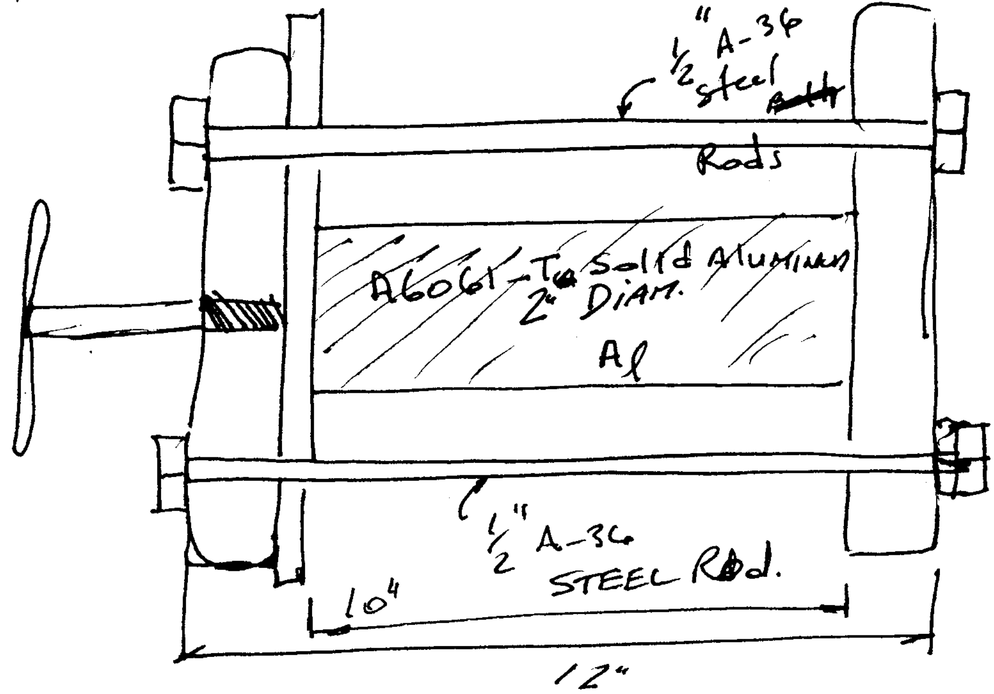
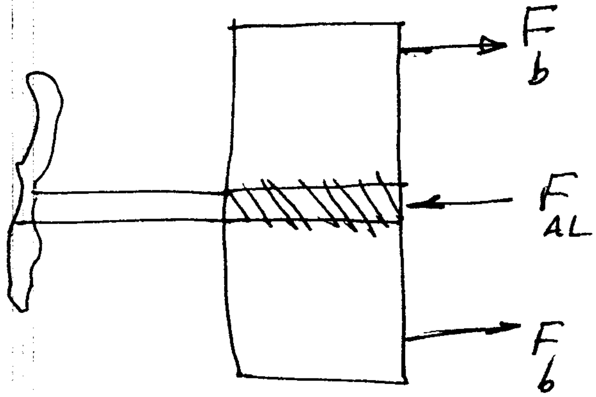
Lecture #8

4-57



Determine the angle through which the screws can be turned before the Rods or the specimen begin to yield.
The lead is 0.01 in per one full turn



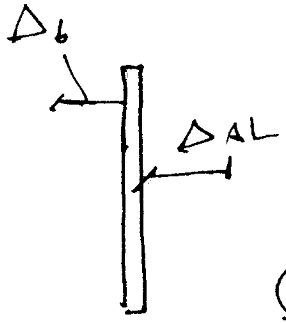
$$\boxed{F_{AL} = 2F_b} \quad (1)$$

$$(\sigma_y)_{Al} = 37 \text{ ksi}$$

$$(\sigma_y)_{ST} = 36 \text{ ksi}$$

$$E_{AL} = 10 \times 10^3 \text{ ksi}$$

$$E_{ST} = 29 \times 10^3 \text{ ksi}$$



$$\Delta_b + \Delta_{AL} = n(0.01) \quad (2)$$

$$\frac{(F_b)(12)}{(.196)(29\times10^3)} + \frac{F_{AL}\times 10}{(3.14)(10\times10^3)} = (n)(.01)$$

$$\boxed{F_b + 0.151\, F_{AL} = 4.74\, n} \quad (2)$$

but $2F_b = F_{AL}$ from equation (1)

