Université d'Ottawa
Faculté de génie

Département de
génie civil

uOttawa
L'Université canadienne
Canada's university

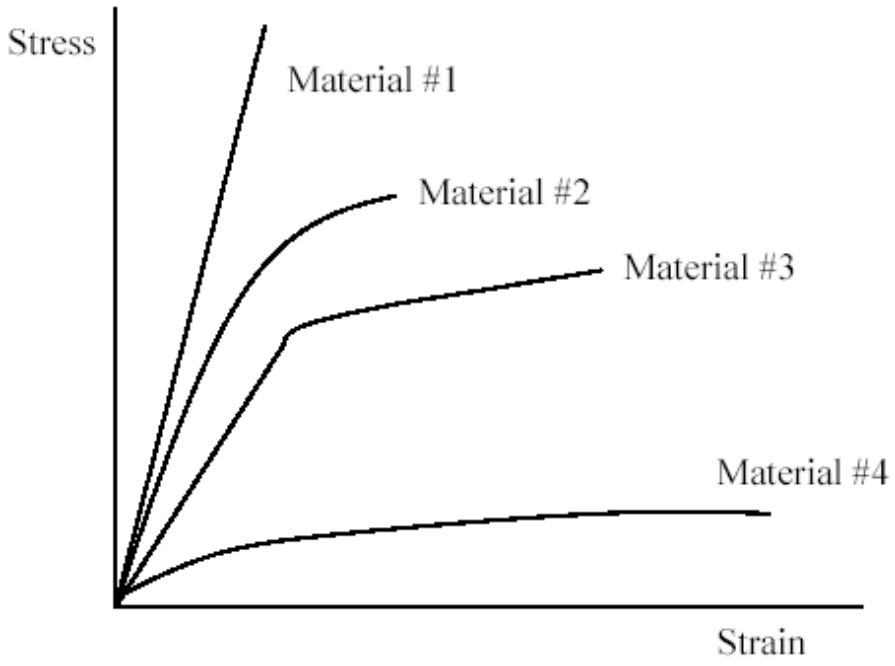
University of Ottawa
Faculty of Engineering

Department of
Civil Engineering

CVG 2141 – CIVIL ENGINEERING MATERIALS

Quiz I
Dr. Leandro F. M. Sanchez Date: **September 21st, 2020**

1. Based on the stress-strain curve below, answer the questions A to D.



A) What is the material having the **greatest toughness**?

(a) 1 (b) 2
(c) 3 (d) 4

B) What is the material having the greatest **modulus of resilience**?

(a) 1 (b) 2
(c) 3 (d) 4

C) What is the **most ductile** material?

(a) 1 (b) 2

(c) 3 (d) 4

D) What is the **most brittle** material?

(a) 1 (b) 2

(c) 3 (d) 4

2. How do you define the following materials as per their stress-strain behaviour?

A. Material 1: high stiffness, brittle, low ductility, medium modulus of resilience, low toughness

B. Material 2: high stiffness, medium ductility, medium modulus of resilience, medium toughness

C. Material 3: moderate stiffness, ductile, high modulus of resilience, high toughness

D. Material 4: low stiffness (soft), high ductility, low modulus of resilience, low toughness

3. Which of those materials (i.e. 1, 2, 3 or 4) would you select for structural applications? Why?

I would select material 3 because it has the best balance between toughness and ductility. The materials 1 and 2 both are strong but provide little warning before breaking. While material 4 has a lot of deformation which makes it not suitable. Material 3 would provide moderate strength, but more importantly is safer since the modulus of resilience is higher meaning that it will be able to absorb energy without damage better and it will show slight deformations to warn workers to possibly fix the structure before an incident can occur.

4. Can you guess/estimate the atomic bonds of materials 1, 2, 3 and 4 based on their stress-strain curves?

A. Material 1: ionic bond and covalent bond

B. Material 2: covalent bond

C. Material 3: metallic bond

D. Material 4: covalent bond

5. **You work for a company XX and will participate in a project YY. Your boss decide you should use Material 3 for the structural member that will be built. You perform then the tensile strength tests in 30 samples in the laboratory and obtain an average value of 100000 N. Knowing that you are testing a rebar with a diameter of 5 cm, please answer the following questions:**

   A) What's the average tensile strength obtained in the test? Please show the calculations.

   B) Your boss request you to recommend him the maximum stress allowed to be applied to the rebar regarding safety considerations. Could you please suggest him a value? Please justify.

P.S/: It is worth noting that 1 N/m2 is 1 Pa.

a) Average Tensile Strength = F/A

= 100000/(pi*(0.025)^2)

= 50929581.80 N/m^2

= 5.1x10^7 N/m^2 or Pa

= 51.0 MPa

r = d/2 = 2.5cm = 0.025m

b) σ (allow) = σ (max)/ FS

= 51.0 MPa / 2 = 25.5 MPA

= 51.0 MPa / 3 = 17 MPa

FS = 2-3

Therefore, the suggested maximum stress value would be between 17 MPa and 25.5 MPa