QUIZ 1
Fall 2001-2002
(Monday, November 26, 2001)
CVEV 041 – MECHANICS OF MATERIALS
CLOSED BOOK, 1 ½ HOURS

Name: _____ **ID#:** _____

NOTES

- ALL YOUR ANSWERS SHOULD BE PROVIDED ON THE QUESTION SHEETS.
- **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.

YOUR COMMENT(S)

_ _

_ _

DO NOT WRITE IN THE SPACE BELOW

MY COMMENT(S)

_ _

_ _

YOUR GRADE

Problem I: _ _ _ /50
Problem II: _ _ _ /30
Problem III: _ _ _ /20
Other: _ _ _
_____

TOTAL: /100

Problem I: *(50 points)*

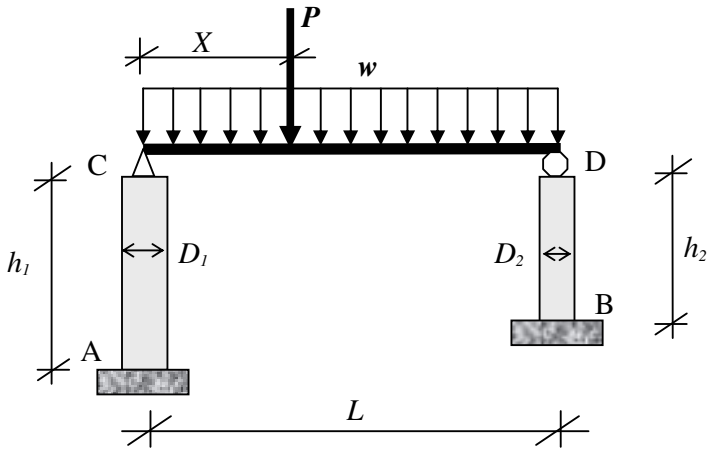


Figure I

The system shown in Figure I is composed of a simply supported beam (CD) of length L, supported on two circular columns (AC) and (BD), of respective heights h_1 and h_2, and diameters D_1 and D_2. The vertical reactions from the beam are applied at the center of the circular cross-sections at (C) and (D). Assume linear elastic behavior of beam and columns and small deformations.

The ***dimensions*** of the system are given as follows:

- L = 6 m
- h_1 = 3 m h_2 = 2 m
- D_1 = 0.30 m D_2 = 0.20 m

The following are the ***properties*** of the system:

- E = 20 x 10^6 kPa (kN/m^2) : Modulus of elasticity
- σ_Y = 20000 kPa : Yield stress
- γ= 25 kN/m^3 : Weight density of the columns

The following ***loads/weights*** are to be considered:

- w = 25 kN/m : Distributed own weight of the beam
- P = 500 kN : Moving load positioned at X between (C) and (D)
- Own weight of the columns represented by γ

1. Let P be applied at $X = L/2 = 3$ m
   Discuss the safety of the columns (Assume beam is safe). (*13 points*)
   Compute the vertical displacement of column (BD) at its top (D). (*12 points*)
   What conclusion can you make on the effect of the columns own weight, based on the questions above? *(5 points)*
   (NOTE: YOU MAY USE THIS CONCLUSION TO SIMPLIFY YOUR SOLUTIONS IN QUESTIONS 2 AND 3 WHICH FOLLOW)

   Calculations and/or Diagrams:

Calculations and/or Diagrams (cont'd):

2. Determine the position *X* of the load *P* so that the beam deflects (vertically) equally at its ends (C) and (D). *(13 points*)

Calculations and/or Diagrams:

3. Discuss the columns safety for a worst-case condition of *P*. Show that condition. *(7 points)*

Calculations and/or Diagrams:

Take a break!

Problem II: *(30 points)*

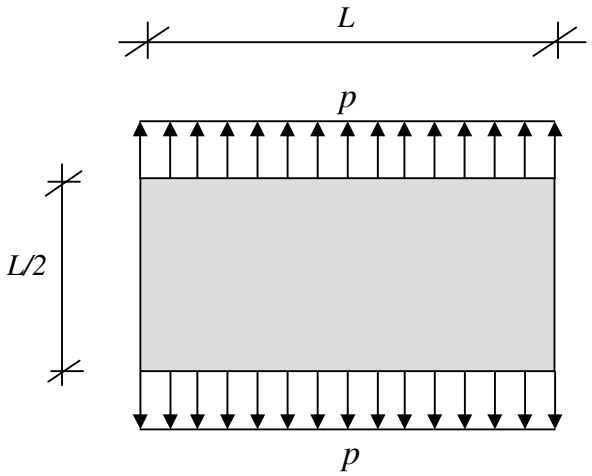


Figure II

The thin steel plate of dimensions *Lx0.5L* and uniform thickness *t*, is subjected to a constant pressure *p*, as shown in Figure II. Assume linear elastic behavior and neglect the own weight of the plate.