Max possible $F_b = (0.196)(36) = 7.056^k$

Max possible $F_{AL} = (3.14)(37) = 116.8^k$

∴ clearly the Bolt dictates the Force that could be applied without any of the two Materials yielding ∴ $F_b = 7.056^k$ $F_{AL} = 14.11^k$

$7.056 + 0.151(14.11) = 4.74\, n$

$n = 1.94$ Revolution

or 698°

1

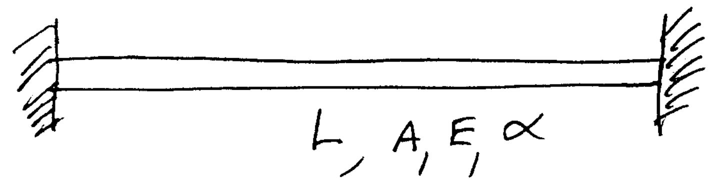
Lecture # 8

~~Thermo~~ TEMPERATURE EFFECTS

α = coefficient of thermal expansion

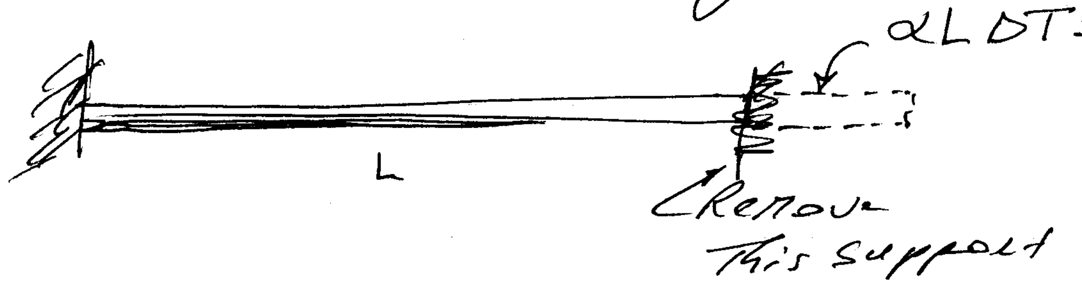
Length/length/° of temperature

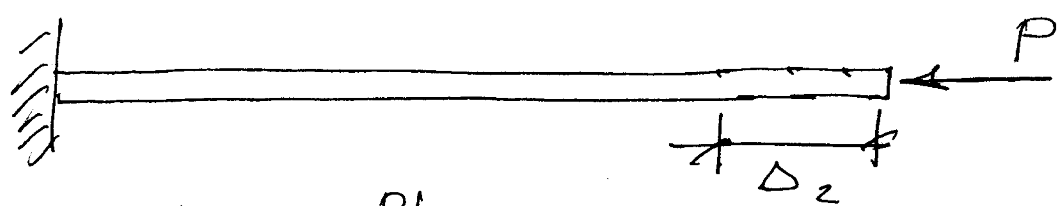
i.e. mm/mm/°C or in/in/°F or ft/ft/°F



$T_1 \longrightarrow T_2 \quad \therefore \Delta T = T_2 - T_1$

determine the stress resulting from ΔT





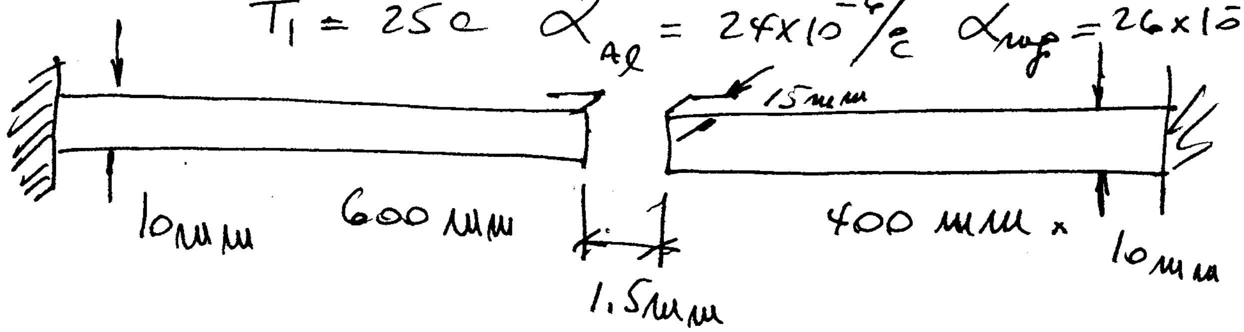
$$\Delta_2 = \frac{PL}{AE}$$

$$\therefore \alpha \cancel{L}(\Delta T) = \frac{P\cancel{L}}{AE} \quad (\tfrac{P}{A} = \sigma) \qquad \therefore \boxed{P = \alpha(\Delta T)AE}$$

