A36 steel column is encased in high-strength concrete, $P = 60 \text{ kips}$.

Determine required steel area for $P_{ct} = P_{conc}$, Also how far does the column shorten, if the original length is $8 \text{ ft}$.  

Two Bar in Parallel Type Problem

**DEFORMATION Compatibility:** \( S_{st} = S_{conc} \) \text{ in general } \( S = \frac{PL}{AE} \)

\[
\frac{P_{st}}{A_{st}} = \frac{P_{conc}}{A_{conc}} \cdot E_{conc}
\]

\[
\frac{30 \text{ kips}}{29 \times 10^3 \text{ ksi}} = \frac{30 \text{ kips}}{(16 \times 9^3 - A_{st}) (4.2 \times 10^3 \text{ ksi})}
\]

\[
(144 \text{ in}^2 - A_{st})(4.2 \times 10^3 \text{ ksi}) = A_{st} (29 \times 10^3 \text{ ksi})
\]

\[
60480 \text{ kips} = (33.2 \times 10^3 \text{ ksi}) A_{st}
\]

\[
A_{st} = 18.217 \text{ in}^2
\]

**Calc. Deformation of Column:**

\[
S = S_{st} = S_{conc} = \frac{(30 \text{ kips})(8 \text{ ft})(12 \text{ in/ft})}{(18.217 \text{ in}^2)(29 \times 10^3 \text{ ksi})} = 0.00545 \text{ in}
\]

\[
S = 0.00545 \text{ in}
\]