

A drilling core is pulled up a shaft (depth z) with an initial speed of 1.2 m/s . The pulling force is 100 N per meter of core raised, which makes an equivalent fluid density with the fluid and $\rho_{\text{core}} = 2.7 \times 10^4 \text{ kg/m}^3$. Assume that the core is pulled at a constant 1.2 m/s . Find the following:

- (a) the work done by the fluid on the core

$$\begin{aligned}
 W_{\text{fluid}} &= \int_{z=0}^z \mathbf{F}_{\text{fluid}} \cdot d\mathbf{z} \\
 &= \int_{z=0}^z (-\rho_{\text{fluid}} g z) dz \\
 &= -\rho_{\text{fluid}} g \int_{z=0}^z z dz \\
 &= -\frac{1}{2} \rho_{\text{fluid}} g z^2
 \end{aligned}$$



- (b) the work done by the force of lifting on the core

$$\begin{aligned}
 W_{\text{lift}} &= \int_{z=0}^z \mathbf{F}_{\text{lift}} \cdot d\mathbf{z} \\
 &= \int_{z=0}^z (\rho_{\text{core}} g z) dz \\
 &= \rho_{\text{core}} g \int_{z=0}^z z dz \\
 &= \frac{1}{2} \rho_{\text{core}} g z^2
 \end{aligned}$$