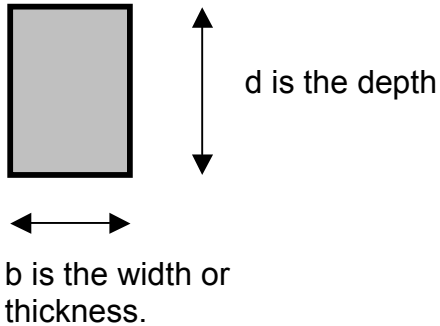


Practice Problems

1. Consider a wood beam with rectangular cross-section. The limit state for bending is

$$Y = F_b - \frac{6M}{bd^2}$$

where



Assume that all random variables are Normal with the means and coefficients of variation as tabulated.

Variable	Mean	COV
Moment, M	100,000 lb-in	0.12
F_b	1600 psi	0.32
b	5.6 in	0.04
d	11.4 in	0.03

Calculate the reliability index for the beam.

2. The annual operating cost for a waste treatment plant is a function of the weight of solid waste, W , and the unit cost factor, F , and an efficiency coefficient, E , as follows:

$$C = \frac{WF}{\sqrt{E}}$$

Given the following table, calculate the probability of the annual cost exceeding \$35,000.

Variable	Mean	COV
W	2000 tons per year	20%
F	\$20 per ton	15%
E	1.6	12.5%

3. According to the Manning equation, the velocity of uniform flow, in fps, in an open channel is

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

S = slope of the energy line in %

R = the hydraulic radius in ft

n = the roughness coefficient of the channel

For a rectangular open channel with concrete surface, assume the following mean values and corresponding COVs.

Variable	Mean	COV
S	1%	0.10
R	2	0.05
n	0.013	0.30

Find the mean and COV of V.

4. The yield mean stress and standard deviation of a steel member are 47.9 ksi and 3.3 ksi, respectively. Assume the member is loaded such that the induced stress has a mean of 36.0 ksi and a standard deviation of 7.2 ksi.
- What is the probability of failure of the beam?
 - What if the COV of the load-induced stress were 10%?
5. A wood cantilever beam weighing 50 lbs/ft carries a random upward concentrated force with a mean of 4000 lbs at the end. The COV of the upward load is 15%.
- Calculate the mean and standard deviation of the maximum bending moment at a section 6 ft from the free end.
 - If the probability of failure is required to be less than 0.5%, what is the minimum required mean value of the moment capacity?
6. Consider the limit state $g(X) = Y = \frac{R}{S}$ for Y being a lognormal variable. Find the probability of failure for $Y \leq 1$. Assume
- $$\mu_R = 865.6 \text{ in} - \text{kips}$$
- $$COV_R = 16.7\%$$
- $$\mu_S = 326.4 \text{ in} - \text{kips}$$
- $$COV_S = 17\%.$$

Hint: Find λ_Y and ζ_Y .