Raft Footing:

Calculation of soil pressure under Raft:

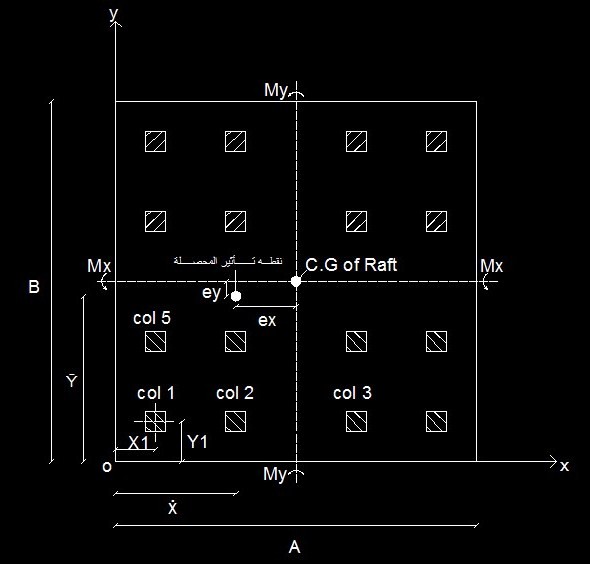
Steps of Calculation:

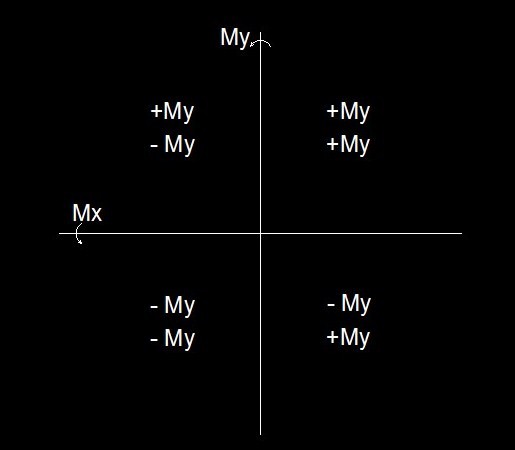
1 ) Determination of C.G of Raft:

تحديد C.G للبشة.

2 ) Determination of Resultant Load and its point of application:

تحديد محصلة القوي ( أحمال الأعمدة ) ونقطة تأثيرها.





يتم عمل جدول:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| P\*Y | P\*X | Y | X | Load (p) | Col No. |
| P1\* Y1 | P1\* X1 | Y1 | X1 | P1 | 1 |
| P2\* Y2 | P2\* X2 | Y2 | X2 | P2 | 2 |
| P3\* Y3 | P3\* X3 | Y3 | X3 | P3 | 3 |
| P4\* Y4 | P4\* X4 | Y4 | X4 | P4 | 4 |
| P5\* Y5 | P5\* X5 | Y5 | X5 | P5 | 5 |
| P6\* Y6 | P6\* X6 | Y6 | X6 | P6 | 6 |
|  |  |  | |  |

|  |
| --- |
|  |

Ῡ = = … m

= = … m

3 ) Determination the value and direction determined:

تحديد قيمة واتجاه العزم:

ex = - = … m

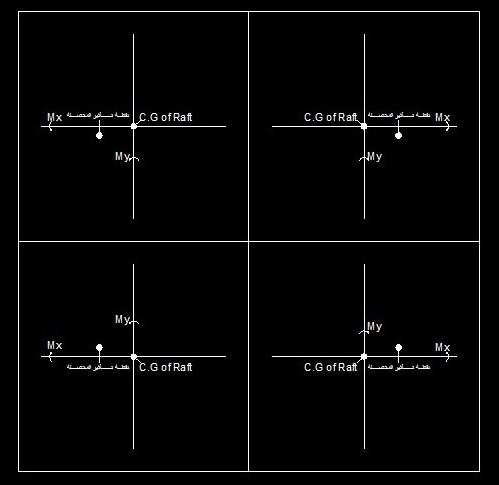
ey = - = … m

*حيث أن:*

*مكان* C.G *للبشة →*

*مكان* C.G *للبشة →*

*اتجاه العزم في الحالات المختلفة:*



Mx = \* ey = … KN.m

My = \* ex = … KN.m

4 ) Calculate the soil pressure at the points required:

= \* y \* x = … KN/m2

*حيث أن:*

N →

*إذا كانت النقطة ناحية رأس سهم العزم ⭠ سالب (ضغط)*

*إذا كانت النقطة ناحية ذيل سهم العزم ⭠ موجب (شد)*

A → Area of Raft

Area of Raft (A) = (A\*B) = … m2

= = … m4= = … m4

حيث أن:

الموازي ⭠ البعد الموازي للمحور (X)

= = … m4= = … m

حيث أن:

الموازي ⭠ البعد الموازي للمحور (Y)

البعد الأفقي والرأسي من C.G of Raft للنقطة المراد حساب soil pressure عندها ( دائما موجب ) X ,Y ⭠

5 ) If required to Draw the soil pressure on Nutural axies:

خطوات الرسم :

نوجد مكان (N.A) Nutural axies

1. نعوض عن = 0 , x = 0 *ونوجد* y = ✓

= \* y \* x

0 = \* y \* 0

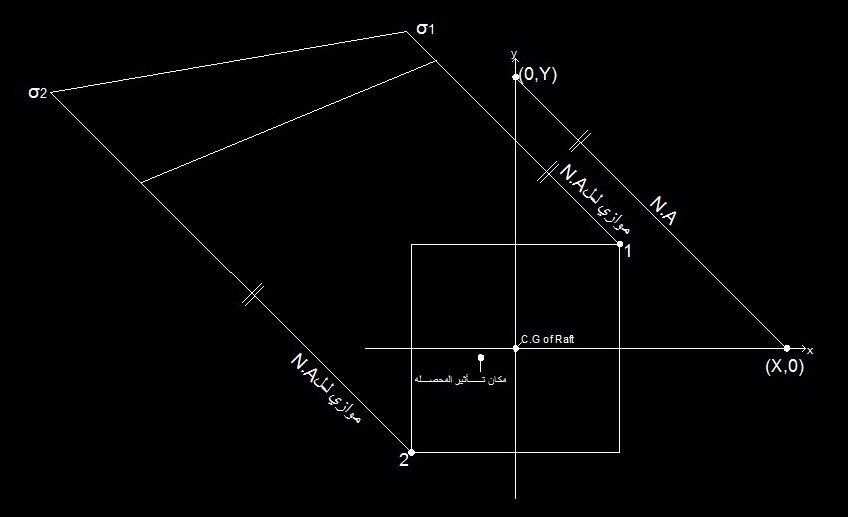
1. نعوض عن = 0 , y = 0 *ونوجد* x = ✓

= \* y \* x

0 = \* 0 \* x

*ملاحظة:*

N.A ⭠ *يظهر خارج حدود اللبشه ويظهر ناحية المربع المقابل لمربع المحصلة.*



|  |
| --- |
|  |

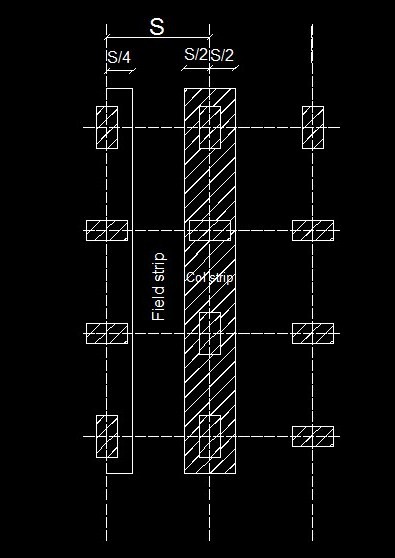
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6 )Raft Foundation Design:



Method ( 1 ):

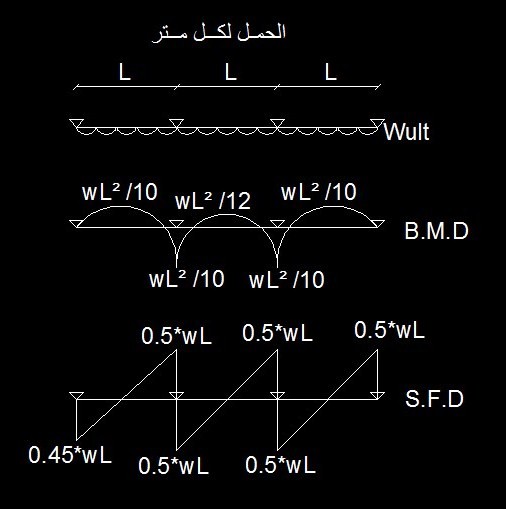
If not given Col strip width take:

عرض الشريحة للأعمدة الداخلية Col strip width =

عرض الشريحة للأعمدة الجار Col strip width =

qun =

wult = qun \* B = … t/m'



Mmax = take the bigger Moment from B.M.D

Qmax = take the bigger Shear from S.F.D

d = C1 = … cm

حيث أن:

c1 = 5

B= 100 cm

Check Shear:

Qsh = Qmax – ( ) \* wult = … 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)

Check Punching:

QP = Pu – qU (A' \*B') = … Ton

*حيث أن :*

*أعلي حمل عمود في الشريحة* Pu →

A' = (a1 + d ) = … m

B' = (b1 + d) = … m

عرض العمود b → , طول العمود a →

qp =  = … kg/cm2

qpcu = (0.5 + ) = … kg/cm2

*حيث أن:*

If qpcu > qp  ok safe

If qpcu < qp  un safe → increase depth

t = d + cover

cover = (5 to 10 cm)

7) Reinforcement of the footing:

As Top = =… cm2 /m'

As Bot = =… cm2 /m'

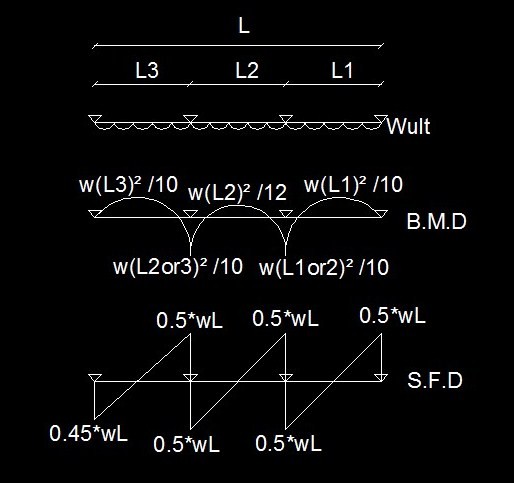
*حيث أن:*

*أعلي عزم علوي* ⭠

*أعلي عزم سفلي* ⭠

Method ( 2 ):

W = = … KN/B



حيث أن:

مجموع أحمال أعمدة Col strip فقط ⭠

عرض شريحة ال Col strip ⭠ B

طول شريحة ال Col strip ⭠ L

WU = W \* 1.5

Mmax = take the bigger Moment from B.M.D

Qmax = take the bigger Shear from S.F.D

d = C1 = … cm

حيث أن:

c1 = 5

عرض شريحة ال Col strip ⭠ B

Check Shear:

Qsh = Qmax – ( ) \* wult = … ton

qsh = = … kg/cm2

*حيث أن:*

عرض شريحة ال Col strip ⭠ B

qcu = 0.4\* = … kg/cm2

If qcu > qsh  ok safe

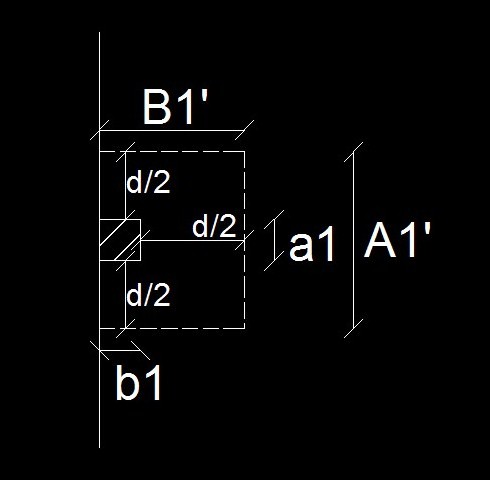
If qcu < qsh  un safe increase depth

Take d = Qsh / (qcu \* B) = … cm

t = d + cover

cover =(5 to 10 cm)

Check Punching:



qun = = … KN/m2

QP = Pu – qU (A' \*B') = … Ton

*حيث أن :*

*أعلي حمل عمود في الشريحة بوحدة* tonPu →

A' = (a1 + d ) = … m

B' = (b1 + d) = … m

عرض العمود b → , طول العمود a →

qp =  = … kg/cm2

*حيث أن:*

qpcu = (0.5 + ) = … kg/cm2

*حيث أن:*

If qpcu > qp  ok safe

If qpcu < qp  un safe → increase depth

t = d + cover

cover = (5 to 10 cm)

Reinforcement of the footing:

As Top1 = =… cm2 /B'= /m'

As Top2 = =… cm2 /B'= /m'

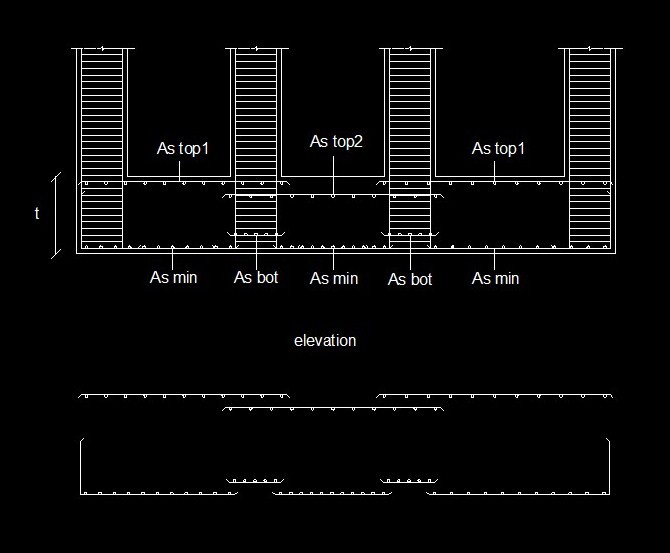
As Bot = =… cm2 /B'= /m'

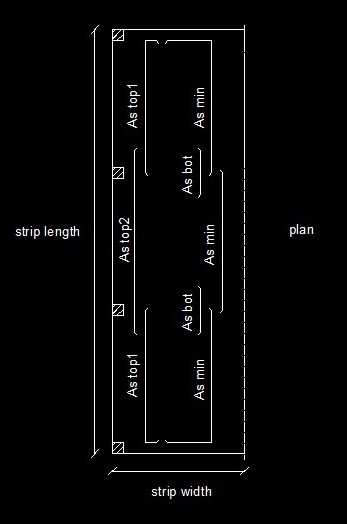
*حيث أن:*

*أعلي عزم علوي* ⭠

*أعلي عزم سفلي* ⭠

Details of Reinforcement:





Example: 1

The Raft footing shown in fig all columns 40 X 40 cm .

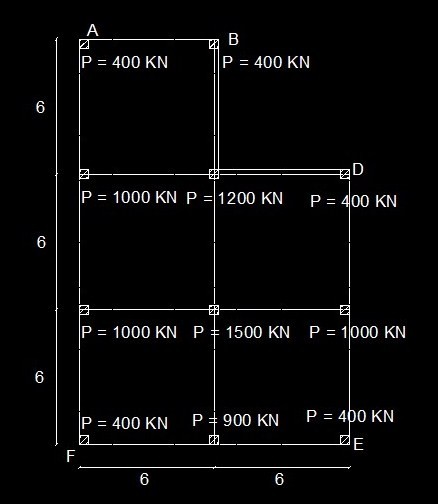
It is required to:

1 ) Determine the soil pressure under the corners of the given Raft.

2 ) Make Full design for strip AF take strip width=3m.

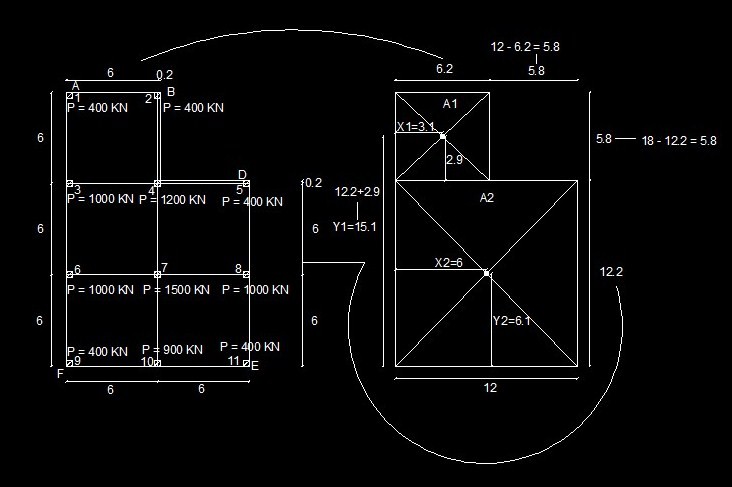
3 ) Determine the reinforcement steel of the Raft footing .

4 ) Draw net sketch showing dimensions of Raft footing and steel details.



Solution

Given: fcu = 250 kg/cm2 , Fy = 3600 kg/cm2



نلاحظ أن الشكل غير متماثل فيتم تقسيم الشكل

A1 = 6.2 \* 5.8 = 35.96 m2

A2 = 12.2 \* 12 = 146.4 m2



1 ) Determination of C.G of Raft:

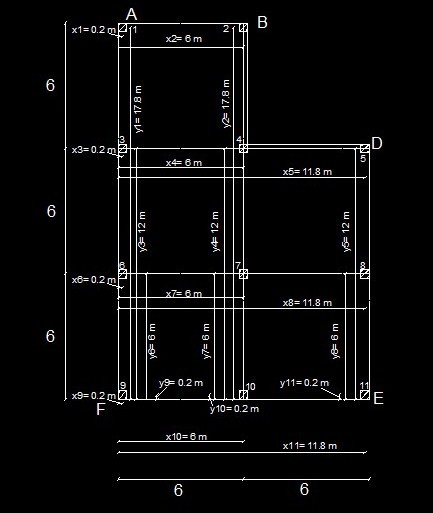
تحديد C.G للبشة.

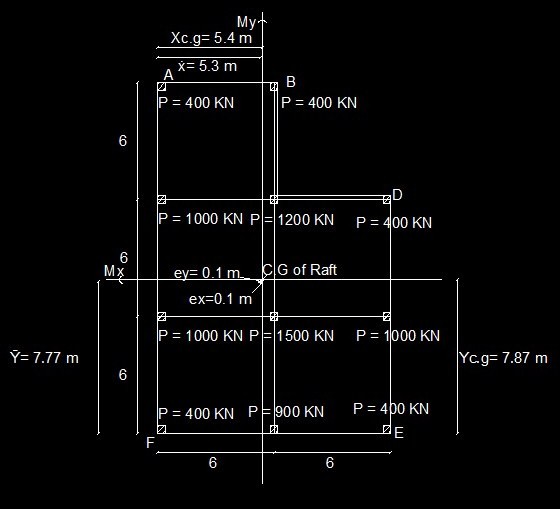
XC.G = = = 5.4 m

YC.G = = = 7.87 m

2 ) Determination of Resultant Load and its point of application:

تحديد محصلة القوي ( أحمال الأعمدة ) ونقطة تأثيرها.







Ῡ = = = 5.3 m

= = = 7.77 m

3 ) Determination the value and direction determined:

تحديد قيمة واتجاه العزم:

ex = XC.G – = 5.4 – 5.3 = 0.1 m

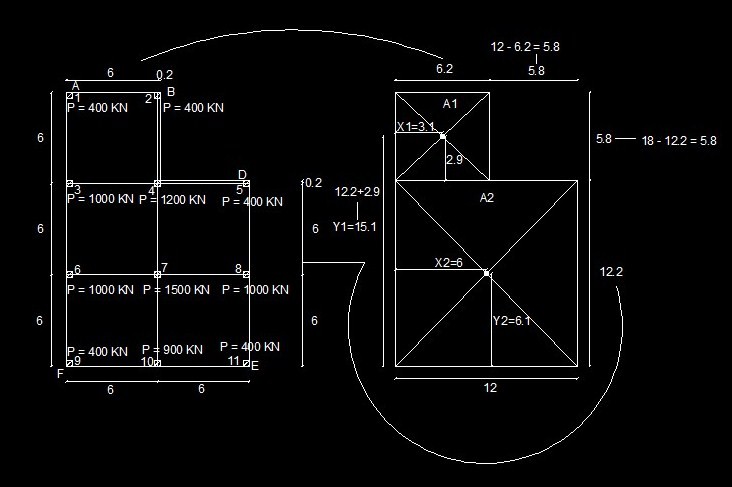
ey = YC.G – = 7.87 – 7.77 = 0.1 m

Mx = \* ey = 8600 \* 0.1 = 860 KN.m

My = \* ex = 8600 \* 0.1 = 860 KN.m

4 ) Calculate the soil pressure at the points required:

= \* y \* x = … KN/m2



نلاحظ أن الشكل غير متماثل فيتم تقسيم الشكل

A1 = 6.2 \* 5.8 = 35.96 m2

A2 = 12.2 \* 12 = 146.4 m2

Area of Raft (A) = = 182.36 m2

For A1 :

A1= 6.2 , B1=5.8, YC.GA1 = 15.1, YC.G=7.87

For A2 :

A2= 12 , B2=12.2, YC.GA2 = 6.1, YC.G=7.87

={ +A1 \*(YC.GA1 – YC.G )2 } +{ +A2 \*(YC.GA2 – YC.G )2 = … m4

={ +35.96\*(15.1– 7.87)2}+{ +146.4\*(6.1–7.87)2

= (100.81 + 1879.73)+ (1815.85+458.66)

= 4255m4

For A1 :

A1= 5.8 , B1=6.2, XC.GA1 = 3.1, XC.G=5.4

For A2 :

A2= 12.2 , B2=12, XC.GA2 = 6, XC.G=5.4

={ +A1 \*(XC.GA1 – XC.G )2 } +{ +A2 \*(XC.GA2 – XC.G )2 = … m4

={ +35.96\*(3.1–5.4)2}+{ +146.4\*(6–5.4)2

=(115.19 +190.23)+(1756.8+52.7)

= 2115 m4

= \* y \* x = … KN/m2

= + \*(18-7.87)- \*5.4

=-47.3 KN/ m2

= + \*(12.2-7.87)+ \*(12-5.4)

= - 43.6 KN/ m2

= - \*(7.87)- \*(5.4)

= -51 KN/ m2

= - \*(7.87)+ \*(12-5.4)

= -46 KN/ m2

6 )Raft Foundation Design:

For strip AF

strip width=3m

Method ( 2 ):

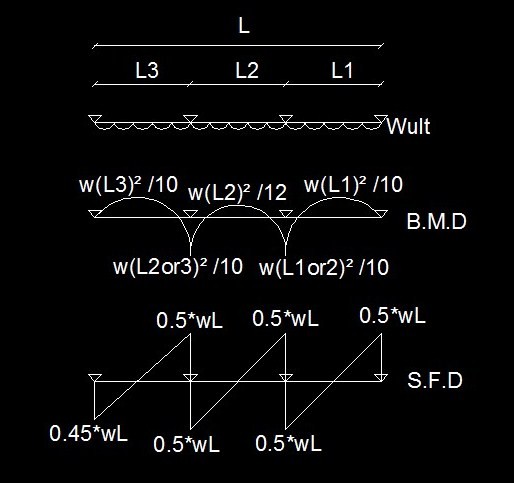
= 400+1000+1000+400 = 2800 KN

L = 3\*6 =18 m

W = = = 155.56 KN/B

= 15.56 t/B

WU = W \* 1.5 = 15.56 \*1.5 = 23 .33 t/B



Mult = = = 84 mt

Mult = = = 70 mt

Mmax = 84 mt

Q = 0.45\*wL = 0.45\*23.33\*6 = 63 t

Q = 0.5\*wL = 0.5\*23.33\*6 = 70 t

Qmax = 70 t

d = C1 = 5= 53 cm 60 cm

Check Shear:

Qsh=Qmax – ()\*wult =70–()\* 23.33= 63 ton

qsh = = = 3.5 kg/cm2

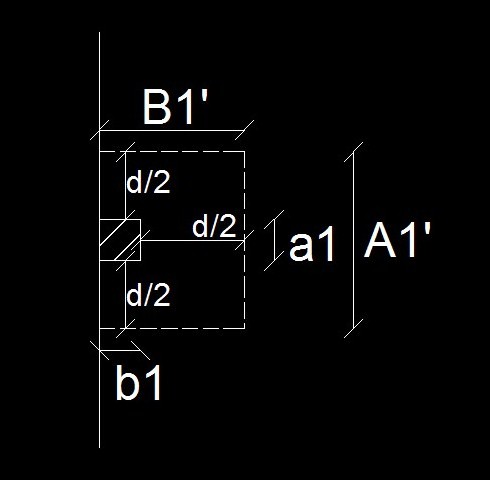
qcu = 0.4\* = 0.4\* = 6.3 kg/cm2

qcu > qsh

6.3 > 3.5 ok safe

t = d + cover = 60 + 10 = 70 cm

Check Punching:



qun = = = 47.2 KN/m2  4.72 t/m'

QP = Pu – qU (A' \*B') = … Ton

A' = (a1 + d ) = 0.4+0.6 = 1 m

B' = (b1 + ) = (0.4+ ) = 0.7 m

QP = 100 – 4.72(1 \*0.7) = 96.7 Ton

qp =  = = 4.74 kg/cm2

qpcu =(0.5 + ) =(0.5+)

=19.36 kg/cm2

qpcu > qp

19.36 > 4.74 ok safe

t = d + cover = 60 + 10 = 70 cm

Reinforcement of the footing:

As Top1 = =… cm2 /B'= /m'

=  = 47cm2 /3= 15.6cm2/m'

Use 8Y 16 /m'

As Top2 = =… cm2 /B'= cm2/m'

=  = 39 cm2 /3= 13 cm2/m'

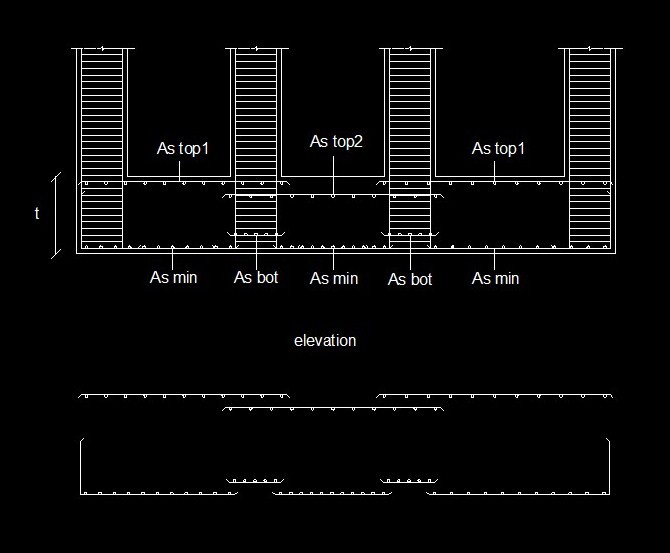
Use 7Y 16 /m'

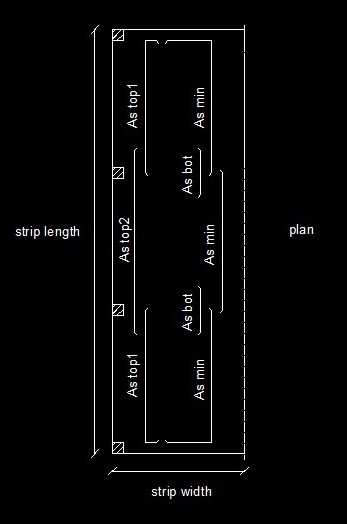
As Bot = =… cm2 /B'= cm2/m'

=  = 47 cm2 /3= 15.6 cm2/m'

Use 8Y 16 /m'

Details of Reinforcement:





Example: 2

The Raft footing shown in fig all columns 50 X 50 cm .

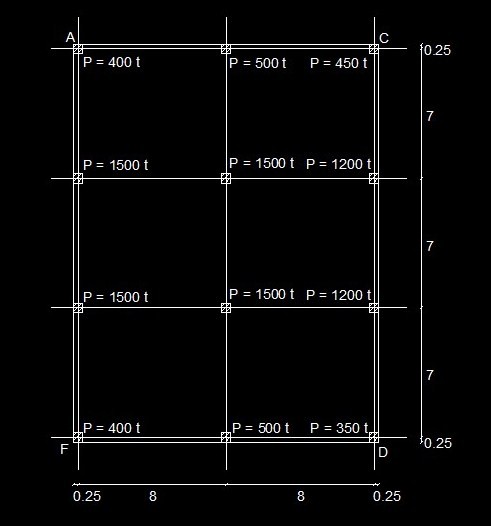
It is required to:

1 ) Determine the soil pressure under the corners of the given Raft.

2 ) Make Full design for strip width=3m.

3 ) Determine the reinforcement steel of the Raft footing .

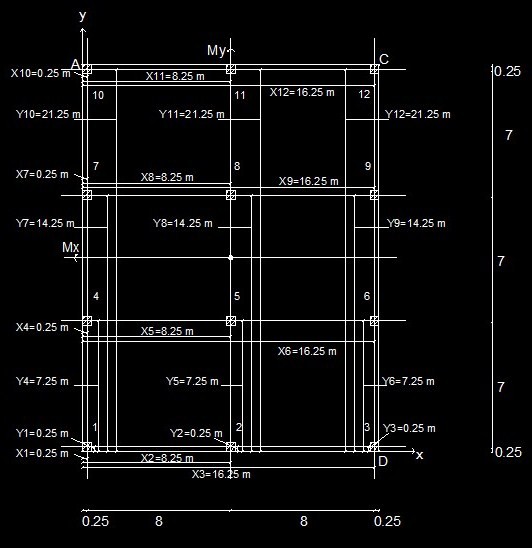
4 ) Draw net sketch showing dimensions of Raft footing and steel details.

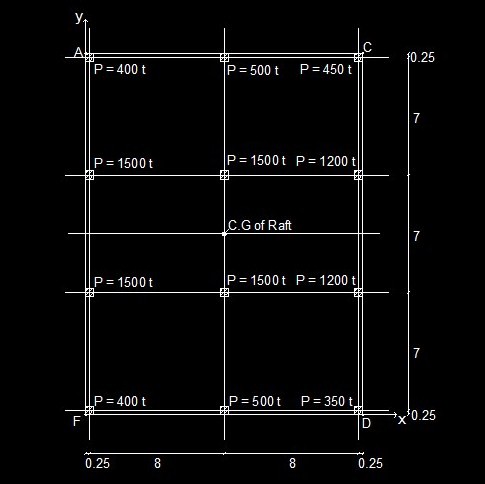


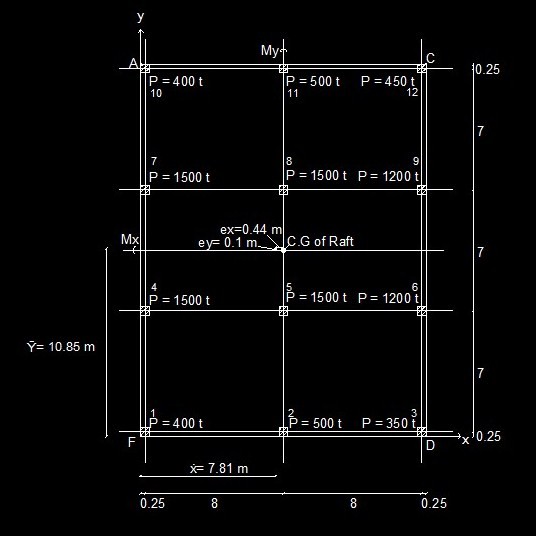
Solution

Given: fcu = 250 kg/cm2 , Fy = 3600 kg/cm2

, qall = 60 KN/m2







1 ) Determination of C.G of Raft:

تحديد C.G للبشة.

2 ) Determination of Resultant Load and its point of application:

تحديد محصلة القوي ( أحمال الأعمدة ) ونقطة تأثيرها.



Ῡ = = = 7.81 m

= = = 10.85 m

3 ) Determination the value and direction determined:

تحديد قيمة واتجاه العزم:

ex = - = -7.81 = 0.44 m

ey = - = - 10.85 = 0.1 m

Mx = \* ey = 11000 \* 0.1 = 1100 KN.m

My = \* ex = 11000 \*0.44 = 4840 KN.m

4 ) Calculate the soil pressure at the points required:

= \* y \* x = … KN/m2

Area of Raft (A) = (A\*B)=16.5\*21.5= 354.75 m2

= = = 13665 m4

= = = 8048 m

الباقي نفس الشئ

Example: 3

The Raft footing shown in fig all columns 50 X 50 cm .

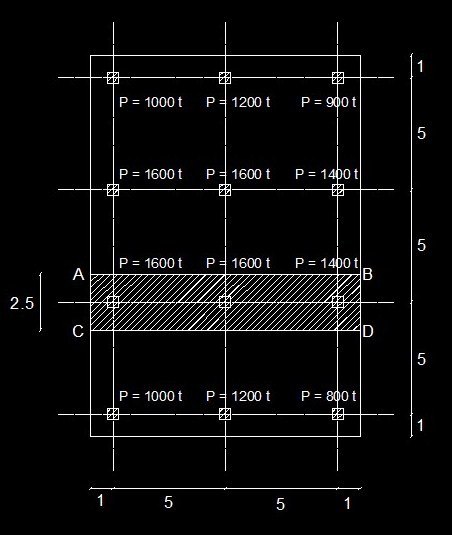
It is required to:

1 ) Determine the soil pressure under the corners of the given Raft.

2 ) Make Full design for strip ABDC strip width=2.5m.

3 ) Determine the reinforcement steel of the Raft footing .

4 ) Draw net sketch showing dimensions of Raft footing and steel details.



Solution

Given: fcu = 250 kg/cm2 , Fy = 3600 kg/cm2

Example: 4

The Raft footing shown in fig all columns 40 X 40 cm .

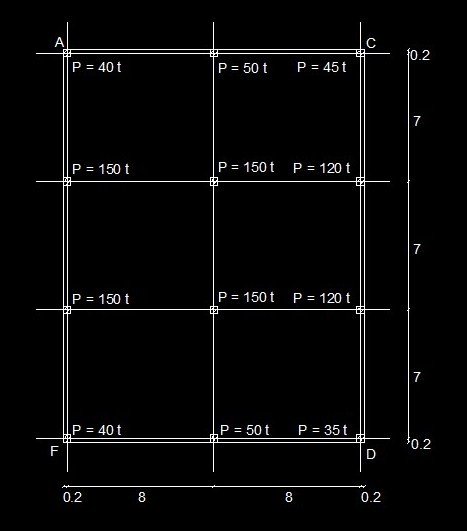
It is required to:

1 ) Determine the soil pressure under the corners of the given Raft.

2 ) Make Full design for strip width=2.5m.

3 ) Determine the reinforcement steel of the Raft footing .

4 ) Draw net sketch showing dimensions of Raft footing and steel details.



Solution

Given: fcu = 250 kg/cm2 , Fy = 3600 kg/cm2