

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

King Fahd University of Petroleum & Minerals
DEPARTMENT OF CIVIL ENGINEERING
First Semester 1431-32 / 2010-11 (101)
CE 203 STRUCTURAL MECHANICS I

Major Exam I

Tuesday, March 29, 2011 7:00-9:30 P.M.

Student Name	Family					First			
ID No. (9 Digits)									

CIRCLE YOUR COURSE--SECTION NO.						
Section #	1 & 2	3	4	5	6 & 7	8
Instructor	Altayyib	Dulaijan	Ghamdi	Suwaiyan	Khathlan	Ahmad

Summary of Scores

Problem	Full Mark	Score
1	20	
2	20	
3	20	
4	10	
5	20	
Total	100	
Remarks		

Notes:

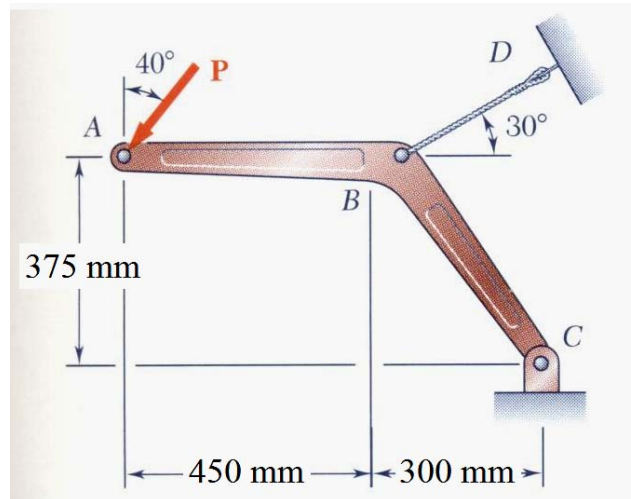
1. A sheet that includes selected Basic Formulae and definitions is provided with this examination.
2. Write clearly and show all calculations, FBDs, and units.

Problem # 1

Rigid member ABC , which is supported as shown, is subjected to a load P . If the diameter of the pin at C is 20 mm and the diameter of cable BD is 10 mm, determine the *largest load* P that can be applied.

Given: τ_{fail} in the pin at $C = 240$ MPa; σ_{fail} in the cable $BD = 300$ MPa,
factor of safety (F.S.) for both types of stresses is 3.0

The pin at C is in *double shear*

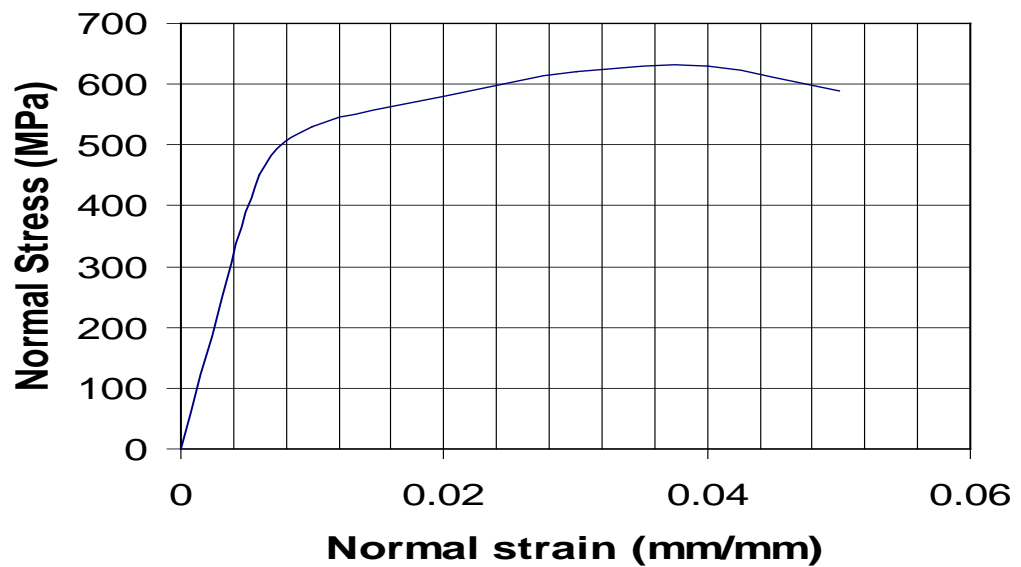


Problem # 2

The stress-strain diagram for an aluminum alloy that is used for making aircraft parts is shown below. A specimen having a gauge length of 300 mm and a diameter of 25 mm is stressed to 600 MPa. If Poisson's ratio, ν , for this material is 0.35, determine the following:

- 1- The modulus of elasticity and the shear modulus.
- 2- The new length when the specimen is loaded.
- 3- The new diameter when the specimen is loaded.
- 4- The final length if the load is removed.

