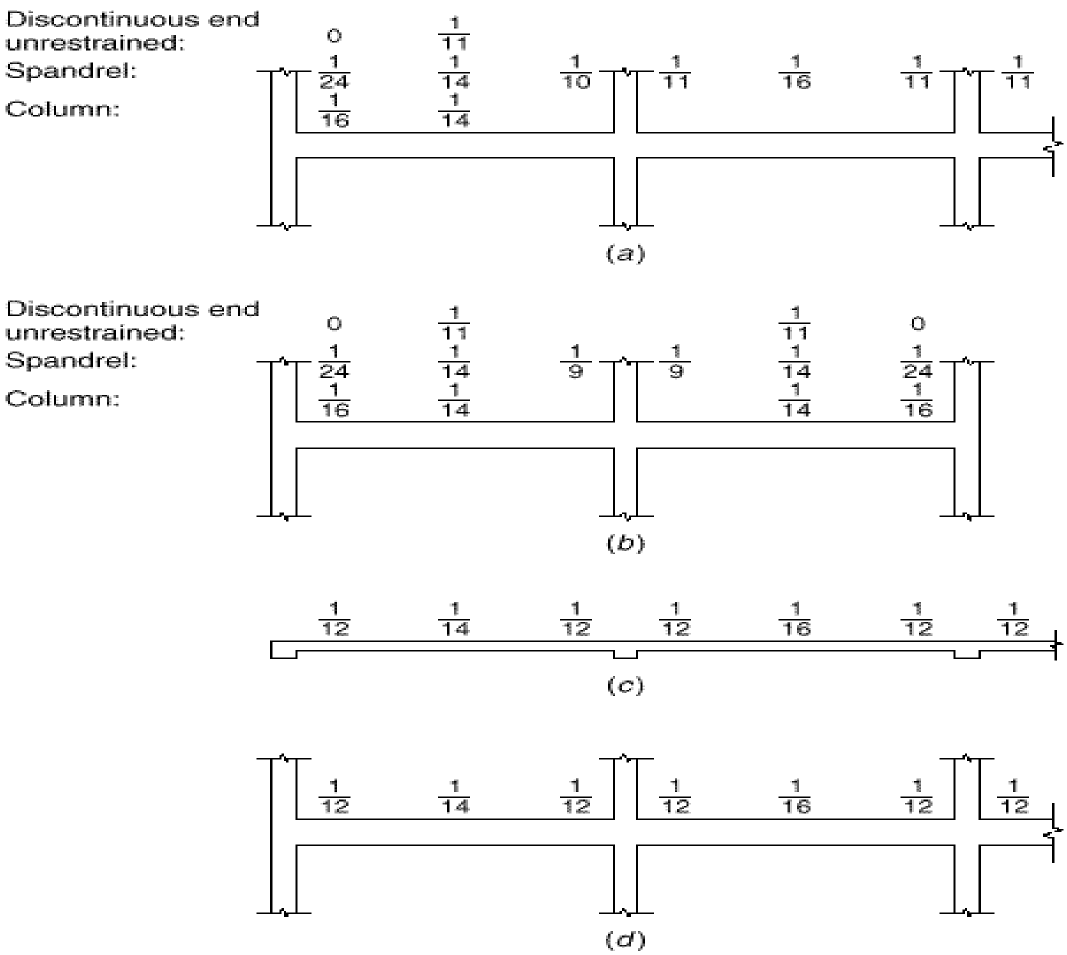
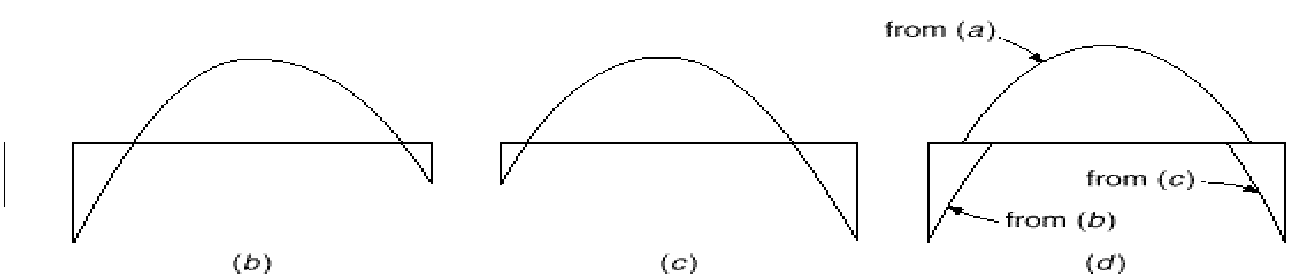
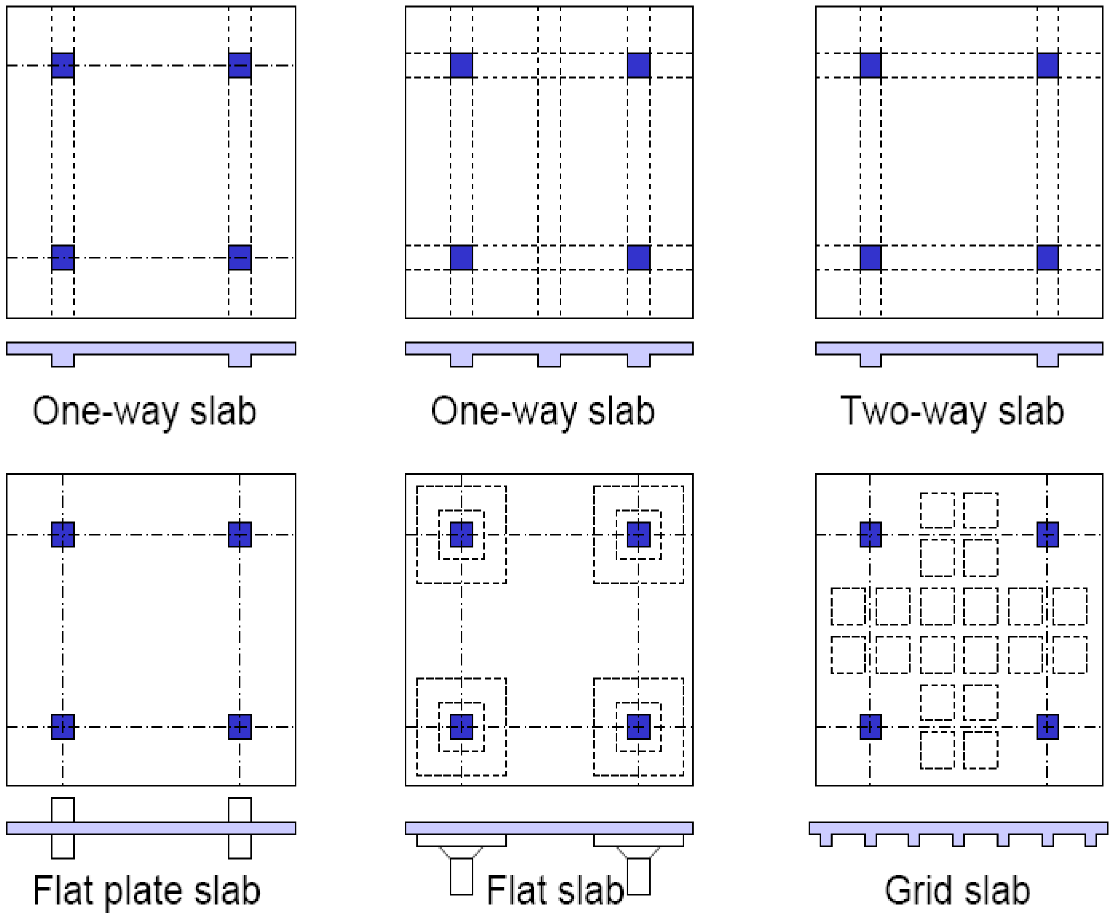


