Topics: Open Systems

Problem 1 (Flow expansion)
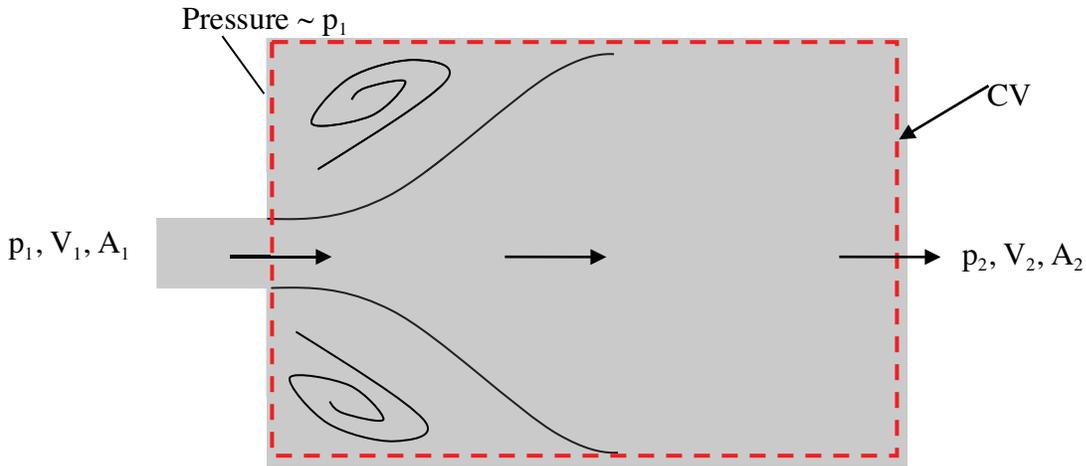
When a pipe flow suddenly expands from A_1 to A_2, low speed, low-friction eddies appear in the corners and the flow gradually expands to A_2 downstream. Using the suggested control volume for incompressible steady flow and assuming that $p \approx p_1$ on the corner annular ring as shown,

show that the downstream pressure is given by $p_2 = p_1 + \rho V_1^2 \dfrac{A_1}{A_2}(1 - \dfrac{A_1}{A_2})$. Neglect wall

friction.

Problem 2 (Cart)
A cart tied to a mass M hanging over a pulley is kept stationary by an incoming jet of water. The water jet, which has a velocity $v_1 = 15$ m/s and a cross-sectional area $A_{jet} = 0.05$ m^2, is deflected upwards by the cart at an angle of 45 degrees. Calculate the mass M assuming that the flow is steady and frictionless. The density of water is $\varrho = 1000$ kg/m^3.
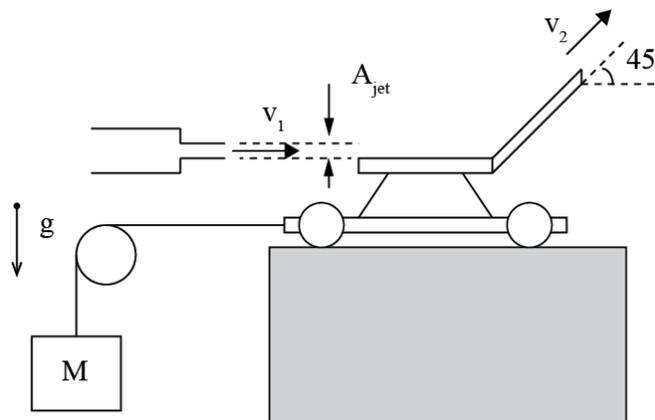
2.06 Fluid Dynamics
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