High Performance Concrete Engineering

Homework #5 (Deadline by 6pm on Nov 13th)

Submission of hand-written homework will be accepted.

Total 100 marks

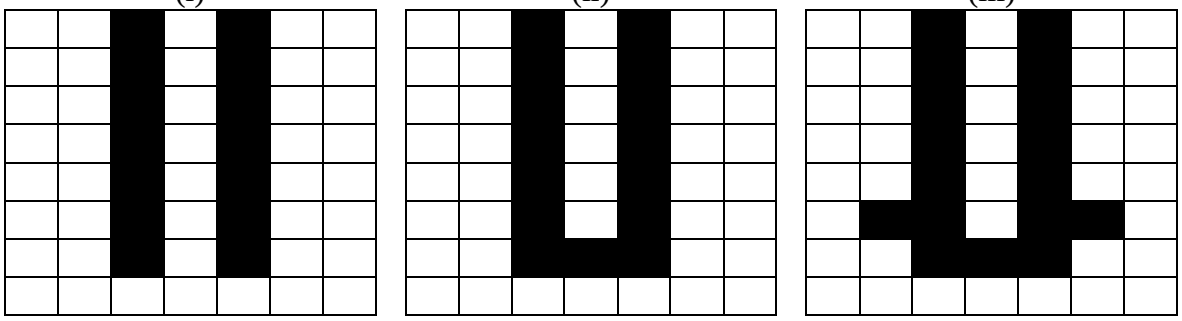
(a) What effect does increasing the rate of loading have on (i) concrete strength; (ii) the strain corresponding to peak stress? **[10 marks]**

(b) Why does concrete response as described in the answer to Prob. (a)? **[10 marks]**

(c) Explain how ITZ of lightweight concrete can be denser than that of normal weight concrete **[10 marks]**

(d) Among below three cases, which pore system will have the weakest durability performance? White area is solid and black area is open pore. **[10 marks]**

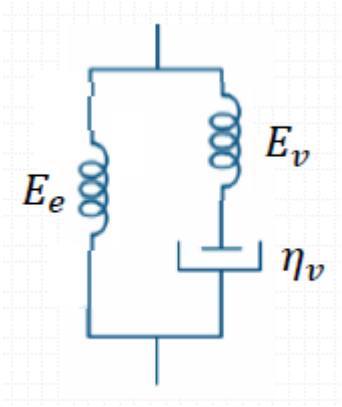
(i) (ii) (iii)



(e) Derive below equation for the critical tensile stress of fiber-reinforced cement composite. Notation is given in Lecture slide of HPCE_7_UHPC_2. Modeling. **[20 marks]**

$$\sigma_{cc} = \sigma_{mu}(1 - V_f) + \alpha\tau V_f \frac{L}{d}$$

(f) Derive solution of below standard solid model for creep and relaxation **[10 marks]**



(g) If the tensile strength of concrete at early age is 1.5 MPa, will this concrete structure be at risk of thermal cracking under the below condition? **[10 marks]**

Maximum temperature difference = 25 °C

Degree of restraint = 1

Elastic modulus = 10 GPa

Creep coefficient = 0.5

Coefficient of thermal expansion = 10×10^{-6}/°C

(h) A concrete column with a 28-day cylinder strength of 32 MPa is calculated to bear an applied compressive load equivalent to 0.3 of its strength. If the creep coefficient after one year is found to be 1.85, calculate the strain in the column. What is its specific creep? Solve this question based on ACI and FIB code, respectively. **[20 marks]**