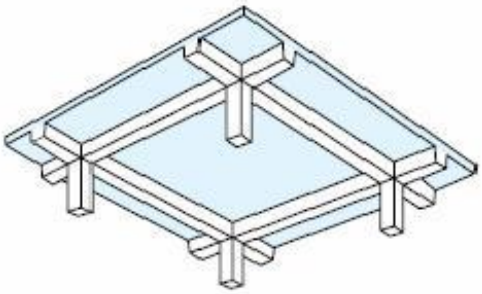


; and moment envelope for a continuous beam: (*a*) maximum positive moment; (*b*) maximum negative
mum negative moment at right end; (*d*) composite moment envelope.

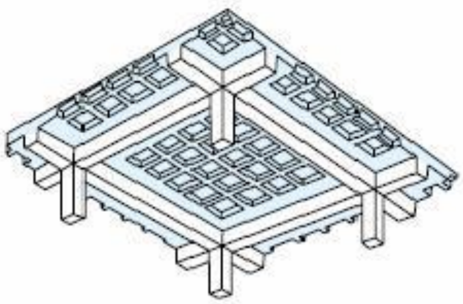
Types of Slab



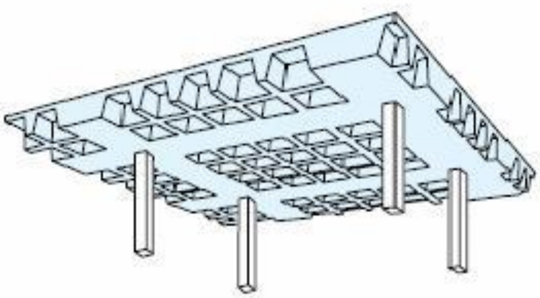
TWO-WAY SLABS



Solid (with beams) p 26

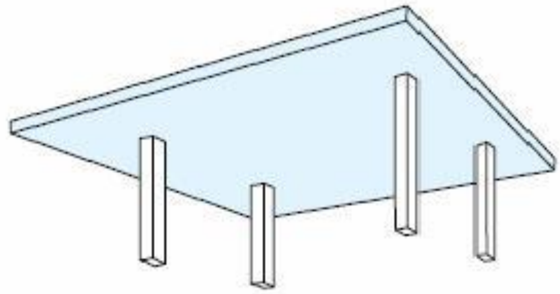


Waffle (with beams) pp 28, 30

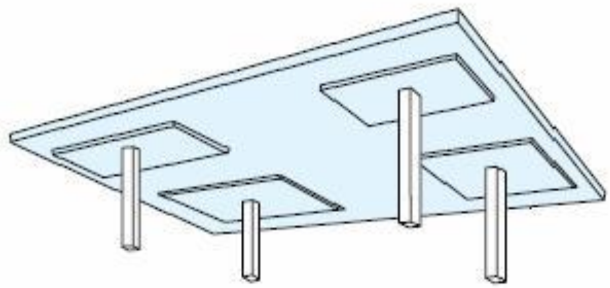


Waffle with integral beams pp 32, 34

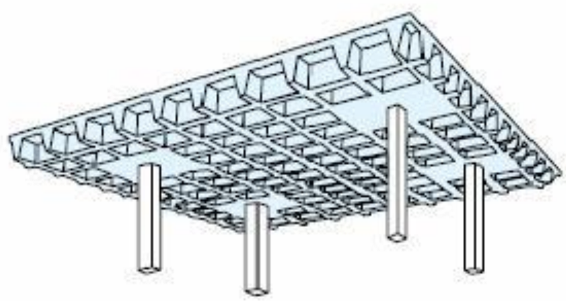
FLAT SLABS



Solid p 36
(post-tensioned p 106)



Solid with drops p 38
Solid with column heads p 40
Solid with edge beams p 42



Waffle p 44

One way Solid Slab formula:

$$R_n = \frac{M_u/0.9}{1000 * d^2} * 10^6 = \_\_Mpa\ , \qquad d = h - 20 - \frac{d_b}{2} = \ \_\_mm$$

$$m = \frac{f_y}{0.85 * f_c} = \_\ , \qquad \rho = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2 * R_n * m}{f_y}}\right) = \_$$

$$A_s = \rho * 1000 * d = \_\ mm^2\ , \qquad A_{s\ min} = 0.0018 * 1000 * h = \_\ mm^2$$

$$S_{max} = \min\left(\frac{A_b}{A_s} * 1000\ , 300mm\ , 2 * h\right) = \_\ mm$$

$$for\ flexural\ \rightarrow use\ \emptyset d_b @ S_{max}$$

$$A_{s\ min} = 0.0018 * 1000 * h = \_\_\ mm^2$$

$$S_{max} = \min\left(\frac{A_b}{A_s} * 1000\ , 300mm\ , 4 * h\right) = \_mm$$

$$for\ shrinkage\ \rightarrow use\ \emptyset d_b @ S_{max}$$

Beam formula:-

$$R_n = \frac{M_u/0.9}{1000 * d^2} * 10^6 = \_\_Mpa$$

$$d = 600 - 40 - d_s - \frac{d_b}{2} = \_\_\ mm\ \ (one\ layer)$$

$$d = 600 - 40 - d_s - 25 - \frac{S}{2} = \_\_\ mm\ \ (two\ layer)$$

$$m = \frac{f_y}{0.85 * f_c} = \_\_\ , \qquad \rho = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2 * R_n * m}{f_y}}\right) = \_\_$$

$$A_s = \rho * b * d = \_\ mm^2\ ,$$

$$A_{s\ min}(1) = \frac{1.4}{420} * b_w * d = \_mm^2$$

$$A_{s\ min}(2) = \frac{\sqrt{f_c}}{4 * 420} * b_w * d = \_\_\ mm^2$$

$$A_{s\ min} = \max(A_{s\ min}(1)\ , A_{s\ min}(2)\ ) = \_mm^2$$

$$check \qquad A_s > A_{s\ min}\ \ ok$$

$$n = \frac{A_s}{A_b} = real\ number$$

$$check \quad b_{min} = 80 + 60 + (n-1)(d_b + 25) > b \quad ok$$

$$if \ \frac{a_b}{d} = \beta_1 \left(\frac{600}{600 + f_y}\right) > \frac{a}{d} \quad \therefore f_{s=fy}$$

$$if \ \frac{a_{TCL}}{d_t} = 0.375\,\beta_1 > \frac{a}{d_t} \quad \therefore Tension - controlled\ section$$

$$\emptyset V_c = 0.75 * \frac{\sqrt{f_c}}{6} * b_w * d * 10^{-3} = \_\_kn$$

$$V_s = \frac{V_u - \emptyset V_c}{0.75} = \_kn$$

$$A_v = 2 * \pi \frac{{d_s}^2}{4} = \_\_ mm^2 \ (two\ leg)$$

$$S = \frac{A_v * f_y * d}{V_s} * 10^{-3}\_\_mm$$

$$if \ V_s \le 2V_c$$

$$S_{max} = \min(600\ , \frac{d}{2})$$

$$if \ 2V_c < V_s \le 4V_c$$

$$S_{max} = \min\left(300\ , \frac{d}{4}\right)$$

$$if \ V_s > 4V_c$$

$$need\ to\ increse\ the\ section$$

$$if \ V_u < \frac{1}{2} \emptyset V_c$$

$$no\ need\ for\ shear\ reinforcment$$

$$if \ \emptyset V_c > V_u > \frac{1}{2} \emptyset V_c$$

$$need\ to\ provide\ minmume$$

$$a_{v\,min} = \max\{\left(\frac{1}{16}\sqrt{f_c} * b_w * \frac{s}{f_y}\right), (\frac{b_w * s}{3f_y})\}$$

Example 1:

The figure shown below shows the architectural plan for 3-story building. The slab will be designed to carry super imposed dead load ($2.5 KN/m^2$) and Live load ($3 KN/ m^2$) by compressive strength 25 Mpa and steel yield strength 420 Mpa.

Given data:

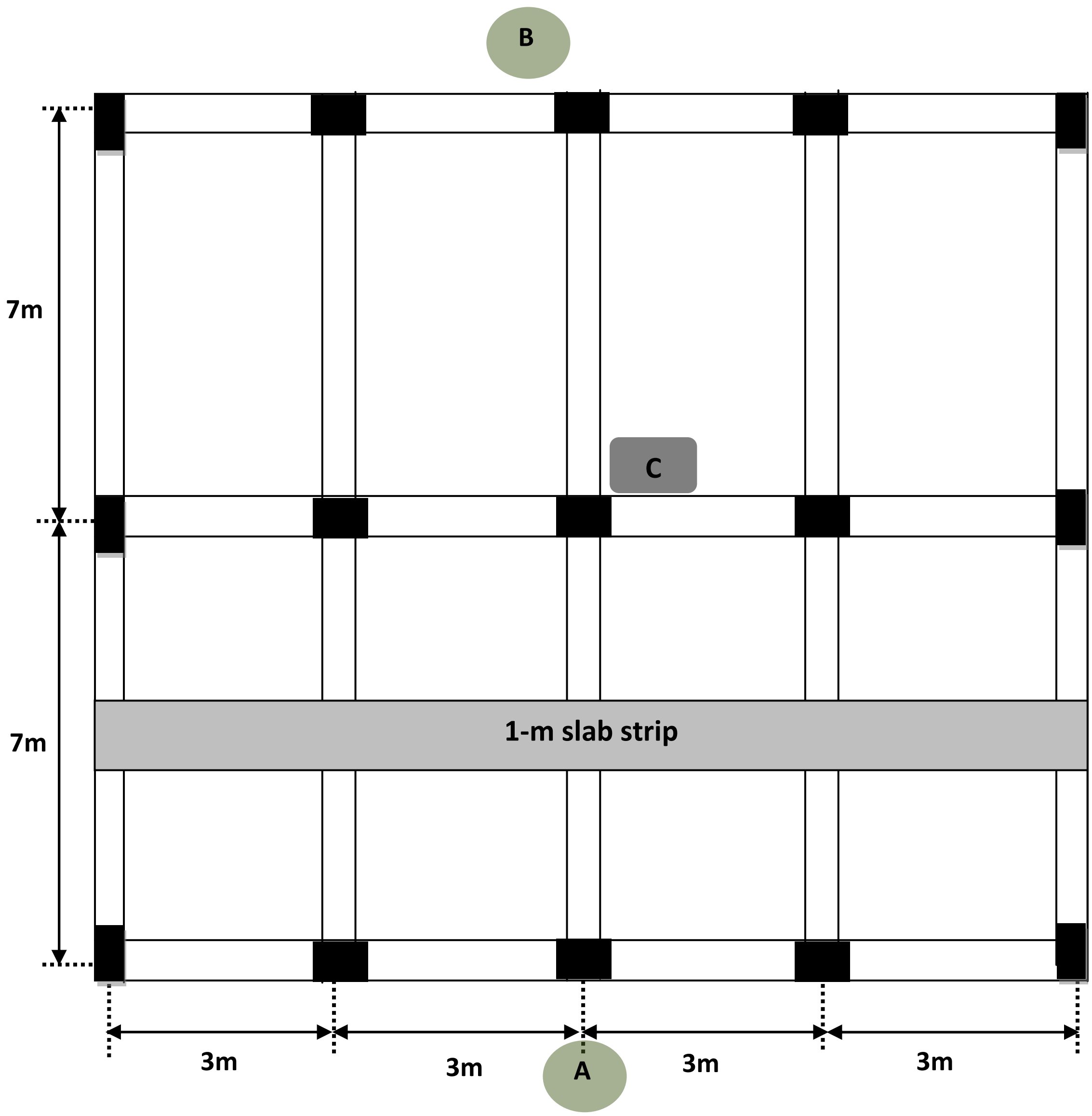
The one way solid slab is used.

Weight of Wall =15Kn/m

The slab thickness= 130mm

The beams dimensions = (300,600) mm

The columns dimensions= (300,500) mm



Determine the following:

1- Check if Slab thickness meets SBC304.
2- Design the slab for Max +Ve moment.
3- Design the slab for Max -Ve moment.
4- Check the slab for Shear reinforcement.
5- Draw the details and show all value.
6- Design the beam (A-B) for flexure and shear.
7- Calculate the axial load acting on column C.

Solution:

$$h_{min} = \frac{l}{28} = \frac{3000}{28} = 107.14\ mm$$

$$h_{min} = \frac{l}{24} = \frac{3000}{24} = 125\ mm$$

$$h_{min} = \max(107.14,125) = 125\ mm$$

$$h > h_{min} \rightarrow ok$$

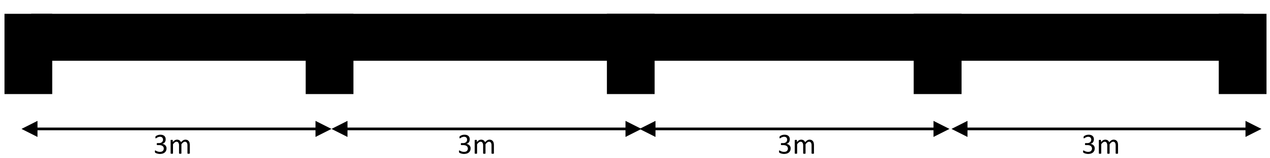
$$DL = own\ weight + superimposed$$

$$DL = (0.13 * 25) + 2.5 = 5.75\ kn/m^2$$

$$LL = 3\ kn/m^2$$

$$Wu = 1.4DL + 1.7LL$$

$$Wu = 1.4(5.75) + 1.7(3) = 13.15\ kn/m^2$$



Lu (m)	3m			3m			3m			3m		
Ln (m)	2.7m			2.7m			2.7m			2.7m		
Cm	1/12	1/14	1/12	1/12	1/16	1/12	1/12	1/16	1/12	1/12	1/14	1/12
Wu(kn/m^2)	13.15	13.15	13.15	13.15	13.15	13.15	13.15	13.15	13.15	13.15	13.15	13.15
Mu(kn.m)	7.99	6.85	7.99	7.99	5.99	7.99	7.99	5.99	7.99	7.99	6.85	7.99
D (mm)	104	104	104	104	104	104	104	104	104	104	104	104
Rn (Mpa)	0.821	0.704	0.821	0.821	0.615	0.821	0.821	0.615	0.821	0.821	0.704	0.821
P	0.002	0.0017	0.002	0.002	0.0015	0.002	0.002	0.0015	0.002	0.002	0.0017	0.002
As (mm^2)	208	176.8	208	208	156	208	208	156	208	208	176.8	208

As $_{min}$(mm^2)	234	234	234	234	234	234	234	234	234	234	234	234
As (mm^2)	234	234	234	234	234	234	234	234	234	234	234	234
S $_{max}$ (mm)	260	260	260	260	260	260	260	260	260	260	260	260
As $_{rinkashge}$ (mm^2)	234	234	234	234	234	234	234	234	234	234	234	234
S $_{max}$ (mm)	300	300	300	300	300	300	300	300	300	300	300	300
Cv	1		1.15	1		1	1		1	1		1
Vu (kn)	17.75		20.42	17.75		17.75	17.75		17.75	20.42		17.75
ϕVc (kn)	65		65	65		65	65		65	65		65

sample of cacluations

$$L_u = 3m\,, \qquad L_n = 3 - 0.15 - 0.15 = 2.7m$$

$$C_m = \frac{1}{12}\,, \qquad M_u = \frac{1}{12} * 13.15 * 2.7^2 = 7.99\ kn.m$$

$$d = 130 - 20 - \frac{12}{2} = 104mm\ \ , \qquad R_n = \frac{7.99/0.9}{1000 * 104^2} * 10^6 = 0.821\ Mpa$$

$$m = \frac{420}{0.85 * 25} = 19.765\,, \qquad \rho = \frac{1}{19.765}\left(1 - \sqrt{1 - \frac{2 * 0.985 * 19.765}{420}}\right) = 0.002$$

$$A_s = 0.002 * 1000 * 104 = 208\ mm^2\,, \qquad A_{s\ min} = 0.0018 * 1000 * 130 = 234\ mm^2$$

$$S_{max} = \min\left(\frac{113.04}{234} * 1000 = 483.1\ mm, 300mm, 2 * 130 = 260\right) = 260mm$$

$$for\ flexural\ \rightarrow use\ \emptyset 12@260\ mm$$

$$A_{s\ shrinkage} = 0.0018 * 1000 * 130 = 234\ mm^2$$

$$S_{max} = \min\left(\frac{113.04}{234} * 1000 = 483.1mm, 300mm, 4 * 130 = 520\right) = 300mm$$

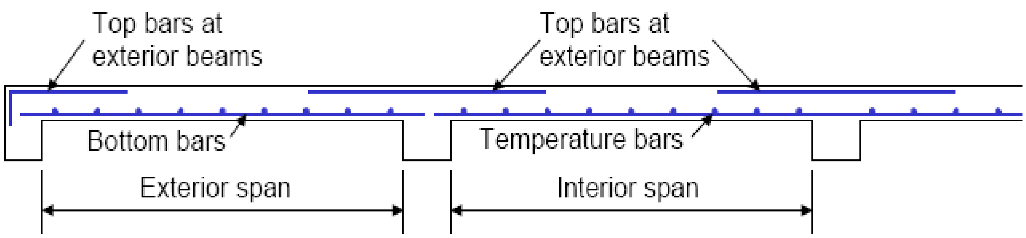
$$for\ shrinkage\ \rightarrow use\ \emptyset 12@300\ mm$$

