Université d'Ottawa
Faculté de génie

Départment de
Génie Civil

uOttawa
L'Université canadienne
Canada's university

University of Ottawa
Faculty of Engineering

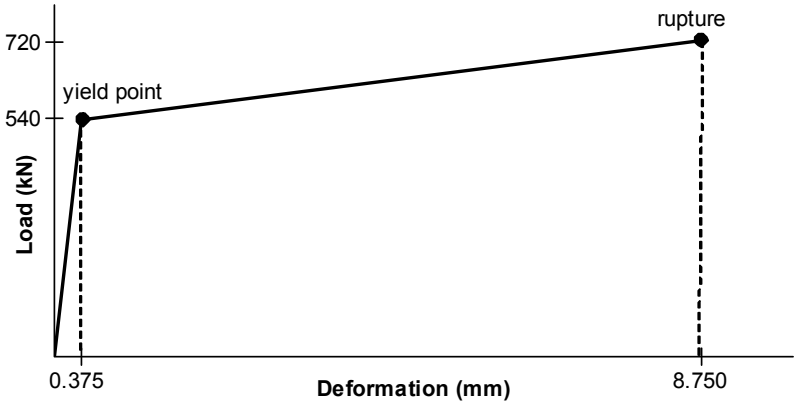
Department of
Civil Engineering

CVG 2141 – CIVIL ENGINEERING MATERIALS

Mid Term Examination (Closed book) **Oct. 25th, 2005**
Dr. B. Martín-Pérez Time: **1 hour & 20 minutes**

QUESTION 1: (25 marks)

A tension test on a specimen made of an elastoplastic material and loaded along its long axis produced the following load-deformation curve. Knowing that the specimen has dimensions of 30 mm × 30 mm × 300 mm, and that deformation was measured using an extensometer with a 125-mm gauge length, estimate the following:



(a) Yield stress

(b) Rupture stress

(c) Modulus of elasticity

(d) Modulus of resilience

(e) % elongation of the specimen at rupture

(f) If a bar made out of this material is subjected to a tensile load of 600 kN, what would be its minimum cross-sectional area so that the material does not yield under the applied load?;

(g) Would you classify this material as brittle or ductile? Explain your answer.

QUESTION 2: (25 marks)

Specify the mix proportions of a concrete to be used in reinforced foundation walls and footings subjected to severe sulphate attack and frequent freezing and thawing in saturated conditions. The 28-day average (not specified) compressive strength required is 35 MPa. The following materials are available:

Cement:	Type 10 Relative density = 3.15
Coarse aggregate:	20-mm nominal maximum size Oven-dry relative density = 2.70 Absorption capacity = 0.4% Bulk density = 1600 kg/m^3 Coarse aggregate has a moisture content of 0.1%
Fine aggregate:	Saturated-surface-dry relative density = 2.60 Absorption capacity = 0.8% Fine aggregate has a moisture content of 1%
Air entrainer:	Wood resin type, ASTM C 260. Recommended dosage is 6.3ml/1% air/100 kg cementing materials

Sieve analysis of the fine aggregate is as follows:

Sieve (mm)	5	2.5	1.25	0.630	0.315	0.160
Percentage of individual fraction passing	97	89	82	82	65	79

QUESTION 3: (25 marks)

1. An aggregate sample of 1000 g has the following properties: oven-dried mass = 970 g and saturated surface dry mass = 1007 g. What is the effective absorption capacity of the aggregate?

   (a) 3.1% (b) 3.8% (c) 0.7%

   (d) 2.5% (e) None of the above

2. What type of Portland cement is often used to produce high strength at early ages?

   (a) Type 20 (b) Type 30 (c) Type 40

   (d) Type 50 (d) None of the above

3. When does ettringite formation pose a problem in concrete?

   (a) When concrete is hardened (b) When concrete is fresh (c) Using Type 20 cement

   (d) Using Type 50 cement (e) None of the above

4. In which of the cases listed would you most likely use a set retarding admixture in concrete?

   (a) To increase productivity (b) In cold weather (c) In hot weather

   (d) To open a concrete pavement early for service (e) None of the above

5. With what cement hydration product does a pozzolan react with?

   (a) Calcium silicate hydrate (b) Calcium hydroxide (c) Ettringite

   (d) Gypsum (e) Tri-calcium aluminate

6. Why is the amount of $CaCl_2$ used as an accelerating admixture limited to 2% by weight of cement?

   (a) To prevent reinforcement corrosion (b) To prevent concrete from freezing

   (c) To delay early hardening (d) To permit early removal of the forms

   (d) None of the above

7. How do water-reducing admixtures function?

   (a) Causing cement particles to flocculate (b) Increasing C-S-H

   (c) Increasing the viscosity (d) Increasing the fluid volume in concrete

   (e) None of the above

8. How do air-entraining agents function?

   (a) Creating air bubbles by chemical reaction (b) Stabilizing air entrapped during mixing

   (c) Causing cement particles to flocculate (d) Plasticizing the concrete

   (e) None of the above

9. Which compound contributes to late strength development in concrete?

   (a) C_3S (b) $Ca(OH)_2$ (c) C_2S

   (d) Gypsum (e) C_3A

10. Which of the listed improvements in concrete properties can be attributed to the appropriate use of supplementary cementing materials?

    (a) Improved long-term strength (b) Reduced permeability

    (c) Increased resistance to sulphate-ion penetration (d) Reduced potential for corrosion

    (e) All of the above