Stress-strain Diagram

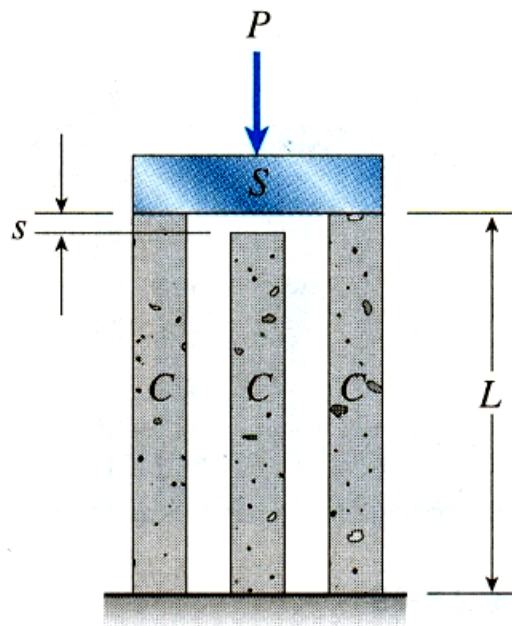


Problem # 3

A rigid plate (placed symmetrically atop three identical concrete posts) carries a load P as shown in the set-up given. If with an *initial* gap $s = 1$ mm, the set-up is also subjected to a temperature change $\Delta T = -40$ °C:

1. Determine the load P just to close the gap.
2. Determine the axial strain in middle post (for the loading from part 1 and temperature conditions specified).
3. Determine the normal stresses in *middle* and *right* posts (for the loading from part 1 and temperature conditions specified).

Assume: $L = 3$ m; $A_{\text{post}} = 40 \times 10^3 \text{ mm}^2$; $E = 30$ GPa; $\alpha = 12 \times 10^{-6} / ^\circ\text{C}$.



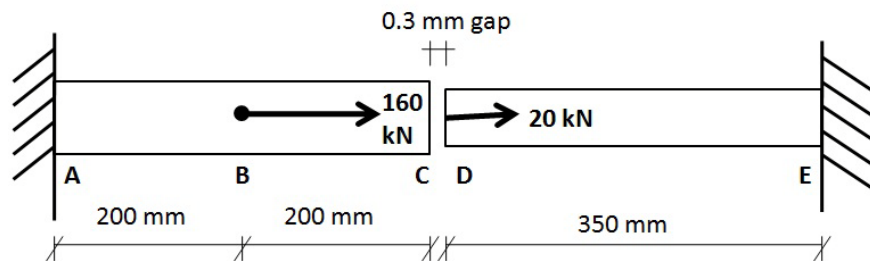
Problem # 4

The two rods have an initial gap of 0.3 mm before the application of the given loads.

- Show that the given problem is statically indeterminate.
- Determine the support reaction at point E.
- Determine the final length of rod DE.

For rod AC : $E = 20 \text{ GPa}$, and $A = 800 \text{ mm}^2$

For rod DE : $E = 40 \text{ GPa}$, and $A = 400 \text{ mm}^2$



Problem # 5

A rigid material has a smooth rectangular cavity of dimensions ($a \times b \times h$), 25 mm x 30 mm x 90 mm engraved in it as shown below. The cavity is filled with a linearly elastic, isotropic material with modulus of elasticity, $E = 2.5$ GPa, and Poisson's ratio, $\nu = 0.40$, and compressed as shown in the figure by a rigid cap with a force P acting on it. If $P = 70.8$ kN, determine the decrease c in the height h , and the change in volume ΔV of the material.

