



TEMP RANGE $10^{\circ}\text{C} - 100^{\circ}\text{C}$

$$\alpha_A = 25 \times 10^{-6} / ^{\circ}\text{C} \quad \alpha_S = 12 \times 10^{-6} / ^{\circ}\text{C}$$

FREE EXPANSION $A_{\text{Alum}} = 65 \times 25 \times 10^{-6} \times (100 - 10) = 0.14625 \text{ mm}$, $\text{STEEL} = 65 \times 12 \times 10^{-6} \times (100 - 10)$
 $= 0.0702 \text{ mm}$

USING THE AREA OF THE WASHOR FOR THE ALUMINIUM $= \pi \left(\frac{21^2 - 10.5^2}{4} \right) = 259.77 \text{ mm}^2$

AREA OF BOLT $= \frac{\pi \times 10^2}{4} = 78.5398 \text{ mm}^2$

Now The Thermal Strain For Steel & Aluminium is:-

$$\Delta_{\text{Alum}} = \frac{\Delta_s - 0.14625}{65} = \epsilon_s$$

Now After Expansion, Force On The Aluminium Should Be Equal To That On The Steel i:-

$$\Delta_s A_s + \Delta_A A_A = 0 - \textcircled{1} \quad \Delta = \epsilon E \text{ SUBSTITUTE IN } \textcircled{1}$$

$$200 \times 10^3 \times \frac{(\Delta - 0.0702)}{65} \times 78.5398 + 70 \times 10^3 \times (\Delta - 0.14625) = 0$$

$\rightarrow \times 259.77/65$

$$\text{Find } \Delta :- 241660.9231 (\Delta - 0.0702) + 279752.3 (\Delta - 0.14625)$$

$$\Delta = \frac{57878.37068}{521413.2309} = 0.111003 \text{ mm}$$

$$\Delta_{\text{Steel}} = \frac{200 \times 10^3 \times 0.111003 - 0.0702}{65} = 125 \text{ N/mm}^2$$

$$\Delta_{\text{Alum}} = \frac{70 \times 10^3 \times 0.111003 - 0.14625}{65}$$

$$\Delta_{\text{Alum}} = -37.958 \text{ N/mm}^2$$

* These are stresses due only to the expansion.