Problem 2.4

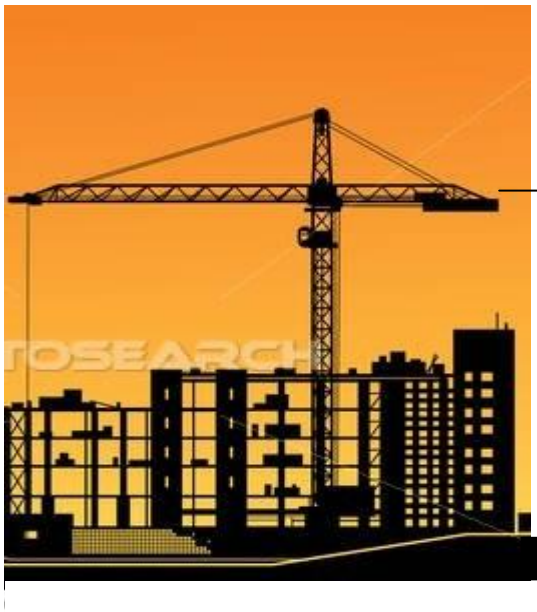
A construction crane weighing 12,000 lbf fell from a height of 400 ft to the street below during a severe storm. For $g$ = 32.05 ft/s$^2$, determine mass, in lb, and the change in gravitational potential energy of the crane, in ft·lbf.

---

**KNOWN**: A crane of known weight falls from a known elevation to the street below.

**FIND**: Determine the change in gravitational potential energy of the crane.

**SCHMATIC AND GIVEN DATA**:




**ENGINEERING MODEL**: (1) The crane is the closed system. (2) The acceleration of gravity is constant.

**ANALYSIS**:

To get the mass, note that $F_{grrav} = mg$. Thus

$$m = \frac{F_{grav}}{g} = \frac{12000 \text{ lbf}}{32.05 \text{ ft/s}^2}\left|\frac{32.174 \text{ lb·ft/s}^2}{1 \text{ lbf}}\right| = 12{,}046 \text{ lb}$$

The change in gravitational potential energy is

$$\Delta PE = mg(z_2 - z_1) = F_{grav}\Delta z = (12000 \text{ lbf})(-400 \text{ ft}) = -4.8 \text{ x } 10^6 \text{ ft} \cdot \text{lbf}$$