$$C_v = 1.15\,, \qquad V_u = \frac{1.15 * 13.15 * 2.7}{2} = 20.42\ kn$$

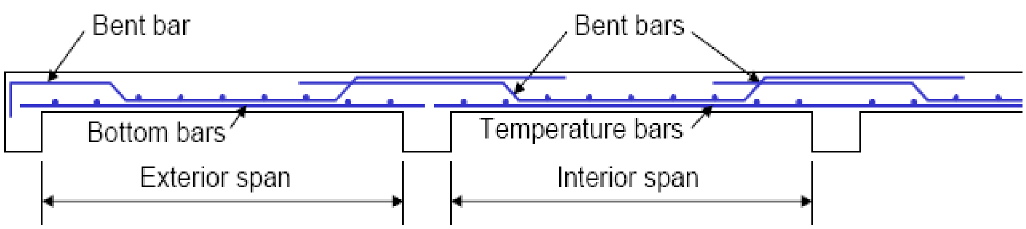
$$\emptyset V_c = 0.75 * \frac{\sqrt{25}}{6} * 1000 * 104 * 10^{-3} = 65\ kn$$

$$\emptyset V_c > V_u \rightarrow\ shear\ reinforcment\ is\ not\ needed$$

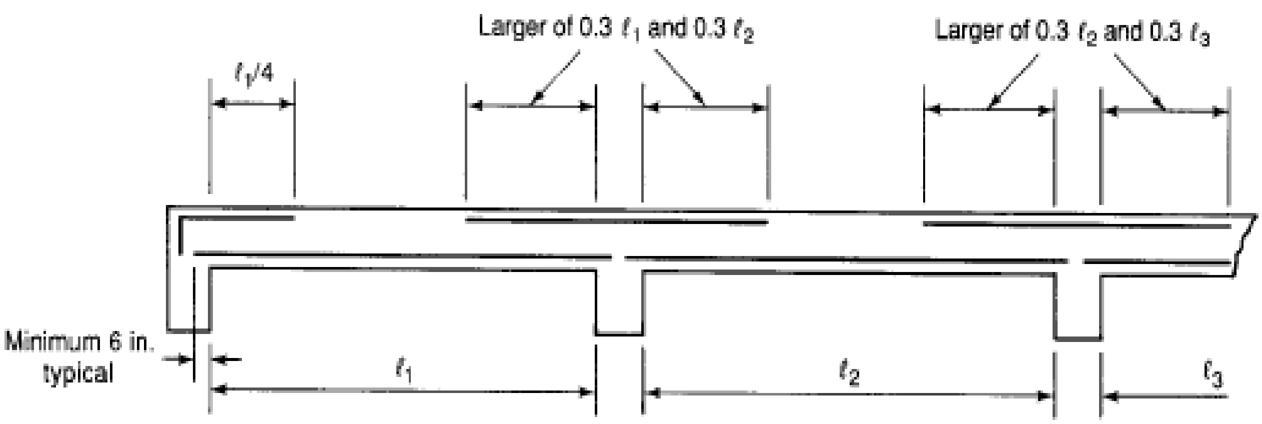
Typical reinforcement in a one-way slab



(a) Straight top and bottom bars

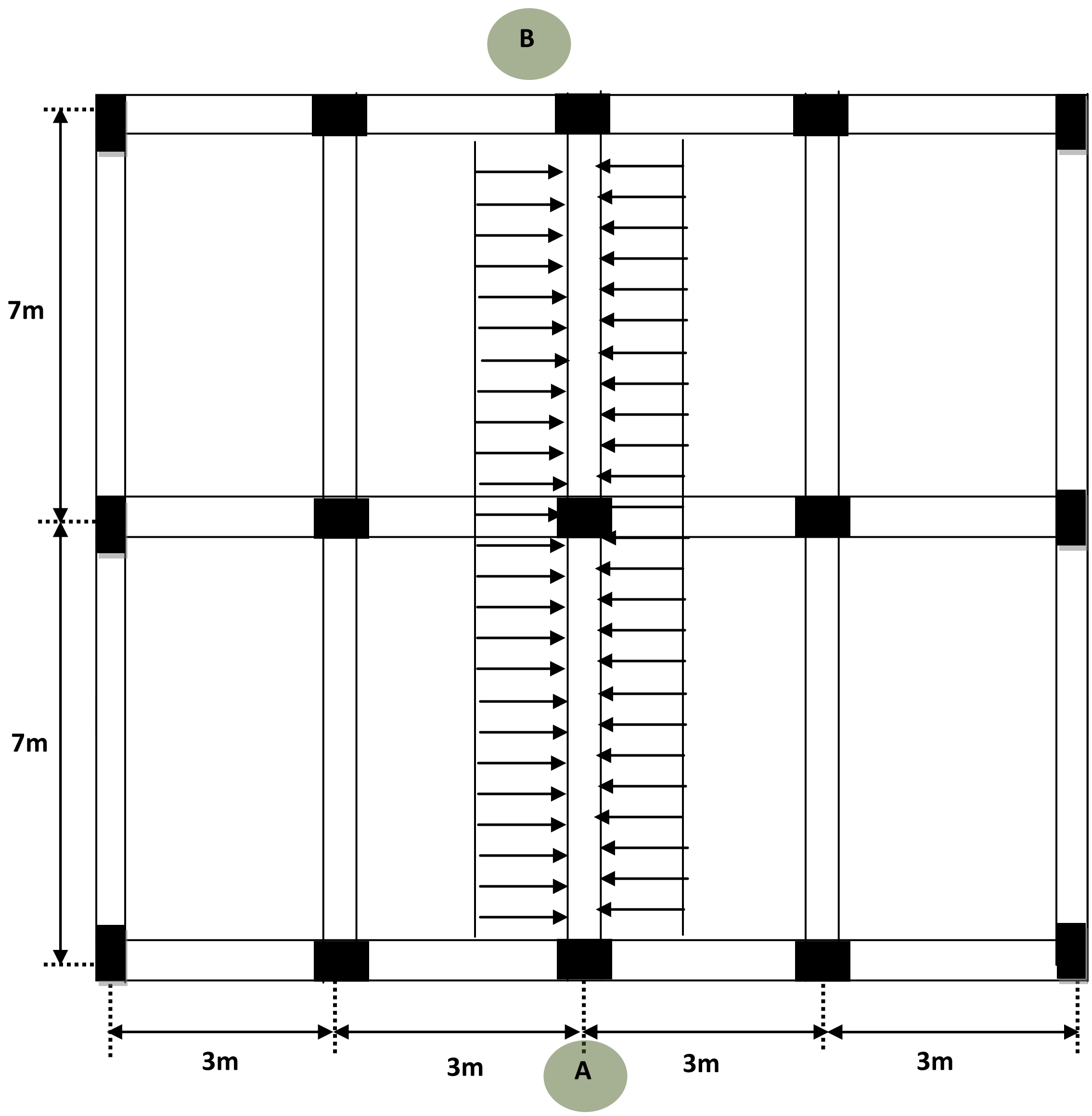


(b) Alternate straight and bent bars



(c) One-way slab

Design of beam (A-B) :-



Load acting on the beam (A-B)

1- Dead load:

$$DL = 5.75 * (1.5 + 1.5) + 15 + (0.47 * 0.3 * 25) = 35.775\ kn/m$$

2- Live load

$$LL = 3 * (1.5 + 1.5) = 9\ kn/m$$

$$Wu = 1.4(35.775) + 1.7(9) = 65.385\ \ kn/m$$

Lu (m)	7m			7m		
Ln(m)	6.7m			6.7m		
Wu(kn/m)	**65.385**					
Cm	1/16	1/14	1/9	1/9	1/14	1/16
Mu (kn.m)		210	326.13	326.13	210	
d(mm)		540 (one layer)	517.5(two layer)	517.5(two layer)	540 (one layer)	
Rn(Mpa)		2.667	4.51	4.51	2.667	
P		0.00681	0.01221	0.01221	0.00681	
As(mm^2)		1103.2	1896	1896	1103.2	
As_{min} (mm^2)		540	517.5	517.5	540	
n		3.51≈4	6.03≈7	6.03≈7	3.51≈4	
Fs=Fy		Ok	Ok	Ok	Ok	
TCL		Ok	Ok	Ok	Ok	
b_{min} (mm)		275	275	275	275	
Use		4Ø20	7Ø20	7Ø20	4Ø20	
Cv	1		1.15	1.15		1
Vu (kn)	219.04		252	252		219.04
ϕVc (kn)	101.25		97.03	97.03		101.25
Vs (kn)	157.05		206.67	206.67		157.05
Av (mm^2)	157		157	157		157
S (mm)	226.72		165.1	165.1		226.72
S_{max} (mm)	270		258.75	258.75		270
Use	Ø10@270		Ø10@160	Ø10@160		Ø10@270

sample of cacluations

$$L_u = 7m\,, \qquad L_n = 7 - 0.15 - 0.15 = 6.7m$$

$$C_m = \frac{1}{9}\,, \qquad M_u = \frac{1}{9} * 65.385 * 6.7^2 = 326.13\ kn.m$$

$$d = 600 - 40 - 10 - \frac{20}{2} = 540\ mm\ \ (one\ layer)$$

$$R_n = \frac{326.13/0.9}{300 * 540^2} * 10^6 = 4.14\ Mpa$$

$$m = \frac{420}{0.85 * 25} = 19.765\,, \qquad \rho = \frac{1}{19.765}\left(1 - \sqrt{1 - \frac{2 * 4.41 * 19.765}{420}}\right) = 0.0111$$

$$A_s = 0.0111 * 300 * 540 = 1798.2\ mm^2\,,$$

$$A_{s\,min} = \frac{1.4}{420} * 300 * 540 = 540\ mm^2$$

$$A_{s\,min} = \frac{\sqrt{25}}{4 * 420} * 300 * 540 = 483\ mm^2$$

$$A_{s\,min} = \max(540,483) = 540 mm^2$$

$$n = \frac{1798.2}{314} = 5.72 \approx 6$$

$$b_{min} = 80 + 60 + (5)(20 + 25) = 365mm > b = 300 \ \therefore use\ two\ layer$$

$$d = 600 - 40 - 10 - 20 - \frac{25}{2} = 517.5\ mm\ \ (two\ layer)$$

$$R_n = \frac{326.65/0.9}{300 * 517.5^2} * 10^6 = 4.51\ Mpa$$

$$m = \frac{420}{0.85 * 25} = 19.765\ , \qquad \rho = \frac{1}{19.765}\left(1 - \sqrt{1 - \frac{2 * 4.51 * 19.765}{420}}\ \right) = 0.01221$$

$$A_s = 0.01224 * 300 * 517.5 = 1896\ mm^2\ ,$$

$$A_{s\,min} = \frac{1.4}{420} * 300 * 517.5 = 517\ mm^2$$

$$A_{s\,min} = \frac{\sqrt{25}}{4 * 420} * 300 * 517.5 = 462.1\ mm^2$$

$$A_{s\,min} = \max(517,462.1) = 517 mm^2$$

$$n = \frac{1900.3}{314} = 6.03 \approx 7$$

$$a = \frac{7 * 314 * 420}{0.85 * 25 * 300} = 144.81\ mm$$

$$\frac{a_b}{d} = 0.5 > \frac{a}{d} = \ 0.28 \qquad \therefore\ f_{s=fy}$$

$$\frac{a_{TCL}}{d_t} = 0.31875\ > \frac{a}{d_t} = 0.268 \qquad \therefore\ Tension - controlled\ section$$

$$for\ flexure\ use\ \ 7\emptyset 20$$

$$C_v = 1.15\ , \qquad V_u = \frac{1.15 * 65.385 * 6.7}{2} = 252\ kn$$

$$\emptyset V_c = 0.75 * \frac{\sqrt{25}}{6} * 300 * 517.5 * 10^{-3} = 97.03kn$$

$$V_s = \frac{252.3 - 97.03}{0.75} = 206.67kn$$

$$A_v = 2 * \pi \frac{10^2}{4} = 157\ mm^2\ \ (two\ leg)$$

$$S = \frac{157 * 420 * 517.5}{206.67} * 10^{-3} = 165.1\ \ mm$$

$$V_s \leq 2V_c$$

$$S_{max}\ = min\left(300, \frac{517.5}{2} = 258.75\right) = 258.75\ mm$$

$$use\ \emptyset 10@160mm$$

Axial load on column C:-

Beam s in x- direction:

$$DL = \left\{\left((0.3 * 0.47 * 25) + 15\right) * \frac{3}{2}\right\} + \left\{\left((0.3 * 0.47 * 25) + 15\right) * \frac{3}{2}\right\} = 55.575\ kn$$

$$LL = 0 + 0 = 0\ kn$$

Beams in y- direction:

$$DL = \left\{\left((0.3 * 0.47 * 25) + (15) + (5.75 * 3)\right) * \frac{7}{2}\right\} + \left\{\left((0.3 * 0.47 * 25) + (15) + (5.75 * 3)\right) * \frac{7}{2}\right\} = 250.425\ kn$$

$$LL = \left\{(3 * 3) * \frac{7}{2}\right\} + \left\{(3 * 3) * \frac{7}{2}\right\} = 63\ kn$$

$$Wu = 1.4(55.575 + 250.425) + 1.7(63) = 388.5\ kn$$

Example 2:

