ARCH 324 - Structures 2, Winter 2009

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1) \[ A_s = \# \text{bars} \quad \text{(area of 16 bars)} \]
\[ A_s = 3 \times (0.79) = 2.37 \text{ in}^2 \]
\[ \text{from table p.341} \]

2) find limit of \( a \) (depth of the stress block)

\[
a = k_1 \left[ \frac{87}{87 + f_y} \right] d (0.75)
\]

Based on strength of concrete:

\[
a = 0.85 \left[ \frac{87}{87 + 60} \right] 18 (0.75) \quad a = 6.79''
\]

3) using

\[
a = \frac{A_s f_y}{0.85 f_c b}
\]

\[
0.85 f_c a b = A_s f_y
\]

\[
a = \frac{A_s f_y}{0.85 f_c b}\]

\[
a = \frac{2.37 \times 60}{0.85 \times 3 \times 12} = 4.65 < \text{limit so steel is yielding before compressive failure in concrete}
\]
4) Find moment capacity

\[ M = A_s f_y j d = 0.85 f_c a b j d \]

For a rectangular section \( j_d = d - a/2 \)

\[ M = M_n = A_s f_y \left( d - \frac{a}{2} \right) = 2.37 (60) \left( 18 - \frac{4.65}{2} \right) \]

\[ M_n = 2228.99 \ k' = 185.75 \ k' \]

5) \( M_u = 0.9 M_n \)

\[ M_u = 0.9 (185.75) = 167.18 \ k' \]