component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

4-2-1 Design of Top Slab

1. Main Reinforcement :

- **Support section**

$f_y = 420N/mm^2$

$f_c` = 28N/mm^2$

$b = 1000mm$

$h = 800mm$

$P = 345kN$

$V_u = 999.2\text{kN}$

$M_u = 3111.1kNm$

$\phi = 0.9$

اولاً: التاكد من قيمة العمق الماخوذة h:

$\because f_c` \leq 28Mpa$

$\beta_1 = 0.85$

$\Rightarrow \rho_b = \frac{0.85*28*0.85}{420}\left(\frac{600}{600+420}\right) = 0.02833$

$\Rightarrow \rho_{max} = 0.6\rho_b = 0.6*0.02833 = 0.01700$

$\Rightarrow \rho_{min} = \frac{1.4}{420} = 0.00333$

$\rho = 0.00849$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

$$\rightarrow m = \frac{420}{0.85*28} = 17.64706$$

$$\rightarrow R_u = 0.00849 * 420 * (1 - 0.5 * 17.64706 * 0.00849)$$

$$= 3.29868\ N/mm^2$$

$$\rightarrow M_n = \frac{3111.1}{0.9} = 3456.77778kNm$$

$$\because\ M_n = R_u b d^2 \quad \rightarrow \quad d = \sqrt{\frac{M_n}{R_u * b}}$$

$$d` = \sqrt{\frac{3456.77778 * 10^6}{3.29868 * 1000}} = 1023.68334mm$$

$$h` = 1023.68334 + 50 + 12.5 = 1086.18334mm \qquad 1086mm$$

$$> h = 800mm \quad \rightarrow \quad Not\ ok$$

∴ يتم تكبير المقطع .

use $h = 1100mm$ 1100mm

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

ثانياً : حساب حديد التسليح :

$$\rightarrow d = 1100 - 50 - 12.5 = 1037.5mm$$

$$\rightarrow \ R_u = \frac{3456.77778*10^6}{1000*1037.5^2} = 3.21141\ N/mm^2$$

$$\rightarrow \rho = \frac{1}{17.64706}\left(1 - \sqrt{1 - \frac{2*17.64706}{420} * 3.21141}\right) =$$

$$0.00825$$

$$\rightarrow A_s = 0.00825 * 1000 * 1037.5 = 8559.375mm^2$$ — $8559mm^2$

$$\emptyset = 25mm \ \rightarrow A_b = \frac{\pi * 25^2}{4}$$

$$= 490.87385mm^2$$

$$\rightarrow S = \frac{490.87385}{8559.375} * 1000 = 57.34926mm$$ — 57mm

$$No.ofbars = \frac{1000}{50} + 1 = 21\ bars/m$$ — 21bars/m

$$\boldsymbol{21\emptyset 25mm@50mm\ c/c\ \ (A_s = 9817.5mm^2)}$$

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

- **Middle span section**

$b = 1000mm$

$h = 800mm \rightarrow 1100mm$

ملاحظة: نسبة لتغير السمك في حالة التسليح السابق تم تغير سمك البلاطة ككل .

$$M_u = 1533.3kNm$$

اولاً : التاكد من قيمة العمق المأخوذة h :

$$\because f_c` \leq 28Mpa$$

$$\therefore \beta_1 = 0.85$$

$$\Rightarrow \rho_b = \frac{0.85*28*0.85}{420}\left(\frac{600}{600+420}\right) = 0.02833$$

$$\Rightarrow \rho_{max} = 0.6 * 0.02833 = 0.01700$$

$$\Rightarrow \rho_{min} = \frac{1.4}{420} = 0.00333$$

$$\rho = 0.00849$$

$$\rightarrow m = \frac{420}{0.85*28} = 17.64706$$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output
	$\rightarrow R_u = 0.00849 * 420 * (1 - 0.5 * 17.64706 * 0.00849) = 3.29868\ N/mm^2$ $\rightarrow M_n = \frac{1533.3}{0.9} = 1703.66667 kNm$ $\because\ M_n = R_u b d^2 \rightarrow \qquad d = \sqrt{\frac{M_n}{R_u * b}}$ $d` = \sqrt{\frac{1703.66667 * 10^6}{3.29868 * 1000}} = 718.65793 mm$  $h` = 718.65793 + 50 + 12.5 = 781.15793 mm\ < h = 1100 mm\ \rightarrow ok$	781mm

