Chapter 1-5 formulas

$$\sigma = \frac{P}{A} \qquad \nu = \frac{-\varepsilon_{transverse}}{\varepsilon_{long}} \qquad P_S = n A_B \tau_{allowable} N$$

$$\varepsilon = \frac{\Delta L}{L} = \frac{\delta}{L} \qquad \varepsilon_x = \frac{1}{E}(\sigma_x - \nu\sigma_y - \nu\sigma_z) \qquad P_P = d\,t\,\sigma_{P-allowable} N$$

$$E = \frac{\sigma}{\varepsilon} \qquad \varepsilon_y = \frac{1}{E}(\sigma_y - \nu\sigma_x - \nu\sigma_z) \qquad P_G = b\,t\,\sigma_{G-allowable}$$

$$\delta = \frac{PL}{AE} \qquad \varepsilon_z = \frac{1}{E}(\sigma_z - \nu\sigma_x - \nu\sigma_y) \qquad P_N = (bt - N_F\,d_H\,t)\,\sigma_{N-allowable}$$

$$\tau = \frac{P}{A} \qquad \delta = \alpha L(\Delta T) \qquad \text{Joint efficiency} = \frac{P_{min.}}{P_G}$$

$$\gamma = \frac{\delta}{L} \qquad \sigma_{thermal} = -\alpha E(\Delta T) \qquad \text{1 ft. = 12 inches}$$

$$G = \frac{\tau}{\gamma} \qquad \sigma_{hoop} = \frac{p\,d_i}{2\,t} \qquad 180 \text{ degrees} = \pi \text{ radians}$$

$$A_{circle} = \frac{\pi}{4} d^2 \qquad \sigma_{long} = \frac{p\,d_i}{4t} \qquad \text{Pa} = \text{N/m}^2$$

$$\sigma = K\,\sigma_{net} \qquad \text{1 kip = 1000 lb., 1 ksi = 1 kip/in.}^2\text{, 1 psi = 1 lb./in.}^2$$

Allowable Shear Stress for Bolts

Bolt Specification	τ_{all}	τ_{all}
A307 low-carbon steel	12.0 ksi	82.5 MPa
A325N, threads in the shear plane	24.0 ksi	165 MPa
A325X, threads excluded from the shear plane	30.0 ksi	207 MPa
A490N, threads in the shear plane	30.0 ksi	207 MPa
A490X, threads excluded from the shear plane	37.5 ksi	260 MPa

Allowable Plate Stress

Plate Material	σ_{YS}		σ_{UTS}		$\sigma_{P\text{-}all}$		$\sigma_{G\text{-}all}$		$\sigma_{N\text{-}all}$	
	(ksi)	**(MPa)**	**(ksi)**	**(MPa)**	**(ksi)**	**(MPa)**	**(ksi)**	**(MPa)**	**(ksi)**	**(MPa)**
A36 carbon steel	36	250	58	400	87	600	21.6	150	29	200
A992 high-strength steel	50	345	65	448	97.5	672	30	207	32.5	224

Units

Giga, G-, 10^9

Mega, M-, 10^6

kilo, k-, 10^3

centi, c-, 10^{-2}

milli, m-, 10^{-3}

Exam I problem topics

Unit conversions	Thermal expansion
(Factor-Label method is required)	Pressure vessels
Stress & strain	Bolted joints
Poisson's ratio	Welded joints