50.3: Transverse (Shear) Stress—Translational

In transverse (or shear) stress, the applied force is parallel to the surface. There are two types of transverse stress: translational and torsional. In this section we'll examine translational transverse stress.

As an example of translational transverse stress, imagine placing your physics textbook face-up on a table. Now put your hand on the front cover and push the cover to the right, so that the front cover moves to the right but the rear cover remains stationary on the table (by friction). Now if you look at the bottom end of the book, it will look like a parallelogram. In this case, the stress is given by Eq. 50.1.2, where the force F is the component of the force parallel to the surface (front cover of the book), and A is the area of the surface (the area of the book cover).

Strain

For translational transverse stress, the strain is the angle ϕ (in radians) by which the body is deformed (Fig. 50.4.1). For small deformations, we can write $\phi \approx \tan\phi = d/l$, and so the strain

$$\phi \approx d/l. \tag{50.3.1}$$

Shear Modulus

In the case of translational transverse stress, the appropriate elastic modulus is the shear modulus S. Since the elastic modulus is the ratio of the stress to the strain, we have

$$S = \frac{F_t/A}{d/l} \tag{50.3.2}$$

where F_t is the component of the applied force parallel to the area A, d is the displacement of the body, and l is its thickness (Fig. 50.4.1).

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