Given data:-

$f_c = 30\ Mpa \quad , f_y = 420\ Mpa$

$super\ imposed = 2.5kn/m^2 \quad , \ LL = 3kn/m^2$

$weight\ of\ wall = 12kn/m$

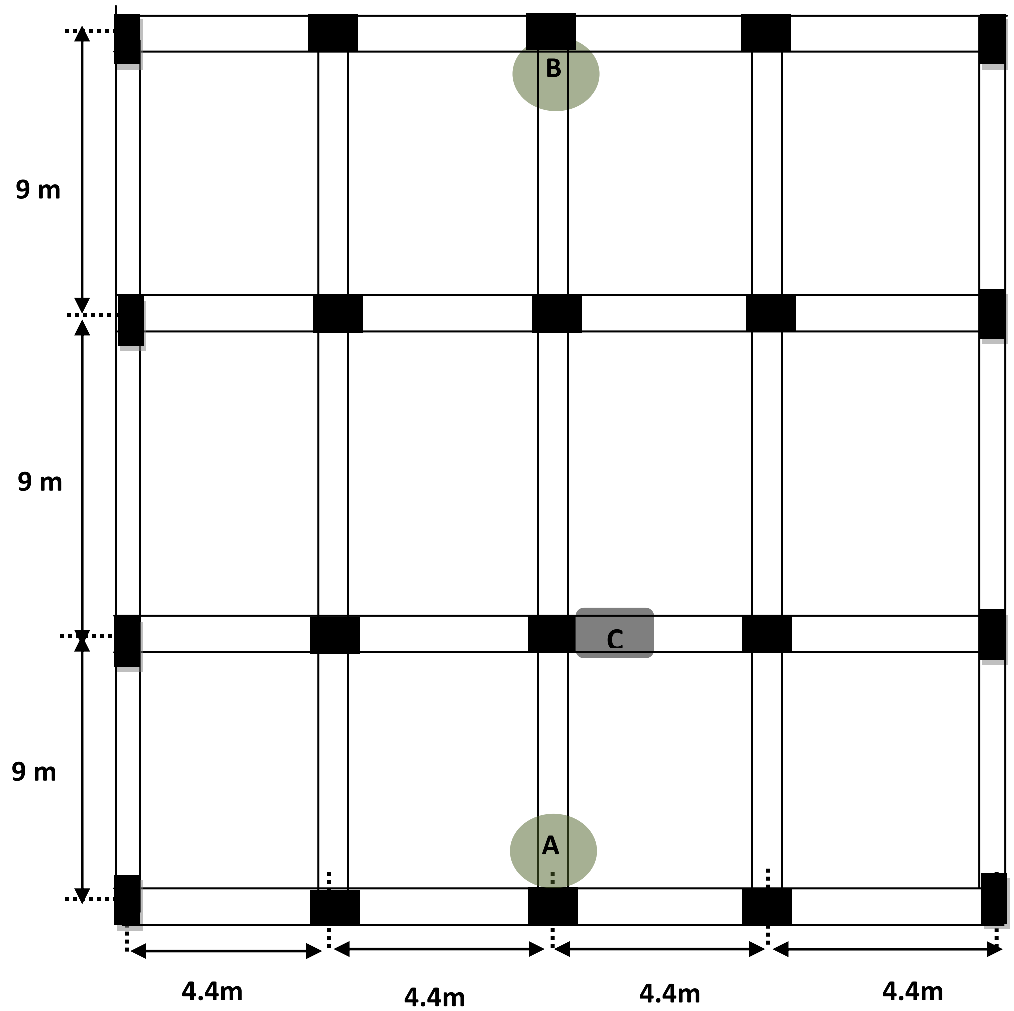
$h_s = 170mm \quad , beam\ size = (700{,}400) \quad , columns\ size\ (500{,}400)$

Required:-

Design the one way solid slab for flexure and shear.

Design the beam (A-D) for flexure and shear.

Compute the axial load on column C.



$$h_{min} = \frac{l}{28} = \frac{4400}{28} = 157.14\, mm$$

$$h_{min} = \frac{l}{24} = \frac{4400}{24} = 183.33\, mm$$

$$h_{min} = \max(157.14\ , 183.33) = 183.33\, mm$$

$$h < h_{min} \rightarrow not\ satisfied\ deflection\ requiremnt$$

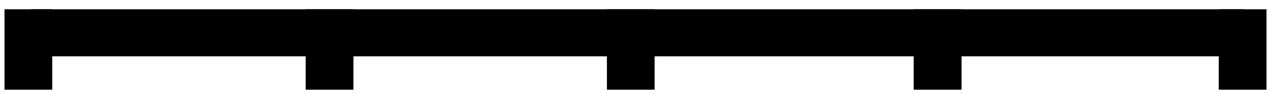
$$DL = own\ weight + superimposed$$

$$DL = (0.17 * 25) + 2.5 = 6.75\ kn/m^2$$

$$LL = 3\ kn/m^2$$

$$Wu = 1.4DL + 1.7LL$$

$$Wu = 1.4(6.75) + 1.7(3) = 14.55\, kn/m^2$$



Lu (m)	4.4m			4.4m			4.4m			4.4m		
Ln (m)	4m			4m			4m			4m		
Cm	1/24	1/14	1/10	1/11	1/16	1/11	1/11	1/16	1/11	1/10	1/14	1/24
Wu(kn/m^2)	14.55	14.55	14.55							14.55	14.55	14.55
Mu(kn.m)		16.63	23.28							23.28	16.63	
d (mm)		144	144							144	144	
Rn (Mpa)		0.891	1.25							1.25	0.891	
P		0.00216	0.0031							0.0031	0.00216	
As (mm^2)		311	446.4							446.4	311	
As $_{min}$(mm^2)		306	306							306	306	
As (mm^2)		311	446.9							446.9	311	
S $_{max}$ (mm)		300	253							253	300	
As $_{rinkashge}$ (mm^2)		306	306							306	306	
S $_{max}$ (mm)		300	300							300	300	
Cv			1.15							1.15		
Vu (kn)			33.465							33.465		
ϕVc (kn)			98.59							98.59		

sample of cacluations

$$L_u = 4.4m\ , \qquad L_n = 4.4 - 0.2 - 0.2 = 4m$$

$$C_m = \frac{1}{10}\ , \qquad M_u = \frac{1}{10} * 14.55 * 4^2 = 23.28kn.m$$

$$d = 170 - 20 - \frac{12}{2} = 144mm\ , \qquad R_n = \frac{23.28/0.9}{1000 * 144^2} * 10^6 = 1.25\ Mpa\ ,$$

