**concrete construction:**

**T-beams & slabs**

**T sections**

- two areas of compression in moment possible
- one-way joists
- effective flange width

**Systems**

- beams separate from slab
- beams integral with slab
  - close spaced
- continuous beams
- no beams

**T sections**

- negative bending: \( A_s = \min \frac{6 \sqrt{f'^c}}{f_y} (b_w \cdot d) \)
- effective width (interior)
  - \( L/4 \)
  - \( b_w + 16t \)
  - center-to-center of beams

\[
A_s = 6 \sqrt{f'^c}, \quad A_s = 3 \sqrt{f'^c}
\]
T sections
• usual analysis steps
1. assume no compression in web
2. design like a rectangular beam
3. needs reinforcement in slab too
4. also analyze for negative moment, if any

One-Way
• Joists
  – standard stems
  – 2.5” to 4.5” slab
  – ~30” widths
  – reusable forms

Compression Reinforcement
• doubly reinforced
• negative bending
• two compression forces
• bigger $M_n$
• control deflection
• increase ductility
• needs ties because of buckling

One-Way
• Joists
  – standard stems
  – 2.5” to 4.5” slab
  – ~30” widths
  – reusable forms
Compression Reinforcement

- analysis
  - \( A_s \) & \( A_s' \)
  - \( T = C_c + C_s \)
  - \( T = A_s f_y \)
  - \( C_s = A_s'(f'_s - 0.85f'_c) \)
  - \( C_c = 0.85f'_c ba \) with \( a = \beta x \)
  - \( f_s' \) not known, so solve for \( x \) (n.a.)
  - \( f_s' < f_y ? \)
  - \( M_n = T(d-a/2)+C_s(d-d') \)

Slabs

- one way behavior – like beams
- two way behavior – more complex

Slab Design

- one unit wide “strip”
- with uniform loads
  - like “wide” beams
  - moment / unit width
  - uniform curvature
- with point loads
  - resisted by stiffness of adjacent strips
  - more curvature in middle

Slab Design

- min thickness by code
- reinforcement
  - bars, welded wire mesh
  - cover
  - minimum by steel grade
  - 40-50:
    \[ \rho = \frac{A_s}{bt} = 0.002 \]
  - 60:
    \[ \rho = \frac{A_s}{bt} = 0.0018 \]
One-Way Slabs

- $A_s$ tables
- max spacing
  - $\leq 3(t)$ and 18”
  - $\leq 5(t)$ and 18” – temp & shrinkage steel
- no room for stirrups

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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
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Precast

- prestressed
  - PCI Design Handbook
  - double T’s
  - hollow core
  - L’s
- topping
- load tables