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:

$\because f_c^` \leq 28Mpa$

$\beta_1 = 0.85$

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

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

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

❖ $\rho = 0.00849$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output
	$\rightarrow m = \frac{420}{0.85*28} = 17.64706$	
	$\rightarrow R_u = 0.00849 * 420 * (1 - 0.5 * 17.64706 * 0.00849)$	
	$= 3.29868\ N/mm^2$	
	$\rightarrow M_n = \frac{3111.1}{0.9} = 3456.77778 kNm$	
	$\because\ M_n = R_u b d^2 \quad \rightarrow \quad d = \sqrt{\frac{M_n}{R_u * b}}$	
	$d^{`} = \sqrt{\frac{3456.77778 * 10^6}{3.29868 * 1000}} = 1023.68334 mm$	
	$h^{`} = 1023.68334 + 50 + 12.5 = 1086.18334 mm$	1086mm
	$> h = 800mm \quad \rightarrow \quad Not\ ok$	
	∴ يتم تكبير المقطع .	
	use $\boldsymbol{h = 1100mm}$	1100mm

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output
	ثانياً : حساب حديد التسليح :	
	$\rightarrow d = 1100 - 50 - 12.5 = 1037.5mm$	
	$\rightarrow \quad R_u = \frac{3456.77778*10^6}{1000*1037.5^2} = 3.21141\ N/mm^2$	
	$\rightarrow \rho = \frac{1}{17.64706}\left(1 - \sqrt{1 - \frac{2*17.64706}{420} * 3.21141}\right) =$ 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
	$No. of bars = \frac{1000}{50} + 1 = 21\ bars/m$	21bars/m
	$\mathbf{21\emptyset 25mm@50mm\ c/c}\ \ (\boldsymbol{A_s = 9817.5mm^2})$	

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 :

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

$$\therefore \beta_1 = 0.85$$

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

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

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

❖ $\rho = 0.00849$

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

component	Designed by :	Page NO :
	Checked by :	

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

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output
	ثانياً : حساب حديد التسليح :	
	$\rightarrow d = 1100 - 50 - 12.5 = 1037.5mm$	
	$\rightarrow \ R_u = \frac{1703.66667 * 10^6}{1000 * 1037.5^2} = 1.58274 N/mm^2$	
	$\rightarrow \rho = \frac{1}{17.64706}\left(1 - \sqrt{1 - \frac{2 * 17.64706}{420} * 1.58274}\right)$	
	$= 0.00390$	
	$\rightarrow A_s = 0.00390 * 1000 * 1037.5 = 4046.25mm^2$	$4046mm^2$
	$\emptyset = 25mm \ \rightarrow A_b = \frac{\pi * 25^2}{4}$	
	$= 490.87385mm^2$	
	$\rightarrow S = \frac{490.87385}{4046.25} * 1000 = 121.42829mm$	121mm
	$No. of bars = \frac{1000}{120} + 1 = 9.33333 \ bars/m$	9bars/m
	$\mathbf{9\emptyset 25mm@120mmc/c} \ (\mathbf{A_s = 4090.58mm^2})$	

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output
	2- Shear Design: $(\phi = 0.75)$ ⇨ $d = 1100 - 50 - 12.5 = 1037.5mm$ ⇨ $V_c = 0.17\sqrt{28} * 1000 * 1037.5 * 10^{-3} = 933.29\text{kN}$ ⇨ $V_u = 999.2kN \; > \; \frac{\phi V_c}{2} = \frac{0.75*933.29}{2} = 352.32\text{kN}$ ⇨ $V_u = 999.2kN \; > \; \phi\text{V}_\text{c} = 0.75 * 933.29 = 699.97kN$ $\emptyset = 10mm$ $A_v = \frac{2 * \pi * 10^2}{4} = 157.0736mm^2$ $V_n = \frac{999.2}{0.75} = 1332.26667\text{kN}$ $V_n = V_c + V_s \quad \rightarrow V_s = V_n - V_c$ $V_s = 1332.27 - 933.29 = 398.98\text{kN}$ $S = \frac{157.0736 * 420 * 1037.5}{398.98 * 10^{-3}} = 171.55mm$	$157mm^2$ 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
	$\therefore S = 150mm$	
	$\mathbf{\emptyset 10mm@150mm \quad c/c}$	
	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
	$\boldsymbol{\emptyset 16mm@80mm \ c/c \ (A_s = 2045.3mm^2)}$	

