1.010 - Fall 1999
Homework Set #8

Due November 23, 1999

1. Consider the simple model shown below of a flexible structure resisting on two footings. The foundation engineer's concern is in the relative deflection of the ends of the structure.

   $\Delta = \delta_1 - \delta_2 = Qf_1 - Qf_2$

   Assume that Q is a deterministic load and the flexibilities (reciprocal of stiffness) f_1 and f_2 of the two soil and footing systems are random variables with common mean m, variance σ^2 and covariance $\rho\sigma^2$ (ρ is the correlation coefficient, hence a measure of the lateral homogeneity of the soil). Find:

   (a) The expected value of Δ
   (b) The standard deviation of Δ

   How do you intuitively explain the dependence of the standard deviation on ρ? Would you consider more plausible to have positive or negative correlations? Is this in favor of safety (relative to differential settlement) ?

2. The modulus of elasticity E of a cocrete elements produced at a factory is known to have a mean value of 3600 ksi and a coefficient of variation v=0.15.

   In order to reduce uncertainty, the elements are tested with a device that makes measurements of E with "noise" i.e. the device gives

   $Z=E+\varepsilon$

   Where ε is a random variable independent of E. ε has mean value zero and standard deviation $\sigma_\varepsilon=\sigma_E/3$. Find an expression for the mean value of E following a measurement Z=z. What is the conditional standard deviation of [E|Z=z] ? Compare with the unconditional value

3. Read *Application Example 9.2* and do *Problem 9.2.1*.