Water at a pressure of 3.6 atm at street level flows into an office building at a speed of 0.4 m/s through a pipe 6 cm in diameter. The pipes taper down to 2.8 cm in diameter by the top floor, 28 m above. Calculate the water pressure in such a pipe on the top floor.(g=9.8 m/s square)

Solution

According to Bernoulli's law applies:

$$P_1 + \frac{1}{2} * \rho * v_1^2 + \rho * g * y_1 = P_2 + \frac{1}{2} * \rho * v_2^2 + \rho * g * y_2$$

P_1 with the initial pressure of 3,6 atm, the initial velocity v_1 of $0.4 \frac{m}{s}$ and $y_1 \ = \ 0$. Y_2 is

28 m and P_2 and v_2 are asked.

According to the law of continuity applies:

$$A_1 * v_1 = A_2 * v_2$$

A_1 indicates the initial cross-section, v_1 is the initial velocity, A_2 is the cross-sectional end and v_2 requested.

Solving this system gives the final speed

$$v_2 = \frac{A_1 * v_1}{A_2}$$

$$v_2 = \frac{0.03^2 * \pi * 0.4}{0.014^2 * \pi}$$

$$v_2 = 1{,}84 \frac{m}{s}$$

And for the final pressure:

$$P_2 = P_1 + \frac{1}{2} * \rho * v_1^2 - (\frac{1}{2} * \rho * v_2^2 + \rho * g * y_2)$$

$$P_2 = 3.6 * 101325 + 0.5 * 1000 * 0.4^2 - 0.5 * 1000 * 1{,}84^2 - 1000 * 10 * 28\ Pa$$

$$P_2 = 83157{,}2\ Pa$$

$$P_2 = 0{,}82\ atm$$