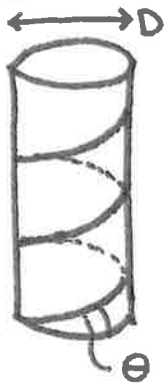


Ex 23.10 Grain elevator

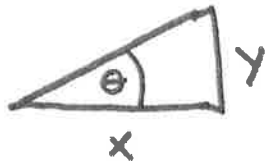


$$D = \text{dia} = 1 \text{ ft.}, \quad \text{Area} = \pi \left(\frac{D}{2}\right)^2 = 0.785 \text{ ft}^2$$

$$\theta = \text{pitch} = 15^\circ$$

Need to lift 1000 bushels/hour.
1 bushel = 1.244 cubic feet.

- What is the rise during one rotation? Call rise "y".
Use x = circumference of tube.



$$\frac{y}{x} = \tan \theta$$

$$y = (\pi D) \tan \theta =$$

- The volume flow rate through the grain elevator tube is given by

$$\frac{\text{Volume}}{\text{time}} = \left(\frac{\text{cross sectional area of tube}}{\text{area of tube}} \right) (\text{flow velocity})$$

$$= \left(\frac{\text{cross sectional area of tube}}{\text{area of tube}} \right) \left(\frac{\text{vertical rise}}{\text{per rotation}} \right) \left(\frac{\text{rotations}}{\text{per time}} \right)$$

$$\frac{1244 \text{ ft}^3}{\text{hour}} = A y R$$

$$= (0.785 \text{ ft}^2) \left(\frac{0.812 \text{ ft}}{\text{rot}} \right) R$$

$$R = \boxed{0.52 \text{ rotations per second}}$$

- This does work at a rate of $\left(\frac{70 \text{ lbs}}{\text{bushel}} \right) \left(\frac{1000 \text{ bushels}}{\text{hour}} \right) (15 \text{ feet})$
which is about $\boxed{\text{a million foot-pounds per hour.}}$