1.105 Solid Mechanics Laboratory
Fall 2003

Experiment 5[1] Compressive and Tensile Strength of Concrete

Objective:

This lab is designed to develop your understanding of standard measurement techniques for determining the compressive and tensile strengths of concrete.

Overview:

Several cylindrical concrete specimens have been prepared for testing to failure: Two of them will be subjected to compression. One will be subjected to a loading which engenders failure in tension, albeit indirectly.

The specimens are cylinders four (4) inches in diameter and eight (8) inches in height. The specimens were cast and cured for _____ days[2].

The compressive strength is given as _____ psi, or _____ MPa.

Tests will be conducted using one of the heavy testing machines in the Rock Mechanics Laboratory, room 1-034. A computer will automatically record the data for load level and displacement.

You are to record all supplementary data "by hand", process the data, plot and describe results according to the directions and suggestions included in what follows and do so within the three hours allotted for this lab. (Leave laptop at home for this session but **bring a calculator**)

Experiment 5.1: Compression Test

The standard for compression testing of concrete can be found in ASTM standard: D39, [1]

The test specimen will be subjected to an axial load, i.e., along the axis of the cylinder, between the two *platens* of the testing machine. The specimens are first subjected to seating load (less than 50 lbs) at the outset to eliminate the effects of contact surface mis-alignment and any slack within the internal mechanism of the machine.

Two extensionmeters will be used to measure the displacement over a gage length of 1 inch. You will average the two readings to obtain a single measure of strain.

For safety reason, you must wear a safety glass. A plastic shatter shield will be put in place prior the starting of the subsequent loading stage to contain any flying debris.

The computer will record more data than you will need to construct a plot of stress versus strain. (You will need to sample pairs of load-displacement values over the full test range). The test will be stopped when specimen fail (load clearly decreased and deformation continues). You will need to sketch the failure geometry. Note any failure planes and angles.

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1. Formerly, Experiment #5
2. Download the Quikrete Specs (Fast-Setting Concrete #1004-50) at (http://www.firstsourceonl.com/members/result.asp?key=quikrete) to see how the strength is thought to vary with curing time.

Data[1]:

Cylinder Dimensions:

Diameter: Height:

Area =

Extens. 1	Extens. 2		LOAD	Stress	Strain	Secant Modulus
in.	in		lbs.			

1. Make sure 1) You indicate units of ALL quantities and 2) You include an estimate of uncertainty

Data Cylinder #2.

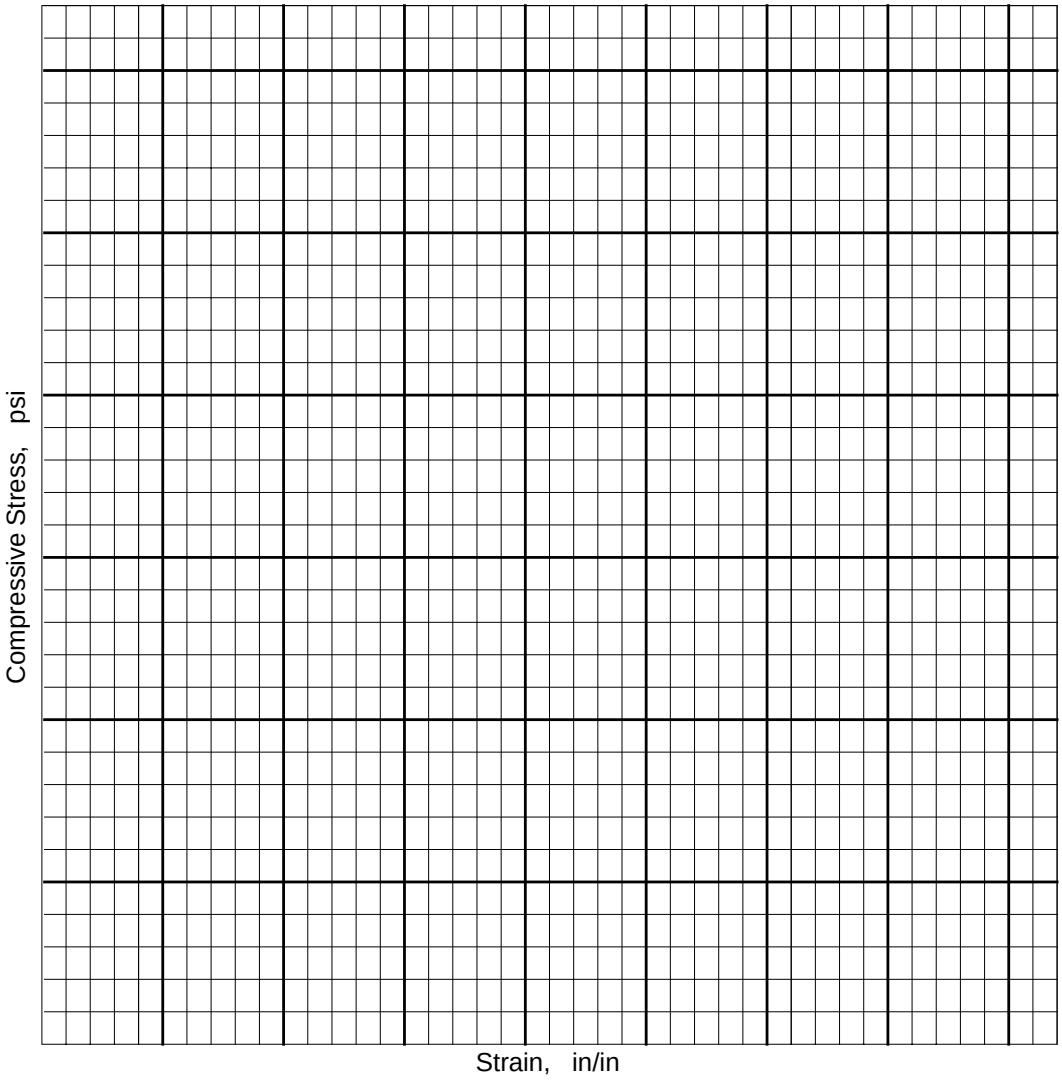
Cylinder Dimensions:

Diameter: Height:

Area =

Extens. 1	Extens. 2		LOAD	Stress	Strain	Secant Modulus
in.	in		lbs.			

Results

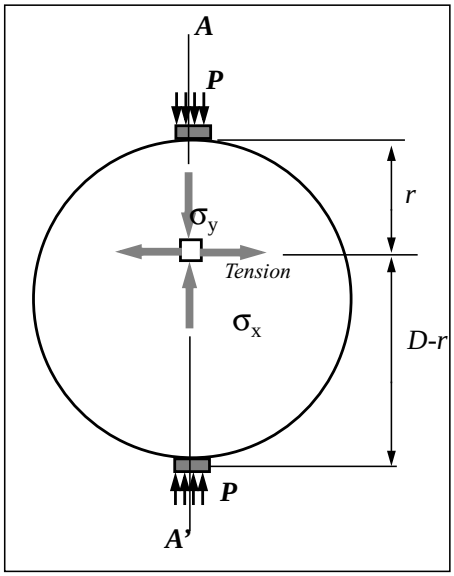


Stress versus strain - Uniaxial Compression Test
Concrete Cylinder

Observations and Discussion

Experiment 5.2: Indirect Tension Test

In this test, you will perform an *indirect* tension test. The figure shows the how the cylinder is loaded with a distributed load along diametrically opposed, sides of the cylinder. These line loads engender a uniform tensile stress distributed within the cylinder over the plane section A-A', bisecting the cylinder - except within the vicinity of the circumference. This tensile stress can be shown to be



$$\sigma_x = 2P/(\pi LD)$$

where L is the length (or height) of the cylinder along which the load P is distributed, and D is the cylinder diameter.

A compressive stress on planes orthogonal to A-A' is also engendered at each point. This can be shown to be equal to

$$\sigma_y = \frac{2P}{\pi LD} \cdot \left[\frac{D^2}{r(D-r)} - 1 \right]$$

For this test you **will record only the displacement at fracture and the failure load,** and compare the failure stress in tension with the failure stress in compression obtained in experiment 6.1.

Data

Cylinder Dimensions: Diameter: Height:

Failure Load: Pounds Tensile Stress, σ_x=

The failure stress in tension is _____% +/- of the failure stress in compression.

Compressive stress, σ_y , at $_{r=D/2}$ = _____ ; at $_{r=D/4}$ = _____ .

Observations and Discussion

References:

1 ASTM standards: D39

2 Neville A.M., 1963, Properties of Concrete, John Wiley and Sons, Inc., New York.

Murdock L.J., Brook K.M., and Dewar J.D., 1991, Concrete: Materials & Practice, Edward Arnold, a division of Hodder & Stoughton, London.