QUIZ 1

Fall 2003-2004 (Monday, November 24, 2003) CIVE310 - MECHANICS OF MATERIALS CLOSED BOOK, 1 ½ HOURS

Name:

ID#:

<u>NOTES</u>

- 2 PROBLEMS 10 PAGES.
- ALL YOUR <u>ANSWERS</u> SHOULD BE PROVIDED ON THE QUESTION SHEETS.
- ONE <u>EXTRA</u> SHEET IS PROVIDED AT THE END.
- ASK FOR ADDITIONAL SHEETS IF YOU NEED MORE SPACE.
- SOME ANSWERS MAY REQUIRE <u>MUCH LESS</u> THAN THE SPACE PROVIDED.
- **DO NOT** USE THE <u>BACK</u> OF THE SHEETS FOR ANSWERS.
- <u>DRAFT</u> BOOKLET WILL BE PROVIDED; BUT DO NOT USE FOR ANSWERS.
- BOTH QUESTION SHEETS AND DRAFT BOOKLET SHOULD BE <u>RETURNED</u>.
- CHECK BOXES ARE FOR YOU TO CONFIRM THAT HAVE SOLVED A QUESTION

FORMULAS/EQUATIONS: GENERAL FORM (USE CAREFULLY)

<i>P/A;</i>	Tc/J;	Mc/I;	VQ/It	
bh ³ /12;	$\Pi R^{4}/2;$	$2\Pi R^3 t$		

YOUR COMMENT(S)

DO NOT WRITE IN THE SPACE BELOW

MY COMMENT(S)

YOUR GRADE

Problem I: ____/70 *Problem II:* ____/30

Other: ____

TOTAL: /100

Problem I: (70 points)



The free-standing circular solid column monument with diameters of 0.40 m and 0.20 m as shown in Figure I-a is loaded with P=1,000 kN and has the following properties:

- $E = 20 \times 10^6 \text{ kPa} (\text{kN/m}^2)$
- $\gamma = 20 \text{ kN/m}^3$
- $\sigma_v = 20,000 \text{ kPa}$
- FS = 2.0

- : Modulus of elasticity
- : Weight density (about 2 times water)
- : Yield strength in tension and compression
- : Factor of safety

1. IGNORE OWN WEIGHT and solve for the problem as follows:

- Reaction, Force, Stress, Strain, and Displacement Diagrams. (25 points)
- Discuss safety. (5 points)
- Compute the stiffness of the system. (5 points)

Calculations and/or Diagrams:

Calculations and/or Diagrams (cont'd): _____ _____ _____ _____ _____ _____ -----_____ _____ _____ _____ _____ _____ _____ _____

Calculations and/or Diagrams (cont'd): _____ _____ _____ _____ _____ _____ -----_____ _____ _____ _____ _____ _____ _____ _____

2.	<u>AGAIN IGNORING THE OWN WEIGHT</u> , and referring to Figure I-b, what is the force F in each cable which will be required to ensure that the top displacement due to P in question 1 is reduced to zero. (15 points) <u>Deduce</u> the top reaction in the system in Figure I-c, and solve as in question 1 (Reactions, Force, Stress, Strain, and Displacement Diagrams, check safety, and compare safety with question 1). (10 points)	
	Calculations and/or Diagrams:	

Calculations and/or Diagrams (cont'd): _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

3. Referring to Figure I-a, show that the own weight is negligible by calculating a displacement value, using a very simple model which approximates the real model (look for a range, and not for an exact value). DARE TO APPROXIMATE AND THIS COULD BE A 3 MN QUESTION. (10 points + up to 5 bonus points to the most daring which make sense)

Calculations and/or Diagrams:

Problem II: (30 points)



Design (find cross-section and length) the thin tubular steel shaft shown in <u>Figure II</u>, given the following loading, properties and constraints:

- <u>This should be a thin tube with t/D < 1/20, and Area = πDt </u>
- Ignore own weight
- P = 1,000 kN
- $E = 200 \text{ x} 10^6 \text{ kPa} (\text{kN/m}^2)$
- $\sigma_{allowable} = 100,000 \text{ kPa}$
- Elongation limited to 1 mm
- : Modulus of elasticity
- : Allowable strength in tension

Calculations and/or Diagrams:

Calculations and/or Diagrams (cont'd): _____ _____ _____ _____ _____ _____ -----_____ _____ _____ _____ _____ _____ _____ _____ _____

EXTRA SHEET: Continued from page _

Name:	<u>ID#:</u>
Calculations and/or Diagrams:	