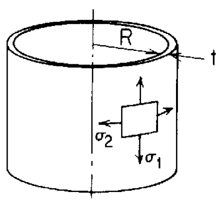
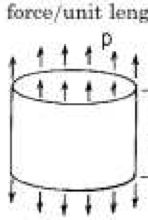
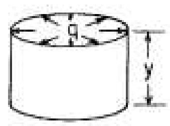
13.8 Tables

TABLE 13.1 Formulas for membrane stresses and deformations in thin-walled pressure vessels

NOTATION: P = axial load (force); p = unit load (force per unit length); q and w = unit pressures (force per unit area); δ = density (force per unit volume); σ_1 = meridional stress; σ_2 = circumferential, or hoop, stress; R_1 = radius of curvature of a meridian, a principal radius of curvature of the shell surface; R_2 = length of the normal between the point on the shell and the axis of rotation, the second principal radius of curvature; R = radius of curvature of a circumference; ΔR = radial displacement of a circumference; Δy = change in the height dimension y; y = length of cylindrical or conical shell and is also used as a vertical position coordinate, positive upward, from an indicated origin in some cases; ψ = rotation of a meridian from its unloaded position, positive when that meridional rotation represents an increase in ΔR when y or θ increases; E = modulus of elasticity; and ν = Poisson's ratio

Case no., form of vessel	Manner of loading	Formulas
1. Cylindrical  $\frac{R}{t} > 10$	1a. Uniform axial load, p force/unit length 	$\sigma_1 = \frac{p}{t}$ $\sigma_2 = 0$ $\Delta R = \frac{-p\nu R}{Et}$ $\Delta y = \frac{py}{Et}$ $\psi = 0$
	1b. Uniform radial pressure, q force/unit area 	$\sigma_1 = 0$ $\sigma_2 = \frac{qR}{t}$ $\Delta R = \frac{qR^2}{Et}$ $\Delta y = \frac{-qR\nu y}{Et}$ $\psi = 0$