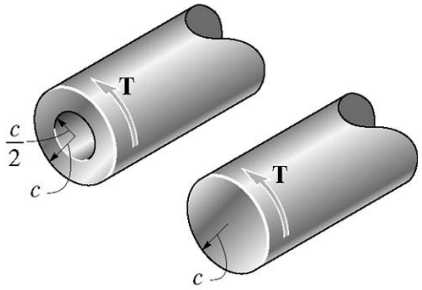
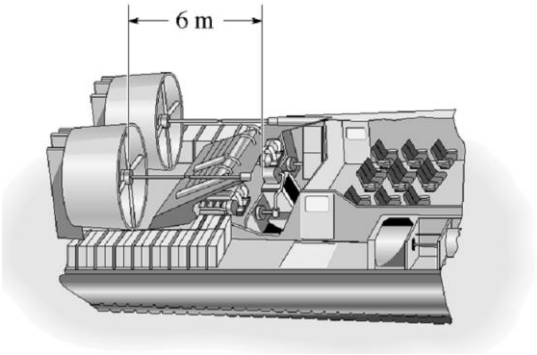
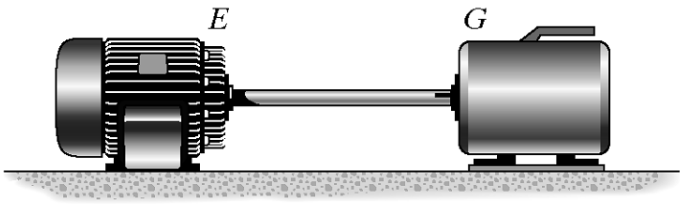
1. A shaft is subjected to a torque *T*. Compare the effectiveness of using the tube shown in the figure with that of a solid section of radius *c*. To do this, compute the percentage change in torsional stress and angle of twist per unit length.



2. The tubular drive shaft for the propeller of a hover-craft is 6 m long. If the motor delivers 4 MW of power to the shaft when the propellers rotate at 25 rad/s, determine the required inner diameter of the shaft if the outer diameter is 250 mm. What is the angle of twist of the shaft when it is operating? Take [τ] = 90 MPa and G = 75 GPa.



3. The stainless steel shaft is 3 m long and has an outer diameter of 60 mm. When it is rotating at 60 rad/s, it transmits 30 kW of power from the engine *E* to the generator *G*. determine the smallest thickness of the shaft if the allowable shear stress is $[\tau]$ = 150 MPa and the shaft is restricted not to twist more than 0.08 rad. G = 80 GPa.



4. When drilling a well, the deep end of the drill pipe is assumed to encounter a torsional resistance T_A. Furthermore, soil friction along the sides of the pipe creates a linear distribution of torque per unit length, varying from zero at the surface *B* to t_0 at *A*. Determine the necessary torque T_B that must be supplied by the drive unit to turn the pipe. Also, what is the relative angle of twist of one end of the pipe with respect to the other end at the instant the pipe is about to turn? The pipe has an outer radius r_o and an inner radius r_i. The shear modulus is *G*.