

A-solid slab design:**a)**

$$h_{min} = \frac{l}{24} = \frac{3500}{24} = 145.83 \text{ mm}$$

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

b)

$$DL = \text{own weight} + \text{superimposed}$$

$$DL = (0.18 * 25) + 2 = 6.5 \text{ kn/m}^2$$

$$LL = 3 \text{ kn/m}^2$$

$$Wu = 1.4DL + 1.7LL$$

$$M_u + = \frac{1}{14} * 14.2 * 3.2^2 = 10.386 \text{ kn.m}$$

$$M_u - = \frac{1}{9} * 14.2 * 3.2^2 = 16.156 \text{ kn.m}$$

c)

$$M_u = 25 \text{ kn.m} , \text{ Assume } d_b = 12$$

$$d = 180 - 20 - \frac{12}{2} = 154 \text{ mm} , \quad R_n = \frac{25/0.9}{1000 * 154^2} * 10^6 = 1.1713 \text{ Mpa}$$

$$m = \frac{420}{0.85 * 25} = 19.765 , \quad \rho = \frac{1}{19.765} \left(1 - \sqrt{1 - \frac{2 * 1.1713 * 19.765}{420}} \right) = 0.00287$$

$$A_s = 0.00287 * 1000 * 154 = 441.98 \text{ mm}^2 , \quad A_{s \min} = 0.0018 * 1000 * 180 = 324 \text{ mm}^2$$

$$S_{max} = \min \left(\frac{113.04}{449.98} * 1000 = 255.76 \text{ mm} , 300 \text{ mm} , 2 * 180 = 360 \right) = 255.76 \text{ mm}$$

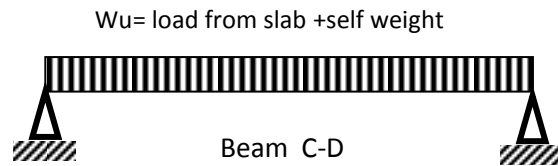
for flexural \rightarrow use $\phi 12 @ 250 \text{ mm}$

$$A_{s \text{ shrinkage}} = 0.0018 * 1000 * 180 = 324 \text{ mm}^2$$

$$S_{max} = \min \left(\frac{113.04}{324} * 1000 = 348.89 \text{ mm} , 300 \text{ mm} , 4 * 180 = 720 \right) = 300 \text{ mm}$$

for shrinkage \rightarrow use $\phi 12 @ 300 \text{ mm}$

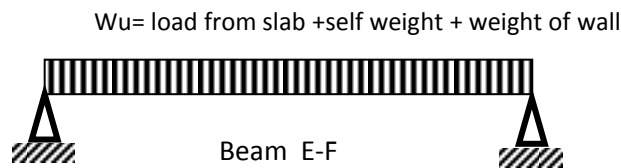
d)



$$Wu \text{ slab} = 14.2 \text{ kn/m}^2$$

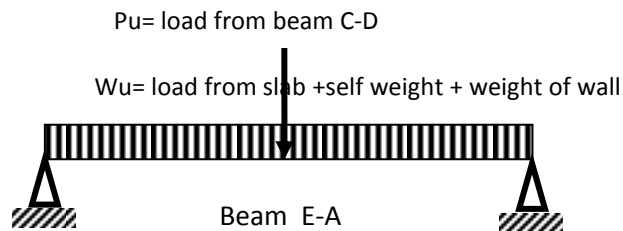
$$Wu \text{ beam}(C - D) = 14.2 * \left(\frac{3.5}{2} + \frac{3.5}{2} \right) + 1.4 * (0.42 * 0.3 * 25) = 54.11 \text{ kn/m}$$

e)



$$Wu \text{ beam}(E - F) = 14.2 * \left(\frac{3.5}{2} + 0.15 \right) + 1.4 * [(0.42 * 0.3 * 25) + (3 * 0.2 * 15)] = 43.99 \text{ kn/m}$$

$$\text{Axial load on column(E) from beam (E - F)} = 43.99 * \frac{7.5}{2} = 164.9625 \text{ Kn}$$



$$Wu \text{ beam}(E - A) = 1.4 * (0.42 * 0.3 * 25) = 4.41 \text{ kn/m}$$

$$Pu \text{ beam}(E - A) = 54.11 * \frac{7.2}{2} = 194.796 \text{ Kn}$$

$$\text{Axial load on column(E) from beam (E - A)} = \left[4.41 * \frac{7.5}{2} \right] + \left[194.796 * \frac{1}{2} \right] = 113.9355 \text{ Kn}$$

$$\text{Self weight of column E} = 1.4 * 0.3 * 0.3 * 25 * 3 = 9.45 \text{ Kn}$$

Total axial load on column E =

*No. of story * (Axial load from beam (E – F) + Axial load from beam (E – A)
+ self weight of column E)*

$$\textbf{\textit{Total axial load on column E = 3 * (164.9625 + 113.9355 + 9.45) = 865.044 Kn}}$$