$$\text{but } \frac{P}{A} = \sigma \qquad \therefore \boxed{\sigma = \alpha(\Delta T)E}$$

Similar to 4-77

$T_1 = 25°C \quad \alpha_{Al} = 24 \times 10^{-6}/°C \quad \alpha_{mg} = 26 \times 10^{-6}$



a) At what temperature will the Gap close?

b) If the Temperature is increased to 100°C determine the normal stresses in each BAR

$$(\Delta T)(24 \times 10^{-6}) \times (600) + \Delta T (26 \times 10^{-6}) \times 400 = 1.5$$

$$\Delta T = 60.5°C$$

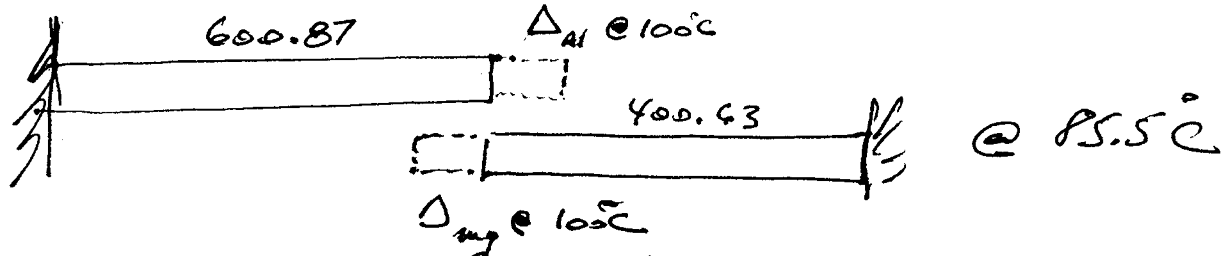
$$\therefore \; T_2 = T_1 + \Delta T = 25 + 60.5 = 85.5°C$$

The New Length of Al $= 600 + (60.5)(24 \times 10^{-6})(600)$

$= 600.87$ mm

The New Length of Mg $= 400 + (60.5)(26 \times 10^{-6})(400)$

$= 400.63$ mm.



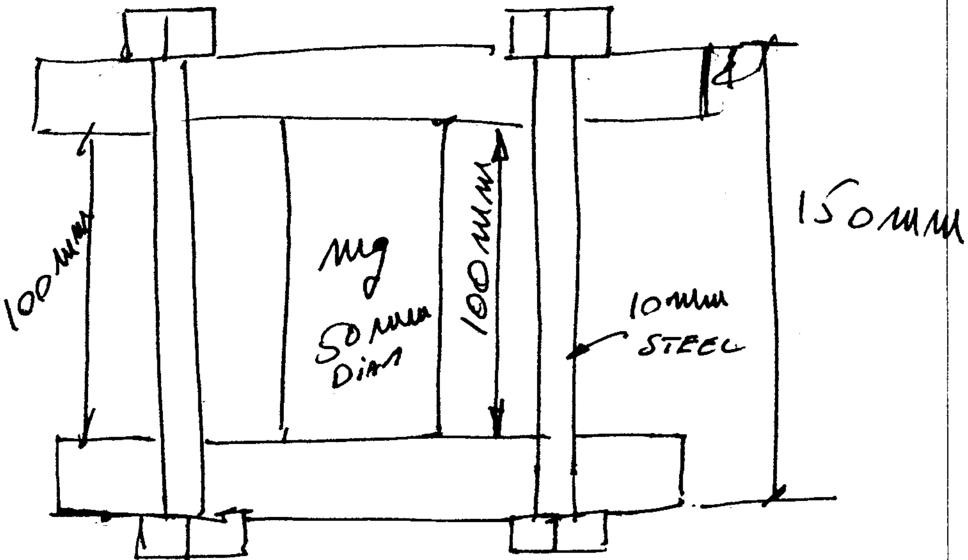
$$\Delta_{al} \text{ @ } 100°C = (\overset{L}{600.87})(\overset{\Delta T}{14.5})(24 \times 10^{-6}) = 0.209 \text{ mm}$$

