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: \( A_s \) larger of:
  \[ A_s = \frac{6}{f_y} \left( b_w d \right) \]
  \[ A_s = \frac{3}{f_y} \left( b_f d \right) \]
- effective width (interior)
  - \( L/4 \)
  - \( b_w + 16t \)
  - center-to-center of beams

**Figure 9.5.1** Actual and equivalent stress distribution over flange width.
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

\[ T = C_c + C_s \]
\[ T = A_s f_y \]
\[ C_s = A_s' f_y \]
\[ M_n = T(d - a/2) + C_s(d - d') \]
Compression Reinforcement

- needs ties because of buckling
- simplified method in text assumes
  - \( A_s' = 0.3A_s \)
  - \( M_n > M_u/\phi \)
  - \( f'_s = \frac{1}{2}f_y \)
  - \( a = 2d' \)
  - so
    \[ A_s = \frac{M_u}{\phi f_y(d - d')} \]
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

*not in note set

<table>
<thead>
<tr>
<th>Bar spacing (in)</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
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</tr>
</thead>
<tbody>
<tr>
<td>$A_s$</td>
<td>0.09</td>
<td>0.10</td>
<td>0.11</td>
<td>0.12</td>
<td>0.13</td>
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Table 3-7 Areas of Bars per Foot Width of Slab—$A_s$ (in.$^2$/ft)

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