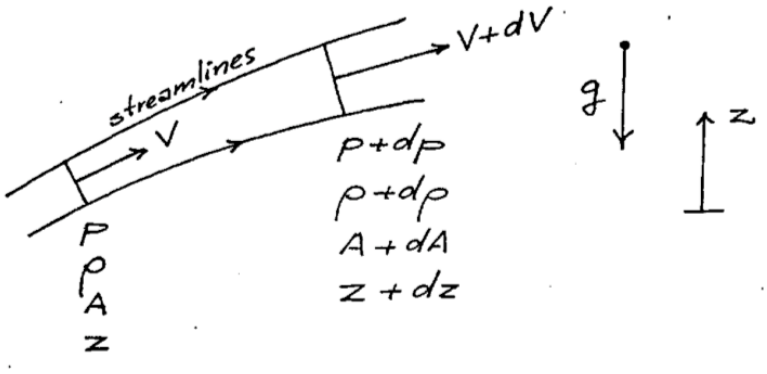
MIT Department of Mechanical Engineering

2.25 Advanced Fluid Mechanics

Problem 4.05

This problem is from "Advanced Fluid Mechanics Problems" by A.H. Shapiro and A.A. Sonin



Consider the frictionless, steady flow of a compressible fluid in an infinitesimal stream tube.

(a) Demonstrate by the continuity and momentum theorems that

$$\frac{d\rho}{\rho}+\frac{dA}{A}+\frac{dV}{V}=0$$

$$dp+\rho V\,dV+\rho g dz=0$$

(b) Determine the integrated forms of these equations for an incompressible fluid.

(c) Derive the appropriate equations for unsteady frictionless, compressible flow, in a stream tube of cross-sectional area which depends on both space and time.

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