

## Assignment #3

## Structural Behavior of Concrete

Due: 2023. 04. 04

Consider a normal weight concrete having a 28-day design strength of 4000psi. The plant where the concrete is produced has standard deviation of compressive strength equal to 500 psi for this mix design.

- (a) What true tensile strength should be counted on in design for this concrete?
- (b) What mean 28-day compressive strength is likely for the concrete if it was produced so that less than one in one hundred samples will have strength less than 500 psi below the design concrete strength? (Note: Codes actually have more detailed requirements.)
- (c) Suppose concrete cylinders prepared and stored according to the standard ASTM procedures test out at 4000 psi at 28-days. What mean strength would you expect from 3-in. by 3-in. cylinders cored from the structure at 28 days?
- (d) For the same concrete described in part (c), what strength would you expect from 6-in. by 12-in. lab cured cylinders at age of 7 days?
- (e) A slab of concrete is cast and cured in a manner similar to a standard cylinder, so that its in-situ uniaxial compressive strength is 4000 psi. The slab is loaded under biaxial principal stressed  $f_1$  and  $f_2$ .
- I. The loading plan is to increase  $f_2$  to 2000 psi while  $f_1$  is held at 0, and then increase  $f_1$ . When do you expect failure?
  - II. The loading plan is to increase  $f_2$  to 5000 psi while  $f_1$  is held at 0, and then increase  $f_1$ . When do you expect failure?
- (f) A plain concrete column is subjected to hydrostatic confining stressed of 1000 psi in all three principal directions. A load is then applied to the column along one principal axis. At what stress in addition to the hydrostatic stress will the column fall? (Assume the concrete has exactly 4000-psi uniaxial compressive strength in the column.)
- (g) If the concrete in part (c) is cycled for 1 million cycles between 1000 psi compression and some maximum stress, what maximum stress will result in failure?
- (h) What true tensile strengths are expected for the concrete described in part (c) if it is 120 pcf lightweight concrete?
- (i) A finite element analysis results in the following stresses at a point. If the concrete is that which is described in part (c), will it fail?

