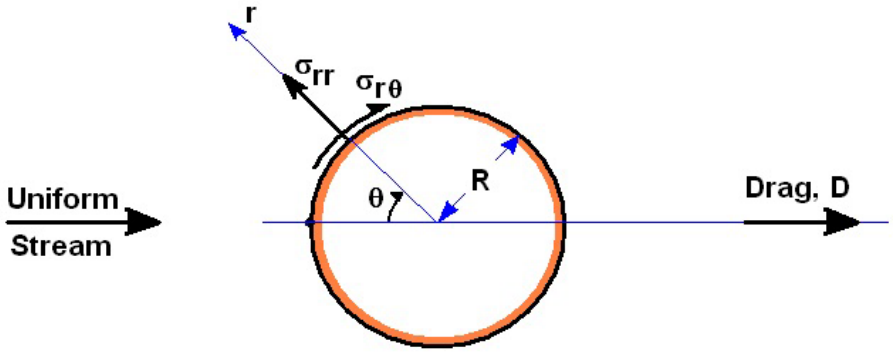
Solution to Problem 145A:

This problem involves an idealized flow of a uniform stream around a cylinder of radius, R: in which the



normal stress, σ_{rr}, and the tangential stress, $\sigma_{r\theta}$, acting on the surface of the cylinder vary with angular location, θ, according to:

$$\sigma_{rr} = -A\cos 2\theta - B\cos\theta$$

$$\sigma_{r\theta} = C\sin\theta$$

where A, B, and C are known constants.

The drag, D, acting on the cylinder per unit depth normal to the sketch is given by

$$D \;=\; 2\int_0^{\pi} (\sigma_{r\theta}\;\sin\theta - \sigma_{rr}\;\cos\theta)\;R\;d\theta$$

The term involving σ_{rr} constitutes the form drag which is therefore

$$\text{Form Drag} \;=\; -2\int_0^{\pi} \sigma_{rr}\;\cos\theta\;R\;d\theta \;=\; \pi RB$$

The term in D involving $\sigma_{r\theta}$ constitutes the skin friction drag which is therefore

$$\text{Skin Friction Drag} \;=\; 2\int_0^{\pi} \sigma_{r\theta}\;\sin\theta\;R\;d\theta \;=\; \pi RC$$