /m'

If As1  As min → ok

If As1 < As min  → take As1= As min

Footing 2 (F2 ):



qu2 = = … t/m2

M2 = qu2 \* = … mt

d2 = c1 = … cm

حيث أن:

B = 100 cm , c1 = 5 for Footing

Check Shear:

Qsh = qu2 \*( + )= … ton

qsh = = … kg/cm2

*حيث أن:*

B = 100 cm

qcu = 0.4\* = … kg/cm2

If qcu > qsh  ok safe

If qcu < qsh  un safe increase depth

Take d = Qsh / (qcu \* B) = … cm

t = d + cover

cover =(5 to 10 cm)

Reinforcement of the footing (2):

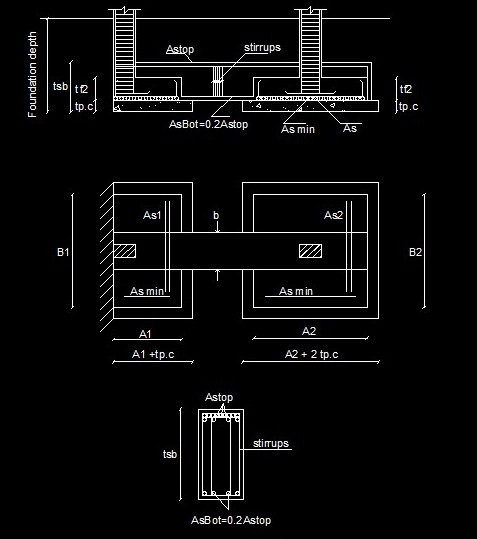
As2 = = … cm2 /m'

As min = 5y12/m' = … cm2 /m'

If As2  As min → ok

If As2 < As min  → take As2= As min

Details of Reinforcement:



Example: 1

The two column shown in fig are supported to be connected with a strap beam passing through the outer face of footing (1) to the outer face of

footing (2)

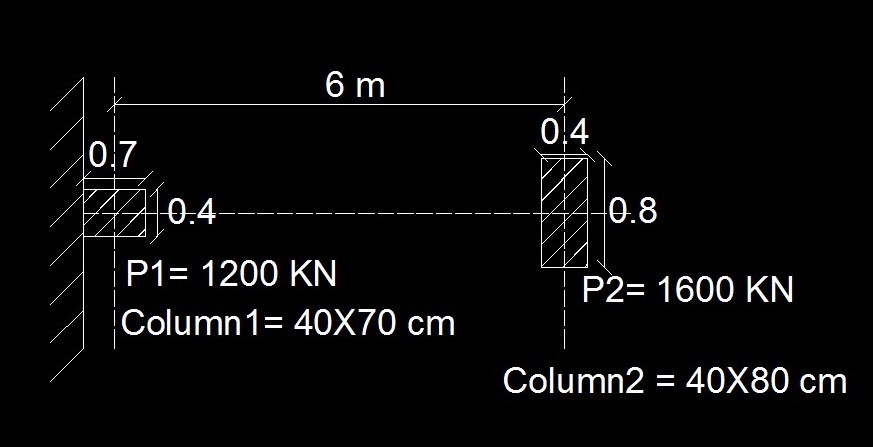
It is required to:

1 ) Determine the footing Area.

2 ) Draw bending Moment and shear of the strap beam.

3 ) Determine the depth & reinforcement steel of the strap beam wish satisfy bending Moment and shear .

4 ) Draw clear sketch showing dimensions of strap beam and steel details.