$$m = \frac{420}{0.85 * 30} = 16.471\ , \qquad \rho = \frac{1}{16.471}\left(1 - \sqrt{1 - \frac{2 * 1.25 * 16.471}{420}}\right) = 0.0031$$

$$A_s = 0.0031 * 1000 * 144 = 446.4\ mm^2\ , \qquad A_{s\ min} = 0.0018 * 1000 * 170 = 306\ mm^2$$

$$S_{max} = \min\left(\frac{113.04}{446.4} * 1000 = 253.22mm, 300mm, 2 * 170 = 340\right) = 253.22mm$$

$$for\ flexural\ \rightarrow use\ \emptyset 12@250\ mm$$

$$A_{s\ shrinkage} = 0.0018 * 1000 * 170 = 306\ mm^2$$

$$S_{max} = \min\left(\frac{113.04}{306} * 1000 = 452.88mm, 300mm, 4 * 170 = 680\right) = 300mm$$

$$for\ shrinkage\ \rightarrow use\ \emptyset 12@300\ mm$$

$$C_v = 1.15\ , \qquad V_u = \frac{1.15 * 14.55 * 4}{2} = 33.465\ kn$$

$$\emptyset V_c = 0.75 * \frac{\sqrt{30}}{6} * 1000 * 144 * 10^{-3} = 98.59\ kn$$

$$\emptyset V_c > V_u \rightarrow\ shear\ reinforcment\ is\ not\ needed$$

Load acting on the beam (A-B)

1- Dead load:

$$DL = 6.75 * (2.2 + 2.2) + 12 + (0.53 * 0.4 * 25) = 47\ kn/m$$

2- Live load

$$LL = 3 * (2.2 + 2.2) = 13.2\ kn/m$$

$$Wu = 1.4(47) + 1.7(13.2) = 88.24\ \ kn/m$$

Lu (m)	9m			9m			9m		
Ln(m)	8.6m			8.6m			8.6m		
Wu(kn/m)	**88.24**								
Cm	1/16	1/14	1/10	1/11	1/16	1/11	1/10	1/16	1/11
Mu (kn.m)		466.2	652.6				652.6	466.2	
d(mm)		615.5	615.5				615.5	615.5	
Rn(Mpa)		3.4	4.8				4.8	3.4	
P		0. 009	0.0128				0.0128	0. 009	
As(mm^2)		2215.8	3151.4				3151.4	2215.8	
As_{min} (mm^2)		821	821				821	821	
N		7.05≈8	10.03≈11				7.05≈8	10.03≈11	
b_{min} (mm)									
Fs =Fy		Ok	Ok				Ok	Ok	
TCL		Ok	Ok				Ok	Ok	
Use		8ϕ20	11ϕ20				8ϕ20	11ϕ20	
Cv			1.15				1.15		
Vu (kn)			436.35				436.35		
ϕVc (kn)			168.56				168.56		
Vs (kn)			357.1				357.1		
Av (mm^2)			226.08				226.08		
S (mm)			163.7				163.7		
S_{max} (mm)			307.75				307.75		
Use			Φ12@160				Φ12@160		

sample of cacluations

$$L_u = 9m\ , \qquad L_n = 9 - 0.2 - 0.2 = 8.6m$$

$$C_m = \frac{1}{10}\ , \qquad M_u = \frac{1}{10} * 88.24 * 8.6^2 = 652.6\ kn.m$$

$$d = 600 - 40 - 12 - 20 - \frac{25}{2} = 615.5\ mm\ \ (two\ layer)$$

$$R_n = \frac{652.6/0.9}{400 * 615.5^2} * 10^6 = 4.8\ Mpa$$

$$m = \frac{420}{0.85 * 30} = 16.471\ , \qquad \rho = \frac{1}{16.471}\left(1 - \sqrt{1 - \frac{2 * 4.8 * 16.471}{420}}\ \right) = 0.0128$$

$$A_s = 0.0128 * 400 * 615.5 = 3151.4\ mm^2\ ,$$

$$A_{s\ min} = \frac{1.4}{420} * 400 * 615.5 = 821\ mm^2$$

$$A_{s\ min} = \frac{\sqrt{30}}{4 * 420} * 400 * 615 = 803\ mm^2$$

$$A_{s\ min} = \max(821{,}803\ ) = 821mm^2$$

$$n = \frac{3151.4}{314} = 10.03 \approx 11$$

$$a = \frac{11 * 314 * 420}{0.85 * 30 * 400} = 142.22\ mm$$

$$\frac{a_b}{d} = 0.5 > \frac{a}{d} = \ 0.23 \qquad \therefore\ f_{s=fy}$$

$$\frac{a_{TCL}}{d_t} = 0.31875\ > \frac{a}{d_t} = 0.222 \qquad \therefore\ Tension - controlled\ section$$

$$for\ flexure\ use\ \ 11\emptyset20$$

$$C_v = 1.15\ , \qquad V_u = \frac{1.15 * 88.24 * 8.6}{2} = 436.35\ kn$$

$$\emptyset V_c = 0.75 * \frac{\sqrt{30}}{6} * 400 * 615.5 * 10^{-3} = 168.56\ kn$$

$$V_s = \frac{436.35 - 168.56}{0.75} = 357.1kn$$

$$A_v = 2 * \pi \frac{12^2}{4} = 226.08mm^2 \ \ (two\ leg)$$

$$S = \frac{226.08 * 420 * 615.5}{357.1} * 10^{-3} = 163.7mm$$

$$V_s < 2V_c$$

$$S_{max} = min\left(300, \frac{615.5}{2} = 307.75\right) = 300\ mm$$

$$use\ \emptyset 12@160mm$$

Axial load on column C:-

Beams in x- direction:

$$DL = \left\{\left((0.4 * 0.53 * 25) + 12\right) * \frac{4.4}{2}\right\} + \left\{\left((0.4 * 0.53 * 25) + 12\right) * \frac{4.4}{2}\right\} = 76.12\ kn$$

$$LL = 0 + 0 = 0\ kn$$

Beams in y- direction:

$$DL = \left\{\left((0.4 * 0.53 * 25) + 12 + (6.75 * 4.4)\right) * \frac{9}{2}\right\} + \left\{\left((0.4 * 0.53 * 25) + 12 + (6.75 * 4.4)\right) * \frac{9}{2}\right\} = 423\ kn$$

$$LL = \left\{(3 * 4.4) * \frac{9}{2}\right\} + \left\{(3 * 4.4) * \frac{9}{2}\right\} = 118.8kn$$

$$Wu = 1.4(76.12 + 423) + 1.7(118.8) = 900.728\ kn$$