Typical Solutions

Q.1 (50%) Find the minimum thickness of a slab for an interior panel due to deflection control for the following: Use **fy = 420 MPa**. (60000 psi).

a- Slab with beams (8.2 × 7.8) m clear span with $\boldsymbol{\alpha_m}$**= 2.2**
b- Slab without drop panels (5.4 × 5.0) m clear span with $\boldsymbol{\alpha_m}$**= 0.11**
c- Flat plate (4.4 × 4.6) m clear span.
d- Flat slab with drop panels (6.2 × 6.2) m clear span.
e- Slab with beams (5.2 × 5.8) m clear span with $\boldsymbol{\alpha_m}$**= 1.7**

Solution:

a- Slab with beams (8.2 × 7.8) m clear span with $\boldsymbol{\alpha_m}$**= 2.2**

$\boldsymbol{\alpha_m = 2.2 > 2.0}$

$$h = \frac{\ell n(0.8+\frac{fy}{1400})}{36+9\beta} \quad \beta = \frac{\ell n}{Sn} = \frac{8.2}{7.8} = 1.051$$

$$h = \frac{8200*(0.8+\frac{420}{1400})}{36+9*1.051} = 198.421 \text{ mm} > 90 \text{ mm O.K}$$

Use h = 200 mm

b- Slab without drop panels (5.4 × 5.0) m clear span with $\boldsymbol{\alpha_m}$**= 0.11**

$\boldsymbol{\alpha_m = 0.11 < 0.2}$ go to **Table 8.3.1.1**

From table $h = \frac{\ell n}{33} = \frac{5400}{33} = 163.636$ mm > 125 mm O.K

Use h = 170 mm

c- Flat plate (4.4 × 4.6) m clear span.

From **Table 8.3.1.1** $h = \frac{\ell n}{33} = \frac{4600}{33} = 139.394$ mm > 125 mm O.K

Use h = 140 mm

d- Flat slab with drop panels (6.2 × 6.2) m clear span

From **Table 8.3.1.1** $h = \frac{\ell n}{36} = \frac{6200}{36} = 172.22$ mm > 100 mm O.K

Use h = 180 mm.

e- Slab with beams (5.2 × 5.8) m clear span with $\boldsymbol{\alpha_m}$**= 1.7**

$\boldsymbol{0.2 < \alpha_m = 1.7 < 2.0}$

$$h = \frac{\ell n\left(0.8+\frac{fy}{1400}\right)}{36+5\beta(\alpha_{fm}-0.2)} \quad \beta = \frac{\ell n}{Sn} = \frac{5.8}{5.2} = 1.115$$

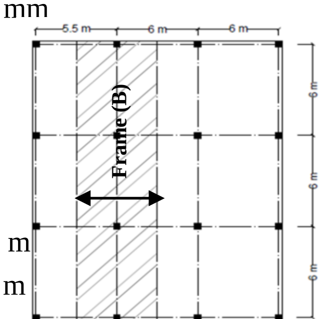
$$h = \frac{5800*\left(0.8+\frac{420}{1400}\right)}{36+5*1.115*(1.7-0.2)} = 143.815 \text{ mm} > 125 \text{ mm O.K}$$

Use h = 150 mm ■

Q.2 (50%) For the the transverse interior (Frame B) of the flat plate floor, without edge beams, shown in Figure, and by using the Direct Design Method, find:

a. Longitudinal distribution of the total static moment at factored loads.
b. Lateral distribution of moment at interior and exterior panels (column and middle strip moments at negative and positive moments).

Slab thickness = 200 mm, d =165 mm
$q_u = 17$ kN/m^2
All columns = 300 × 300 mm
fc\` = 25 MPa, fy = 400 MPa



Solution

a-Longitudinal distribution

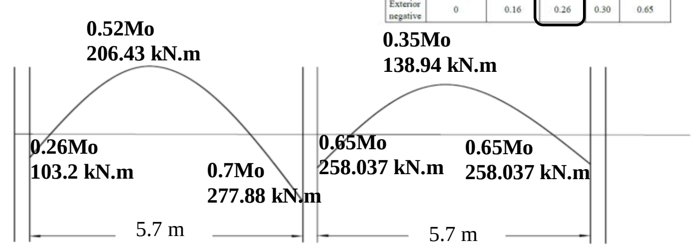
q_u=17 kN/m^2 , $\ell_2 = \left(\frac{6}{2}+\frac{5.5}{2}\right) = 5.75$ m

ℓ_n= 6 −0.3 = **5.7** m > 0.65*6 =3.9 m

$$M_o = \frac{q_u*\ell_n^2*\ell_2}{8} = \frac{17*5.7^2*575}{8} = 396.98 \text{ kN.m}$$

Table 8.10.4.2—Distribution coefficients for end spans

	Exterior edge unrestrained	Slab with beams between all supports	Slab without beams between interior supports: Without edge beam	Slab without beams between interior supports: With edge beam	Exterior edge fully restrained
Interior negative	0.75	0.70	0.70	0.70	0.65
Positive	0.63	0.57	0.52	0.50	0.35
Exterior negative	0	0.16	0.26	0.30	0.65



b-Lateral distribution

For interior panel

Negative moment = 258.037 kN.m

$\alpha_f = 0$

Negative moment at CS = 0.75 × 258.037 = 193.52 kN.m

Negative moment at MS = 258.037−193.52 = 64.57 kN.m

Table 8.10.5.1—Portion of interior negative M_u in column strip

$\alpha_{f1}\ell_2/\ell_1$	ℓ_2/ℓ_1 = 0.5	1.0	2.0
0	0.75	0.75	0.75
≥1.0	0.90	0.75	0.45

Note: Linear interpolations shall be made between values shown.

Positive moment = 138.94 kN.m

$\alpha_f = 0$

Positive moment at CS = 0.6 × 138.94 = 83.36 kN.m

Positive moment at MS = 138.94−83.36 = 55.58 kN.m

Table 8.10.5.5—Portion of positive M_u in column strip

$\alpha_{f1}\ell_2/\ell_1$	ℓ_2/ℓ_1 = 0.5	1.0	2.0
0	0.60	0.60	0.60
≥1.0	0.90	0.75	0.45

Note: Linear interpolations shall be made between values shown.

For exterior panel

Interior Negative moment = 277.88 kN.m

$\alpha_f = 0$

Negative moment at CS = 0.75 × 277.88 = 208.41 kN.m

Negative moment at MS = 277.88 − 208.41 = 69.47 kN.m

Positive moment = 206.43 kN.m

Positive moment at CS = 0.6 × 206.43 = 123.86 kN.m

Positive moment at MS = 206.43 −123.86 = 82.57 kN.m

Exterior negative moment = 103.2 kN.m

$\alpha_f = 0$ & $\beta_t = 0$

Negative moment at CS = 1 × 103.2 = 103.2 kN.m

Negative moment at MS = 103.2 − 103.2 = 0 ■

Table 8.10.5.2—Portion of exterior negative M_u in column strip

$\alpha_{f1}\ell_2/\ell_1$	β_t	ℓ_2/ℓ_1 = 0.5	1.0	2.0
0	0	1.0	1.0	1.0
	≥2.5	0.75	0.75	0.75
≥1.0	0	1.0	1.0	1.0
	≥2.5	0.90	0.75	0.45

Note: Linear interpolations shall be made between values shown. β_t is calculated using Eq. (8.10.5.2a), where C is calculated using Eq. (8.10.5.2b).