Table 1.1.

TYPE OF STRESS	PRINCIPAL STRAINS	PRINCIPAL STRESSES
Uniaxial	$\epsilon_1 = \frac{\sigma_1}{E}$ $\epsilon_2 = -\nu\epsilon_1$ $\epsilon_3 = -\nu\epsilon_1$	$\sigma_1 = E\epsilon_1$ $\sigma_2 = 0$ $\sigma_3 = 0$
Biaxial	$\epsilon_1 = \frac{\sigma_1}{E} - \frac{\nu\sigma_2}{E}$ $\epsilon_2 = \frac{\sigma_2}{E} - \frac{\nu\sigma_1}{E}$ $\epsilon_3 = -\frac{\nu\sigma_1}{E} - \frac{\nu\sigma_2}{E}$	$\sigma_1 = \frac{E(\epsilon_1 + \nu\epsilon_2)}{1-\nu^2}$ $\sigma_2 = \frac{E(\epsilon_2 + \nu\epsilon_1)}{1-\nu^2}$ $\sigma_3 = 0$
Triaxial	$\epsilon_1 = \frac{\sigma_1}{E} - \frac{\nu\sigma_2}{E} - \frac{\nu\sigma_3}{E}$ $\epsilon_2 = \frac{\sigma_2}{E} - \frac{\nu\sigma_1}{E} - \frac{\nu\sigma_3}{E}$ $\epsilon_3 = \frac{\sigma_3}{E} - \frac{\nu\sigma_1}{E} - \frac{\nu\sigma_2}{E}$	$\sigma_1 = \frac{E\epsilon_1(1-\nu) + \nu E(\epsilon_2 + \epsilon_3)}{1-\nu-2\nu^2}$ $\sigma_2 = \frac{E\epsilon_2(1-\nu) + \nu E(\epsilon_1 + \epsilon_3)}{1-\nu-2\nu^2}$ $\sigma_1 = \frac{E\epsilon_3(1-\nu) + \nu E(\epsilon_1 + \epsilon_2)}{1-\nu-2\nu^2}$

Source: J. E. Shigley and C. R. Mischke, *Mechanical Engineering Design*, McGraw-Hill, New York, 1989.

Table 1.2.

MATERIAL	MODULUS OF ELASTICITY E		MODULUS OF RIGIDITY G		POISSON's RATIO ν	UNIT WEIGHT w		
	Mpsi	GPa	Mpsi	GPa		lb/in^3	lb/ft^3	kN/m^3
Aluminum (all aloy)	10.3	71.0	3.80	26.2	0.334	0.098	169	26.6
Beryllium coper	18.0	124.0	7.0	48.3	0.285	0.297	513	80.6
Brass	15.4	106.0	5.82	40.1	0.324	0.309	534	83.8
Carbon steel	30.0	207.0	11.5	79.3	0.292	0.282	487	76.5
Cast iron, gray	14.5	100.0	6.0	41.4	0.211	0.260	450	70.6
Cooper	17.2	119.0	6.49	44.7	0.326	0.322	556	87.3
Douglas fir	1.6	11.0	0.6	4.1	0.33	0.016	28	4.3
Glass	6.7	46.2	2.7	18.6	0.245	0.094	162	25.4
Inconel	31.0	214.0	11.0	75.8	0.290	0.307	530	83.3
Lead	5.3	36.5	1.9	13.1	0.425	0.411	710	111.5
Magnesium	6.5	44.8	2.4	16.5	0.350	0.065	112	17.6
Molybdenum	48.0	331.0	17.0	117.0	0.307	0.368	636	100.0
Monel metal	26.0	179.0	9.5	65.5	0.320	0.319	551	86.6
Nickel silver	18.5	127.0	7.0	48.3	0.322	0.316	546	85.8
Nickel steel	30.0	207.0	11.5	79.3	0.291	0.280	484	76.0
Phosphor bronze	16.1	111.0	6.0	41.4	0.349	0.295	510	80.1
Stainless steel (18-8)	27.6	190.0	10.6	73.1	0.305	0.280	484	76.0

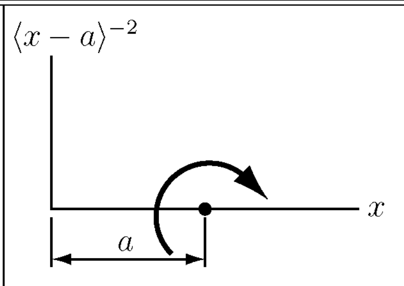
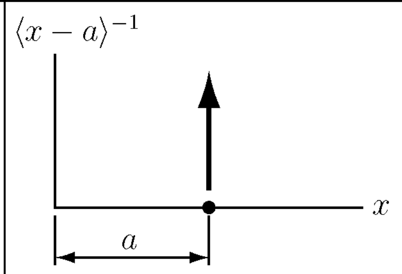
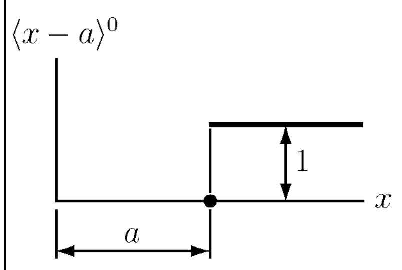
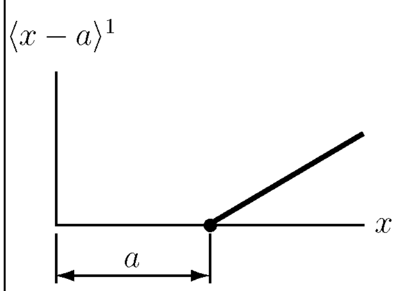
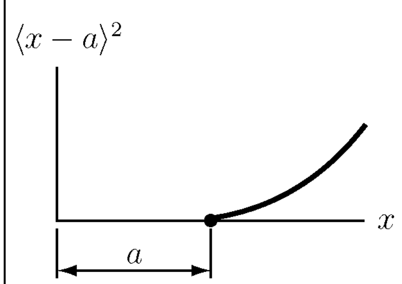
Source: J. E. Shigley and C. R. Mischke, *Mechanical Engineering Design*, McGraw-Hill, New York, 1989.

Table 1.4

DISTANCE y_1	0	$0.2c$	$0.4c$	$0.6c$	$0.8c$	c
Factor C	1.50	1.44	1.26	0.96	0.54	0

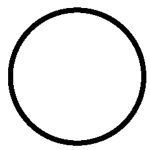
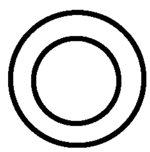
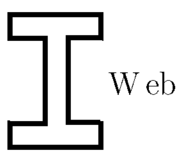
Source: J. E. Shigley and C. R. Mischke, *Mechanical Engineering Design*, McGraw-Hill, New York, 1989.

Table 1.3

FUNCTION	GRAPH OF $f_n(x)$	MEANING
Concentrated moment (unit doublet)		$\langle x-a\rangle^{-2}=0 \quad x\neq a$ $\int_{-\infty}^{x}\langle x-a\rangle^{-2}\,dx=\langle x-a\rangle^{-1}$ $\langle x-a\rangle^{-2}=\pm\infty \quad x=a$
Concentrated force (unit impulse)		$\langle x-a\rangle^{-1}=0 \quad x\neq a$ $\int_{-\infty}^{x}\langle x-a\rangle^{-1}\,dx=\langle x-a\rangle^{0}$ $\langle x-a\rangle^{-1}=+\infty \quad x=a$
Unit step		$\langle x-a\rangle^{0}=\begin{cases}0 & x<a\\ 1 & x\geq a\end{cases}$ $\int_{-\infty}^{x}\langle x-a\rangle^{0}\,dx=\langle x-a\rangle^{1}$
Ramp		$\langle x-a\rangle^{1}=\begin{cases}0 & x<a\\ x-a & x\geq a\end{cases}$ $\int_{-\infty}^{x}\langle x-a\rangle^{1}\,dx=\dfrac{\langle x-a\rangle^{2}}{2}$
Parabolic		$\langle x-a\rangle^{2}=\begin{cases}0 & x<a\\ (x-a)^2 & x\geq a\end{cases}$ $\int_{-\infty}^{x}\langle x-a\rangle^{2}\,dx=\dfrac{\langle x-a\rangle^{3}}{3}$

Source: J. E. Shigley, and C. R. Mischke, "Mechanical Engineering Design", McGraw-Hill, Inc., 1989.

Table 1.5

BEAM SHAPE	FORMULA
 Rectangular	$\tau_{max} = \dfrac{3V}{2A}$
 Circular	$\tau_{max} = \dfrac{4V}{3A}$
 Hollow round	$\tau_{max} = \dfrac{2V}{A}$
 Structural	$\tau_{max} = \dfrac{V}{A_{web}}$

Source: J. E. Shigley, and C. R. Mischke, "Mechanical Engineering Design", McGraw-Hill, Inc., 1989.

Table 1.6

BEAM CROSS-SECTIONAL SHAPE	FACTOR C
Rectangular	1.50
Circular	1.33
Tubular, Round	2.00
Box sections	1.00
Structural sections	1.00

Source: Arthur P. Boresi, Omar M. Sidebottom, Fred B. Seely, and James O. Smith, *Advanced Mechanics of Materials*, 3d ed.,Wiley, New York, 1978, p. 173.

Table 1.7

COLUMN END CONDITIONS	END-CONDITION CONSTANT C		
	THEORETICAL VALUE	CONSERVATIVE VALUE	RECOMMENDED VALUE *
Fixed-free	1/4	1/4	1/4
Rounded-rounded	1	1	1
Fixed-rounded	2	1	1.2
Fixed-fixed	4	1	1.2

* To be used only with liberal factors of safety when the column load is accurately known.

Source: J. E. Shigley and C. R. Mischke, *Mechanical Engineering Design*, McGraw-Hill, New York, 1989.