concrete construction: flat spanning systems

Reinforced Concrete Design

• flat plate
  - 5”-10” thick
  - simple formwork
  - lower story heights

• flat slab
  - same as plate
  - 2 ¼”-8” drop panels

Reinforced Concrete Design

• beam supported
  - slab depth ~ L/20
  - 8”–60” deep

• one-way joists
  - 3”–5” slab
  - 8”–20” stems
  - 5”-7” webs

The Architect's Studio Companion

http://nisee.berkeley.edu/godden
**Reinforced Concrete Design**

- **two-way joist**
  - “waffle slab”
  - 3”-5” slab
  - 8”-24” stems
  - 6”-8” webs

- **beam supported slab**
  - 5”-10” slabs
  - taller story heights

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**Reinforced Concrete Design**

- **simplified frame analysis**
  - strips, like continuous beams

- **moments require flexural reinforcement**
  - top & bottom
  - both directions of slab
  - continuous, bent or discontinuous

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**Reinforced Concrete Design**

- **one-way slabs (wide beam design)**
  - approximate analysis for moment & shear coefficients
  - two or more spans
  - ~ same lengths
  - \( w_u \) from combos
  - uniform loads with \( L/D \leq 3 \)
  - \( \ell_n \) is clear span (+M) or average of adjacent clear spans (-M)
Shear in Concrete

- at columns
- want to avoid stirrups
- can use shear studs or heads

Openings in Slabs

- careful placement of holes
- shear strength reduced
- bending & deflection can increase
**General Beam Design**

- $f'_c$ & $f_y$ needed
- usually size just $b$ & $h$
  - even inches typical (forms)
  - similar joist to beam depth
  - $b$:h of 1:1.5-1:2.5
  - $b_w$ & $b_f$ for $T$
  - to fit reinforcement + stirrups
- slab design, $t$
  - deflection control & shear

\[ S = \frac{bh^2}{6} \]

**General Beam Design (cont’d)**

- custom design:
  - longitudinal steel
  - shear reinforcement
  - detailing