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
	$\boldsymbol{\emptyset 16mm@80mmc/c}$ ($\boldsymbol{A_s = 2513.28mm^2}$)	
	➢ **Axial load Check:**	
	$A_{s.provide} = 4090.617 + 9817.48$ $= 13908.097mm^2$	
	$A_{s.required} = 4049.174 + 8555.437$ $= 12604.61mm^2$	
	$A_s = A_{s.provide} - A_{s.required} = 13908.097 - 12604.61$ $= 1303.487mm^2$	$1304mm^2$
	$F = A_s * f_y = 1303.487 * 420 = 547.465kN$	
	$\because P = 345kN < F = 547.465kN$	
	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**

$f_y = 420N/mm^2$

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

$b = 1000mm$

$h = 1000mm$

$P = 387.6kN$

$V_u = 967.4kN$

$M_u = 2102.3kNm$

$\phi = 0.9$

اولاً: التاكد من قيمة العمق الماخوذة h:

$\because f_c^` \leq 28Mpa$

$\beta_1 = 0.85$

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

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

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

❖ $\rho = 0.00849$

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output
	$\rightarrow m = \frac{420}{0.85*28} = 17.64706$	
	$\rightarrow R_u = 0.00849 * 420 * (1 - 0.5 * 17.64706 * 0.00849)$	
	$= 3.29868\ N/mm^2$	
	$\rightarrow M_n = \frac{2102.3}{0.9} = 2335.88889kNm$	
	$\because\ M_n = R_u b d^2 \quad \rightarrow \quad d = \sqrt{\frac{M_n}{R_u * b}}$	
	$d^` = \sqrt{\frac{2335.88889 * 10^6}{3.29868 * 1000}} = 841.50364\ mm$	
	$h^` = 841.50364 + 50 + 12.5 = 904.00364mm \ < h = 1000mm \ \rightarrow \ ok$	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
	$No.of bars = \frac{1000}{70} + 1 = 15.28571\ bars/m$	15bars/m
	$\mathbf{15\emptyset 25mm@50mm\ c/c}\ \ (\boldsymbol{A_s} = \mathbf{18817.5mm^2})$	

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 :** $\because f_c^` \leq 28Mpa$ $\therefore \beta_1 = 0.85$ ⇨ $\rho_b = \frac{0.85*28*0.85}{420}\left(\frac{600}{600+420}\right) = 0.02833$ ⇨ $\rho_{max} = 0.6 * 0.02833 = 0.01700$ ⇨ $\rho_{min} = \frac{1.4}{420} = 0.00333$ ❖ $\rho = 0.00849$ $\rightarrow m = \frac{420}{0.85*28} = 17.64706$	

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output
	$\rightarrow R_u = 0.00849 * 420 * (1 - 0.5 * 17.64706 * 0.00849)$ $= 3.29868\ N/mm^2$ $\rightarrow M_n = \frac{1948.3}{0.9} = 2164.77778\ KN.m$ $\because\ M_n = R_u b d^2 \rightarrow \qquad d = \sqrt{\frac{M_n}{R_u * b}}$ $d^` = \sqrt{\frac{2164.77778 * 10^6}{3.29868 * 1000}} = 810.09615\ mm$   $h^` = 810.09615 + 50 + 12.5 = 872.59615\ mm\ <\ h = 1000mm\ \rightarrow ok$	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
	$No.of bars = \frac{1000}{80} + 1 = 13.5\ bars/m$	13bars/m
	$\mathbf{13\emptyset 25mm@120mmc/c}\ (\boldsymbol{A_s = 6135.875\ mm^2})$	

component	Designed by :	Page NO :
	Checked by :	

