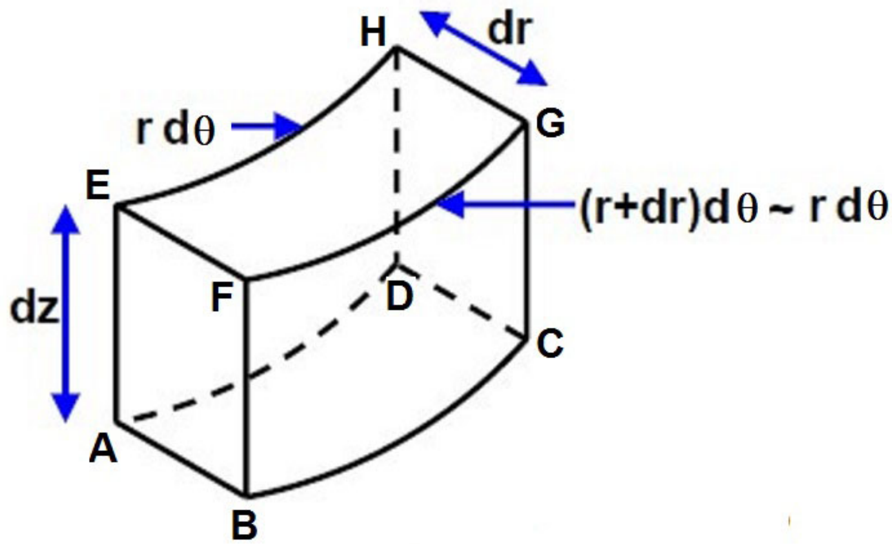
Problem 114C:

Consider the elemental control volume in cylindrical coordinates (r, θ, z) as sketched below: Show that



mass conservation in this coordinate system leads to the following form of the equation of continuity:

$$\frac{\partial \rho}{\partial t} + \frac{1}{r}\frac{\partial(\rho r u_r)}{\partial r} + \frac{1}{r}\frac{\partial(\rho u_\theta)}{\partial \theta} + \frac{\partial(\rho u_z)}{\partial z} = 0 \quad (1)$$

where (u_r, u_θ, u_z) denote the velocity components in the (r, θ, z) directions.