Ex4) Worm Gear for Lowering Down

- **For worm gear with the following parameters, determine if it is self-locking or not**

  $d_W = 2$ in, $\mu = 0.1$, $N_w = 1$, $p_x = 0.5236$, $\phi_n = 20^o$

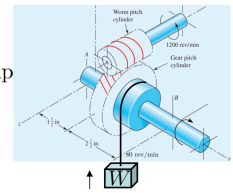
- **Compare the torques for lift-up & lower-down**

  $d_G = 6$ in, $W = 30$ lbf, $r_{drum} = 2$ in

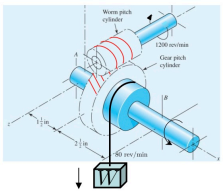
Condition for self-locking :

$\mu \geq \tan\lambda \cos\phi_n$

Lift-up



Lower-down



$$\tan\lambda = \frac{L}{\pi d_w} = \frac{N_w p_x}{\pi d_w} = \frac{1 \times 0.5236}{\pi \times 2} = 0.0833$$

$$\cos\phi_n = \cos 20^\circ = 0.9397$$

$$\tan\lambda \cdot \cos\phi_n = 0.0833 \cdot 0.9397 = 0.083 < 0.1 = \mu$$

$\Rightarrow$ self-locking

Lift-up torque (from worm gear formula)

$$T_{up} = W_{tw} \cdot \frac{d_w}{2} = W_{tG} \frac{\mu + \cos\phi_n \tan\lambda}{\cos\phi_n - \mu\tan\lambda} \cdot \frac{d_w}{2}$$

($W_{tw} = W_{tG}$)

$$W \cdot r_{drum} = W_{tG} \cdot \frac{d_G}{2}$$

$$W_{tG} = \frac{r_{drum}}{r_G} W = \frac{2}{3} \cdot 30 = 20 \text{ lbf}$$

$$T_{up} = 20 \times \frac{0.1 + \cos 20^\circ \times 0.0833}{\cos 20^\circ - 0.1 \times 0.0833} \times 1 = \boxed{3.828 \text{ lb-in}}$$

$$T_{down} = 20 \times \frac{0.1 - \cos 20^\circ \times 0.0833}{\cos 20^\circ + 0.1 \times 0.0833} \times 1 = \boxed{0.453 \text{ lb-in}}$$