Gere and Timoshenko, Reference 3

Let

υ_s	= deflection due to shear alone
α_s	= shear coefficient
V	= shear force
A	= cross-sectional area
G	= shear modulus

The average shear stress is

$$V/A \tag{5}$$

The shear stress varies over the height of the beam. The shear coefficent α_s is the numerical factor by which the average shear stress must be multiplied to obtain the shear stress at the neutral axis.

The shearing rigidity is

$$\frac{GA}{\alpha_s} \tag{6}$$

Again, the shear stress varies throughout the height of the beam. Thus, the principle of virtual work must be used to obtain a more exact method. Specifically, the unit-load method is used. The derivation is given in Reference 3.

This approach leads to a new factor in place of the shear coefficient α_s. The new factor is the form factor f_s. The revised shearing rigidity is thus

$$\frac{GA}{f_s} \tag{7}$$

The form factor is calculated from

$$f_s = \frac{A}{I^2}\int_A \frac{Q^2}{b^2}\, dA \tag{8}$$

where

Q	= first area moment about neutral axis
I	= area moment of inertia
b	= width
A	= cross-sectional area

Shear coefficients and shear factors are shown in Table 3.

Table 3. Timoshenko's Shear Coefficients and Form Factors		
Cross-Section	Shear Coefficient α_s	Form Factor f_s
Rectangular	3/2	6/5
Circular	3/4	10/9
Thin-wall Hollow Circular	2	2
I-Beam of Box Section	A / A_{web}	A / A_{web}

Conclusion

Thomson's shear factors are the same as Timoshenko's shear coefficients.

Lee's shape factors are the reciprocal of Timoshenko's form factors.

Timoshenko's form factor is more accurate than his shear coefficient because the form factor accounts for shear stress variation per beam height.

References

1. W. Thomson, Theory of Vibration with Applications, Second Edition, Prentice-Hall, New Jersey, 1981.
2. J. Lee, MSC/NASTRAN Common Questions and Answers, MacNeal-Schwendler Corporation.
3. Gere and Timoshenko, Mechanics of Materials, Brooks/Cole Engineering Division, Monterey, California, 1984.