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CIE429 – RC Design

<http://civil.eng.buffalo.edu/cie429/>

Lecture #8

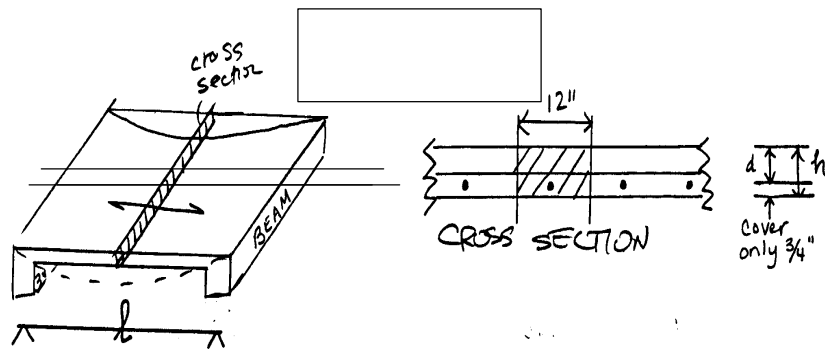
One Way Slabs Design

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Design of One Way Slabs

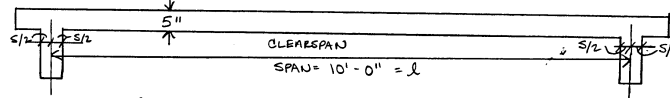


Design of one way slabs is like design of parallel 12" beams.

Example of One Way Slab



Example: $f_y = 40\text{ksi}$ $f'_c = 3\text{ksi}$ $LL = 325\text{psf}$



$$(1) h \cong \frac{l}{20} \left(0.4 + \frac{f_y}{100} \right) = \frac{10 \times 12}{20} \left(0.4 + \frac{40}{100} \right) = 4.8'' \rightarrow 5''$$

$$(2) w_D = \frac{5 \times 12}{144} \times 0.15 \text{ksf} = 62.5 \text{psf}$$

$$(3) w_d = 1.4w_D + 1.7w_L = 1.4 \times 62.5 + 1.7 \times 325 = 640 \text{ (lb/ft) / ft}$$

$$(4) M_{d,max} = \frac{w_d \cdot L^2}{8} = \frac{640 \times 10^2}{8} = 8 \text{ kips-ft / ft}$$

$$(5) d = h - \text{cover} - \frac{d}{2} = 5 - 0.75 - 0.375 \cong 3.88 \text{ in}$$

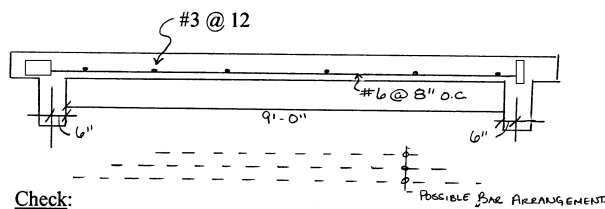
$$(6) k_{req} = 1 - \sqrt{1 - \frac{2 \times 8 \times 12 / 0.9}{0.85 \times 40 \times 12 \times 3.88^2}} = 0.0175$$

$$(7) A_s = \frac{8.0 \times 12}{40 \times 3.88 \left(1 - \frac{0.0175}{2} \right)} \cong 0.68 \text{ in}^2 / \text{ft} \rightarrow \#6 @ 8''$$

One Way Slab - Final Design



Reinforcement arrangement: All length vs. Critical section design



Check:

(1) Maximum spacing: Table (3-4)

$$\text{either } \leq 3h = 3 \times 5 = 15'' \quad \leftarrow \text{governs}$$

$$\leq 18''$$

$$s = 8'' \leq 15'' \quad \text{ok.}$$

(2) Transverse reinforcement: Table (3-5)

$$A_{s,min} = 0.0018 bh = 0.022h$$

$$h = 5'' \quad A_{s,min} = 0.11 \text{ in}^2 / \text{ft} \quad \rightarrow \#3 @ 12$$

(3) Length of bars:

$\frac{1}{3}$ needs to extend 6'' into support.

Area of bars in Slabs



Table 3-7 - Areas of Bars per Foot Width of Slab - A_s (in^2/ft)

| BAR SIZE | BAR SPACING - in. | | | | | | | | | | | | |
|----------|-------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| #3 | 0.22 | 0.19 | 0.17 | 0.15 | 0.13 | 0.12 | 0.11 | 0.10 | 0.09 | 0.09 | 0.08 | 0.08 | 0.07 |
| #4 | 0.39 | 0.34 | 0.29 | 0.26 | 0.24 | 0.22 | 0.20 | 0.18 | 0.17 | 0.16 | 0.15 | 0.14 | 0.13 |
| #5 | 0.61 | 0.53 | 0.46 | 0.41 | 0.37 | 0.34 | 0.31 | 0.29 | 0.27 | 0.25 | 0.23 | 0.22 | 0.21 |
| #6 | 0.88 | 0.76 | 0.66 | 0.59 | 0.53 | 0.48 | 0.44 | 0.41 | 0.38 | 0.35 | 0.33 | 0.31 | 0.29 |
| #7 | 1.20 | 1.03 | 0.90 | 0.80 | 0.72 | 0.65 | 0.60 | 0.55 | 0.51 | 0.48 | 0.45 | 0.42 | 0.40 |
| #8 | 1.57 | 1.35 | 1.18 | 1.05 | 0.94 | 0.85 | 0.78 | 0.72 | 0.67 | 0.62 | 0.59 | 0.55 | 0.52 |
| #9 | 2.00 | 1.71 | 1.50 | 1.33 | 1.20 | 1.09 | 1.00 | 0.92 | 0.86 | 0.80 | 0.75 | 0.71 | 0.67 |
| #10 | 2.53 | 2.17 | 1.89 | 1.69 | 1.52 | 1.39 | 1.27 | 1.17 | 1.09 | 1.02 | 0.95 | 0.90 | 0.85 |
| #11 | 3.12 | 2.68 | 2.34 | 2.08 | 1.87 | 1.70 | 1.56 | 1.44 | 1.34 | 1.25 | 1.17 | 1.10 | 1.04 |

Area of Reinforcing Bars



Table 3-6 - Total Areas of Bars - A_s (in^2)

| BAR SIZE | BAR DIAMETER | NUMBER OF BARS | | | | | | | |
|----------|--------------|----------------|------|------|------|------|------|-------|-------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| #3 | 0.375 | 0.11 | 0.22 | 0.33 | 0.44 | 0.55 | 0.66 | 0.77 | 0.88 |
| #4 | 0.500 | 0.20 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 1.40 | 1.60 |
| #5 | 0.625 | 0.31 | 0.62 | 0.93 | 1.24 | 1.55 | 1.96 | 2.17 | 2.48 |
| #6 | 0.750 | 0.44 | 0.88 | 1.32 | 1.76 | 2.20 | 2.64 | 3.08 | 3.52 |
| #7 | 0.875 | 0.60 | 1.20 | 1.80 | 2.40 | 3.00 | 3.60 | 4.20 | 4.80 |
| #8 | 1.000 | 0.79 | 1.58 | 2.37 | 3.16 | 3.95 | 4.74 | 5.53 | 6.32 |
| #9 | 1.128 | 1.00 | 2.00 | 3.00 | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 |
| #10 | 1.270 | 1.27 | 2.54 | 3.81 | 5.08 | 6.35 | 7.62 | 8.89 | 10.16 |
| #11 | 1.410 | 1.56 | 3.12 | 4.68 | 6.24 | 7.80 | 9.36 | 10.92 | 12.48 |