2.163

2.163 (See Fluids in the News article titled **"Rotating mercury mirror telescope,"** Section 2.12.2.) The largest liquid mirror telescope uses a 6-ft-diameter tank of mercury rotating at 7 rpm to produce its parabolic-shaped mirror as shown in Fig. P2.163. Determine the difference in elevation of the mercury, Δh, between the edge and the center of the mirror.

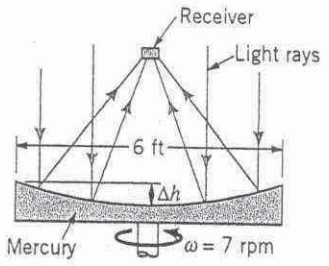

FIGURE P2.163

For free surface of rotating liquid,

$$z = \frac{\omega^2 r^2}{2g} + \text{constant} \qquad \text{(Eq. 2.32)}$$

Let $z=0$ at $r=0$ and therefore constant $=0$. Thus,

$\Delta h = \Delta z$ for $r = 3$ ft and with

$$\omega = (7 \text{ rpm})\left(2\pi \frac{\text{rad}}{\text{rev}}\right)\left(\frac{1 \text{ min}}{60 \text{ s}}\right)$$

$$= 0.733 \frac{\text{rad}}{\text{s}}$$

it follows that

$$\Delta h = \frac{\left(0.733 \frac{\text{rad}}{\text{s}}\right)^2 (3 \text{ ft})^2}{2\left(32.2 \frac{\text{ft}}{\text{s}^2}\right)} = \underline{0.0751 \text{ ft}}$$