Determine the angle through which the screw can be turned before the rods or the specimen begin to yield. The load is 0.01 m per one full turn.

\[ F_{\text{AL}} = 2F_b \quad (1) \]

\[ (\sigma_{y})_{\text{Al}} = 37 \text{ ksi} \]
\[ (\sigma_{y})_{\text{St}} = 36 \text{ ksi} \]

\[ E_{\text{Al}} = 10 \times 10^3 \text{ ksi} \]
\[ E_{\text{St}} = 29 \times 10^3 \text{ ksi} \]

\[ \Delta_b + \Delta_{\text{Al}} = n \times 0.01 \quad (2) \]

\[ \frac{(F_b)(12)}{1014 \times (29 \times 10^3)} + \frac{F_{\text{AL}} \times 10}{(3.14) \times (10 \times 10^3)} = n \times 0.01 \]
\[ F_b + 0.151 \cdot F_{AL} = 4.74 \text{ N} \quad (2) \]

but \[ 2 \cdot F_b = F_{AL} \quad \text{from equation (1)} \]

Max possible \( F_b = (0.196)(36) = 7.056 \text{ kN} \)

Max possible \( F_{AL} = (3.14)(37) = 116.9 \text{ kN} \)

\[ \Rightarrow \text{ clearly the bolt dictates the force that could be applied without any of the two materials yielding} \]

\[ F_b = 7.056 \text{ kN} \quad F_{AL} = 14.11 \text{ kN} \]

\[ 7.056 + 0.151(14.11) = 4.74 \text{ N} \]

\[ N = 1.94 \; \text{ Revolution} \]

or 698°
Lecture # 8

TEMPERATURE EFFECTS

\[ \alpha = \text{coefficient of thermal expansion} \]
\[ \text{length/length/}^0\text{C} \]

- i.e. \( \text{mm/m/}^0\text{C} \) or \( \text{in/in/}^0\text{F} \) or \( \text{m/m/}^0\text{C} \)

\[ T_1 \rightarrow T_2 : \Delta T = T_2 - T_1 \]

determine the stress resulting from \( \Delta T \)

\[ \Delta L \Delta T = \Delta \]

\[ \Delta_2 = \frac{PL}{AE} \]

\[ \therefore \alpha L (\Delta T) = \left( \frac{PL}{AE} \right) \]

\[ \text{but} \quad \frac{P}{A} = \sigma \quad \therefore \sigma = \alpha (\Delta T) E \]
a) At what temperature will the gap close?

b) If the temperature is increased to 100°C, determine the normal forces in each bar.

\[
\begin{align*}
\Delta T &= 60.5°C \\
\therefore \Delta T &= T_1 + AT = 25 + 60.5 = 85.5°C
\end{align*}
\]

The new length of \( A L \) = 600 + (60.5)(24 \times 10^{-6})(600) = 600.87 mm

The new length of \( A L_{ng} \) = 400 + (60.5)(24 \times 10^{-6})(400) = 400.63 mm

\[
\begin{align*}
\Delta AL @ 100°C &= 600.87 - 400.63 = 200.24 mm \\
\Delta AL_{ng} @ 100°C &= (600.87)(14.5)(24 \times 10^{-6}) = 0.209 mm \\
\Delta AL_{ng} @ 100°C &= (400.63)(14.5)(24 \times 10^{-6}) = 0.151 mm
\end{align*}
\]

\[
\begin{align*}
P &= 3.05 KN \\
\sigma_{AL} &= \frac{3.05 \times 10^3}{150} = 20.36 \text{ N/mm}^2
\end{align*}
\]
This difference will have to be amended by:

\[ \Delta T = 17 \times 10^{-8} \times 110 \times 150 = 0.296 \text{ mm} \]

This difference is obtainable from the following: 

\[ F_{C} - F_{W} = 0 \]

\[ F_{C} = 5 \times 10^{-6} \times 150 \times 100 \times 10 \]

\[ F_{W} = 7.8 \times 10^{-3} \times 193 \times 10 \]

\[ E_{m} = 5500 \text{ MPa} \]

\[ c_{e} = 0.286 \text{ mm} \]

\[ T = 20 \text{ C} \]

2081 = 22

1000 mm

10 mm

50 mm

100 mm