The ***dimensions*** and ***properties*** of the plate are given as follows:

- L = 2 m t = 2 cm
- E = 200 x 10^6 kPa (kN/m^2) : Modulus of elasticity
- ν : Poisson's ratio

1. Let p = 3 x 10^5 kPa and ν = 0.3
   Describe and evaluate the state of stress and strain and compute the final volume of the plate. (*15 points*)

   Calculations and/or Diagrams:

Calculations and/or Diagrams (cont'd):

2. Let p = 30 x 10^6 kPa and $\nu = 0.3$
   Explain (maximum 2 lines) how you would evaluate the final volume of the plate. Compute this volume. (*10 points*)

   Calculations and/or Diagrams:

3. Let $\nu = 0.5$
   What is the final volume of the plate? (*5 points*)

   Calculations and/or Diagrams:

Problem III: *(20 points)*

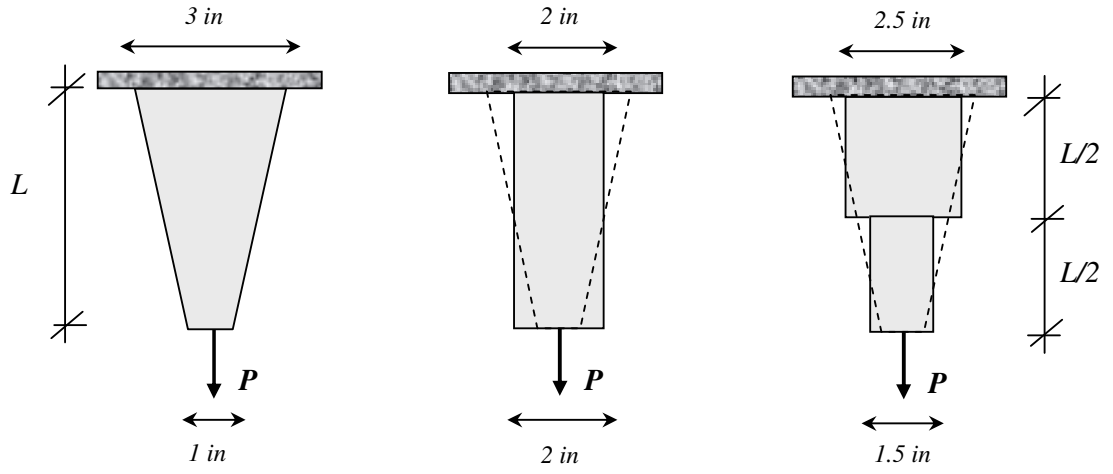


Figure III

The axial bars shown in Figure III are assumed "weightless", and have the same modulus of elasticity E, length L, and thickness t = 1 in. Assume linear elastic behavior.

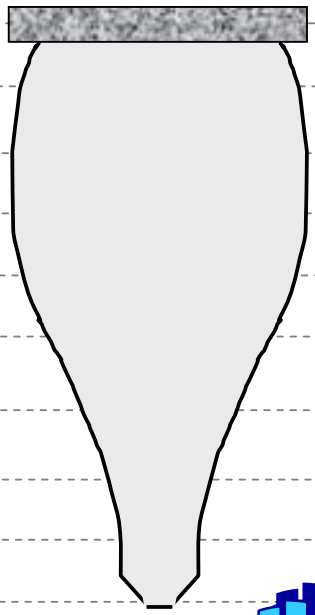
1. The displacement of Bar (a) at the bottom is computed as (PL/E).[ln(3)/2] = 0.5493 (PL/E) Compare with bottom displacements of Bars (b) and (c), and compute the axial stiffness of each of the bars. Briefly assess your results. (*13 points*)

   Calculations and/or Diagrams:

Calculations and/or Diagrams (cont'd):

2. Based on the results of the previous question, propose a reasonable, accurate, and simple approximation for the solution of complex bars under any type of loading (own weight and concentrated loads), such as the one shown below. You can show your proposed solution descriptively on the drawing. (*7 points*)

Calculations and/or Diagrams:



EXTRA SHEET: Continued from page _____

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Calculations and/or Diagrams: