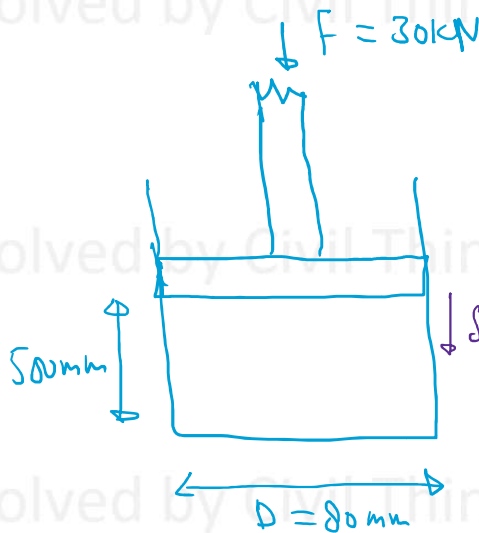


Fluid compression problem solution

A hydraulic cylinder with a piston diameter of $D = 80 \text{ mm}$ and a piston stroke of $s = 500 \text{ mm}$ is completely filled with oil. How much will the displacement of the piston be if an external force of $F = 30 \text{ kN}$ acts on the piston rod? The compressibility coefficient of oil β is $56 \cdot 10^{-5} \text{ mm}^2/\text{N}$.



$$\beta = \frac{-\Delta V/V}{\Delta P} \Rightarrow \frac{\Delta V}{V} = -\beta \times \Delta P$$

$$\Rightarrow \Delta V = -\beta \times \Delta P \times V$$

$$\beta = 56 \times 10^{-5} \frac{\text{mm}^2}{\text{N}}$$

$$\Delta P = \frac{30 \times 10^3}{\frac{\pi}{4} \times 80^2} = 5.968 \text{ N/mm}^2$$

$$V = \frac{\pi}{4} \times 80^2 \times 500 = 2513274.123 \text{ mm}^3$$

$$\Rightarrow \Delta V = -8399.51 \text{ mm}^3$$

$$\Delta V = s \times A \quad [\because \text{Volume} = \text{Depth} \times \text{Area}]$$

$$\Rightarrow s = \frac{\Delta V}{A} = \frac{-8399.51}{\frac{\pi}{4} \times 80^2}$$

$$\Rightarrow s = -1.67 \text{ mm}$$

Ans.

This Fluid Mechanics problem was solved by Civil Thinking (<https://civilthinking.com>)

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