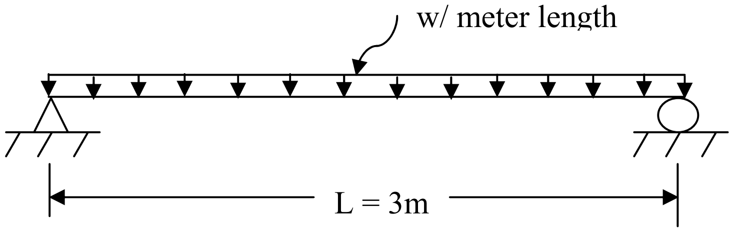
The University of Melbourne
CVEN30008 Engineering Risk Analysis

Tutorial 11

Engineering Reliability

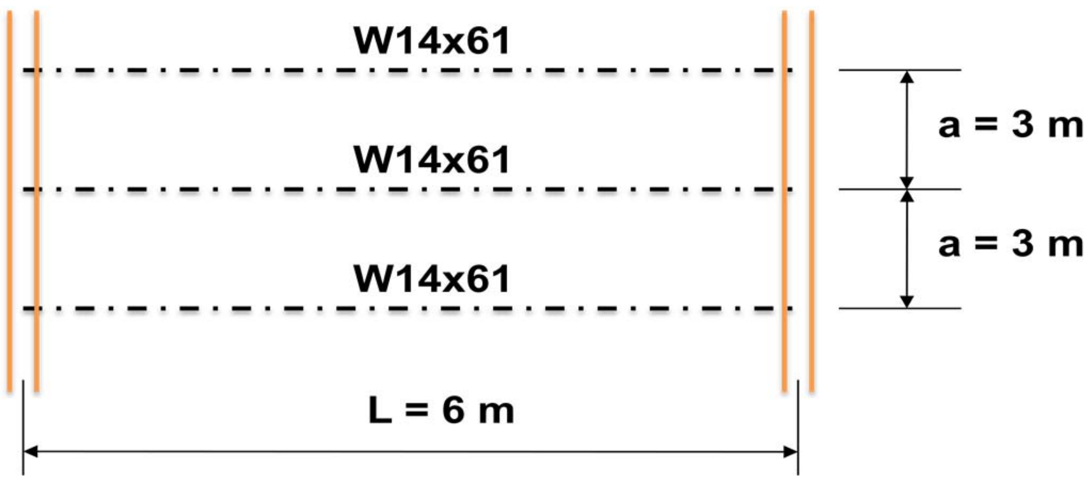
1. A simply supported timber beam of length 3 m is loaded with a uniformly distributed load w with μ = 5 kN/m and σ = 1 kN/m. The bending strength of similar beams has been found to have a mean strength μ_R = 10 kNm with a coefficient of variation (COV) of 0.2. Assuming that the beam self-weight and any variation in the length of beam can be ignored, evaluate the probability of failure.

   Hint: The applied moment is: $S = \frac{wL^2}{8}$



2. A simply supported steel beam W14x61 (capacity μ_R = 360.7 kNm, σ_R = 72.9 kNm) with a 6 m span has been designed to carry a dead load (μ_D = 2.6 kN/m^2, σ_D = 0.35 kN/m^2) and a live load (μ_L = 2.75 kN/m^2, σ_L = 1 kN/m^2). Assuming dead load (D), live load (L) and beam capacity (R) are statistically independent normal variables, evaluate the probability of failure.

   Hint: The applied moment is: $S = \frac{T\times a\times L^2}{8}$; where T is the total load (T=D+L)



3. Consider a case of a steel bridge that deteriorates continuously with time as a result of corrosion. The initial structure performance is 100% with a threshold limit of 25%. Estimate the probability of failure of the bridge after 35 years if the progressive deterioration of the bridge can be modelled as:

(a) Graceful (linear) deterioration with a rate K = 0.70% per year.

(b) Exponential deterioration with a rate α = 0.08/year.

Assume the remaining structural capacity is governed by an exponential distribution with an average rate of = 0.05.