

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

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

$$\delta=\frac{Fs\left(3L^2-4s^2\right)}{48\,E\,I}$$

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

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

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

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

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

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

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

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

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

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

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

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

$$\begin{aligned} \kappa &= \frac{24\,E_1 E_2}{E_1^2 + 14 E_1 E_2 + E_1^2}\,\frac{\Delta\varepsilon}{h} \\ \Delta\alpha &= h\,\frac{E_1^2 + 14 E_1 E_2 + E_2^2}{12\,E_1 E_2\,\Delta T}\,\frac{\sin\left[\tan^{-1}\left(\frac{\delta}{x}\right)\right]}{\sqrt{x^2+\delta^2}} \\ \alpha_{ax,c} &= \frac{\alpha_m(1-f)E_m + \alpha_f^{ax}fE_f^{ax}}{(1-f)E_m + fE_f^{ax}} \end{aligned}$$

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

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

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

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