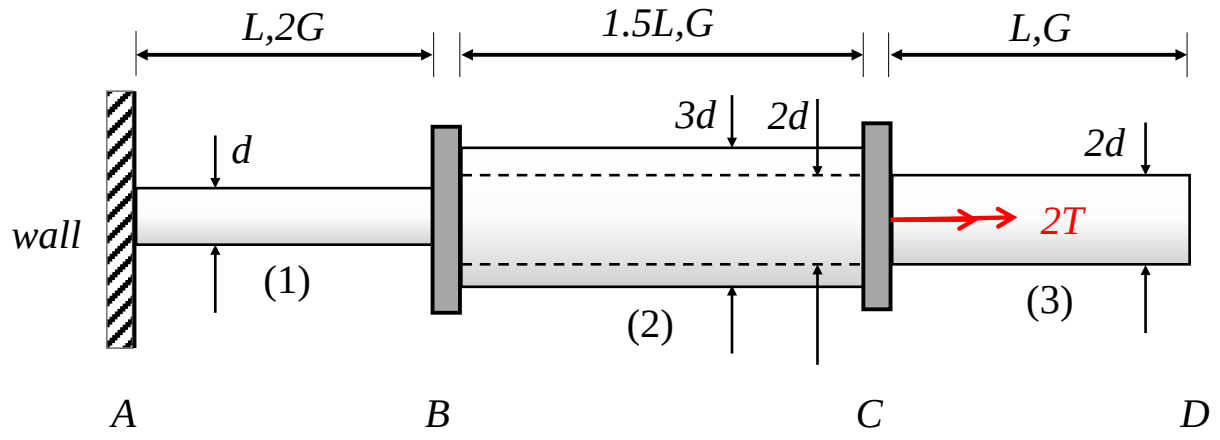
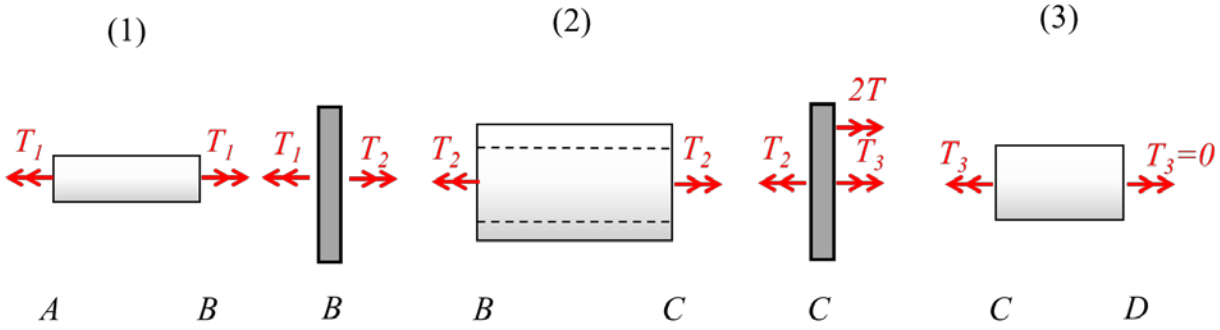




Equilibrium:

a) Shaft (3) is free at end D. $\Rightarrow T_3 = 0$

Connector C: $T_3 + 2T - T_2 = 0 \Rightarrow T_2 = 2T$ (1)

Connector B: $T_2 - T_1 = 0 \Rightarrow T_1 = T_2 = 2T$ (2)

Where, T_1, T_2, T_3 are the torques carried by the three shafts.

Polar moments are represented here as J_i. (They can also be denoted as I_p)

b) $\theta_1 = \frac{T_1 L_1}{G_1 J_1} = \frac{(2T)(L)}{(2G)(J_1)} = \frac{32TL}{\pi G d^4}$; $\theta_2 = \frac{T_1 L_1}{G_1 J_1} = \frac{(2T)(1.5L)}{(G)(J_2)} = \frac{96TL}{65\pi G d^4}$

, where θ_1, θ_2 are rotations between the ends of shafts (1) and (2) respectively. Note that $\theta_3 = 0$, since torque carried by shaft (3) is 0.

Compatibility:

$$\theta_A = 0 \qquad (wall) \tag{3}$$

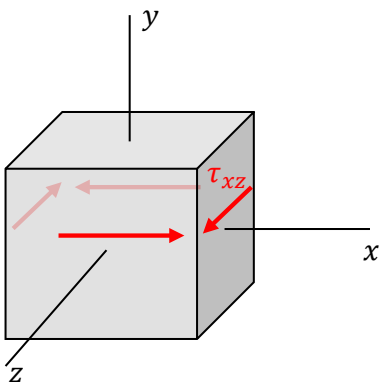
$$\theta_B = \theta_A + \theta_1 = \theta_1 \tag{4}$$

$$\theta_C = \theta_B + \theta_2 = \theta_1 + \theta_2 \tag{5}$$

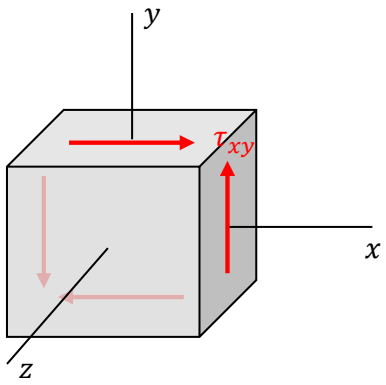
$$\theta_D = \theta_C + \theta_3 = \theta_C \tag{6}$$

From (4): $\theta_B = \frac{32TL}{\pi G d^4}$

From (5): $\theta_C = \theta_B + \theta_2 = \frac{32TL}{\pi G d^4} + \frac{96TL}{65\pi G d^4} = \frac{2176}{65}\frac{TL}{\pi G d^4} = \theta_D$



Element M



Element N