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

ثانياً : حساب حديد التسليح :

$$\rightarrow d = 1100 - 50 - 12.5 = 1037.5mm$$

$$\rightarrow \quad R_u = \frac{1703.66667 * 10^6}{1000 * 1037.5^2} = 1.58274 N/mm^2$$

$$\rightarrow \rho = \frac{1}{17.64706}\left(1 - \sqrt{1 - \frac{2 * 17.64706}{420} * 1.58274}\right)$$

$$= 0.00390$$

$$\rightarrow A_s = 0.00390 * 1000 * 1037.5 = 4046.25mm^2$$ — 4046mm^2

$$\emptyset = 25mm \ \rightarrow A_b = \frac{\pi * 25^2}{4}$$

$$= 490.87385mm^2$$

$$\rightarrow S = \frac{490.87385}{4046.25} * 1000 = 121.42829mm$$ — 121mm

$$No.ofbars = \frac{1000}{120} + 1 = 9.33333 \ bars/m$$ — 9bars/m

$$\mathbf{9\emptyset 25mm@120mmc/c} \ (\boldsymbol{A_s = 4090.58mm^2})$$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

2- Shear Design:

$$(\phi = 0.75)$$

$\Rightarrow d = 1100 - 50 - 12.5 = 1037.5mm$

$\Rightarrow V_c = 0.17\sqrt{28} * 1000 * 1037.5 * 10^{-3} = 933.29\text{kN}$

$\Rightarrow V_u = 999.2kN \ > \ \frac{\phi V_c}{2} = \frac{0.75*933.29}{2} = 352.32\text{kN}$

$\Rightarrow V_u = 999.2kN \ > \ \phi\text{V}_\text{c} = 0.75 * 933.29 = 699.97kN$

$$\emptyset = 10mm$$

$$A_v = \frac{2 * \pi * 10^2}{4} = 157.0736mm^2$$ — $157mm^2$

$$V_n = \frac{999.2}{0.75} = 1332.26667\text{kN}$$

$$V_n = V_c + V_s \quad \rightarrow V_s = V_n - V_c$$

$$V_s = 1332.27 - 933.29 = 398.98\text{kN}$$

$$S = \frac{157.0736 * 420 * 1037.5}{398.98 * 10^{-3}} = 171.55mm$$ — 172mm

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

$$\because V_s = 398.98kN < 0.33\sqrt{f_c`}\, b_w d$$

$$= 0.33 * \sqrt{28} * 1000 * 1037.5 * 10^{-3}$$

$$= 1811.68kN \quad \rightarrow ok$$

$$S_{max} = \frac{d}{2} = \frac{1037.5}{2} = 518.75\text{mm}$$

519mm

$$\therefore S = 150mm$$

∅10mm@150mm c/c

3- Longitudinal Reinforcement :

(50% of main reinforcement)

$$A_s = 4090.58mm^2$$

$$A_{s.long.} = \frac{50}{100} * 4090.58 = 2045.29mm^2$$

$2045mm^2$

$$S = \frac{201.062}{2045.29} * 1000 = 98.305mm$$

98mm

$\emptyset 16mm@80mm \ c/c \ (A_s = 2045.3mm^2)$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

