QUIZ 1
Fall 2006-07
(Wednesday, November 8, 2006)
CIVE310 - MECHANICS OF MATERIALS
CLOSED BOOK, 1 ½ HOURS

Name: _____   **ID#:** _____

NOTES

- 2 PROBLEMS – 14 PAGES.
- ALL YOUR <u>ANSWERS</u> SHOULD BE PROVIDED ON THE QUESTION SHEETS.
- **TWO EXTRA SHEETS ARE PROVIDED AT THE END.**
- **ASK FOR <u>ADDITIONAL</u> 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 YOU HAVE SOLVED A QUESTION ☑

YOUR COMMENT(S)

_ _

_ _

DO NOT WRITE IN THE SPACE BELOW

MY COMMENT(S)

_ _

_ _

YOUR GRADE

Problem I: _ _ _ /45
Problem II: _ _ _ /55
Other: _ _ _
_____

TOTAL: /100

Problem I: *(45 points)*

4kN

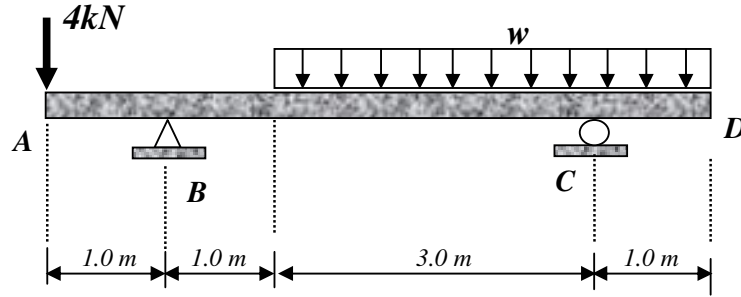w

A

B

C

D

1.0 m   1.0 m   3.0 m   1.0 m

Figure I-a

The rigid beam ABCD shown Figure (I-a) is subjected to a uniform distributed load *w* and a concentrated load of *4 kN* as shown. **Ignore the own weight of the beam and assume linear elastic behavior and small deformations.**

PART [1]

Knowing that *w* = 4 kN/m, determine the following:

1) The support reactions at B and C. (**DOUBLE CHECK YOUR REACTIONS**) (*10 points*)

2) The shearing force diagram (S.F.D) and bending moment diagram (B.M.D) of the beam ABCD.   *(20 points)*

Calculations and/or Diagrams:

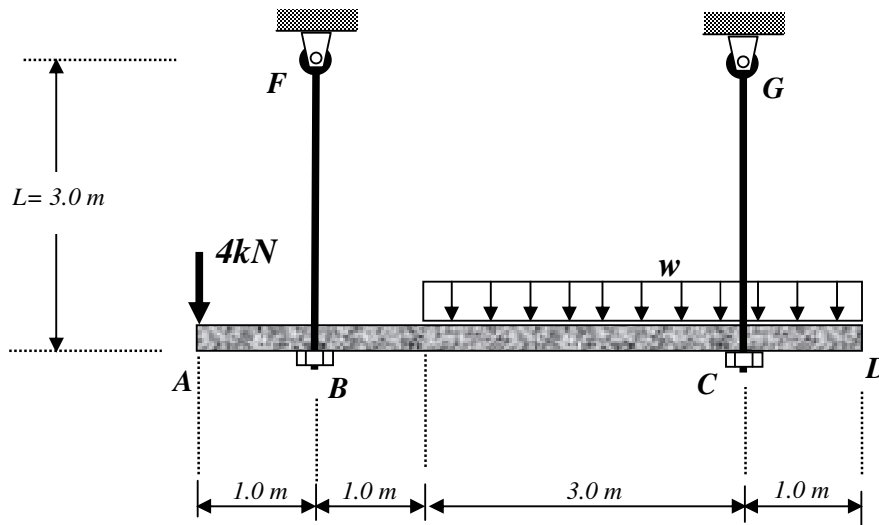
2

Calculations and/or Diagrams (cont'd):

PART [2]

Figure I-b

The structure given in Part [1] was modified such that the supports at B and C were replaced by steel rods BF and CG as shown in Figure (I-b). Rods BF and CG are pin connected at both ends thus resist only axial loads (Beam ABCD will behave the same as in Part 1). The rods have the following properties:

- d_1 : Diameter of Bar BF
- d_2 : Diameter of Bar CG
- $L = 3.0$ m.   : Length of Bars BF and CG
- $E = 200 \times 10^6$ kPa (kN/m^2)   : Modulus of elasticity of steel
- $\sigma_y = 250{,}000$ kPa   : Yield stress of steel in tension and compression
- F.S = 2.0   : Factor of safety
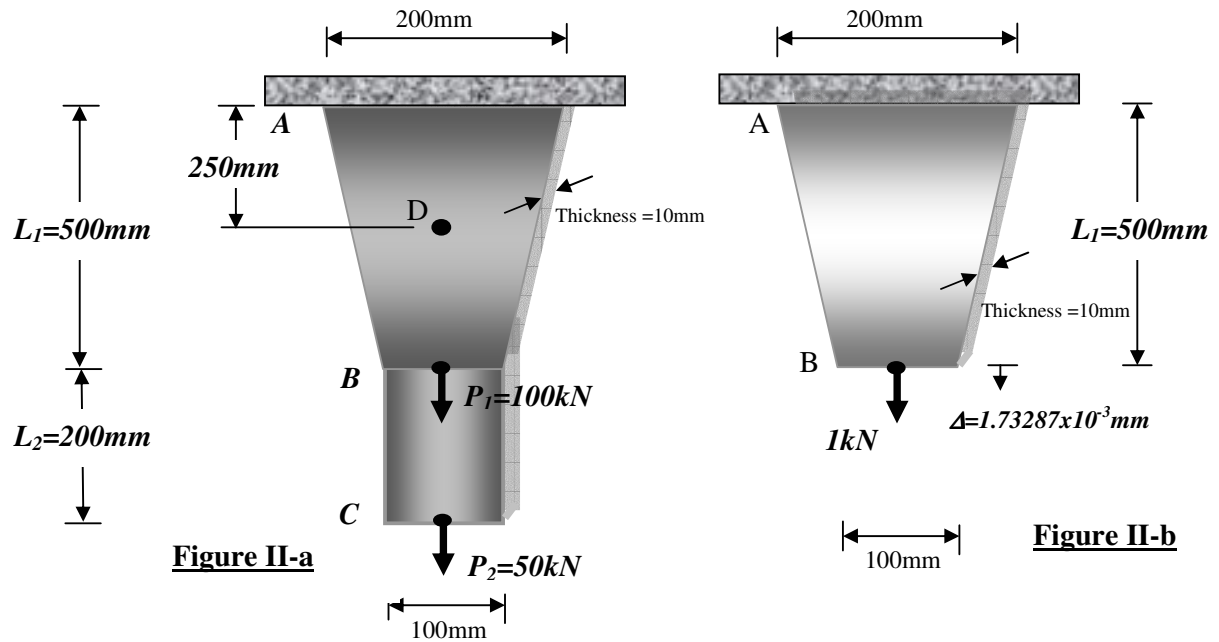
Solve the following:

1) The maximum value of *w* that the structure can safely carry if the diameter of rod BF is 10mm and the diameter of rod CG is twice as much; i.e., $d_2 = 2d_1 = 20$mm. Assume the beam is always safe.   *(15 points)*

Calculations and/or Diagrams:

4

Calculations and/or Diagrams (cont'd):

Calculations and/or Diagrams (cont'd):

Problem II: *(55 points)*

Figure II-a

Figure II-b

The steel bar ABC shown in Figure (II-a) has a uniform thickness equal to 10mm and consists of two parts; a tapered bar AB and a rectangular bar BC, as shown. The bar is subjected to the shown concentrated loads, P_1 and P_2. Figure (II-b) shows that the tapered bar AB will deflect at B a value of 1.73287×10^{-3}mm due to a load of 1kN applied at end B, as shown. Assume small deformation - elastic behavior - and neglect own weight of the bar. The bar has the following properties:

- E = 200,000 MPa (N/mm^2)   : Modulus of elasticity of steel
- σ_{yield}= 250 MPa (N/mm^2)   : Yield stress of material
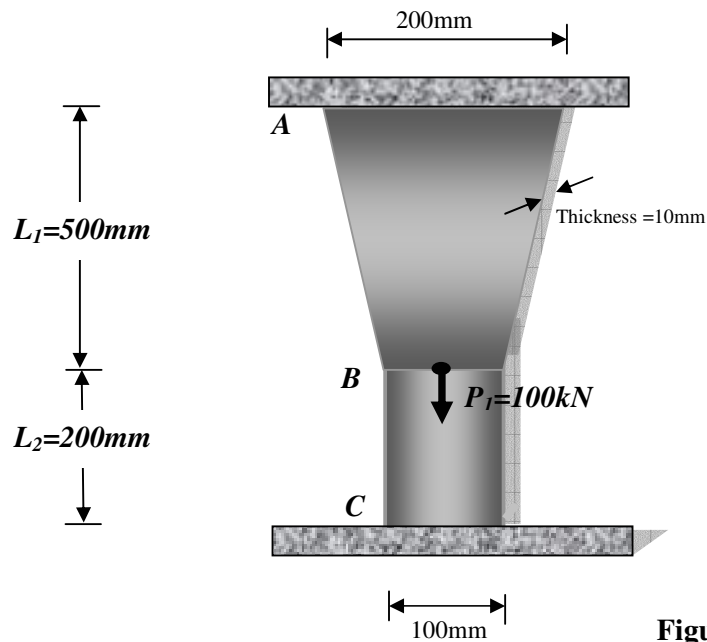
PART [1]

- Calculate axial stresses at points C and D.   *(10 points)*   ☐
- Calculate the maximum axial stress in the bar ABC and discuss its safety. *(10 points)*   ☐
- Calculate the vertical displacement of points B and C.   *(10 points)*   ☐
- Compute axial stiffness of the bar ABC.   *(10 points)*   ☐

Calculations and/or Diagrams:

7

Calculations and/or Diagrams (cont'd):

Calculations and/or Diagrams (cont'd):

Calculations and/or Diagrams (cont'd):

PART [2]

Figure II-c

The rod ABC is made fixed at both ends (indeterminate rod) and the rod was subjected to P_1 only as shown in Figure (II-c).

(THINK BEFORE YOU SOLVE: THIS MAY SAVE YOU QUITE SOME TIME)

• Calculate support reactions at A and C.   *(15 points)*

Calculations and/or Diagrams:

Calculations and/or Diagrams (cont'd):

EXTRA SHEET: *Continued from page* _____

Name: _____   **ID#:** _____

Calculations and/or Diagrams:

EXTRA SHEET: Continued from page _____

Name: _____   **ID#:** _____

Calculations and/or Diagrams: