QUIZ 2
Fall 2004-2005
(Monday, January 10, 2005)
CIVE310 - MECHANICS OF MATERIALS
CLOSED BOOK, 1 ½ HOURS

Name: _____ **ID#:** _____

$P/A;$	$Tc/J;$	Mc/I		
$bh^3/12;$	$\Pi R^2;$	$2\Pi Rt;$	$\Pi R^4/2;$	$2\Pi R^3 t$

NOTES

- 3 PROBLEMS – 12 PAGES.
- ALL YOUR ANSWERS SHOULD BE PROVIDED ON THE QUESTION SHEETS.
- **TWO EXTRA SHEETS ARE PROVIDED AT THE END.**
- **ASK FOR ADDITIONAL SHEETS IF YOU NEED MORE SPACE.**
- SOME ANSWERS MAY REQUIRE MUCH LESS THAN THE SPACE PROVIDED.
- ***DO NOT*** USE THE BACK OF THE SHEETS FOR ANSWERS.
- DRAFT BOOKLET WILL BE PROVIDED; BUT DO NOT USE FOR ANSWERS.
- BOTH QUESTION SHEETS AND DRAFT BOOKLET SHOULD BE RETURNED.
- CHECK BOXES ARE FOR YOU TO CONFIRM THAT HAVE SOLVED A QUESTION ☑

YOUR COMMENT(S)

_ _

_ _

DO NOT WRITE IN THE SPACE BELOW

MY COMMENT(S)

_ _

_ _

YOUR GRADE

Problem I: _ _ _ /20
Problem II: _ _ _ /35
Problem III: _ _ _ /45
Other: _ _ _
_____
TOTAL: /100

Problem I: *(20 points)*

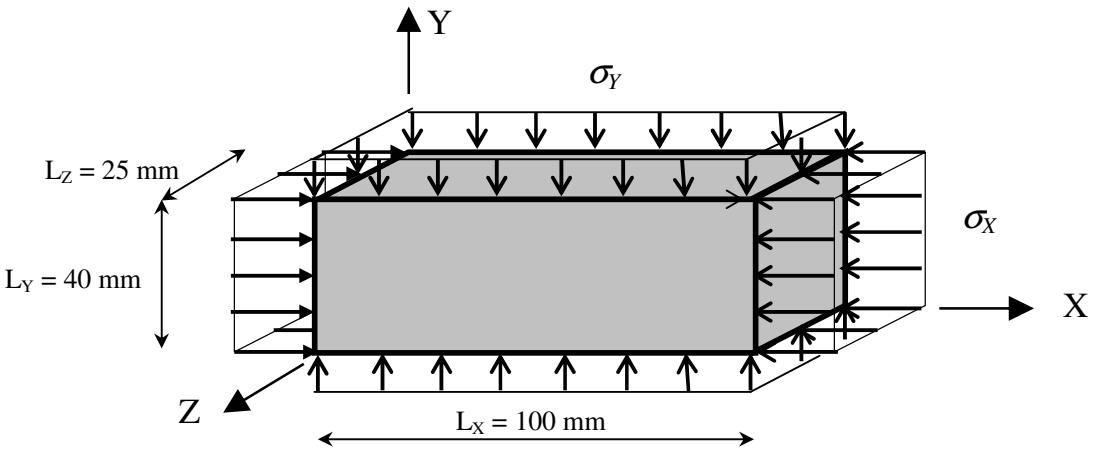

Figure I

The block shown in Figure I is made of a magnesium alloy for which the modulus of elasticity E= 50,000 MPa (N/mm^2) and Poisson's ratio ν= 1/3. Assume linear elastic behavior, and given that σ_X= 180 MPa in compression, determine the following:

1. The magnitude of σ_Y for which the change in height L_Y of the block is zero. *(5 points)*
2. The corresponding change in the horizontal area (XZ Plane). *(7 points)*
3. The corresponding change in volume using 2 different methods and compare. *(8 points)*

Calculations and/or Diagrams:

Calculations and/or Diagrams (cont'd):