4- Shrinkage Reinforcement :

$$(f_y = 420 \rightarrow A_s = 0.002A_g)$$

$$A_s = 0.002 * 1100 * 1000 = 2200mm^2$$ 2200mm^2

$$S = \frac{201.062}{2200} * 1000 = 91.39mm$$ 91mm

$$\emptyset \mathbf{16}mm@\mathbf{80}mmc/c\ (\boldsymbol{A_s = 2513.28mm^2})$$

- **Axial load Check:**

$$A_{s.provide} = 4090.617 + 9817.48$$

$$= 13908.097mm^2$$

$$A_{s.required} = 4049.174 + 8555.437$$

$$= 12604.61mm^2$$

$$A_s = A_{s.provide} - A_{s.required} = 13908.097 - 12604.61$$ 1304mm^2

$$= 1303.487mm^2$$

$$F = A_s * f_y = 1303.487 * 420 = 547.465kN$$

$$\because P = 345kN < F = 547.465kN$$

حديد التسليح يتحمل القوة المحورية الواقعة علي المقطع

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

4-2-2 Design of Base slab:

2. *Main Reinforcement :*

- **Support section**

$f_y = 420N/mm^2$

$f_c^{`} = 28N/mm^2$

$b = 1000mm$

$h = 1000mm$

$P = 387.6kN$

$V_u = 967.4\text{kN}$

$M_u = 2102.3kNm$

$\phi = 0.9$

اولاً: التاكد من قيمة العمق الماخوذة h:

$\because f_c^{`} \leq 28Mpa$

$\beta_1 = 0.85$

$\Rightarrow \rho_b = \frac{0.85*28*0.85}{420}\left(\frac{600}{600+420}\right) = 0.02833$

$\Rightarrow \rho_{max} = 0.6\rho_b = 0.6*0.02833 = 0.01700$

$\Rightarrow \rho_{min} = \frac{1.4}{420} = 0.00333$

$\rho = 0.00849$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

$$\rightarrow m = \frac{420}{0.85*28} = 17.64706$$

$$\rightarrow R_u = 0.00849 * 420 * (1 - 0.5 * 17.64706 * 0.00849)$$

$$= 3.29868\ N/mm^2$$

$$\rightarrow M_n = \frac{2102.3}{0.9} = 2335.88889kNm$$

$$\because\ M_n = R_u b d^2 \quad \rightarrow \quad d = \sqrt{\frac{M_n}{R_u * b}}$$

$$d` = \sqrt{\frac{2335.88889 * 10^6}{3.29868 * 1000}} = 841.50364\ mm$$

$$h` = 841.50364 + 50 + 12.5 = 904.00364mm \ < h$$

$$= 1000mm \quad \rightarrow \quad ok$$

904mm

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

ثانياً : حساب حديد التسليح :

$\rightarrow d = 1000 - 50 - 12.5 = 937.5mm$

$\rightarrow \quad R_u = \frac{2335.88889*10^6}{1000*937.5^2} = 2.65772\ N/mm^2$

$\rightarrow \rho = \frac{1}{17.64706}\left(1 - \sqrt{1 - \frac{2*17.64706}{420} * 2.65772}\right) =$

0.00673

$\rightarrow A_s = 0.00673 * 1000 * 937.5 = 6309.375mm^2$ — 6309mm^2

$$\emptyset = 25mm \ \rightarrow A_b = \frac{\pi * 25^2}{4}$$

$$= 490.87385mm^2$$

$\rightarrow S = \frac{490.87385}{6309.375} * 1000 = 77.80071\ mm$ — 78mm

$No.ofbars = \frac{1000}{70} + 1 = 15.28571\ bars/m$ — 15bars/m

$\mathbf{15\emptyset 25mm@50mm\ c/c\ \ (A_s = 18817.5mm^2)}$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

- **Middle span section**

$b = 1000mm$

$h = 1000\ mm$

$M_u = 1948.3kNm$

اولاً : التاكد من قيمة العمق المأخوذة h :

$\because f_c` \leq 28Mpa$

$\therefore \beta_1 = 0.85$

$\Rightarrow \rho_b = \frac{0.85*28*0.85}{420}\left(\frac{600}{600+420}\right) = 0.02833$

$\Rightarrow \rho_{max} = 0.6 * 0.02833 = 0.01700$

$\Rightarrow \rho_{min} = \frac{1.4}{420} = 0.00333$

❖ $\rho = 0.00849$

$\rightarrow m = \frac{420}{0.85*28} = 17.64706$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output
	$\rightarrow R_u = 0.00849 * 420 * (1 - 0.5 * 17.64706 * 0.00849)$ $= 3.29868\ N/mm^2$ $\rightarrow M_n = \frac{1948.3}{0.9} = 2164.77778\ KN.m$ $\because\ M_n = R_u b d^2 \rightarrow \quad d = \sqrt{\frac{M_n}{R_u * b}}$ $d` = \sqrt{\frac{2164.77778 * 10^6}{3.29868 * 1000}} = 810.09615\ mm$  $h` = 810.09615 + 50 + 12.5 = 872.59615\ mm\ <\ h = 1000mm\ \rightarrow ok$	873mm

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

ثانياً : حساب حديد التسليح :

$$\rightarrow d = 1000 - 50 - 12.5 = 937.5mm$$

$$\rightarrow \quad R_u = \frac{214.77778 * 10^6}{1000 * 937.5^2} = 2.46304\ N/mm^2$$

$$\rightarrow \rho = \frac{1}{17.64706}\left(1 - \sqrt{1 - \frac{2 * 17.64706}{420} * 2.46304}\right)$$

$$= 0.00620$$

$$\rightarrow A_s = 0.00620 * 1000 * 937.5 = 5812.5\ mm^2$$ — 5813mm^2

$$\emptyset = 25mm \ \rightarrow A_b = \frac{\pi * 25^2}{4}$$

$$= 490.87385mm^2$$

$$\rightarrow S = \frac{490.87385}{5812.5} * 1000 = 84.44109\ mm$$ — 84mm

$$No.ofbars = \frac{1000}{80} + 1 = 13.5\ bars/m$$ — 13bars/m

$$\mathbf{13\emptyset 25mm@120mmc/c\ (A_s = 6135.875\ mm^2)}$$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

2- Shear Design:

$$(\phi = 0.75)$$

⇨ $d = 1000 - 50 - 12.5 = 937.5mm$

⇨ $V_c = 0.17\sqrt{28} * 1000 * 937.5 * 10^{-3} = 843.33323\text{kN}$

⇨ $V_u = 967.4\ KN > \frac{\phi V_c}{2} = \frac{0.75*843.33323}{2} =$ 316.24996 KN

⇨ $V_u = 967.4\ KN > \phi V_c = 0.75 * 843.33323 =$ 632.49992 KN

$$\emptyset = 10mm$$

$$A_v = \frac{2 * \pi * 10^2}{4} = 157.0736mm^2$$ — $157mm^2$

$$V_n = \frac{967.4}{0.75} = 1289.86667\ \text{KN}$$

$$V_n = V_c + V_s \quad \rightarrow V_s = V_n - V_c$$

$$V_s = 1289.86667 - 843.33323 = 446.53344\ \text{KN}$$

$$S = \frac{157.0736 * 420 * 937.5}{446.53344 * 10^{-3}} = 138.50638\ mm$$ — 139mm

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

$\because V_s = 446.53344\ KN < 0.33\sqrt{f_c`}\, b_w d$

$= 0.33 * \sqrt{28} * 1000 * 937.5 * 10^{-3}$

$= 1637.05862kN \quad \rightarrow ok$

$$S_{max} = \frac{d}{2} = \frac{937.5}{2} = 468.75\text{mm}$$

469mm

$$\therefore S = 120mm$$

∅10mm@120mm c/c

3- Longitudinal Reinforcement :

(50% of main reinforcement)

$$A_s = 6135.875\ mm^2$$

$$A_{s.long.} = \frac{50}{100} * 6135.875 = 3067.94\ mm^2$$

$3068mm^2$

$$S = \frac{201.062}{3067.94} * 1000 = 65.54\ mm$$

66mm

$\emptyset 16mm@50mm\ \ c/c\ \ (A_s = 4021.24\ mm^2)$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

4- Shrinkage Reinforcement :

$$(f_y = 420 \rightarrow A_s = 0.002A_g)$$

$$A_s = 0.002 * 1000 * 1000 = 2000mm^2$$ — 2000mm^2

$$S = \frac{201.062}{2000} * 1000 = 100.531\ mm$$ — 101mm

$$\emptyset \mathbf{16mm@100mmc/c}\ (\boldsymbol{A_s = 2010.62\ mm^2})$$

- **Axial load Check:**

$$A_{s.provide} = 6135.925 + 7012.486$$

$$= 13148.411\ mm^2$$

$$A_{s.required} = 6306.733 + 5816.235$$

$$= 12122.968\ mm^2$$

$$A_s = A_{s.provide} - A_{s.required}$$

$$= 13148.411 - 12122.968$$

$$= 1025.443\ mm^2$$ — 1026mm^2

$$F = A_s * f_y = 1025.443 * 420 = 430.686\ KN$$

$$\because P = 387.6\ KN < F = 430.686\ KN$$

❖ **حديد التسليح يتحمل القوة المحورية الواقعة علي المقطع**

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output

4-2-3 Design of internal wall

1- Main Reinforcement:

$f_y = 420N/mm^2$

$f_c^{`} = 28N/mm^2$

$b = 1000mm$

$h = 800mm$

$P_u = 982.7kN$

$M_1 = 749kNmm$

$M_2 = 943.3kNmm$

$V_u = 245.3kN$

$L_{slab} = 11.8m$

$L_{column} = 6m$

$\phi = 0.65$

ولا: حساب تأثير النحافة $(K\frac{Lu}{r})$

$$r = \sqrt{\frac{1000 * 800^3}{12 * 800 * 1000}} = 230.94$$

$$K\frac{L_u}{r} = \frac{10 * 6000}{230.94} = 25.98$$

$$34 - 12\left(\frac{M_1}{M_2}\right) = 34 - 12\left(\frac{749}{943.3}\right) = 24.47$$

$$\because K\frac{L_u}{r} > 34 - 12\left(\frac{M_1}{M_2}\right)$$

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

❖ **حساب قيمة K أكثر دقة:**

$$\Psi_{\text{top}} = \frac{1000 * 800^3/12 * 6000}{2(1000 * 1100^3/12 * 11800)} = 0.38$$

$$\Psi_{\text{bottom}} = \frac{1000 * 800^3/12 * 6000}{2(1000 * 1000^3/12 * 11800)} = 0.50$$

$$K \cong 0.93$$

$$K\frac{L_u}{r} = 0.93 * \frac{6000}{230.94} = 24.16$$

$$\because K\frac{L_u}{r} < 34 - 12\left(\frac{M_1}{M_2}\right) = 24.47$$

∴ يتم إهمال تأثير النحافة ويصمم العمود كعمود قصير

$$\rightarrow d = 800 - 50 - \frac{20}{2} = 740\ mm$$

$$\rightarrow c_b = \frac{600}{600+420} * 740 = 435.29\ mm$$

$$\rightarrow a_b = 0.85 * 435.29 = 370\ mm$$

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

$\rightarrow \varepsilon_s = \frac{0.003(435.29-50)}{435.29} = 0.0027$

$\rightarrow \varepsilon_y = 0.0021$

❖ $\varepsilon_s > \varepsilon_y$

❖ $f_s = f_y = 420\ N/mm^2$

$\rightarrow P_b = C_c = 0.85 * 28 * 370 * 1000 = 8806\ kN$

$\rightarrow P_n = \frac{2053.7}{0.65} = 3159.54\ \text{kN}$

$\because \boldsymbol{P_b > P_n}$

∴ نستخدم صيغة وتني للشد

$$P_n = 0.85 f_c^{`} bd \left[ -\rho + (1 - \frac{e^{`}}{d}) + \sqrt{\left(1 - \frac{e^{`}}{d}\right)^2 + 2\rho \left[ (m-1)\left(1 - \frac{d^{`}}{d}\right) + \frac{e^{`}}{d} \right]} \right]$$

$$e = \frac{943.3}{2053.7} = 0.459317m = 459.317\ mm$$

$$e^{`} = 459.317 + \frac{740 - 60}{2} = 799.32\ mm$$

$\rightarrow m = \frac{420}{0.85*28} = 17.65$

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

$$2053.7 * 10^3 = 0.85 * 1000 * 28 * 740 * \left[-\rho + \left(1 - \frac{799.32}{740}\right) + \sqrt{\left(1 - \frac{799.32}{740}\right)^2 + 2\rho\left[(17.65 - 1)\left(1 - \frac{60}{740}\right) + \frac{799.32}{740}\right]} \right]$$

$$\hookrightarrow \rho = 0.002$$

$$\rightarrow A_s = \rho b d = 0.002 * 1000 * 740 = 1480\, mm^2$$

1480mm^2

$$\rightarrow \emptyset = 20mm \rightarrow A_b = \frac{\pi * 20^2}{4} = 314.159 mm^2$$

$$\rightarrow S = \frac{314.159}{1480} * 1000 = 212.16mm$$

212mm

$$\rightarrow No.of\ bars = \frac{1000}{150} + 1 = 8\ bars/m$$

8bars/m

$$\boldsymbol{8\emptyset 20mm@150mm\ c/c\ (A_s = 2094.39mm^2)}$$

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

2-Longitudinal Reinforcement :

(50% of main reinforcement)

$$A_s = 2094.39mm^2$$

$$A_{s.long.} = \frac{50}{100} * 2094.39 = 1047.20mm^2$$ 1047mm^2

$$S = \frac{201.062}{1047.20} * 1000 = 192mm$$ 192mm

$$\emptyset \mathbf{16}mm@\mathbf{150}mm\ c/c\ (A_s = \mathbf{1340.41}mm^2)$$

- *Shear check:*

$$V_c = 0.17\sqrt{28} * 1000 * 740 * 10^{-3} = 665.67\text{kN}$$

$$V_u = 245.3kN < \frac{\phi V_c}{2} = \frac{0.75 * 665.67}{2}$$
$$= 249.63\text{kN}$$

❖ المقطع يتحمل القص الواقع عليها وبذلك لايحتاج إلي كانات.

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

4-2-4 Design of External Wall

1- Main Reinforcement

$f_y = 420N/mm^2$

$f_c` = 28N/mm^2$

$b = 1000mm$

$h = 800mm$

$P_u = 982.7kN$

$M_1 = 509.7kNmm$

$M_2 = 1063kNmm$

$V_u = 195.9kN$

$L_{slab} = 11.8m$

$L_{column} = 6m$

$\phi = 0.65$

- **اولا: حساب تأثير النحافة $(K\frac{Lu}{r})$:**

$$r = \sqrt{\frac{1000 * 800^3}{12 * 800 * 1000}} = 230.94mm$$

$$K\frac{L_u}{r} = 1.0 * \frac{6000}{230.94} = 25.98$$

$$34 - 12\left(\frac{M_1}{M_2}\right) = 34 + 12\left(\frac{509.7}{1063}\right) = 39.75$$

$$\because K\frac{L_u}{r} < 34 - 12\left(\frac{M_1}{M_2}\right)$$

∴ يتم إهمال تأثير النحافة ويصمم العمود كعمود قصير .

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

$$\rightarrow d = 800 - 50 - \frac{20}{2} = 740\ mm$$

$$\rightarrow c_b = \frac{600}{600+420} * 740 = 435.29\ mm$$

$$\rightarrow a_b = 0.85 * 435.29 = 370\ mm$$

$$\rightarrow \varepsilon_s = \frac{0.003(435.29-50)}{435.29} = 0.0027$$

$$\rightarrow \varepsilon_y = 0.0021$$

❖ $\varepsilon_s > \varepsilon_y$

❖ $f_s = f_y = 420\ N/mm^2$

$$\rightarrow P_b = C_c = 0.85 * 28 * 370 * 1000 = 8806\ kN$$

$$\rightarrow P_n = \frac{982.7}{0.65} = 1511.85\ \text{kN}$$

$\because \boldsymbol{P_b > P_n}$

❖ **نستخدم صيغة وتني للشد**

$$\rightarrow P_n = 0.85 f_c^{`} bd \left[-\rho + (1 - \frac{e^{`}}{d}) + \sqrt{\left(1 - \frac{e^{`}}{d}\right)^2 + 2\rho\left[(m-1)\left(1 - \frac{d^{`}}{d}\right) + \frac{e^{`}}{d}\right]}\right]$$

$$e = \frac{1063}{882.7} = 1.08171\ m = 1081.71\ mm$$

$$e^{`} = 1081.71 + \frac{740-60}{2} = 1421.714\ mm$$

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output
	$\rightarrow \mathrm{m} = \frac{420}{0.85*28} = 17.65$	
	$1511.85*10^3 = 085*28*1000*740*\left[-\rho + \left(1 - \frac{1421.714}{740}\right) + \sqrt{\left(1 - \frac{1421.714}{740}\right)^2 + 2\rho\left[(17.65-1)\left(1-\frac{60}{740}\right) + \frac{1421.714}{740}\right]}\right]$	
	$\hookrightarrow \rho = 0.004$	
	$\rightarrow A_s = \rho bd = 0.004 * 1000 * 740 = 2960\, mm^2$	$2960mm^2$
	$\rightarrow \emptyset = 20mm \rightarrow A_b = \frac{\pi*20^2}{4} = 314.159mm^2$	
	$\rightarrow S = \frac{314.159}{2960} * 1000 = 106.08mm$	106mm
	$\rightarrow\ No.of\ bars = \frac{1000}{100} + 1 = 11\ bars/m$	11bars/m
	$\mathbf{11\emptyset 20mm@100mm \quad c/c\ \ (A_s = 3141.6mm^2)}$	

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output

2- Longitudinal Reinforcement:

(50% of main reinforcement)

$$A_s = 3141.6mm^2$$

$$A_{s.long.} = \frac{50}{100} * 3141.6 = 1570.8mm^2$$ 1570mm^2

$$S = \frac{201.062}{1570.8} * 1000 = 128mm$$ 128mm

$$\emptyset \mathbf{16mm@100mm\ c/c\ (A_s = 2010.62mm^2)}$$

- ***Shear check:***

$$V_c = 0.17\sqrt{28} * 1000 * 740 * 10^{-3} = 665.67\text{kN}$$

$$V_u = 195.9kN < \frac{\phi V_c}{2} = \frac{0.75 * 665.67}{2}$$
$$= 249.63\text{kN}$$

❖ **المقطع يتحمل القص الواقع عليها وبذلك لايحتاج إلي كانات .**

4.2.5 Expansion Joints

$$T1 = 45\ C^{\circ}$$
$$T2 = 25C^{\circ}$$
$$\alpha = 1.2 * 10^{-5}$$

بإستخدام وصلات تمدد $20\ mm$

$$L = \frac{0.02}{1.2 * 10^{-5} * (45 - 25)} = 83.33m$$ 83m