B-joist slab design:**a)**

$$h_{min} = \frac{l}{18.5} = \frac{3500}{18.5} = 189.19 \text{ mm}$$

$$h = 380 \text{ mm} > h_{min} \rightarrow \text{ok}$$

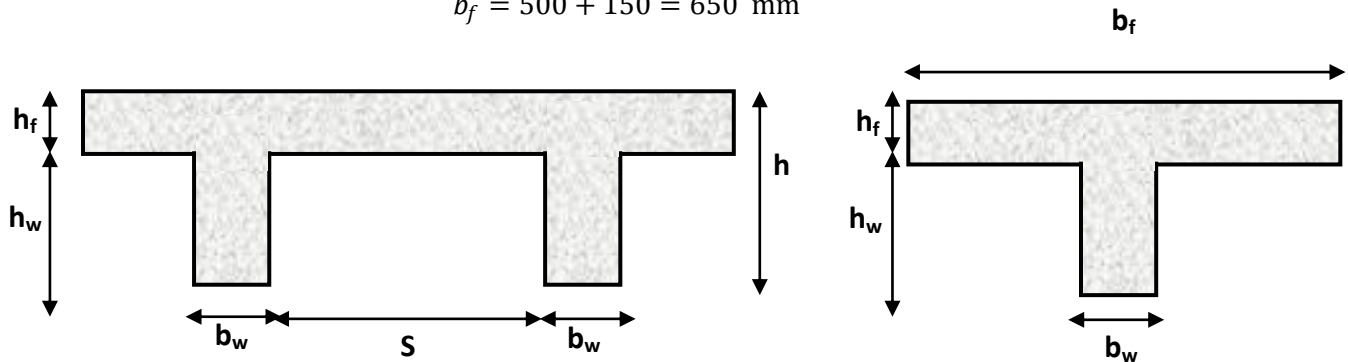
$$h_f \geq \left(50 \text{ mm}, \frac{500}{12} = 41.67 \text{ mm} \right) = 50 \text{ mm} \quad h_f = 80 \text{ mm} \quad \text{ok}$$

$$h_w \geq (3.5 * 150 = 525 \text{ mm}) \quad h_w = 300 \text{ mm} \quad \text{ok}$$

$$b_w \geq 100 \text{ mm} \quad b_w = 150 \text{ mm} \quad \text{ok}$$

$$S \geq 800 \text{ mm} \quad S = 500 \text{ mm} \quad \text{ok}$$

$$b_f = 500 + 150 = 650 \text{ mm}$$

**b)**

$DL = \text{own weight} + \text{superimposed}$

$$DL = (0.08 * 25) + 2 = 4 \text{ kn/m}^2$$

$$LL = 3 \text{ kn/m}^2$$

$$Wu = 1.4DL + 1.7LL$$

$$Wu = 1.4(4) + 1.7(3) = 10.7 \text{ kn/m}^2$$

Load on typical rip:

$$Wu_{/rip} = 10.7 * (0.65) + 1.4 * (0.3 * 0.15 * 25) = 8.53 \text{ kn/m}$$

c)

$$M_u+ = \frac{1}{14} * 8.53 * 3.2^2 = 6.239 \text{ kn.m}$$

$$M_u- = \frac{1}{9} * 8.53 * 3.2^2 = 9.705 \text{ kn.m}$$

d)

$$M_u - ve = 28 \text{ kn.m} \quad , \text{ Assume } d_b = 12$$

$$d = 380 - 20 - 8 - \frac{12}{2} = 346 \text{ mm} \quad , \quad R_n = \frac{28/0.9}{150 * 346^2} * 10^6 = 1.7325 \text{ Mpa}$$

$$m = \frac{420}{0.85 * 25} = 19.765, \quad \rho = \frac{1}{19.765} \left(1 - \sqrt{1 - \frac{2 * 1.7325 * 19.765}{420}} \right) = 0.00431$$

$$A_s = 0.00431 * 150 * 346 = 223.608 \text{ mm}^2, \quad A_{s \min} = \max \left[\begin{array}{l} \frac{1.4}{420} * 150 * 346 \\ \frac{\sqrt{f_c}}{4 * 420} * 150 * 346 \end{array} \right] = 173 \text{ mm}^2$$

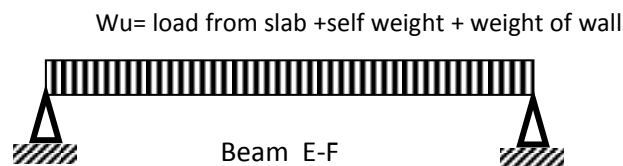
$$n = \frac{A_s}{A_b} = \frac{223.608}{113.04} = 1.98 \approx 2$$

for flexural → use 2 Ø12

$$A_{s \text{ shrinkage}} = 0.0018 * 1000 * 80 = 144 \text{ mm}^2$$

$$S_{\max} = \min \left(\frac{113.04}{144} * 1000 = 785 \text{ mm}, 300 \text{ mm}, 4 * 80 = 320 \right) = 300 \text{ mm}$$

for shrinkage → use Ø12@300 mm

e)

$$W_u \text{ beam}(E - F) =$$

$$\begin{aligned} & \frac{8.53}{0.65} * \left(\frac{3.5}{2} - 0.15 \right) + 1.4 * [(0.6 * 0.3 * 25) + (0.3 * 2) + (3 * 0.2 * 15)] + 1.7 * (0.3 * 3) \\ & = 42.267 \text{ kn/m} \end{aligned}$$