lecture twenty four

crossed 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

Reinforced Concrete Design

• economical & common
• resist lateral loads
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

Reinforced Concrete Design

- simplified frame analysis
  - strips, like continuous beams

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

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)

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**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

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**Shear in Concrete**

- critical section at d/2 from
  - column face, column capital or drop panel

**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