Lecture 10 - Flexure

Lecture Goals

- Doubly Reinforced beams

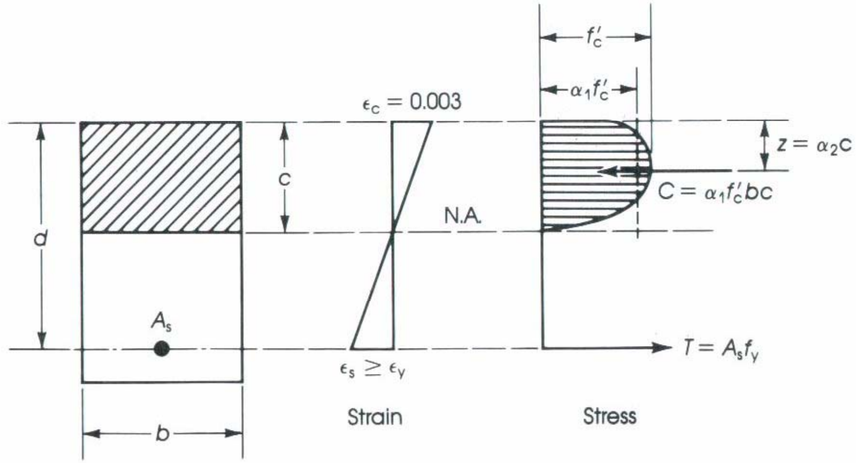
Analysis of Doubly Reinforced Sections

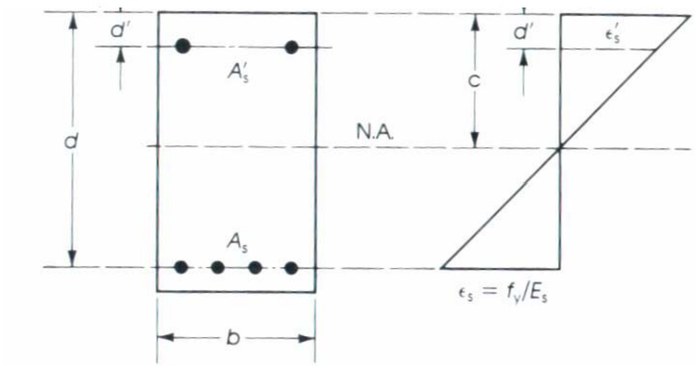
Effect of Compression Reinforcement on the Strength and Behavior

Less concrete is needed to resist the T and thereby moving the neutral axis (NA) up.

$$T = A_s f_y$$

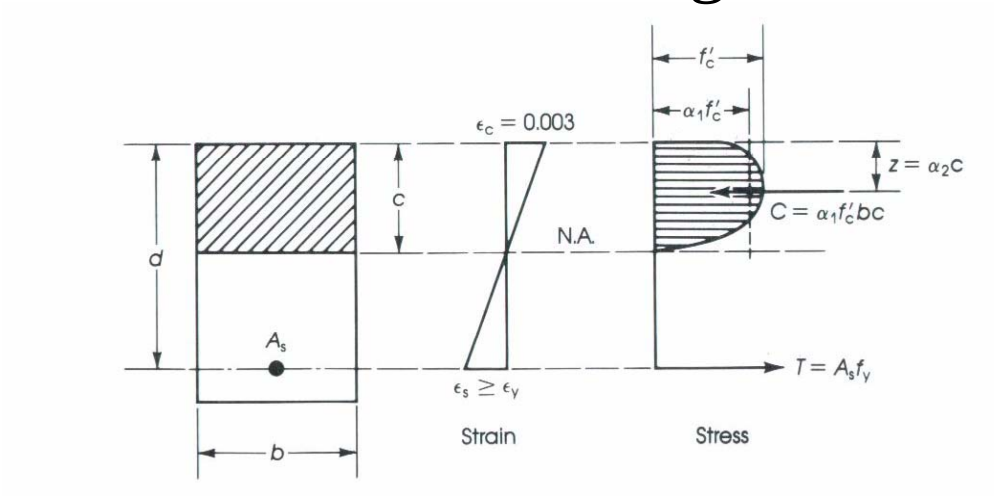
$$C = T$$





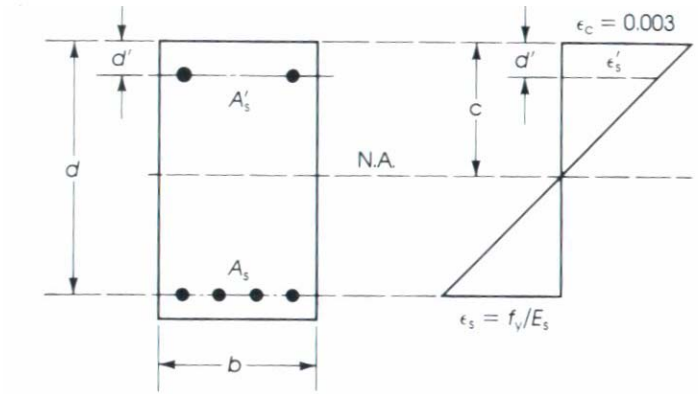
Analysis of Doubly Reinforced Sections

Effect of Compression Reinforcement on the Strength and Behavior



Singly Reinforced $\Rightarrow$

$$C = C_c \;\; ; M_n = A_s f_y \left(d - \frac{a_1}{2} \right)$$



Doubly Reinforced $\Rightarrow$

$$C = C_c + C'_s \;\; ; M_n = A_s f_y \left(d - \frac{a_2}{2} \right)$$

and $(a_2 < a_1)$

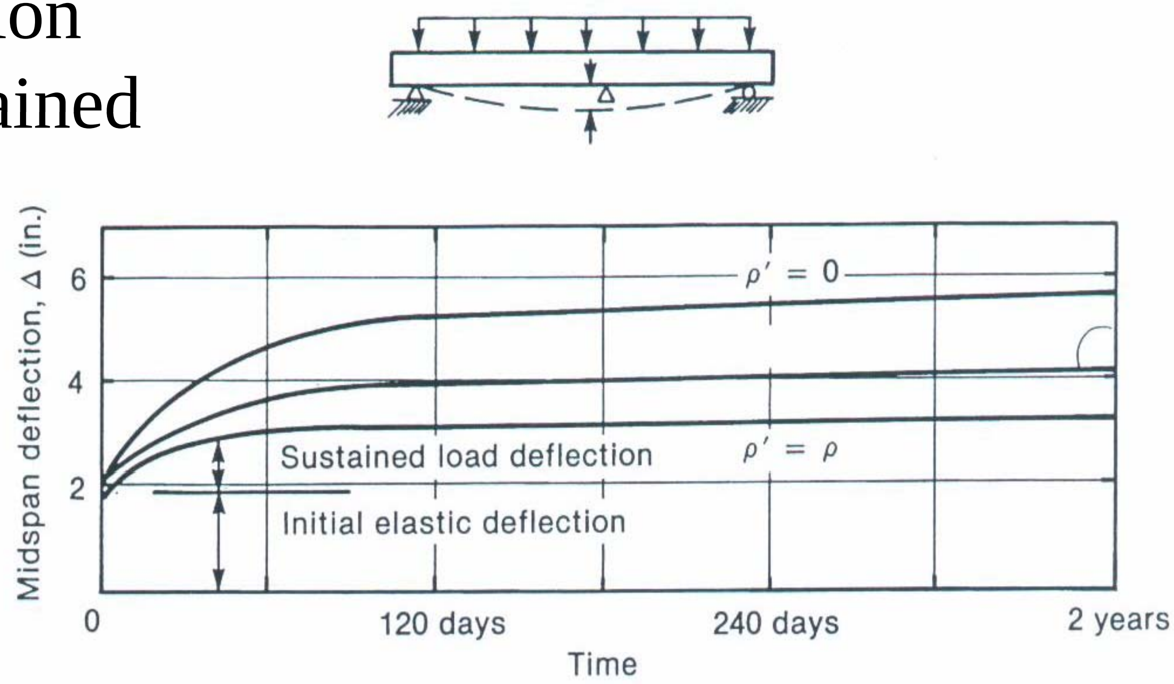
Reasons for Providing Compression Reinforcement

- Reduced sustained load deflections.
  - Creep of concrete in compression zone
  - transfer load to compression steel
  - reduced stress in concrete
  - less creep
  - less sustained load deflection

Reasons for Providing Compression Reinforcement

Effective of compression reinforcement on sustained load deflections.

Fig 5-14 MacGregor



Reasons for Providing Compression Reinforcement

- Increased Ductility

  reduced stress block depth $\longrightarrow$ increase in steel strain larger curvature are obtained.

Reasons for Providing Compression Reinforcement

Effect of compression reinforcement on strength and ductility of under reinforced beams.

$$\rho < \rho_b$$

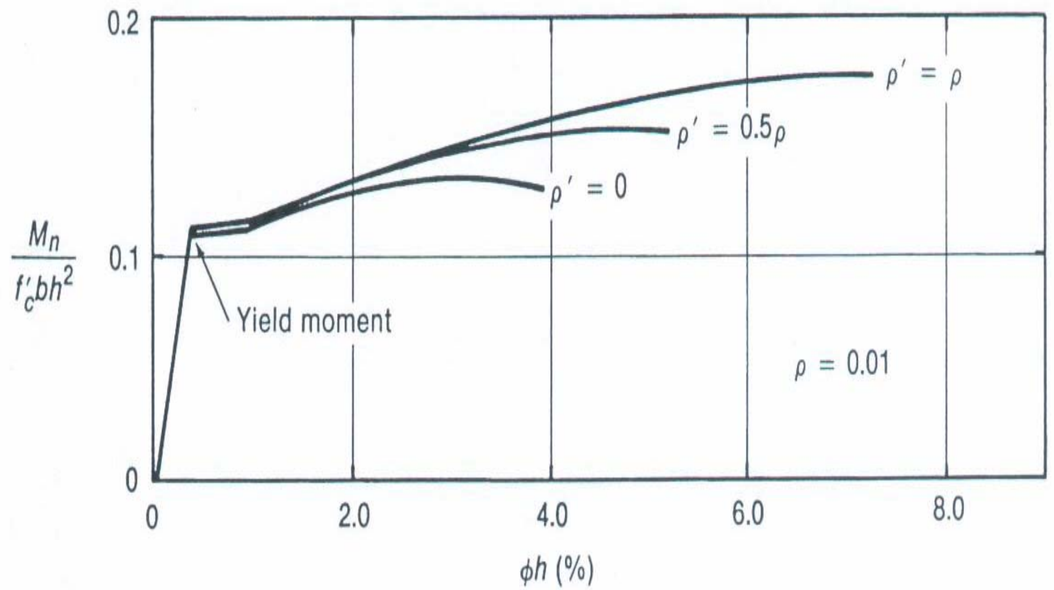


Fig 5-15 MacGregor

Reasons for Providing Compression Reinforcement

- Change failure mode from compression to tension. When $\rho > \rho_{bal}$, addition of As strengthens.

  Compression zone $\longrightarrow$ allows tension steel to yield before crushing of concrete.

  Effective reinforcement ratio $= (\rho - \rho')$

Reasons for Providing Compression Reinforcement

- Eases in Fabrication

  use corner bars to hold & anchor stirrups.

Effect of Compression Reinforcement

Compare the strain distribution in two beams with the same A_s