

$$\rho_c = f \rho_f + (1 - f) \rho_m$$

$$f = \frac{\rho_c - \rho_m}{\rho_f - \rho_m}$$

$$\delta = \frac{F s (3L^2 - 4s^2)}{48 E I}$$

$$I = \frac{wh^3}{12}$$

$$E_f^{\text{ax}} = \text{Axial fibre modulus}$$

$$E_1 = \text{Axial composite modulus}$$

$$E_1 = f E_f^{\text{ax}} + (1 - f) E_m$$

$$E_f^{\text{ax}} = \frac{E_1 - (1 - f) E_m}{f}$$

$$E_f^{\text{tr}} = \text{Transverse fibre modulus}$$

$$E_2 = \text{Transverse composite modulus}$$

$$E_2 = E_m \frac{1 + \eta f}{1 - \eta f}$$

$$\eta = \frac{\left( \frac{E_f^{\text{tr}}}{E_m} \right) - 1}{\left( \frac{E_f^{\text{tr}}}{E_m} \right) + 1} = \frac{E_f^{\text{tr}} - E_m}{E_f^{\text{tr}} + E_m}$$

$$E_f^{\text{tr}} = E_m \frac{1 + \eta}{1 - \eta}$$

$$\kappa = \frac{2 \sin[\tan^{-1}(\frac{\delta}{x})]}{\sqrt{x^2 + \delta^2}}$$

$$\Delta \varepsilon = \Delta \alpha \Delta T$$

$$\kappa = \frac{24 E_1 E_2}{E_1^2 + 14 E_1 E_2 + E_1^2} \frac{\Delta \varepsilon}{h}$$

$$\Delta \alpha = h \frac{E_A^2 + 14 E_A E_B + E_B^2}{12 E_A E_B \Delta T} \frac{\sin \left[ \tan^{-1} \left( \frac{\delta}{x} \right) \right]}{\sqrt{x^2 + \delta^2}}$$

$$\alpha_{ax,c} = \frac{\alpha_m(1-f)E_m + \alpha_f^{ax} f E_f^{ax}}{(1-f)E_m + f E_f^{ax}}$$

$$\alpha_{tr,c} = \alpha_m(1-f)(1+\nu_m) + \alpha_f^{tr} f(1+\nu_f) - \alpha_{ax,c} \nu_{12,c}$$

$$\nu_{12,c} = f \nu_f + (1-f) \nu_m$$

$$\alpha_m = \frac{\alpha_f^{tr} f(1+\nu_f) - \Delta \alpha - \frac{(1+\nu_{12,c}) \alpha_f^{ax} f E_f^{ax}}{(1-f)E_m + f E_f^{ax}}}{\frac{(1+\nu_{12,c})(1-f)E_m}{(1-f)E_m + f E_f^{ax}} - (1-f)(1+\nu_m)}$$