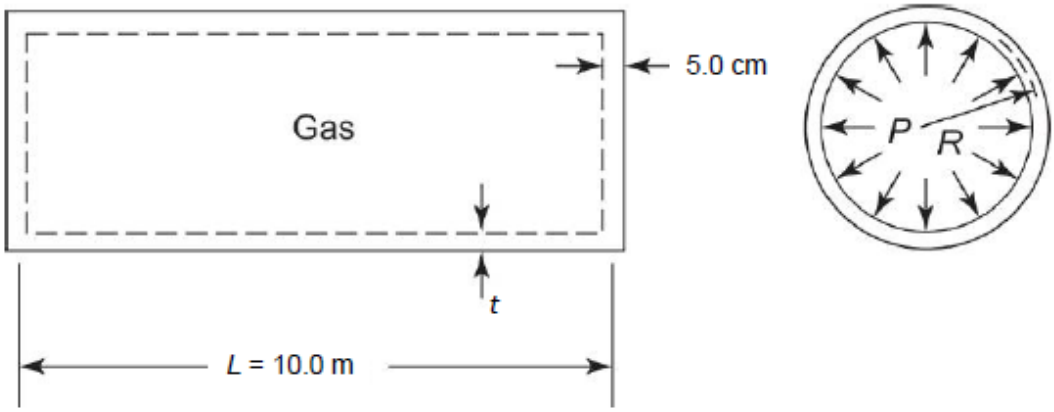
In the design of a closed-end, thin-walled cylindrical pressure vessel shown in the figure below, the design objective is to select the mean radius R and wall thickness t to minimize the total mass. The vessel should contain at least 30.0 m^3 of gas at an internal pressure of P = 5.0 MPa. It is required that the circumferential stress in the pressure vessel not exceed 300 MPa and the circumferential strain not exceed 2.0×10^{-3}. The circumferential stress and strain are calculated from the equations:

$$\sigma_c = \frac{PR}{t}, \qquad \varepsilon_c = \frac{PR(2-\nu)}{2Et}$$

where σ_c is the circumferential stress (in Pa) and ε_c is the circumferential strain.

Parameters describing the vessel are:

ρ = density of vessel = 7850 kg/m^3
E = Young's modulus = 210 GPa
ν = Poisson's ratio = 0.30
L = Length of vessel = 10.0 m
w = Thickness of endcap = 5.0 cm



(a) Carefully set up the problem and concisely describe the optimization problem
(b) Solve the problem graphically
(c) Solve the problem using Excel
(d) Solve the problem using Matlab