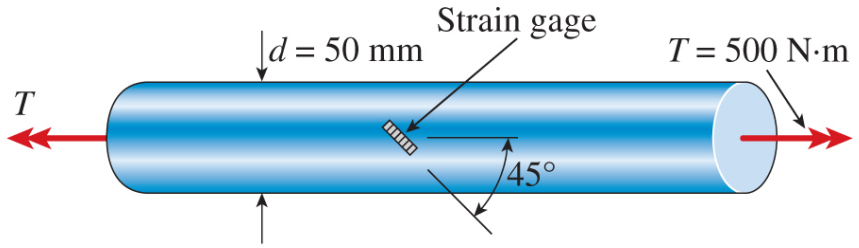
材料力學　作業 9

學號：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿　　姓名：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

3.5-4 A solid circular bar of diameter $d = 50\,\text{mm}$ (see figure) is twisted in a testing machine until the applied torque reaches the value $T = 500\,N \cdot m$. At this value of torque, a strain gage oriented at 45° to the axis of the bar gives a reading $\varepsilon = 339 \times 10^{-6}$.

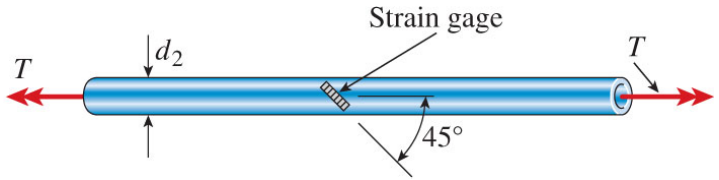
What is the shear modulus *G* of the material?



3.5-7 The normal strain in the 45° direction on the surface of a circular tube (see figure) is 880×10^{-6} when the torque $T=85N\cdot m$. The tube is made of copper alloy with $G=42$ GPa and $v=0.35$.

(a) If the outside diameter d_2 of the tube is 20 mm, what is the inside diameter d_1?

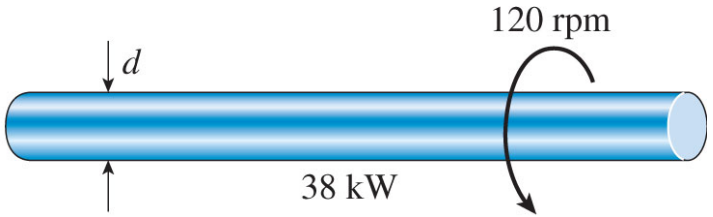
(b) If the allowable normal stress in the tube is 96 MPa, what is the maximum permissible inside diameter d_1?



3.7-1 A generator shaft in a small hydroelectric plant turns at 120 rpm and delivers 38 kW (see figure).

(a) If the diameter of the shaft is $d = 75$ mm, what is the maximum shear stress τ_{max} in the shaft?

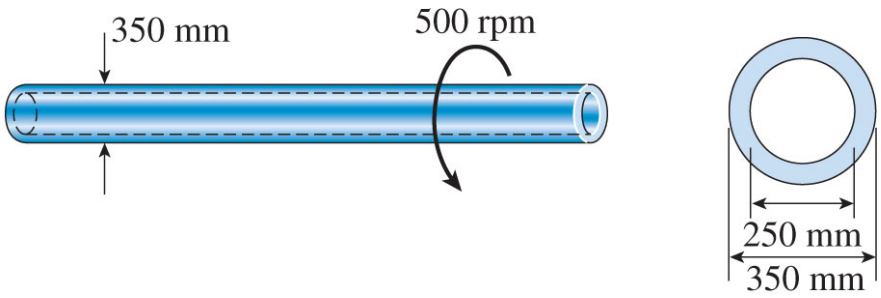
(b) If the shear stress is limited to 28 MPa, what is the minimum permissible diameter d_{min} of the shaft?



3.7-3 The propeller shaft of a large ship has outside diameter 350 mm and inside diameter 250 mm, as shown in the figure. The shaft is rated for a maximum shear stress of 62 MPa.

(a) If the shaft is turning at 500 rpm, what is the maximum horsepower that can be transmitted without exceeding the allowable stress?

(b) If the rotational speed of the shaft is doubled but the power requirements remain unchanged, what happens to the shear stress in the shaft?



3.7-9 A motor delivers 200 kW at 1000 rpm to the end of a shaft (see figure). The gears at *B* and *C* take out 90 and 110 kW, respectively.

Determine the required diameter *d* of the shaft if the allowable shear stress is 50 MPa and the angle of twist between the motor and gear *C* is limited to 1.5°. (Assume $G = 80\,\text{GPa}$, $L_1 = 1.8\,\text{m}$, and $L_2 = 1.2$ m.)