

CIVL 3137  
Homework 5

***Pay attention to significant digits!***

***Most of the measured quantities are only known to 3 significant digits  
in keeping with the measurement accuracy required in the ASTM specifications***

1. A concrete mix design calls for 690 lb of cement and 350 lb of water. What is the water/cement ratio in gallons per sack of cement?
2. A concrete pavement slab 20 feet long and made with limestone aggregate suffers a 40°F drop in temperature. If it was completely unrestrained, by what amount (in inches) would it shrink?
3. If the concrete slab in the previous problem was completely restrained and had an elastic modulus of  $4.2 \times 10^6$  psi, how much tensile stress would develop in the slab?
4. How much would that same pavement slab shrink due to curing/drying shrinkage? NOTE: To estimate the tensile strength of the concrete, assume the empirical ACI relationships are applicable.
5. A concrete cylinder has a measured height of 12.1 in. and a measured diameter of 5.98 in. When tested in unconfined compression, it fails at an axial load of 123,000 lb. What is the compressive strength of this cylinder?
6. If the concrete cylinder in the previous problem only had a height of 10.1 in., would the measured strength be higher or lower than it should be?
7. A concrete cylinder has a measured height of 6.01 in. and a measured diameter of 2.98 in. When tested in unconfined compression, it fails at an axial load of 33,500 lb. Accounting for size effects, at what load would a 6"x12" cylinder of the same concrete be expected to fail?
8. A concrete cylinder has a measured height of 11.9 in. and a measured circumference of 19.0 in. A split cylinder test on this specimen fails at a load of 47,300 lb. What is the tensile strength of this cylinder?
9. A concrete beam specimen has a measured height of 6.01 in., a measured width of 5.75 in., and a length of 20.92 in. It is tested in flexure using beam supports spaced 18.0 in. apart. If the beam fails at an applied load of 6950 lb, what is the modulus of rupture of the specimen?
10. A concrete cylinder has a measured height of 12.1 in. and a measured diameter of 5.98 in. It is to be tested to determine its elastic modulus using a compressometer. Assuming a concrete compressive strength of  $f'_c = 6420$  psi, what load would you apply to the cylinder to achieve a stress of  $0.4 f'_c$ ?
11. Assume that the concrete cylinder in the previous problem supported a measured load of 4500 lb at 50 microstrain (0.000050 in/in) and exhibited a total change in height of  $\Delta = 0.0066$  in. at  $0.4 f'_c$ . What is the elastic modulus of the concrete?