Problem II: *(35 points)*

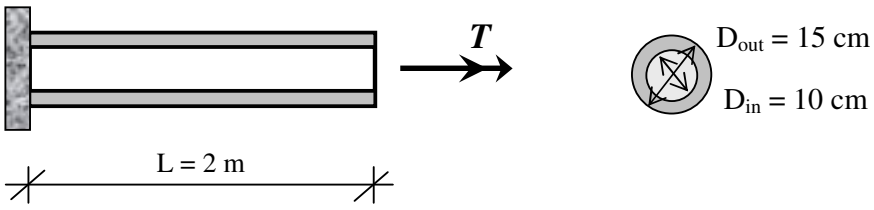

Figure II

The weightless shaft shown in Figure II is made of a ***thick*** tube. Assuming linear elastic behavior, and given that the allowable shear stress τ_{all} is 70,000 kPa (kN/m^2) and shear modulus G is 200x10^6 kPa (kN/m^2), determine:

1. The maximum torque T which can be applied, and plot the shear stress distribution on the cross section. Calculate the torsional stiffness and the rotation at the free end. *(13 points)* ☐
2. The maximum torque which can be applied on a ***solid*** shaft of same weight and material (i.e. same cost). Compare with question 1 and briefly discuss. *(10 points)* ☐
3. The diameter and cross-section area of a ***thin*** shaft of thickness t=1 cm which will result in the same torque capacity as the thick shaft in Figure II; compare cost and briefly discuss. *(12 points)* ☐

Calculations and/or Diagrams:

Calculations and/or Diagrams (cont'd):

Calculations and/or Diagrams (cont'd):

Problem III: *(45 points)*

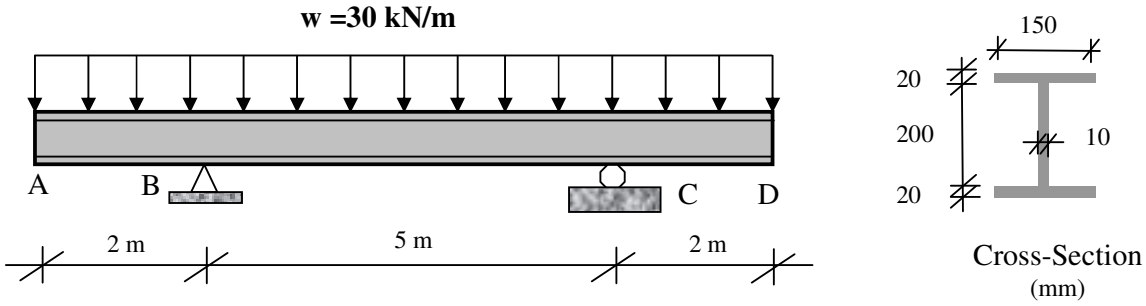

Figure III

A steel I-beam with overhanging ends is subjected to a uniformly distributed load w, as shown in Figure III. The dimensions of the beam are shown on the cross-section. The yield stress in tension and compression is $\sigma_{YT} = \sigma_{YC} = 200$ MPa (N/mm^2) and the factor of safety assumed is 1.6.

1. Draw the shear and bending moment diagram of the beam. *(10 points)* ☐
2. Determine the axial flexural stresses at the critical sections of maximum negative and positive moments, and briefly discuss safety. *(10 points)* ☐
3. Compute the moment capacity of the section in tension and compression, and determine the maximum additional allowable uniform load Δw that can be added to the beam safely. *(15 points)* ☐
4. Compute the maximum permissible concentrated load applied at mid length of the beam (between B and C), in addition to the existing w (without Δw). *(10 points)* ☐

Calculations and/or Diagrams:

Calculations and/or Diagrams (cont'd):

Calculations and/or Diagrams (cont'd):

Calculations and/or Diagrams (cont'd):

EXTRA SHEET 1: Continued from page _____

Name: _____ **ID#:** _____

Calculations and/or Diagrams:

EXTRA SHEET 2: Continued from page _____

Name: _____ **ID#:** _____

Calculations and/or Diagrams: