4th Year Civil
Public Works Department
Foundation Engineering

فونديشن رابعه
أشغال
٢
م/محمود فوزي

2012 - 2013

2

Shallow Foundations
Isolated Footing

* احيانا يكون متاح لدينا اكثر من نظام من القواعد او اكثر من تصميم يجب علينا دراستهم و عمل حصر كميات ***Bill of Quantities (BOQ)***

* يتم عمل حصر لكميات الخرسانة العادية على حدة و الخرسانة المسلحة على حدة و حديد التسليح على حدة ويكون الحصر كالاتى :

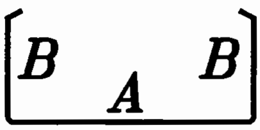
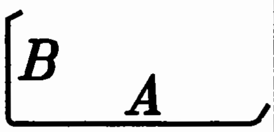
1- P.C. Bill of Quantities (BOQ) :

	النظام الاول			النظام الثانى		
Dimensions	***L (m)***	***B (m)***	***T (m)***	***L (m)***	***B (m)***	***T (m)***
	✓	✓	✓	✓	✓	✓
Total Volume m^3/footing	✓			✓		

2 - R.C. Bill of Quantities (BOQ) :

	النظام الاول			النظام الثانى		
Dimensions	L (m)	B (m)	T (m)	L (m)	B (m)	T (m)
	✓	✓	✓	✓	✓	✓
Total Volume m^3/footing	✓			✓		

3 - RFT Bill of Quantities (BOQ) :

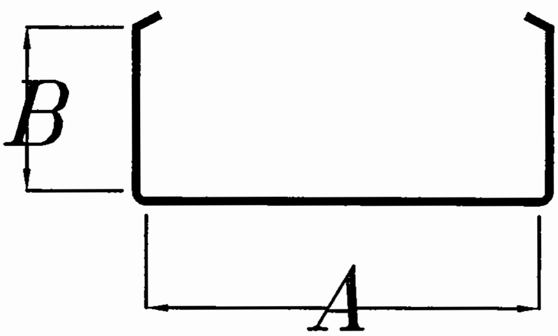
يتم عمل جدول منفصل لكل نظام							
Shape		A (mm)	B (mm)	No./m'	Ø (mm)	Length (m)	Weight (Kg)
1		✓	✓	✓	✓	✓	✓
2		✓	✓	✓	✓	✓	✓
		Total RFT amount (Kg)					✓

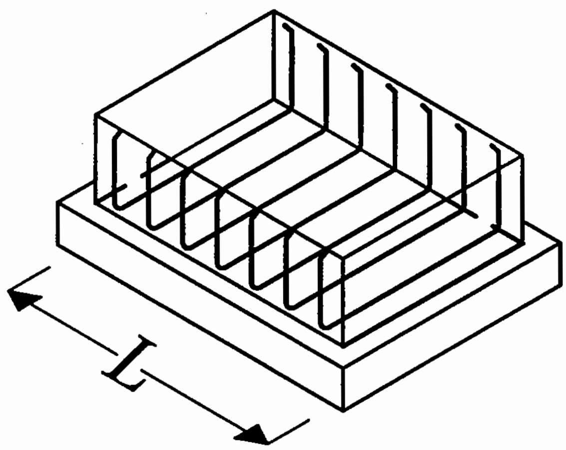
* بعد تجميع اطوال جميع اشكال التسليح فى القاعدة يتم حساب الاوزان عن طريق الجدول الاتى :

ϕ (mm)	8	10	12	16	18	20	22
Weight (Kg/m)	0.395	0.617	0.888	1.580	2.000	2.470	2.980

ϕ (mm)	25	30	32
Weight (Kg/m)	3.850	5.550	6.310

* يتم جمع طول السيخ $A+2B$ ثم ضرب الطول فى عدد القطع فى المتر بعد ذلك يتم الضرب فى الطول الموزع علية الاسياخ و اخيرا الضرب فى وزن المتر الطولى من الجدول السابق اى انة يتم الحساب كالاتى :





$$Weight\ (Kg) = \frac{A+2B}{1000} * No./m' * L\ (m) * Weight\ (Kg/m)$$

٥٠ قرش

Ain Shams University
Faculty of Engineering
Laboratory of Soil Mech. & Foundation Eng.
4th Year Civil – Public Works Department
Foundation Engineering
Academic year 2012 - 2013

جامعة عين شمس – كلية الهندسة
معمل ميكانيكا التربة وهندسة الأساسات
رابعة مدني – طلبة شعبة الأشغال العامة
هندسة الأساسات
العام الجامعي ٢٠١٢ – ٢٠١٣

ASSIGNMENT No. 1

DESIGN OF SHALLOW FOUNDATIONS

- Any missing data may reasonably be assumed

1) Design an isolated footing to support a circular column. The diameter of the circular column is 0.8 m, and it carries an axial load of 3500 KN. The suggested thickness of the plain concrete footing is 30 cm. The allowable net bearing capacity of the subsoil is 150 KPa (f_{cu} = 25 N/mm^2, Steel 36/52). Draw details for the designed footing in both plan and cross sectional elevation using scale 1:50.

2) [a] Design a rectangular isolated footing to support a column (40 x 90 cm) carries an axial load of 2500 KN. Consider the thickness of the plain concrete footing equals 40 cm. The allowable net bearing capacity of the subsoil is 150 KPa (f_{cu} = 25 N/mm^2, Steel 36/52). Draw details for the designed footing in both plan and cross sectional elevation using scale 1:50.
[b] Redesign the previous isolated foundation (2-a) assuming the thickness of the plain concrete footing is 10 cm.
[c] Compare between the designed isolated footings in (2-a) and (2-b), with respect to the volume of the plain concrete footings; the volume of the reinforced concrete footings; and the amount of the reinforcements.

3) Two internal square columns in a residential building are spaced two meters center to center. The two columns are subjected to normal forces of 1700 and 1900 kN, respectively. It is required to design a suitable foundation system to support the two columns.
Data:
$q_{all\ net}$ = 200 KN/m^2
$t_{p.c.}$=40 cm. (f_{cu} = 30 N/mm^2, Steel 36/52)

Example (1):

It is required to design an isolated Footing to Support a circular column with diameter (0.8)m. The column working load is 3500 kN , and the allowable net bearing capacity in the Footing site is 150 kN/m². thickness of P.C.30cm.(F_{cu} = 25 N/mm², F_y = 360 N/mm²). and draw details of RFT. to scale 1:50

Solution.

Area of Footing :

$$t_{P.C.} = 30\ cm > 20\ cm \longrightarrow (Area\ of\ P.C.)$$

نصمم القاعدة مربعة حيث ان العمود دائرى ومن المكلف جدا عمل قاعدة دائرية

كما ان القواعد الدائرية صعبة التنفيذ .

$$A_{P.C.} = \frac{P_w}{q_{all}} = \frac{3500\ (kN)}{150\ (kN/m^2)} = 23.33\ m^2$$

$$A_{P.C.} = (B_{P.C.})^2 = 23.33\ m^2$$

$$B_{P.C.} = 4.83\ m \xrightarrow{Take} \boxed{B_{P.C.} = 4.85\ m}$$

$$B_{R.C.} = B_{P.C.} - 2t_{P.C.} \longrightarrow \boxed{B_{R.C.} = 4.25\ m}$$

Design the critical sections for moment :

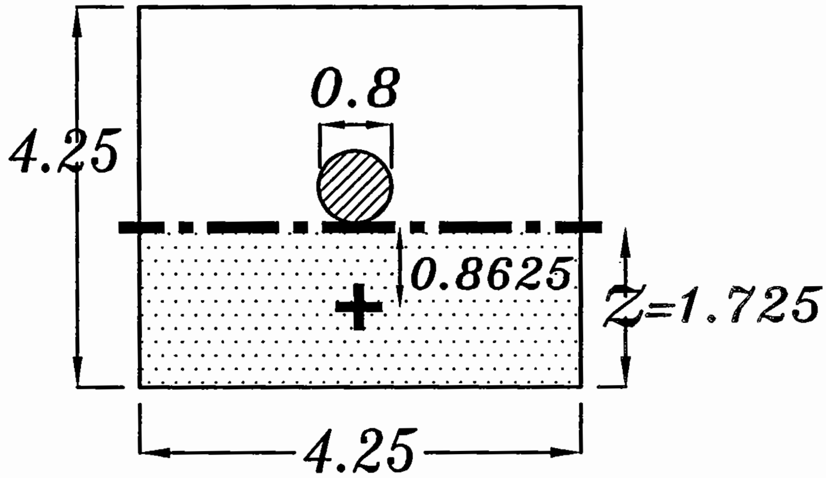
Actual Normal stress on R.C. Footing (U.L.)

$$P_{U.L.} = 3500 * 1.5 = 5250 \text{ kN}$$

$$q_u = \frac{P_{U.L.}}{B_{R.C.} * B_{R.C.}} = \frac{5250}{4.25 * 4.25} = 290.7 \text{ kN/m}^2$$

$$Z = \frac{B_{R.C.} - D}{2} = \frac{4.25 - 0.8}{2}$$

$$= 1.725 m$$

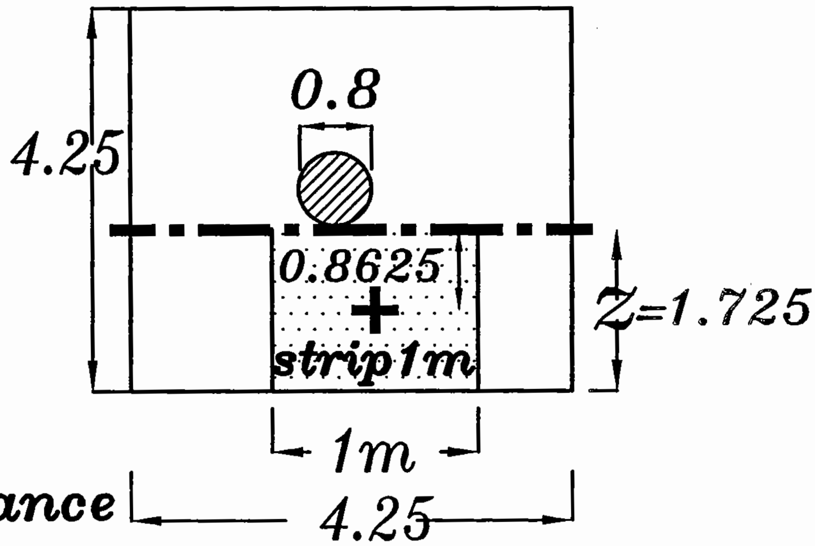


$$Force = Stress * Area$$

$$Force = q_u * Z * 1m$$

$$= 290.7 * 1.725 * 1$$

$$= 501.46 \text{ kN}$$



$$moment = Force * Distance$$

$$M_{act.} = (q_u * Z * 1m) \frac{Z}{2}$$

$$= 501.46 * 0.8625 = 432.5 \text{ kN.m/m'}$$

$$d = C_1 \sqrt{\frac{M_{act.}}{F_{cu} * b}} \qquad \text{Choose } C_1 = 5.0$$

$$d = 5.0 \sqrt{\frac{432.5 * 10^6}{25 * 1000}} = 657.65 \, mm$$

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Take $d = 680 \, mm$

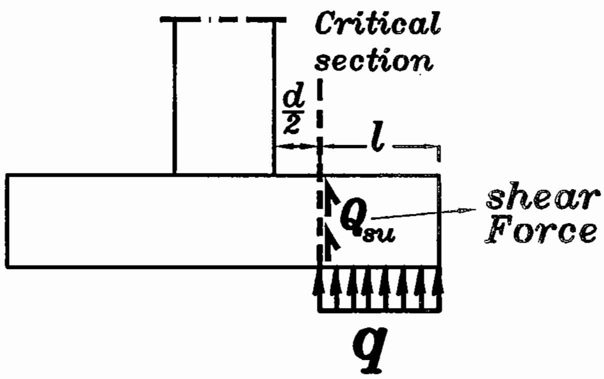
$$t_{R.C.} = d + 70 \, mm = 680 + 70 = 750 \, mm$$

$$\boxed{t_{R.C.} = 750 \, mm} \qquad \boxed{d = 680 \, mm}$$

Check Shear :

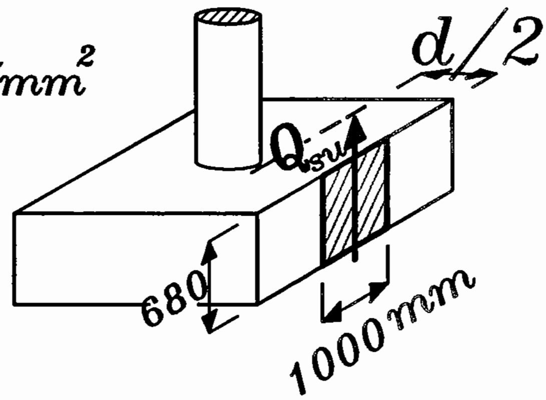
$$l = z - \frac{d}{2}$$

$$l = 1.725 - \frac{0.68}{2} = 1.385 \, m$$



$$Q_{su} = q_u * l * 1.0 \, m = 290.7 * 1.385 * 1.0 = 402.6 \, kN$$

$$q_{su} = \frac{Q_{su}}{b * d} = \frac{402.6 * 10^3}{1000 * 680} = 0.592 \, N/mm^2$$



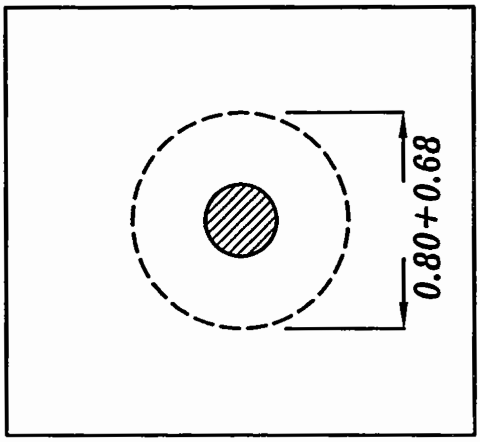
$$q_{scu} = 0.16 \sqrt{\frac{F_{cu}}{\gamma_c}} = 0.16 \sqrt{\frac{25}{1.5}}$$

$$= 0.653 \, N/mm^2$$

$$\boxed{q_{su} < q_{scu}} \longrightarrow \text{Safe shear stresses}$$

Check Punching shear :

$$D + d = 0.80 + 0.68 = 1.48\,m$$

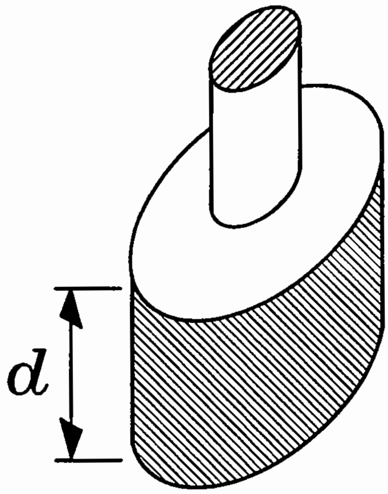


Calculate Punching Force.

$$Q_{pu} = P_{U.L.} - (q_u)\,[\text{Punching Area}]$$

$$Q_{pu} = 5250 - 290.7\left[\pi * \frac{1.48^2}{4}\right] = 4749.9\ kN$$

Calculate Punching shear area.



$$A_p = [\pi * (D+d)] * d$$

$$= [\pi * (1480)] * 680$$

$$A_p = 3161699\ mm^2$$

Calculate Actual Punching shear stress.

$$q_{pu} = \frac{Q_{pu}}{A_p} = \frac{4749.9 * 10^3}{3161699} = 1.5\ N/mm^2$$

$$\left(0.5 + \frac{a}{b}\right) = \left(0.5 + \frac{1.48}{1.48}\right) = 1.50 > 1.0$$

$$q_{pcu} = 0.316\,(1.0)\sqrt{\frac{F_{cu}}{\gamma_c}} = 0.316\,(1.0)\sqrt{\frac{25}{1.5}}$$

$$= 1.29\ N/mm^2$$

$q_{pu} > q_{pcu} \longrightarrow$ UnSafe punching shear.

Try $\boxed{d = 780\ mm}$

$$D + d = 0.80 + 0.78 = 1.58\ m$$

$$Q_{pu} = 5250 - 290.7\ \left[\pi * \frac{1.58^2}{4}\right] = 4680.0\ kN$$

$$A_p = [\pi * (1580)] * 780 = 3871698\ mm^2$$

$$q_{pu} = \frac{Q_{pu}}{A_p} = \frac{4680.0 * 10^3}{3871698} = 1.21\ N/mm^2$$

$q_{pu} < q_{pcu} \longrightarrow$ Safe punching shear.

Reinforcement of Footing :

$$J = 0.826$$

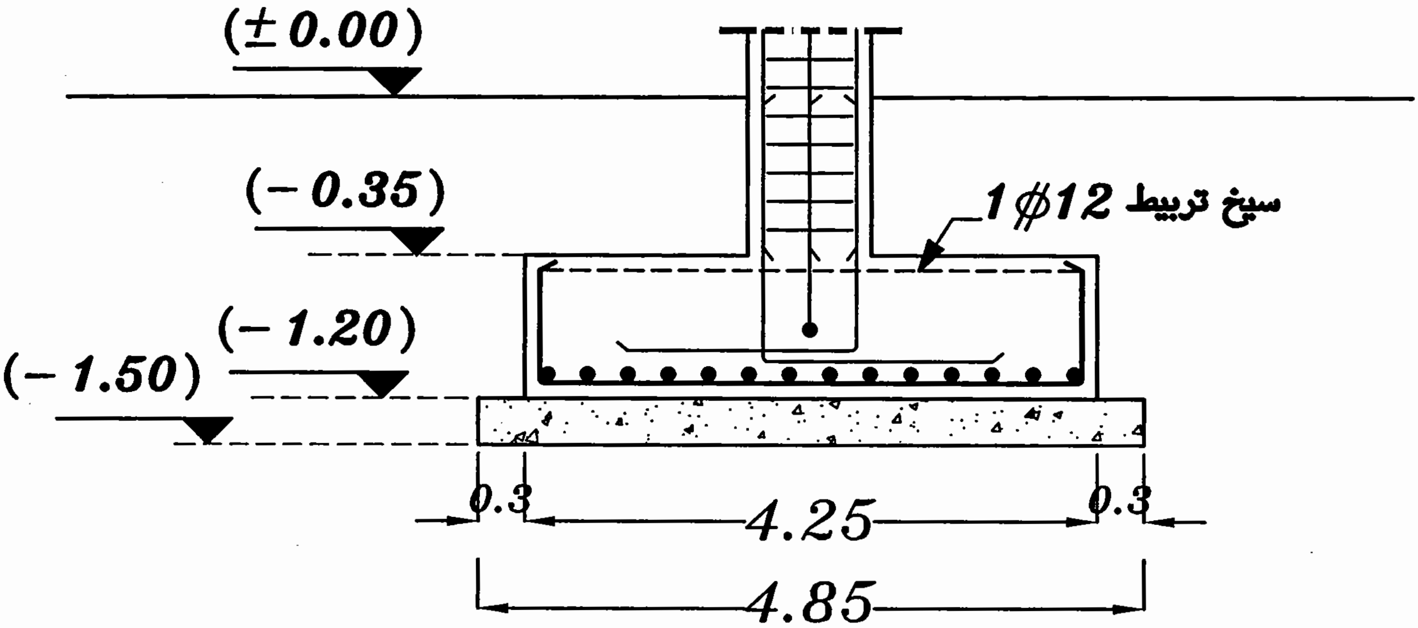
$$A_S = \frac{M_{act.}}{J\ F_y\ d} = \frac{432.5 * 10^6}{0.826 * 360 * 780}$$

$$= 1865.7\ mm^2/m' > A_{Smin}$$

$$A_{Smin} = \left\{ \begin{array}{l} 1.5\,d = 1.5 * 780 = 1170 \\ 5\phi 12/m' = 565 \end{array} \right\} 1170\ mm^2$$

$$\boxed{A_S = 8\phi 18/m'}$$

Details of RFT :



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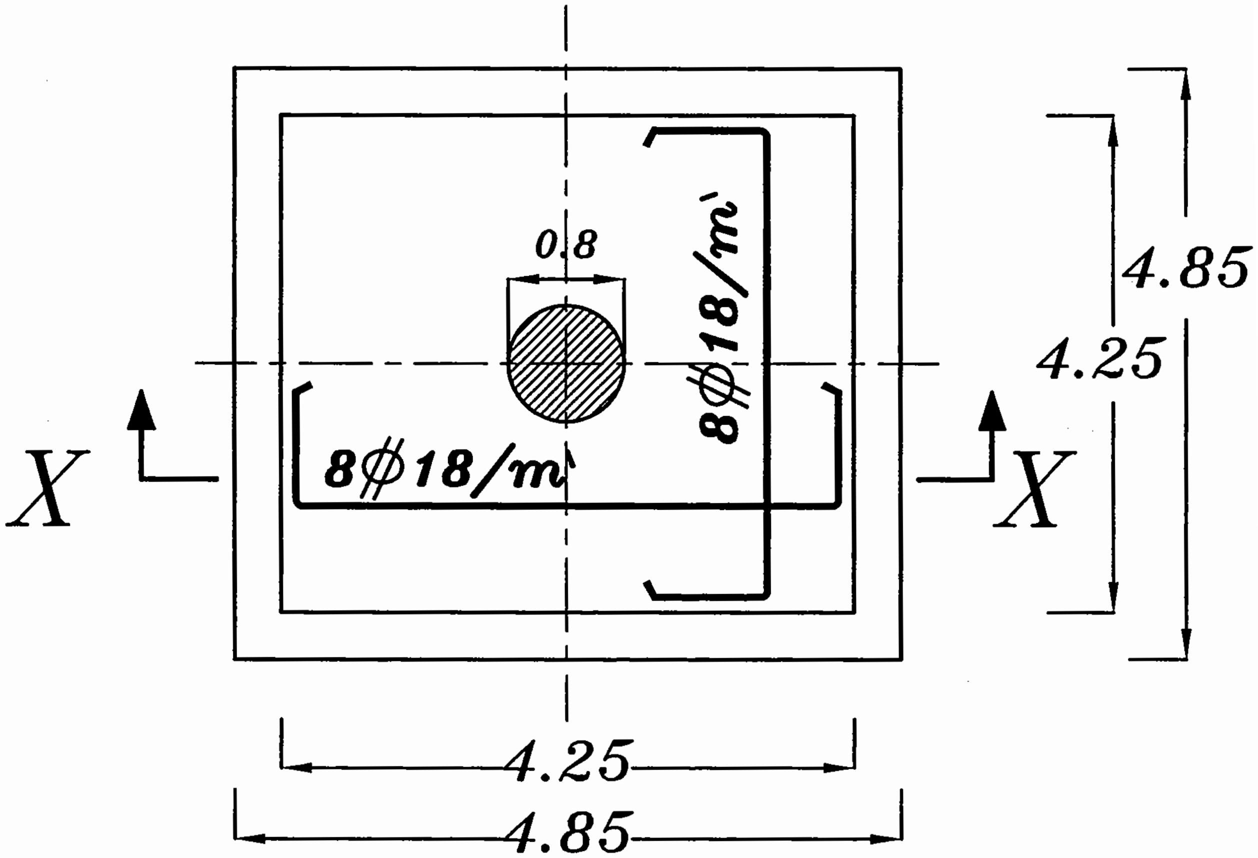


Plan

Example (2)[a]:

*It is required to design a rectangular Footing to Support a R.C column of thickness (40 * 90) cm. The column working load is 2500 kN , and the allowable net bearing capacity in the Footing site is 150 kN/m². thickness of P.C. 40cm.($F_{cu} = 25$ N/mm², $F_y = 360$ N/mm²). and draw details of RFT. to scale 1:50*

Solution.

Givens :

column dimensions (400 * 900) mm

P_{col} (working) = 2500 kN $\qquad$ P_{col} (U.L.) = 2500 * 1.5 = 3750 kN

Bearing capacity of the soil = $q_{all} = 150$ kN/m²

$F_{cu} = 25$ N/mm² $\qquad$ $F_y = 360$ N/mm²

Area of Footing :

$$t_{P.C.} = 40 \text{ cm} > 20 \text{ cm} \longrightarrow (\text{Area of P.C.})$$

$$L_{P.C.} - B_{P.C.} = b - a = 0.90 - 0.40 = 0.50 \text{ m}$$

$$L_{P.C.} = B_{P.C.} + 0.50 \text{ m} \quad \text{------} (1)$$

$$A_{P.C.} = \frac{P_w}{q_{all}} = \frac{2500 \text{ (kN)}}{150 \text{ (kN/m}^2)} = 16.67 \text{ m}^2$$

$$A_{P.C.} = B_{P.C.} * L_{P.C.} = 16.67 \text{ m}^2 \quad \text{-----} (2)$$

$$B_{P.C.} * L_{P.C.} = B_{P.C.} * (B_{P.C.} + 0.50) = 16.67 \ m^2$$

$$B_{P.C.} = 3.84 \ m \xrightarrow{Take} B_{P.C.} = 3.85 \ m$$

$$L_{P.C.} = B_{P.C.} + 0.50 \ m \longrightarrow L_{P.C.} = 4.35 \ m$$

$$B_{R.C.} = B_{P.C.} - 2t_{P.C.} \longrightarrow B_{R.C.} = 3.05 \ m$$

$$L_{R.C.} = L_{P.C.} - 2t_{P.C.} \longrightarrow L_{R.C.} = 3.55 \ m$$

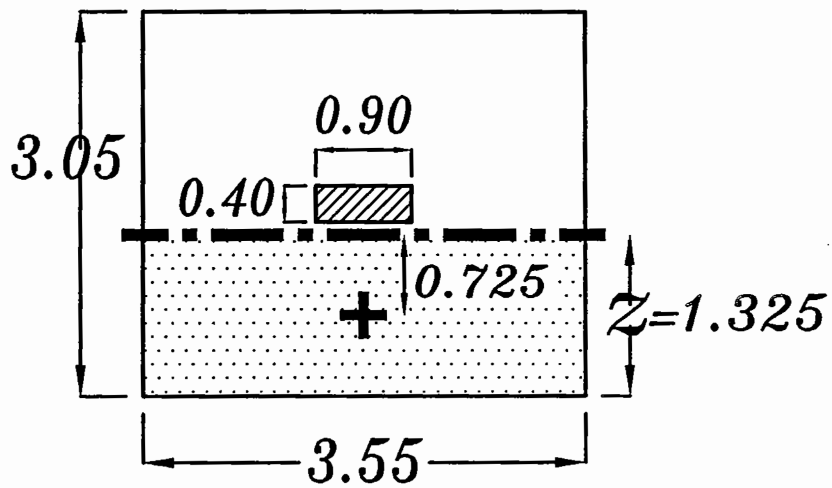
$B_{P.C.} = 3.85 \ m$	$L_{P.C.} = 4.35 \ m$
$B_{R.C.} = 3.05 \ m$	$L_{R.C.} = 3.55 \ m$

Design the critical sections for moment :

Actual Normal stress on R.C. Footing (U.L.)

$$q_u = \frac{P_{U.L.}}{B_{R.C.} * L_{R.C.}} = \frac{3750}{3.05 * 3.55} = 346.34 \ kN/m^2$$

$$Z = \frac{B_{R.C.} - a}{2} = \frac{3.05 - 0.4}{2} = 1.325 m$$



ملحوظه

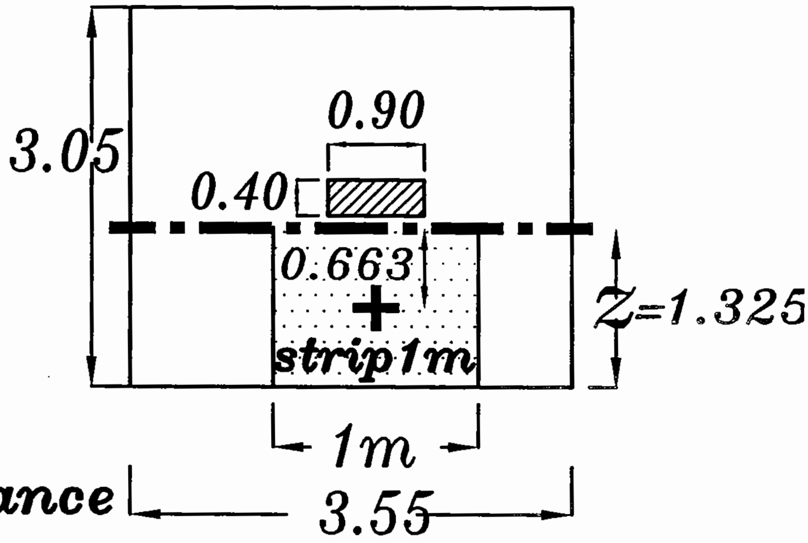
اذا حافظنا على الشرط $L - B = b - a$ فيكون $Z_I = Z_{II}$ و بالتالى سيكون $M_I = M_{II}$ و من ثم يكون $d_I = d_{II}$ لذلك يمكن أن ندرس أتجاه واحد فقط.

$$Force = Stress * Area$$

$$Force = q_u * Z * 1m$$

$$= 346.3 * 1.325 * 1$$

$$= 458.85\ kN$$



$$moment = Force * Distance$$

$$M_{act.} = (q_u * Z * 1m)\frac{Z}{2}$$

$$= (346.3 * 1.325 * 1)\frac{1.325}{2} = 304\ kN.m/m'$$

$$d = C_1 \sqrt{\frac{M_{act.}}{F_{cu} * b}} \qquad Choose\ C_1 = 5.0$$

$$d = 5.0 \sqrt{\frac{304 * 10^6}{25 * 1000}} = 551.4\ mm$$

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$$Take \quad d = 580\ mm$$

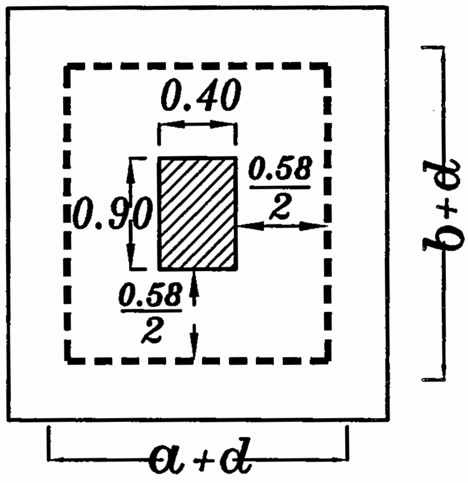
$$t_{R.C.} = d + 70\ mm = 580 + 70 = 650\ mm$$

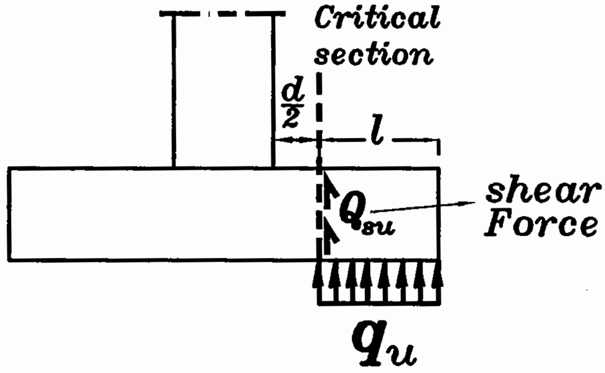
$$\boxed{t_{R.C.} = 650\ mm} \qquad \boxed{d = 580\ mm}$$

Check Shear :

$$a + d = 0.40 + 0.58 = 0.98\,m$$

$$b + d = 0.90 + 0.58 = 1.48\,m$$



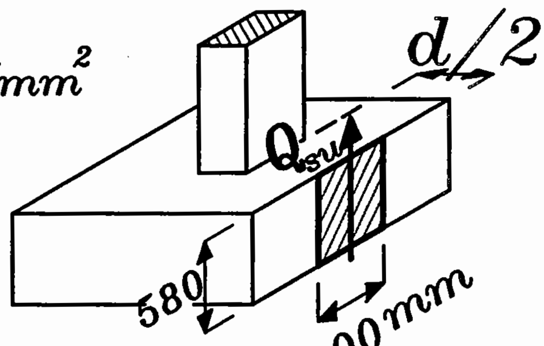


$$l = z - \frac{d}{2}$$ Critical section For Shear.

$$l = 1.325 - \frac{0.58}{2} = 1.035\,m$$

$$Q_{su} = q_u * l * 1.0\,m = 346.3 * 1.035 * 1.0 = 358.4 \;kN$$

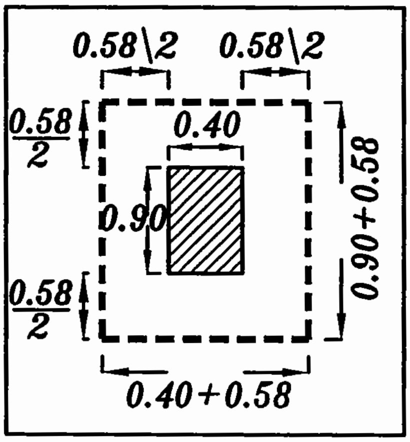
$$q_{su} = \frac{Q_{su}}{b * d} = \frac{358.4 * 10^3}{1000 * 580} = 0.618 \;N/mm^2$$



$$q_{scu} = 0.16\sqrt{\frac{F_{cu}}{\gamma_c}} = 0.16\sqrt{\frac{25}{1.5}} = 0.653 \;N/mm^2$$

$$\boxed{q_{su} < q_{scu}} \longrightarrow$$ Safe shear stresses

Check Punching shear :



$a + d = 0.40 + 0.58 = 0.98\,m$

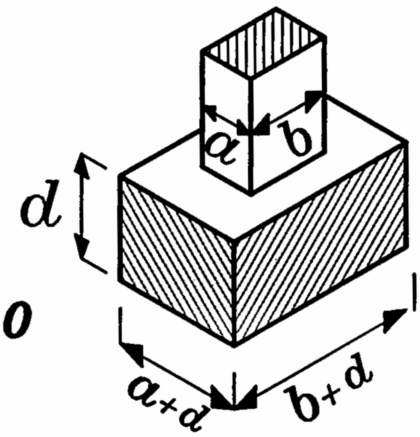
$b + d = 0.90 + 0.58 = 1.48\,m$

Calculate Punching Force.

$Q_{pu} = P_{U.L.} - (q_u)\,[(a+d)(b+d)]$

$Q_{pu} = 3750 - 346.3\,[0.98 * 1.48] = 3247.73\,kN$

Calculate Punching shear area.



$A_p = [2(a+d) + 2(b+d)] * d$

$A_p = [2(400+580) + 2(900+580)] * 580$

$A_p = 2853600\ mm^2$

Calculate Actual Punching shear stress.

$$q_{pu} = \frac{Q_{pu}}{[2(a+d)+2(b+d)] * d}$$

$$q_{pu} = \frac{3247.7 * 10^3}{2853600} = 1.138\ N/mm^2$$

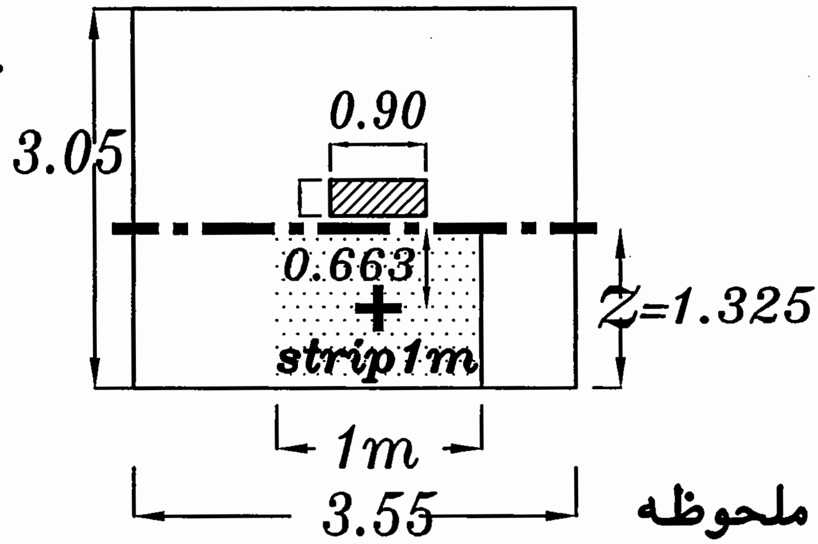
$$(0.5 + \frac{a}{b}) = (0.5 + \frac{0.40}{0.90}) = 0.944 \leqslant 1.0$$

$$q_{pcu} = 0.316\,(0.5 + \frac{a}{b})\sqrt{\frac{F_{cu}}{\delta_c}} = 0.316\,(0.944)\sqrt{\frac{25}{1.5}}$$

$$= 1.218\ N/mm^2$$

$q_{pu} < q_{pcu} \longrightarrow$ Safe punching shear.

Reinforcement of Footing :



ملحوظه

اذا حافظنا على الشرط $L - B = b - a$ فيكون $z_I = z_{II}$ و بالتالى سيكون $M_I = M_{II}$ و من ثم يكون $A_{SI} = A_{SII}$ لذلك يمكن أن ندرس أتجاه واحد فقط.

$$M_{act.} = (q_u * z * 1m)\frac{z}{2}$$

$$= (346.3 * 1.325 * 1)\frac{1.325}{2} = 304 \quad kN.m/m'$$

$$J = 0.826$$

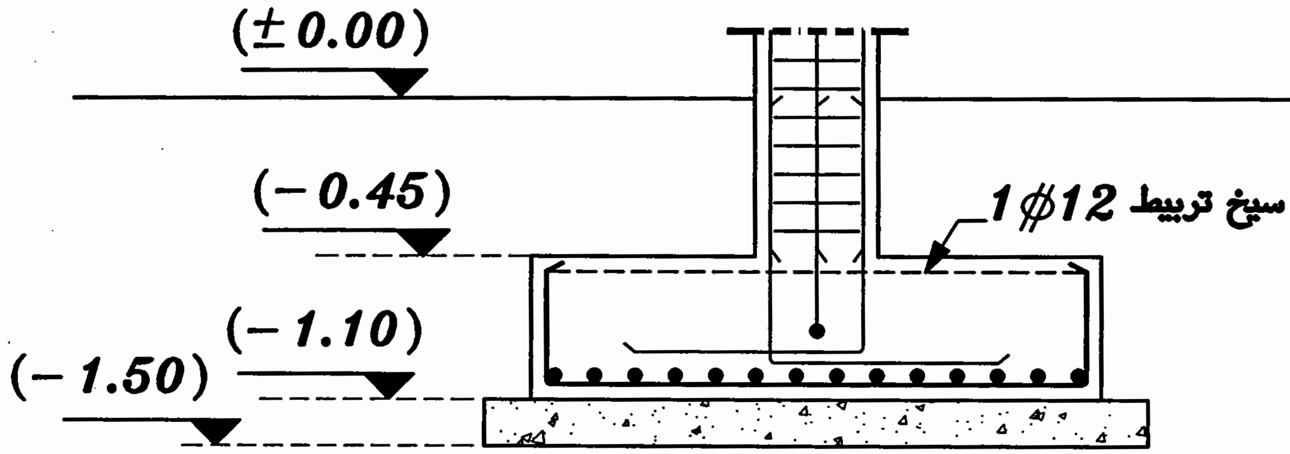
$$A_S = \frac{M_{act.}}{J F_y d} = \frac{304 * 10^6}{0.826 * 360 * 580}$$

$$= 1762.6 \ mm^2/m' > A_{Smin}$$

$$A_{Smin} = \left\{ \begin{array}{l} 1.5\,d = 1.5 * 580 = 870 \\ 5\phi 12/m' = 565 \end{array} \right\} 870 mm^2$$

$$\boxed{A_S = 7\phi 18/m'}$$

Details of RFT :



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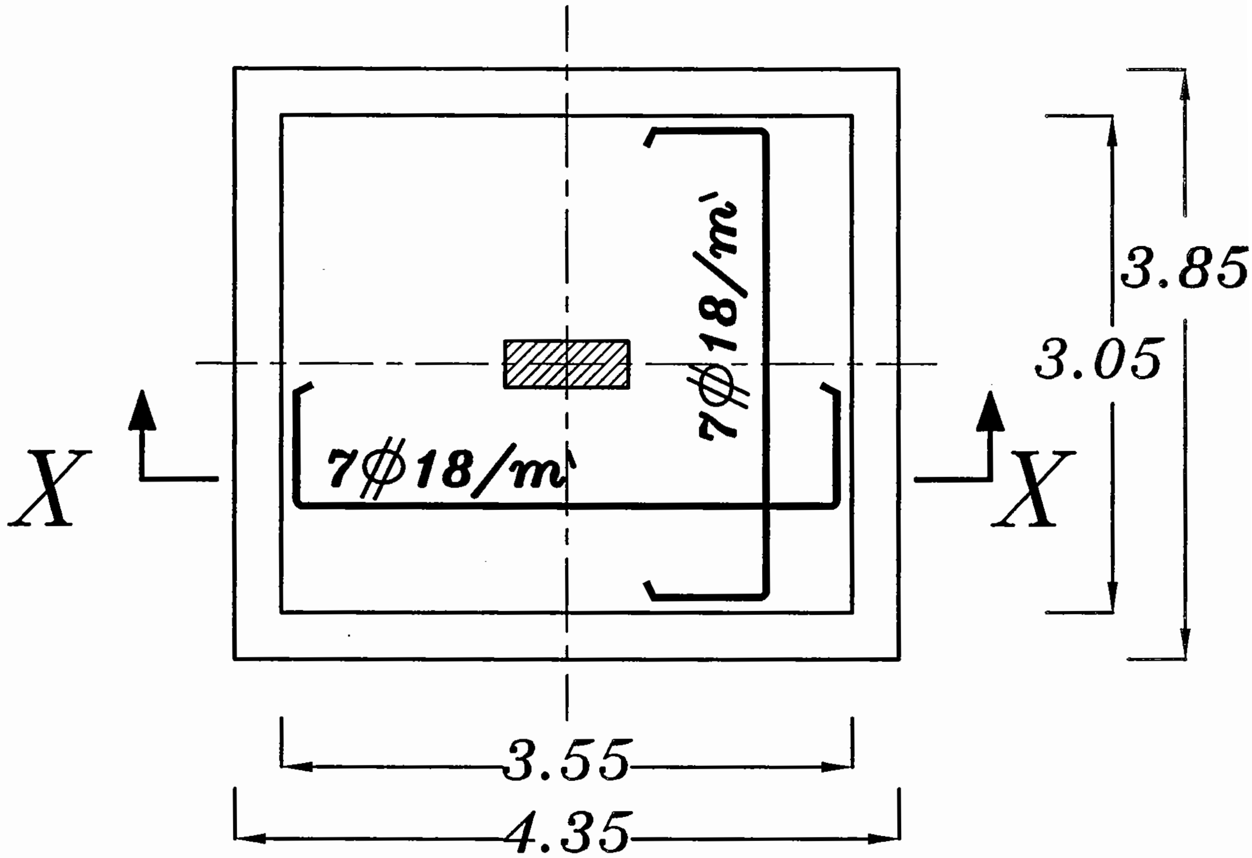


Plan

Example (2)[b]:

Redesign the previous isolated footing assuming the thickness of the plain concrete footing is 10 cm.

Solution.

Givens :

column dimensions (400*900) mm

$P_{col.}$ (working) = 2500 kN $P_{col.}$ (U.L.) = 2500 * 1.5 = 3750 kN

Bearing capacity of the soil = q_{all} = 150 kN/m²

F_{cu} = 25 N/mm² F_y = 360 N/mm²

Area of Footing :

$$t_{P.C.} = 10 \text{ cm} < 20 \text{ cm} \longrightarrow (\text{Area of R.C.})$$

$$L_{R.C.} - B_{R.C.} = b - a = 0.90 - 0.40 = 0.50 \text{ m}$$

$$L_{R.C.} = B_{R.C.} + 0.50 \text{ m} \quad \text{------} (1)$$

$$A_{R.C.} = \frac{P_w}{q_{all}} = \frac{2500 \text{ (kN)}}{150 \text{ (kN/m}^2\text{)}} = 16.67 \text{ m}^2$$

$$A_{R.C.} = B_{R.C.} * L_{R.C.} = 16.67 \text{ m}^2 \quad \text{-----} (2)$$

$$B_{R.C.} * L_{R.C.} = B_{R.C.} * (B_{R.C.} + 0.50) = 16.67 \ m^2$$

$$B_{R.C.} = 3.84 \ m \xrightarrow{Take} B_{R.C.} = 3.85 \ m$$

$$L_{R.C.} = B_{R.C.} + 0.50 \ m \longrightarrow L_{R.C.} = 4.35 \ m$$

$$B_{P.C.} = B_{R.C.} + 2t_{P.C.} \longrightarrow B_{P.C.} = 4.05 \ m$$

$$L_{P.C.} = L_{R.C.} + 2t_{P.C.} \longrightarrow L_{P.C.} = 4.55 \ m$$

$$\boxed{B_{P.C.} = 4.05 \ m} \quad \boxed{L_{P.C.} = 4.55 \ m}$$

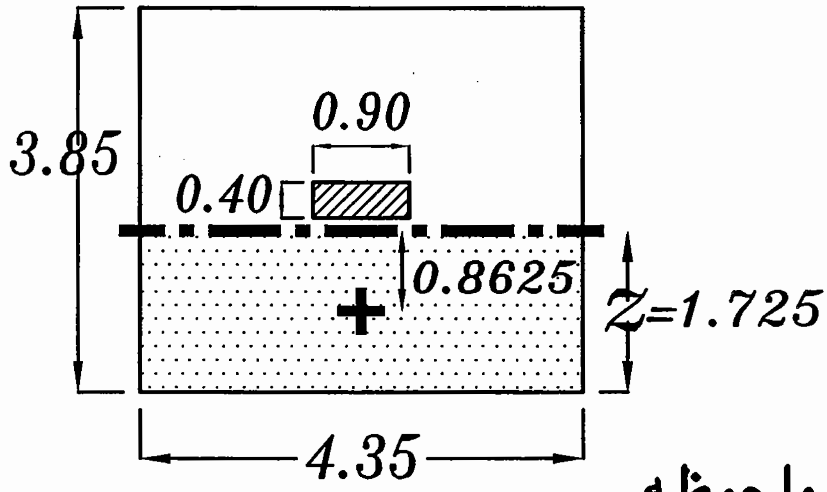
$$\boxed{B_{R.C.} = 3.85 \ m} \quad \boxed{L_{R.C.} = 4.35 \ m}$$

Design the critical sections for moment :

Actual Normal stress on R.C. Footing (U.L.)

$$q_u = \frac{P_{U.L.}}{B_{R.C.} * L_{R.C.}} = \frac{3750}{3.85 * 4.35} = 223.90 \ kN/m^2$$

$$z = \frac{B_{R.C.} - a}{2} = \frac{3.85 - 0.4}{2} = 1.725 m$$



ملحوظه

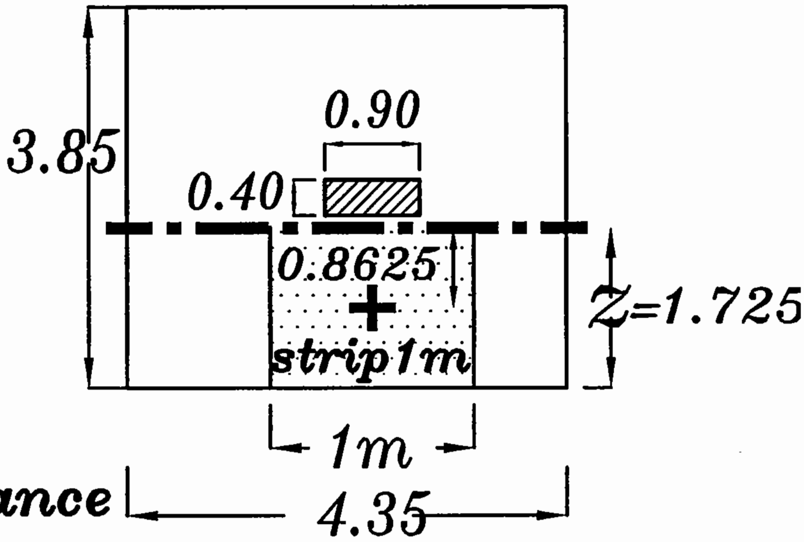
اذا حافظنا على الشرط $L - B = b - a$ فيكون $z_I = z_{II}$ و بالتالى سيكون $M_I = M_{II}$ و من ثم يكون $d_I = d_{II}$ لذلك يمكن أن ندرس أتجاه واحد فقط.

$$Force = Stress * Area$$

$$Force = q_u * Z * 1m$$

$$= 223.9 * 1.725 * 1$$

$$= 386.23 \ kN$$



$$moment = Force * Distance$$

$$M_{act.} = (q_u * Z * 1m)\frac{Z}{2}$$

$$= 386.23 * 0.8625 = 333.1 \ kN.m/m'$$

$$d = C_1 \sqrt{\frac{M_{act.}}{F_{cu} * b}} \qquad \text{Choose } C_1 = 5.0$$

$$d = 5.0 \sqrt{\frac{333.1 * 10^6}{25 * 1000}} = 577.1 \ mm$$

تقرب لاقرب٣٠ مم او ٨٠ مم بالزياده

$$\text{Take} \quad d = 580 \ mm$$

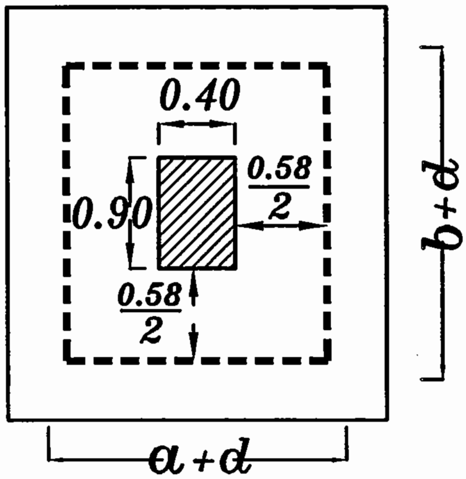
$$t_{R.C.} = d + 70 \ mm = 580 + 70 = 650 \ mm$$

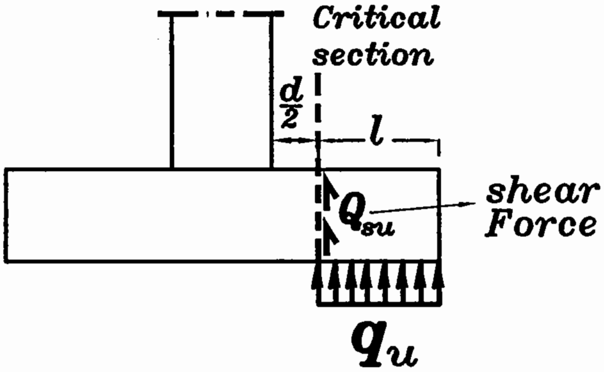
$$\boxed{t_{R.C.} = 650 \ mm} \qquad \boxed{d = 580 \ mm}$$

Check Shear :

$$a + d = 0.40 + 0.58 = 0.98\ m$$

$$b + d = 0.90 + 0.58 = 1.48\ m$$



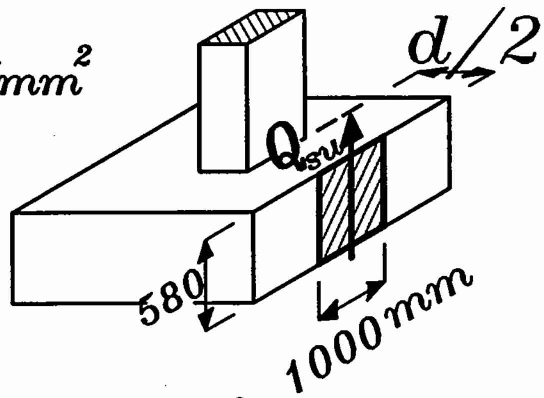


$$l = z - \frac{d}{2} \qquad \text{Critical section For Shear.}$$

$$l = 1.725 - \frac{0.58}{2} = 1.435\ m$$

$$Q_{su} = q_u * l * 1.0\ m = 223.9 * 1.435 * 1.0 = 321.3\ kN$$

$$q_{su} = \frac{Q_{su}}{b * d} = \frac{321.3 * 10^3}{1000 * 580} = 0.550\ N/mm^2$$



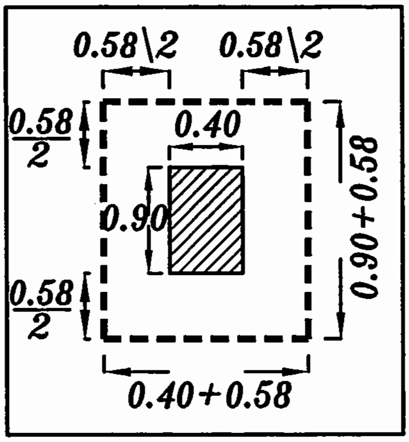
$$q_{scu} = 0.16\sqrt{\frac{F_{cu}}{\gamma_c}} = 0.16\sqrt{\frac{25}{1.5}} = 0.653\ N/mm^2$$

$q_{su} < q_{scu}$ ⟶ Safe shear stresses

Check Punching shear :

$$a + d = 0.40 + 0.58 = 0.98\,m$$

$$b + d = 0.90 + 0.58 = 1.48\,m$$



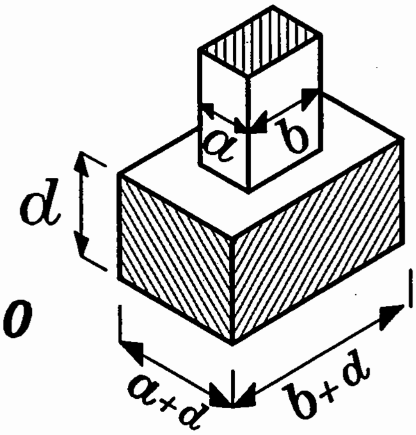
Calculate Punching Force.

$$Q_{pu} = P_{U.L.} - (q_u)\left[(a+d)(b+d)\right]$$

$$Q_{pu} = 3750 - 223.9\left[0.98 * 1.48\right] = 3425.25\,kN$$

Calculate Punching shear area.

$$A_p = \left[2(a+d) + 2(b+d)\right] * d$$



$$A_p = \left[2(400 + 580) + 2(900 + 580)\right] * 580$$

$$A_p = 2853600\ mm^2$$

Calculate Actual Punching shear stress.

$$q_{pu} = \frac{Q_{pu}}{\left[2(a+d) + 2(b+d)\right] * d}$$

$$q_{pu} = \frac{3425.25 * 10^3}{2853600} = 1.2\ N/mm^2$$

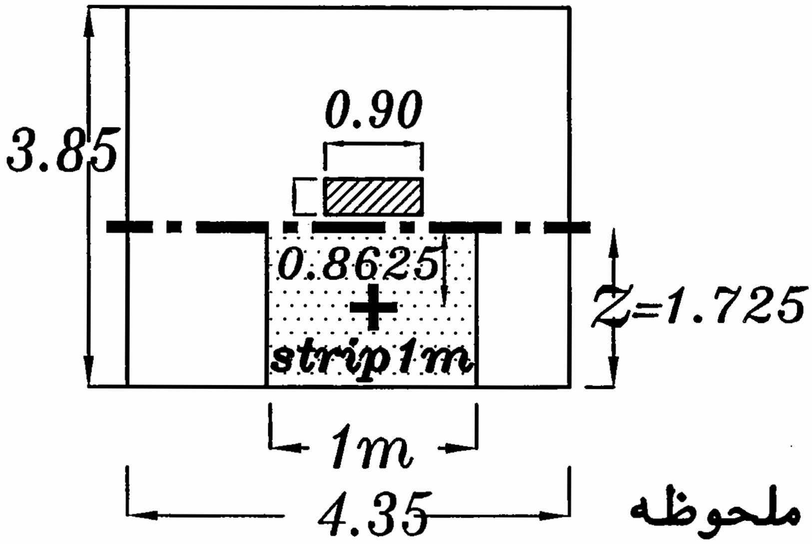
$$\left(0.5 + \frac{a}{b}\right) = \left(0.5 + \frac{0.40}{0.90}\right) = 0.944 \leqslant 1.0$$

$$q_{pcu} = 0.316\left(0.5 + \frac{a}{b}\right)\sqrt{\frac{F_{cu}}{\gamma_c}} = 0.316(0.944)\sqrt{\frac{25}{1.5}}$$

$$= 1.218\ N/mm^2$$

$q_{pu} < q_{pcu} \longrightarrow$ ***Safe punching shear.***

Reinforcement of Footing :



ملحوظه

اذا حافظنا على الشرط $L - B = b - a$ فيكون $z_I = z_{II}$ و بالتالى سيكون $M_I = M_{II}$ و من ثم يكون $A_{sI} = A_{sII}$ لذلك يمكن أن ندرس أتجاه واحد فقط.

$M_{act.} = 333.1$ kN.m/m'

$J = 0.826$

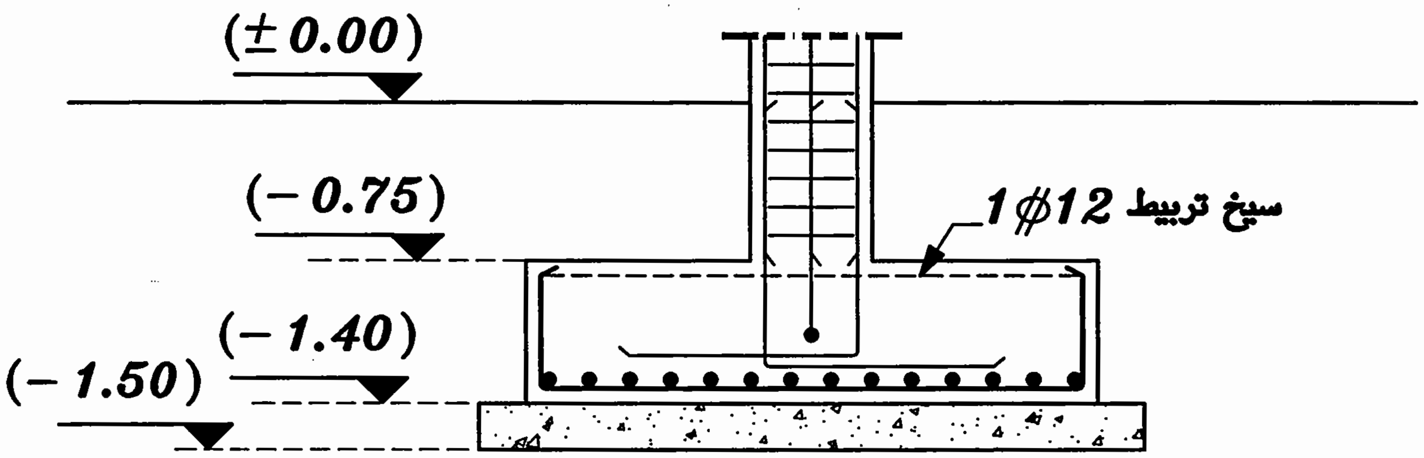
$$A_S = \frac{M_{act.}}{J\, F_y\, d} = \frac{333.1 * 10^6}{0.826 * 360 * 580}$$

$$= 1931.5\ mm^2/m' > A_{Smin}$$

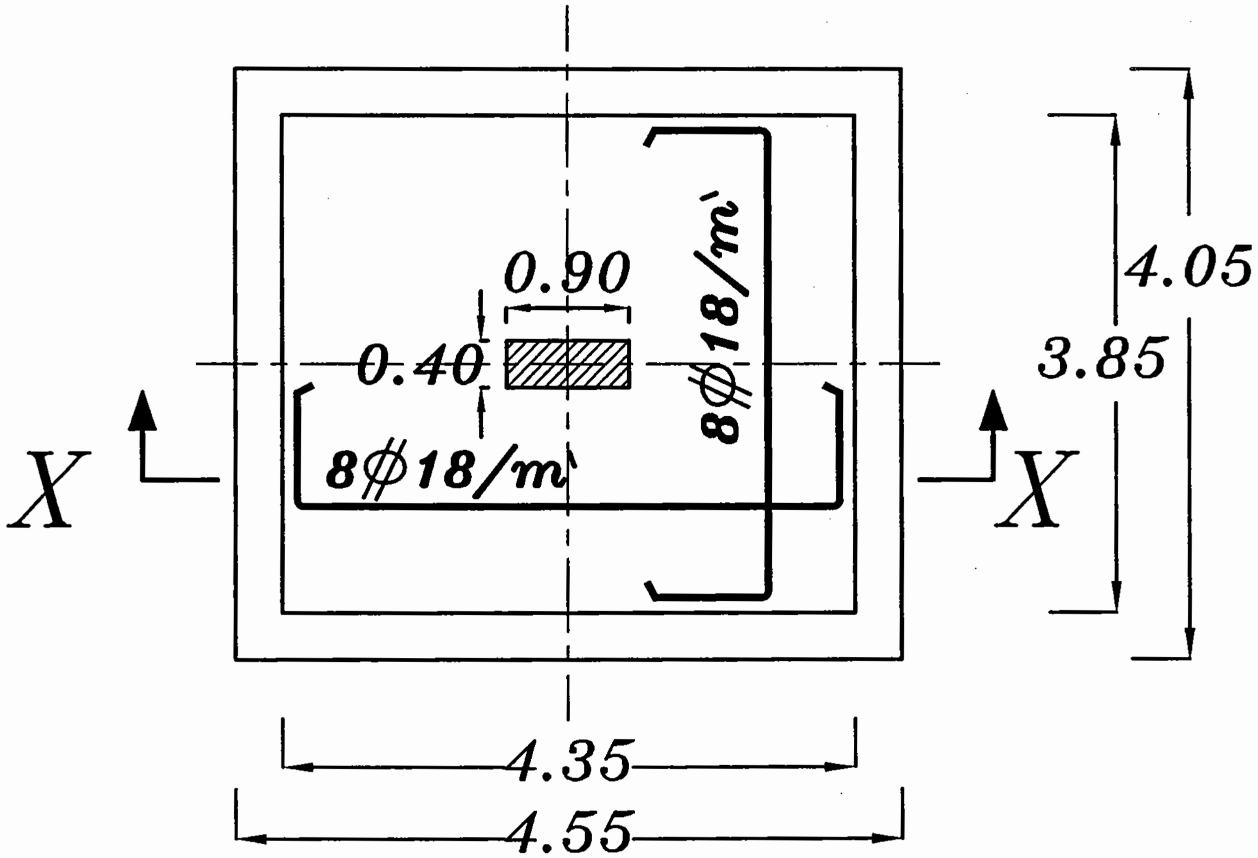
$$A_{Smin} = \left\{ \begin{array}{l} 1.5\, d = 1.5 * 580 = 870 \\ 5\phi 12/m' = 565 \end{array} \right\} 870\, mm^2$$

$$\boxed{A_S = 8\phi 18/m'}$$

Details of RFT :



Sec X–X



Plan

Example (2)[c]:

Compare between the designed isolated footing in Example (2)[a] and Example (2)[b] with respect to the volume of the reinforced concrete & the volume of plain concrete & the amount of the reinforcement .

Solution.

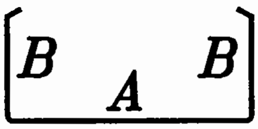
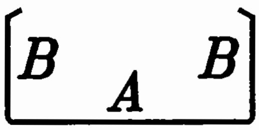
1 - P.C. Bill of Quantities (BOQ) :

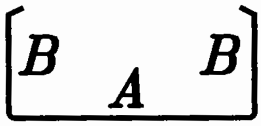
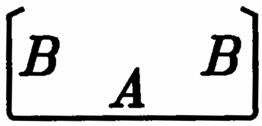
	$t_{P.C.} = 40$ cm			$t_{P.C.} = 10$ cm		
Dimensions	L (m)	B (m)	T (m)	L (m)	B (m)	T (m)
	4.35	3.85	0.40	4.55	4.05	0.10
Total Volume m^3/footing	6.699			1.843		

2 - R.C. Bill of Quantities (BOQ) :

	$t_{P.C.} = 40\ cm$			$t_{P.C.} = 10\ cm$		
Dimensions	L (m)	B (m)	T (m)	L (m)	B (m)	T (m)
	3.55	3.05	0.65	4.35	3.85	0.65
Total Volume m^3/footing	7.038			10.89		

3 - RFT Bill of Quantities (BOQ) :

$t_{P.C.} = 40\ cm$							
Shape		A (mm)	B (mm)	No./m'	ϕ (mm)	Length (m)	Weight (Kg)
1		3450	550	7	18	3.05	194
2		2950	550	7	18	3.55	201
		Total RFT amount (Kg)					395

$t_{P.C.} = 10\ cm$							
Shape		A (mm)	B (mm)	No./m'	ϕ (mm)	Length (m)	Weight (Kg)
1		4250	550	8	18	3.85	329
2		3750	550	8	18	4.35	337
		Total RFT amount (Kg)					666