Example 2.1.6

Figure 1 shows an elastomeric bearing pad consisting of two steel plates bonded to a chloroprene elastomer (an artificial rubber) with the dimensions shown. During a static loading test the pad is subjected to a shear force of 12 kN, which causes the top plate to displace laterally 8.0 mm with respect to the bottom plate. What is the shear modulus of elasticity G of the elastomer?

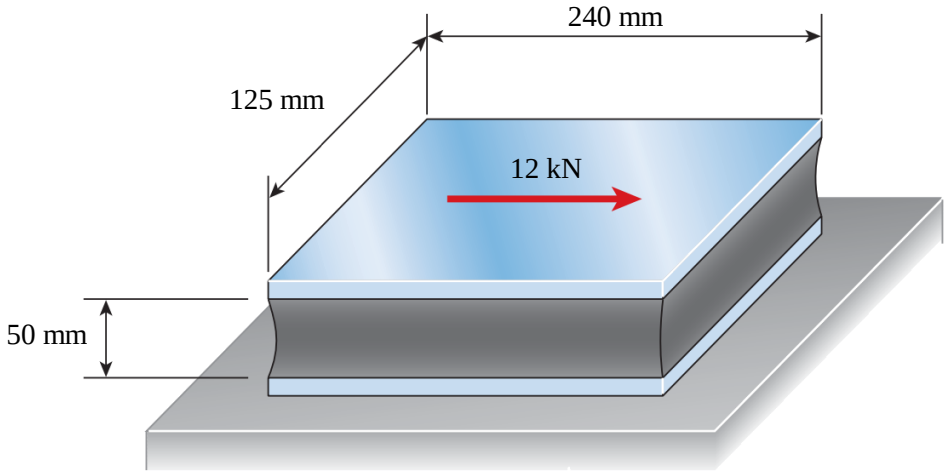

Figure 1: An elastomeric bearing pad.

The shear modulus G relates the shear stress τ applied to the pad and the shear strain γ that ensues.

The engineering shear stress is:

$$\tau = \frac{S}{A} = \frac{12\ \text{kN}}{240\ \text{mm} \times 125\ \text{mm}} = \frac{12\,000\ \text{N}}{30\,000\ \text{mm}^2} = 0.4\ \text{MPa} = 400\ \text{kPa}$$

The engineering shear strain is the angle (in radians) acquired by the side of the pad as the top moves sideways by 8 mm. Therefore,

$$\gamma = \frac{8\ \text{mm}}{50\ \text{mm}} = 0.16$$

The shear modulus G is finally,

$$G = \frac{\tau}{\gamma} = \frac{0.4\ \text{MPa}}{0.16} = 2.5\ \text{MPa}$$

Note how much lower this is compared to the shear modulus say of an aerospace aluminium alloy (~26 GPa) and steel (~79 GPa).