Re	Calculations	output
	2- Shear Design:	
	$$(\phi = 0.75)$$	
	⇨ $d = 1000 - 50 - 12.5 = 937.5mm$	
	⇨ $V_c = 0.17\sqrt{28} * 1000 * 937.5 * 10^{-3} = 843.33323\text{kN}$	
	⇨ $V_u = 967.4\ KN > \frac{\phi V_c}{2} = \frac{0.75*843.33323}{2} = 316.24996\ \text{KN}$	
	⇨ $V_u = 967.4\ KN > \phi \text{V}_\text{c} = 0.75 * 843.33323 = 632.49992\ KN$	
	$$\emptyset = 10mm$$	
	$$A_v = \frac{2 * \pi * 10^2}{4} = 157.0736mm^2$$	$157mm^2$
	$$V_n = \frac{967.4}{0.75} = 1289.86667\ \text{KN}$$	
	$$V_n = V_c + V_s \quad \rightarrow V_s = V_n - V_c$$ $$V_s = 1289.86667 - 843.33323 = 446.53344\ \text{KN}$$	
	$$S = \frac{157.0736 * 420 * 937.5}{446.53344 * 10^{-3}} = 138.50638\ mm$$	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
	$\therefore S = 120mm$ $\mathbf{\emptyset 10mm@120mm \quad c/c}$	
	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
	$\boldsymbol{\emptyset 16mm@50mm\ \ c/c\ \ (A_s = 4021.24\ mm^2)}$	

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:**	
	$A_{s.provide} = 6135.925 + 7012.486$	
	$= 13148.411\ mm^2$	
	$A_{s.required} = 6306.733 + 5816.235$	
	$= 12122.968\ mm^2$	
	$A_s = A_{s.provide} - A_{s.required}$	$1026mm^2$
	$= 13148.411 - 12122.968$	
	$= 1025.443\ mm^2$	
	$F = A_s * f_y = 1025.443 * 420 = 430.686\ KN$	
	$\because P = 387.6\ KN < F = 430.686\ KN$	
	❖ **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 ($\boldsymbol{K\frac{Lu}{r}}$)

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

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

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

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

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 $\therefore$

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

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

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

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

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output
	$2053.7*10^3 = 0.85*1000*28*740 * \left[-\rho + \left(1-\frac{799.32}{740}\right) + \sqrt{\left(1-\frac{799.32}{740}\right)^2 + 2\rho\left[(17.65-1)\left(1-\frac{60}{740}\right)+\frac{799.32}{740}\right]}\right]$	
	↳ $\rho = 0.002$	
	$\rightarrow A_s = \rho bd = 0.002*1000*740 = 1480\ mm^2$	$1480mm^2$
	$\rightarrow \emptyset = 20mm \rightarrow A_b = \frac{\pi*20^2}{4} = 314.159mm^2$	
	$\rightarrow S = \frac{314.159}{1480}*1000 = 212.16mm$	212mm
	$\rightarrow No.of\ bars = \frac{1000}{150}+1 = 8\ bars/m$	8bars/m
	$\mathbf{8\emptyset 20mm@150mm\ \ c/c\ \ (A_s = 2094.39mm^2)}$	

component	Designed by :	Page NO :
	Checked by :	

Re	calculations	output
	2-Longitudinal Reinforcement : (50% of main reinforcement) $A_s = 2094.39mm^2$ $A_{s.long.} = \frac{50}{100} * 2094.39 = 1047.20mm^2$ $S = \frac{201.062}{1047.20} * 1000 = 192mm$ $\boldsymbol{\emptyset 16mm@150mm\ \ c/c\ \ (A_s = 1340.41mm^2)}$ ➢ ***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.***	 $1047mm^2$ 192mm

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

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

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

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

$\rightarrow \varepsilon_y = 0.0021$

❖ $\varepsilon_s > \varepsilon_y$

❖ $f_s = f_y = 420\ N/mm^2$

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

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

$\because \boldsymbol{P_b > P_n}$

❖ **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*10³ =085*28*1000*740*$\left[-\rho + \left(1 - \frac{1421.714}{740}\right) + \sqrt{\left(1 - \frac{1421.714}{740}\right)^2 + 2\rho\left[(17.65 - 1)\left(1 - \frac{60}{740}\right) + \frac{1421.714}{740}\right]}\right]$	
	$\Rsh \rho = 0.004$	
	$\rightarrow A_s = \rho bd = 0.004 * 1000 * 740 = 2960\, mm^2$	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
	$\boldsymbol{\emptyset 16mm@100mm\ \ c/c\ \ (A_s = 2010.62mm^2)}$	
	➢ ***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