Solution

Given: fcu = 250 kg/cm2 , qall = 175 kN / m2 ,

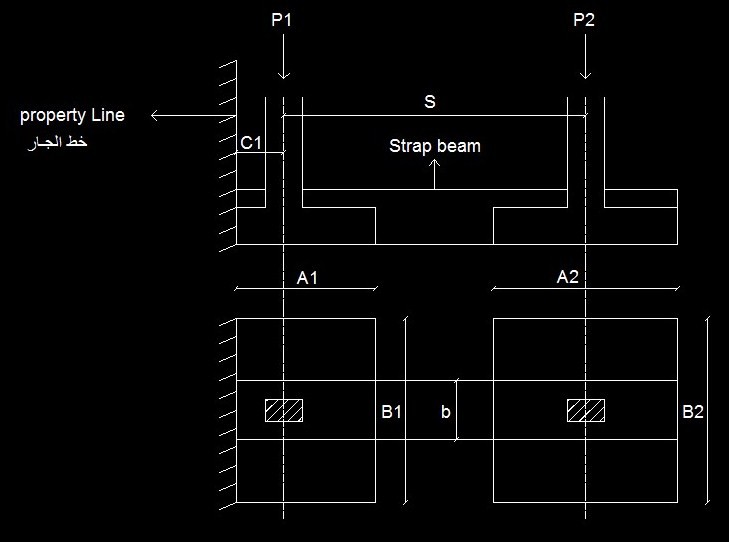
Fy = 3600 kg/cm2 , Foundation depth = 2m

P1 = 1200 KN = 120 Ton

P2 = 1600 KN = 160 Ton

qall = 175 kN /m2 = 17.5 t / m2

1 ) Dimension of Footing:



Pt1 = 1.2\*P1 = 1.2\*120= 144 ton

Pt2 = P2 = 160ton

Take tp.c = 30 cm

Area of Footing (1):

Af1 = = = 8.3 m2→ A1, B1

B1= 3.2 m

A1= 2.6 m

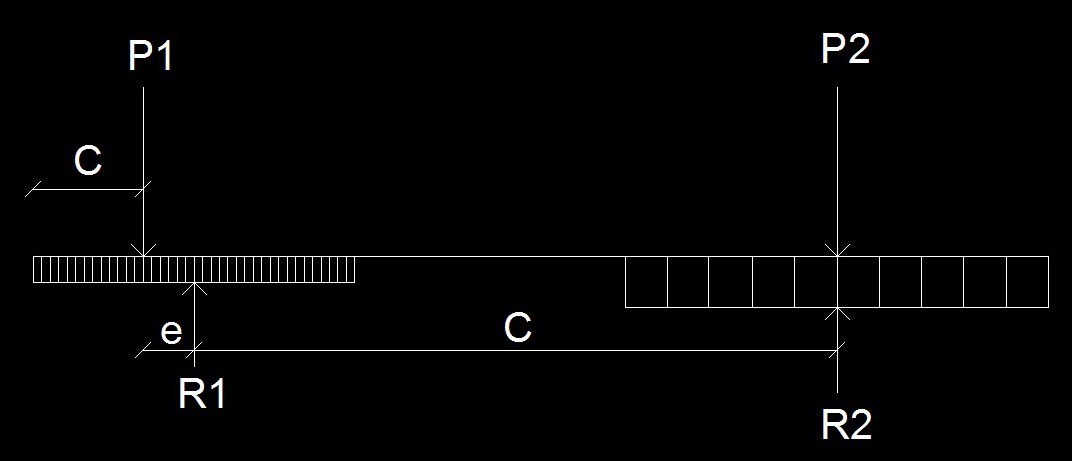
Area of Footing (2):

Af2 = = = 9.15 m2→ A2, B2

B2= 3.3 m

A2= 2.8 m

2 ) Determination of eccentricity:



e = – C1 = – 0.35= 0.95 m

C = s – e = 6 – 0.95 = 5.05 m

3 ) Check Area:

R1u = P1 + P1 \* = 120 + 120\* = 142.6 ton

R2 = P2 – P1 \* = 160 – 120\* = 137.4 ton

q1===18.85 t/m2

q1 > qall

18.85 > 17.5 increase B1

q1=

17.5 =

17.5 \* 2.6 B1 = 142.6 \* 1.1

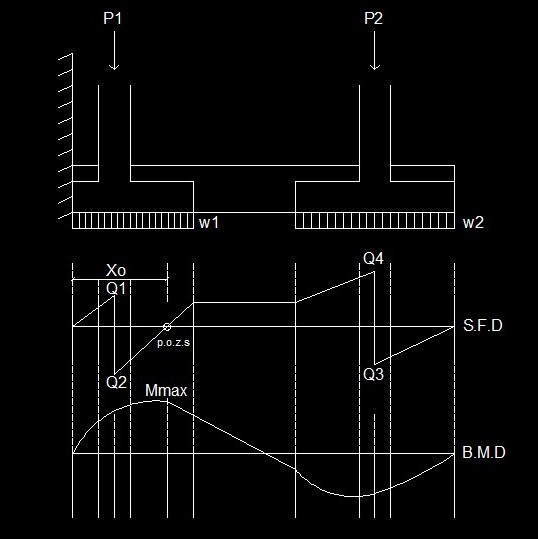
B1 = 3.5 m

q2 = = = 16.3 t/m2 > qall ok

End of Working Loads .

4 ) Design of Strap Beam:

Calculation of Moment and Shear for Strap Beam:



P1u =1.5 P1 = 120\*1.5 = 180 Ton

P2u = 1.5 P2 = 160\*1.5 = 240 Ton

R1u = 1.5 R1 = 1.5 \*142.6= 213.9 Ton

R2u = 1.5 R2 = 1.5 \*137.4 = 206 Ton

W1 = = = 82 t/m'

W2 = = = 73.6 t/m'

Point of Zero Shear

At distance Xo

Xo = = = 2.195 m

Mmax=180(2.195–0.35)– 82\*()= 135 mt

d = c1

Take b = 80 cm

d = 4= 104 110 cm

5 ) Check Shear:

Q1 = W1 \* C1 = 82\* 0.35= 28.7 t

Q2 = Q1 – P1u = 28.7–180 = 151.3 t

Q3 = W2 \* = 73.6\* = 103 t

Q4 = Q3 – P2u = 103– 240= 137 t

Qsh1=Q2–W1\*( + )

= 151.3 – 82 \* ( + ) = 77.5 ton

Qsh2=Q4– W2\*( + )

=137– 73.6\*( + )= 81.8 ton

qsh = = = 9.2 kg/cm2

qcu = 0.75\* = 0.75\* = 9.68 kg/cm2

If qcu > qsh  ok use min stirrups 5y8/m'

t = d + cover = 110 + 10 = 120 cm

Reinforcement of the Strap beam:

As top = = = 41.3 cm2

Use 11 y 22

AS bott = 20 % As top = 0.2 \* 41.3 = 8.3 cm2

Use 5 y 16

6 ) Design of Footing:

Footing 1 (F1 ):

qu1 = = = 23.5 t/m2

M1 = qu1 \* = 23.5\* = 21.4 mt

d1 = c1 = 5= 46.26 50 cm

Check Shear:

Qsh =qu1\*( + )

=23.5\*( + )=37.6 ton

qsh = = = 7.52 kg/cm2

qcu = 0.4\* = 0.4\* = 6.32 kg/cm2

qcu < qsh

6.32 < 7.52 un safe increase depth

Take d1 =Qsh /(qcu\*B)

d1 = = 59.49 65 cm

t1 = d + cover = 65 + 10 = 75 cm

Reinforcement of the footing (1):

As1 = = = 11.07 cm2 /m'

Use 6 y 16

As min = 5y12/m' = 5.65 cm2 /m'

take As1=11.07 cm2 /m'

Use 6 y 16

Footing 2 (F2 ):

qu2 = = = 22.3 t/m2

M2 = qu2 \* = 22.3\* = 17.4 mt

d2 = c1 = 5= 41.71 50 cm

Check Shear:

Qsh =qu2\*( + )

=22.3\*( + )=33.45 ton

qsh = = = 6.69 kg/cm2

qcu = 0.4\* = 0.4\* = 6.32 kg/cm2

qcu < qsh

6.32 < 6.69 un safe increase depth

Take d2 =Qsh /(qcu\*B)

d2 = = 52.92 60 cm

t2 = d2 + cover = 60 + 10 = 70 cm

Reinforcement of the footing (1):

As2 = = = 9.75 cm2 /m'

Use 6 y 16

As min = 5y12/m' = 5.65 cm2 /m'

take As1=9.75 cm2 /m'

Use 6 y 16

Details of Reinforcement:

