بسم الله الرحمن الرحيم

King Fahd University of Petroleum & Minerals

DEPARTMENT OF CIVIL ENGINEERING

Second Semester 1433-34 / 2012-13 (122)

CE 203 STRUCTURAL MECHANICS I

Major Exam I

Tuesday, March 12, 2013 6:30-8:45 P.M.

Student Name	Family					First			
ID No. (9 Digits)									

CIRCLE YOUR COURSE--SECTION NO.					
Section #	1&4	3	2&8	5&6	7
Instructor	Hamdan	Suwaiyan	Salah	Khathlan	Gadhib

Summary of Scores

Problem	Full Mark	Score
1	20	
2	20	
3	20	
4	20	
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.**

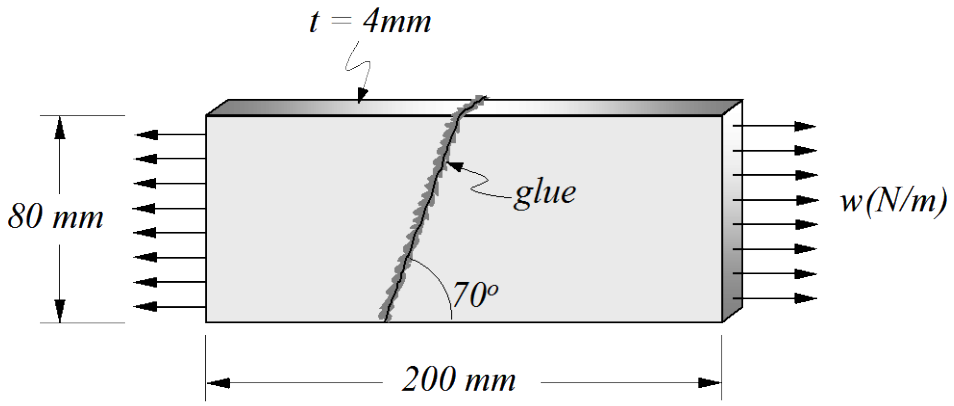
Problem 1: (20 points)

The given thin plate is made of two parts glued together as shown. The plate is subjected to an axial distributed load ***w*** *(N/m)*. Determine the largest value of ***w*** that can be applied.

For the plate material : ultimate normal stress = 60 *MPa*

For the glue : ultimate normal stress = 30 *MPa* , and ultimate shear stress = 15 *MPa*

For the whole problem, use safety factor *S.F.* = 3

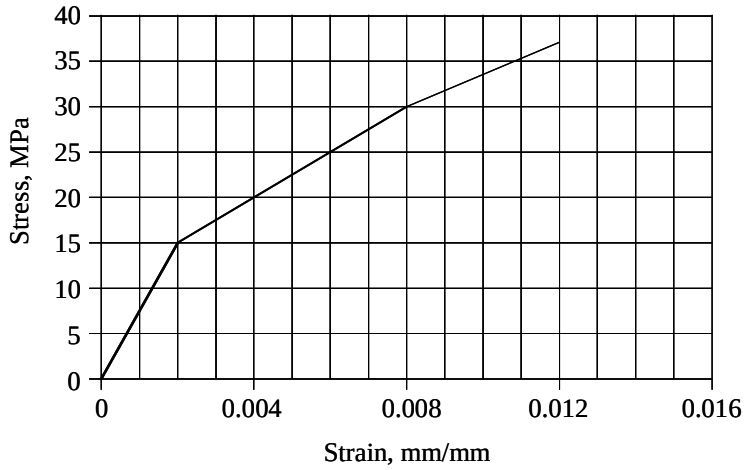


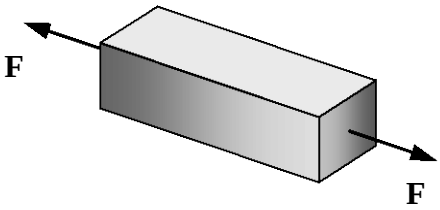
Problem 2: (20 points)

A bar with the stress-strain diagram shown was originally 1 m long with a square cross-sectional area of 100 mm x 100 mm.
When an axial tension load F is applied, the square cross-section became 99.95 mm x 99.95 mm.
Determine the following:

a) The magnitude of the applied force F.
b) The final length of the bar when the load F is applied.
c) The final length of the bar when the load F is released.
d) The final length of the bar when the applied load is 300 kN.
e) The final length of the bar when the 300 kN load is released.

Poisson's ratio, ν = 0.25



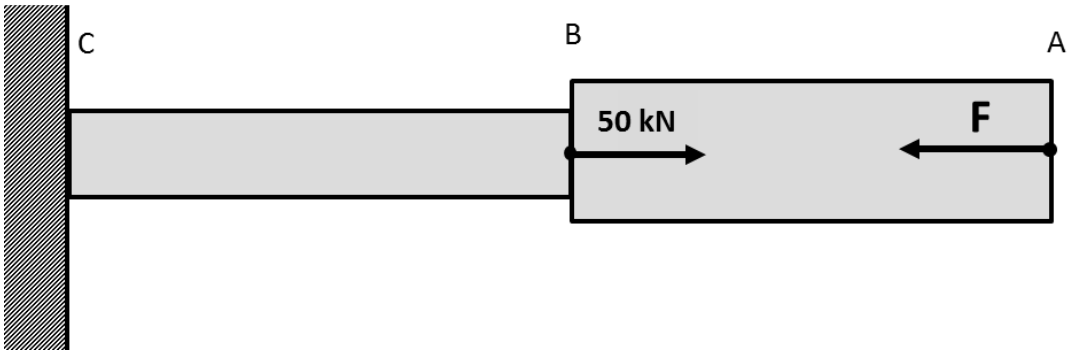


Problem 3 (20 pts.)

The rods AB and BC are subjected to the *loads and temperature changes* shown in the figure and table below. Determine the **maximum allowable force F** that can be applied (in the shown direction) if

- the maximum allowable normal stress in AB is 150 MPa (tension or compression), and
- the maximum allowable normal stress in BC is 100 MPa(tension or compression), and
- the maximum allowable displacement of point A is $5(10)^{-4}$ m.

Properties / *Member*	L (m)	A (m^2)	E (GPa)	ΔT (°C)	α (/°C)
AB	0.5	$4\ (10)^{-4}$	200	+40	$20\ (10)^{-6}$
BC	0.6	$3\ (10)^{-4}$	100	-60	$15\ (10)^{-6}$



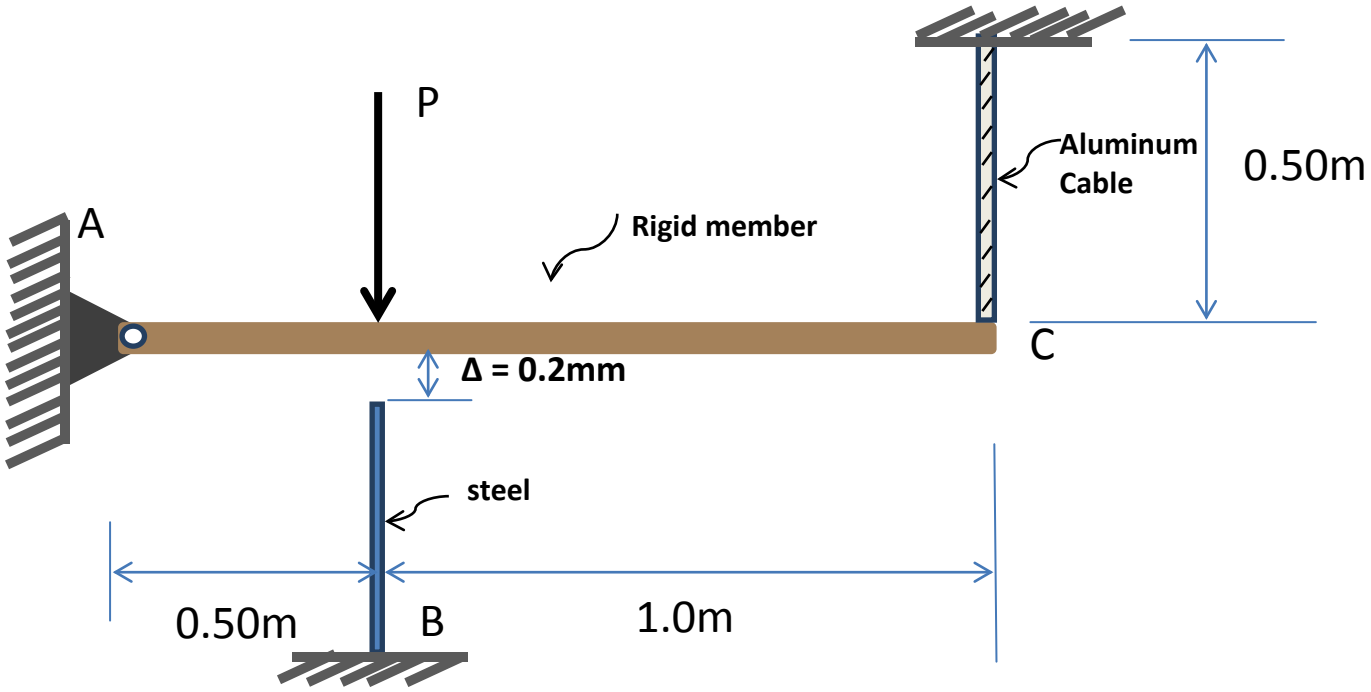
Problem 4: (20 points)

Rigid member AC is hinged at A and is supported by an aluminum cable at C. Before applying the load, AC was horizontal and a gap, $\Delta = 0.2$ mm separated it from a steel rod as shown.

If P = 24 kN, determine the following:

a) the stress in the aluminum cable.
b) the displacement of point C.

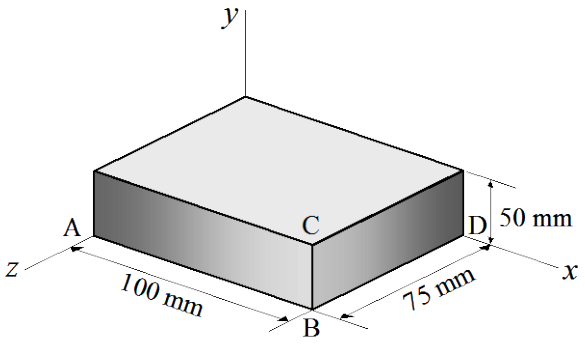
$E_{aluminum}$ = 70 GPa, E_{steel} = 200 GPa, L_{steel} = 0.5 m
$A_{aluminum}$ = A_{steel} = 50 mm^2



Problem 5: (20 points)

The steel block shown is subjected to a uniform pressure p on all the faces. Knowing that the change in length of edge AB is -30×10^{-3} mm and using E = 200 GPa, and G = 75 GPa, determine the followings:

a) The magnitude of the applied pressure, p.
b) The strains in the x, y, and z directions.
c) The new length of AB, CB, and BD after the application of the uniform pressure p.
d) The change in volume, using any approach.



Initial Dimensions