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- Flat slab with drop panels (6.2 × 5.5) m clear span.
b- Flat plate (3.8 × 3.2) m clear span.
c- Slab with beams (7.8 × 7.8) m clear span with **α_m= 3.4**
d- Slab without drop panels (5.9 × 5.3) m clear span with **α_m= 0.11**
e- Slab with beams (6.1 × 5.2) m clear span with **α_m= 1.4**

Solution:

a. Flat slab with drop panels (6.2 × 5.5) m clear span

From **ACI Table 8.3.1.1** $h = \frac{\ell n}{36} = \frac{6200}{36}$ =172 mm > 100 mm O.k

Use h = 180 mm

b. Flat plate (3.8 × 3.2) m clear span.

From **ACI Table 8.3.1.1** $h = \frac{\ell n}{33} = \frac{3800}{33}$ = 115.15 mm < 125 mm

Not O.K use h = 125 mm

c. Slab with beams (7.8 × 7.8) m clear span with **α_m= 3.4**

α_m= 3.4 > 2

$$h = \frac{\ell n(0.8+\frac{fy}{1400})}{36+9\beta} \quad \beta = \frac{\ell n}{Sn} = \frac{7.8}{7.8} = 1$$

$$h = \frac{7800*(0.8+\frac{420}{1400})}{36+9*1} = 190.667 \text{ mm} > 90 \text{ mm O.K}$$

Use h = 200 mm

d. Slab without drop panels (5.9 × 5.3) m clear span with **α_m= 0.11**

α_m= 0.11 < 0.2 Go to **Table 8.3.1.1**

$h = \frac{\ell n}{33} = \frac{5900}{33}$ = 178.78 mm > 125 mm O.K

Use h = 180 mm

e. Slab with beams (6.1 × 5.2) m clear span with **α_m= 1.4**

0.2 < α_m= 1.4 < 2.0

$$h = \frac{\ell n\left(0.8+\frac{fy}{1400}\right)}{36+5\beta(\alpha_{fm}-0.2)} \quad \beta = \frac{\ell n}{Sn} = \frac{6.1}{5.2} = 1.17$$

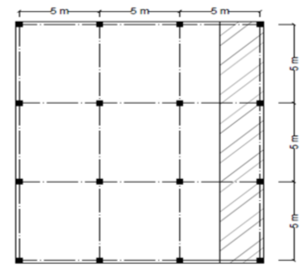
$$h = \frac{6100*\left(0.8+\frac{420}{1400}\right)}{36+5*1.17*(1.4-0.2)} = 155.97 \text{ mm} > 125 \text{ mm O.k}$$

Use h = 160 mm ■

Q.2 (50 %) For the the transverse exterior (Frame D) 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 = 14 kN/m^2
All columns = 250 × 250 mm
fc` = 25 MPa, fy = 400 MPa



Solution

a-Longitudinal distribution

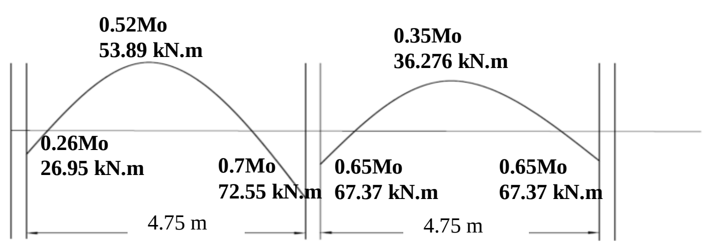
q_u=14 kN/m^2 , $\ell_2=\left(\frac{5}{2}+\frac{0.25}{2}\right)$ =2.625 m

ℓ_n= 5 − 0.25 = **4.75** m > 0.65*5 = 3.25 m

$M_o = \frac{q_u*\ell_n^2*\ell_2}{8} = \frac{14*4.75^2*2.625}{8}$ = 103.646 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

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

Negative moment = 67.37 kN.m
α_f = 0
Negative moment at CS = 0.75 × 67.37 = 50.53 kN.m
Negative moment at MS = 67.37 − 50.53 = 16.84 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

Positive moment = 36.276 kN.m
α_f = 0
Positive moment at CS = 0.6 × 36.276 = 21.76 kN.m
Positive moment at MS = 36.276−21.76 = 14.516 kN.m

For exterior panel

Interior Negative moment = 72.55 kN.m
α_f = 0
Negative moment at CS = 0.75 × 72.55 = 54.413 kN.m
Negative moment at MS = 72.55 – 54.413 = 18.14 kN.m
Positive moment = 53.89 kN.m
Positive moment at CS = 0.6 × 53.89 = 32.33 kN.m
Positive moment at MS = 53.89 −32.33 = 21.56 kN.m
Exterior negative moment = 26.95 kN.m
α_f = 0 & β_t = 0
Negative moment at CS = 1 × 26.95 = 26.95 kN.m
Negative moment at MS = 26.95 − 26.95 = 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).