Question – Materials & Structures


Side View | Cross-section
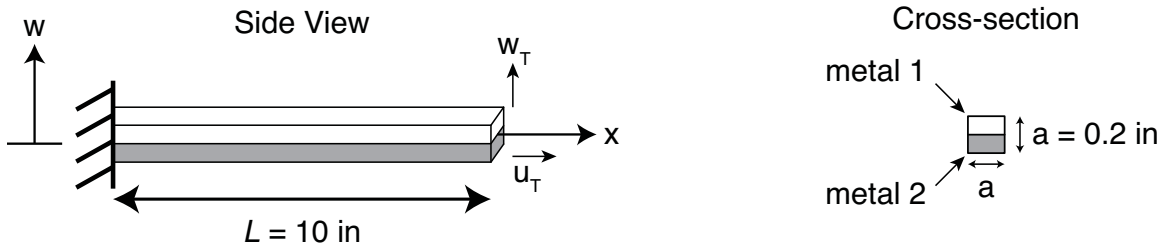
A bimetallic member made up of bonded steel and aluminum strips is to be used as a temperature indicator. Derive the following (state all assumptions):

(1) Assuming that the moduli of the strips are equal (*i.e.*, $E_1 = E_2 = E$), and that the linear coefficients of thermal expansion are $\alpha_1 = \alpha$ and $\alpha_2 \approx 0$, derive the vertical and horizontal tip deflections (at $x = L$), w_T and u_T, respectively, for a member uniformly heated with elevated temperature change, ΔT.

(2) If $E_1 > E_2$, discuss (but do not carry out) how the derivation in **(1)** would be altered.

(3) Consider the same bimetallic member as in **(1)**, but now the member is lying free on a flat surface, and again heated via ΔT. What is the final shape of the bimetallic member?

According to Beam Theory:
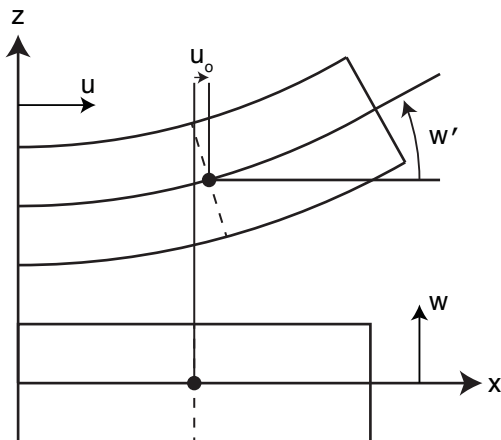
For point on a deflected beam:

$$\begin{cases} u = u_o - zw' \\ w = w \end{cases}$$

$$\epsilon_x = \frac{\partial u}{\partial x}$$