High Performance Concrete Engineering

Homework #4 (Deadline by 6pm on Nov 29th)

Submission of hand-written homework will be accepted.

Total 100 marks

(a) Mass construction project is planned at hot region. Construction engineers consider to use silica fume to shorten the construction time and reduce thermal cracking. Advise them. [10 marks]

(b) Explain why less porosity will not mitigate the frost action in concrete. [10 marks]

(c) Explain why seawater is less corrosive than groundwater with the same concentration of sulfate ions [10 marks]

(d) Explain why adding silica fume (fine silica powder) can reduce the expansive alkali-silica reaction (ASR). [10 marks]

(e) What type of damage (durability related) can occur when concrete is cured at elevated temperatures, such as used at precast plant? [10 marks]

(f) Explain the chemical mechanism of the effect of chloride ions on corrosion problem in reinforced concrete. [10 marks]

(g) Why is concrete highly porous, but relatively impermeable? [10 marks]

(h) Carry out following concrete mix design based on ACI method. [30 marks]

Concrete for a column will be moderately exposed to freezing and thawing. The cross section of the column is 300 by 300 mm. The smallest spacing between reinforcing steel is 30 mm. The specified compressive strength of concrete at 28 days is 35 MPa with a slump of 80 to 100 mm. The properties of materials are as follows:

Cement used is type I Portland cement with a specific gravity of 3.15.

The available coarse aggregate has a maximum size of 20 mm, a dry-rodded unit weight of 1600 kg/m^3, a bulk specific gravity (SSD) of 2.68, absorption capacity of 0.5%, and effective absorption of 0.25%.

The fine aggregate has a bulk specific gravity (SSD) of 2.65, absorption capacity of 1.3%, total moisture content of 4.3%, and a fineness modulus of 2.60. The aggregates conform to the ASTM C33-84 requirement for grading. For the estimation of fine aggregate content, use Volume method.