The University of Iowa  
Department of Civil & Environmental Engineering  
CONSTRUCTION MATERIALS 53:130  
Spring Semester 1997 Midterm Examination  
Prof. C.C. Swan

Answer any 3 of the first four questions

**Question #1: (15 points)**

a. What is work-hardening of steel, and why is it used?
b. Please discuss the potential problems associated with using work-hardened steel.

**Question #2: (15 points)**

a. How is the grain structure of steel related to its strength behavior?
b. How can the grain structure of steel be manipulated to increase the strength of steel?

**Question #3: (15 points)**

Assume that a steel wharf structure is to be constructed in a saltwater coastal port. Much of the underwater hardware associated with the wharf is to be of brass.

a. Since both metals are to be submersed in saltwater (electrolytic) in close proximity would you expect the possibility of corrosion problems?
b. Which metal would you expect to corrode, and why?

**Question #4: (15 points)**

a. Briefly, what is the difference between welding and soldering?
b. Discuss briefly the factors that go into producing high-quality welded steel connections.
c. What considerations might need to be taken in welding cast iron?
Answer all of the remaining three questions.

**Question #5: (20 points)**
As part of a major bridge construction project, massive supporting piers approximately 30m tall, and up to 7m in diameter are to be constructed.

a. Does the size of the concrete structural elements present any potential problem with respect to the quality (strength) of the final cured concrete? If yes, please explain.

b. In terms of the curing process, possible admixtures, and even the concrete mix selection, what special steps might for structural elements of such large size?

**Question #6: (20 Points)**
There are a number of different types of porosity in hardened cement paste (hcp).

a. Briefly, discuss the different types of porosity;

b. Which type of porosity is most closely related to the strength behavior of the hcp?

b. What mix design measures can be taken to reduce this type of porosity?

**Question #7: (15 Points)**
Discuss the how the following aggregate characteristics can affect the performance behaviors of concrete.

a. size and gradation;

b. lightness;

c. porosity;

d. chemical composition;

e. stiffness and strength;