Errors Due to Transverse Sensitivity in Strain Gages

Appendix

The following relationships can be used to correct for transverse sensitivity of the grids in any tee, delta, or rectangular rosette. *The value of* K_t *does not need to be the same in each grid.* In each case, ν_0 is the Poisson's ratio of the material on which the manufacturer's gage factor was measured (usually 0.285).

Two-Element Tee (90-degree) Rosettes & Shear Patterns

$$\varepsilon_1 = \frac{\hat{\varepsilon}_1(1-\nu_0 K_{t_1}) - K_{t_1}\hat{\varepsilon}_2(1-\nu_0 K_{t_2})}{1-K_{t_1}K_{t_2}}$$ Eq. (509.20)

$$\varepsilon_2 = \frac{\hat{\varepsilon}_2(1-\nu_0 K_{t_2}) - K_{t_2}\hat{\varepsilon}_1(1-\nu_0 K_{t_1})}{1-K_{t_1}K_{t_2}}$$ Eq. (509.21)

By first applying these corrections to the indicated strains, the actual shear strain can also be calculated from the actual normal strains:

$$\gamma_{12} = \varepsilon_1 - \varepsilon_2$$ Eq. (509.21a)

where:

$\hat{\varepsilon}_1, \hat{\varepsilon}_2$ = indicated strains from gages (1) and (2), uncorrected for transverse sensitivity.

K_{t_1}, K_{t_2} = transverse sensitivities of gages (1) and (2).

$\varepsilon_1, \varepsilon_2$ = actual strains along gage axes (1) and (2).

γ_{12} = actual shear strain between gage axes (1) and (2).

Three-Element Rectangular (45-degree) Rosettes

$$\varepsilon_1 = \frac{\hat{\varepsilon}_1(1-\nu_0 K_{t_1}) - K_{t_1}\hat{\varepsilon}_3(1-\nu_0 K_{t_3})}{1-K_{t_1}K_{t_3}}$$ Eq. (509.22)

$$\varepsilon_2 = \frac{\hat{\varepsilon}_2(1-\nu_0 K_{t_2})}{1-K_{t_2}} - \frac{K_{t_2}\left[\hat{\varepsilon}_1(1-\nu_0 K_{t_1})(1-K_{t_3}) + \hat{\varepsilon}_3(1-\nu_0 K_{t_3})(1-K_{t_1})\right]}{(1-K_{t_1}K_{t_3})(1-K_{t_2})}$$

Eq. (509.23)

$$\varepsilon_3 = \frac{\hat{\varepsilon}_3(1-\nu_0 K_{t_3}) - K_{t_3}\hat{\varepsilon}_1(1-\nu_0 K_{t_1})}{1-K_{t_1}K_{t_3}}$$ Eq. (509.24)

where:

$\hat{\varepsilon}_1, \hat{\varepsilon}_2, \hat{\varepsilon}_3$ = indicated strains from gages (1), (2) and (3), uncorrected for transverse sensitivity.

$K_{t_1}, K_{t_2}, K_{t_3}$ = transverse sensitivities of gages (1), (2) and (3).

$\varepsilon_1, \varepsilon_2, \varepsilon_3$ = actual strains along gage axes (1), (2) and (3).

Three-Element Delta (60-degree) Rosettes

$$\varepsilon_1 = \frac{\hat{\varepsilon}_1(1-\nu_0 K_{t_1})(3-K_{t_2}-K_{t_3}-K_{t_2}K_{t_3}) - 2K_{t_1}\left[\hat{\varepsilon}_2(1-\nu_0 K_{t_2})(1-K_{t_3}) + \hat{\varepsilon}_3(1-\nu_0 K_{t_3})(1-K_{t_2})\right]}{3K_{t_1}K_{t_2}K_{t_3} - K_{t_1}K_{t_2} - K_{t_2}K_{t_3} - K_{t_1}K_{t_3} - K_{t_1} - K_{t_2} - K_{t_3} + 3}$$

Eq. (509.28)

$$\varepsilon_2 = \frac{\hat{\varepsilon}_2(1-\nu_0 K_{t_2})(3-K_{t_3}-K_{t_1}-K_{t_3}K_{t_1}) - 2K_{t_2}\left[\hat{\varepsilon}_3(1-\nu_0 K_{t_3})(1-K_{t_1}) + \hat{\varepsilon}_1(1-\nu_0 K_{t_1})(1-K_{t_3})\right]}{3K_{t_1}K_{t_2}K_{t_3} - K_{t_1}K_{t_2} - K_{t_2}K_{t_3} - K_{t_1}K_{t_3} - K_{t_1} - K_{t_2} - K_{t_3} + 3}$$

Eq. (509.29)

$$\varepsilon_3 = \frac{\hat{\varepsilon}_3(1-\nu_0 K_{t_3})(3-K_{t_1}-K_{t_2}-K_{t_1}K_{t_2}) - 2K_{t_3}\left[\hat{\varepsilon}_1(1-\nu_0 K_{t_1})(1-K_{t_2}) + \hat{\varepsilon}_2(1-\nu_0 K_{t_2})(1-K_{t_1})\right]}{3K_{t_1}K_{t_2}K_{t_3} - K_{t_1}K_{t_2} - K_{t_2}K_{t_3} - K_{t_1}K_{t_3} - K_{t_1} - K_{t_2} - K_{t_3} + 3}$$

Eq. (509.30)

where:

$\hat{\varepsilon}_1, \hat{\varepsilon}_2, \hat{\varepsilon}_3$ = indicated strains from gages (1), (2) and (3), uncorrected for transverse sensitivity.

$K_{t_1}, K_{t_2}, K_{t_3}$ = transverse sensitivities of gages (1), (2) and (3).

$\varepsilon_1, \varepsilon_2, \varepsilon_3$ = actual strains along gage axes (1), (2) and (3).
