The University of Iowa
Department of Civil & Environmental Engineering
CONSTRUCTION MATERIALS 53:130
Spring Semester 1999 Midterm Examination
Prof. C.C. Swan

Question#1: (25 points)

a. In what type of civil engineering structures, and for what types of structural members might it be useful to specify high strength grades of steel rather than A36?

b. What are iron carbide, pearlite, and martensite and what are their mechanical properties?

c. In structural analysis and design, what concerns might you have with regard to the properties of high-strength grades of steel in the vicinity of welded joints?

d. Is zinc galvanization the same as painting steel with a zinc-based paint? Explain why or why not?

e. If you were to design a steel bridge with the plan of using hot-dip zinc galvanization to protect the members against corrosion, how might your design differ than if you were not going to use hot-dip galvanization?

Question #2: (25 points)

a. Briefly, discuss the more common cement replacement materials in terms of: what they are; the benefits they yield; and in what proportions they are typically used.

b. What types of acids in the environment attack hcp, and what mix-design measures are the most effective in avoiding degradation from such acids? Briefly explain why each measure described should work.

c. What is the fineness modulus of aggregate, and how is it used?

d. How is the grain size of aggregate in concrete related to the bulk permeability, and to the overall compressive strength?

e. For portland cement paste cured under dry conditions, with an original water-cement ratio of 0.43, calculate the capillary porosity, total porosity, and fraction of unhydrated cement. Show your work to receive credit.

Question #3: (50 points)

Perform a quantitative comparison of the characteristics of structural steel, structural aluminum and reinforced-concrete with respect to the following properties:

a. stiffness and specific stiffness;
b. strength and specific strength (tensile and compressive);
c. toughness;
d. ductility;
e. creep;
f. dimensional stability;
g. thermal conductivity;
h. durability;
i. mass density;
j. initial cost;
k. lifecycle cost.