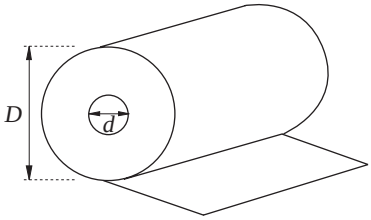
Problem 1

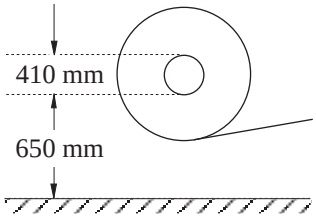


A tinplate user installs a new coil feed line. The coil is placed on a mandrel of diameter 410 mm and the bottom of the mandrel is 650 mm from the floor. What is the maximum coil weight, in kg, that can be fed to the line if

width of coil $= 900$ mm

density of steel $= 7.85$ gm cm^{-3}?

Solution



Maximum outside diameter is given by

$$650 + 650 + 410$$

$$= 1710 \text{ mm}$$

$$= 171 \text{ cm}$$

Now weight of coil

$$= \pi \frac{\left(D^2 - d^2\right)}{4} \times \text{width} \times 7.85 \text{ gm}$$

where

$D =$ outside diameter $(= 171$ cm$)$

$d =$ inside diameter $(= 41$ cm$)$.

So

weight of coil

$$= \frac{\pi}{4} \frac{(171 + 41)(171 - 41) \times 90 \times 7.85}{1000} \text{ kg}$$

$$= \frac{\pi}{4} \left(\frac{212 \times 130 \times 90 \times 7.85}{1000} \right) \text{kg}$$

$$= 15293 \text{ kg}$$

Activity 1

What is the percentage increase in weight if the distance of the bottom of the mandrel from the floor is increased by 10 per cent?

Problem 2

Suppose that the thickness of the tinplate on the coil is 0.16 mm. What will be the length of the coil in metres?

Solution

If L denotes length, then equating the area of cross section gives

$$\frac{\pi}{4}\left(D^2 - d^2\right) = L \times \text{thickness}$$

$$\Rightarrow \quad L = \frac{\pi\left(D^2 - d^2\right)}{4 \times 0.00016}$$

$$= \frac{\pi\left(1.71^2 - 0.41^2\right)}{4 \times 0.00016}$$

$$\approx 13500 \text{ metres}$$

Exercises

1. What is the length for thickness:

   (a) 0.1 mm, (b) 0.5 mm?

2. Find a general solution for the length of coil in terms of D, d, and thickness ω.

Answers to Exercises

1. (a) 21 646 m (b) 4329 m

2. $L = \dfrac{\pi\left(D^2 - d^2\right)}{4\omega}$