$$\Delta_{mg} \text{ @ } 100°C = (400.63)(14.5)(26 \times 10^{-6}) = 0.151 \text{ mm}$$

$$\therefore \frac{10^3 \times (P)(600.87)}{\underset{A_{Al}}{(10 \times 15)(10^{-6})}\underset{E_{al}}{(68.9 \times 10^9)}} + \frac{10^3 \times P \times 400.63}{\underset{A_{mg}}{(10 \times 15)(10^{-6})}\underset{E_{mg}}{(44.7 \times 10^9)}} = .360$$

$$P = 3.05 \text{ KN} \quad \sigma_{Al} = \frac{3.05 \times 10^3}{150} = 20.36 \text{ N/m}^2$$

$$\sigma \ldots = \frac{30.5 \times 10^3}{\ldots} = 20.36 \text{ N/m}^2$$

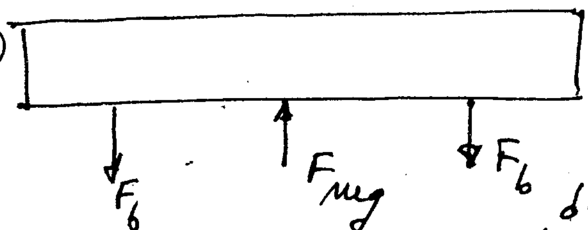


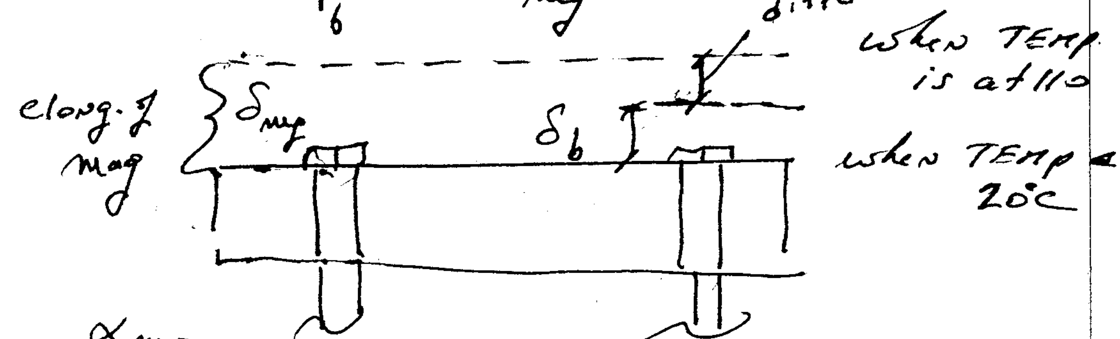
$T_1 = 20°C$

$T_2 = 130°C$

determine the force in the mg cylinder

$$2F_b - F_{mg} = 0 \quad (1)$$





$$\delta_{mg} = \underset{\alpha_{mg}}{26\times10^{-6}} \times \underset{\Delta T}{110} \times \underset{L}{100} = 0.2860 \text{ mm}$$

$$\alpha_{ST} = 17\times10^{-6} \times 110 \times 150 = 0.2805 \text{ mm}$$

difference $= 0.2860 - 0.2805 = 0.0055$ mm

∴ This difference will have to be made up by tensile elongation in bolts and comp. short. in mg.

$$\frac{(F_b \times 10^3)\times 150}{\underset{A_b}{(78.5\times10^{-6})}\ \underset{E_b}{193\times10^{3}}} + \frac{(F_{mg}\times10^3)\times 100}{\underset{A_{mg}}{(1962.5\times10^{-6})}\ \underset{E_{mg}}{44.7\times10^{9}}} = .0055 \quad (2)$$

∴ $F_{mg} = 0.91$ KN

$F_b = 0.45$ KN