بسم الله الرحمن الرحيم

King Fahd University of Petroleum & Minerals

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

Second Semester 2013-14 (132)

CE 203 STRUCTURAL MECHANICS I

FIRST Major Exam

Wednesday 12 March, 2014

Time : 2 hours

Name : ..... Id # : .....

CIRCLE YOUR COURSE--SECTION NO.						
Section #	1 & 5	2	3	4 & 6	7	8
Instructor	Shamshad	Ghamdi	Suwaiyan	Khathlan	Sharif	Osta

Problem	Full Mark	Score
1	25	
2	20	
3	30	
4	25	
Total	100	

Notes:

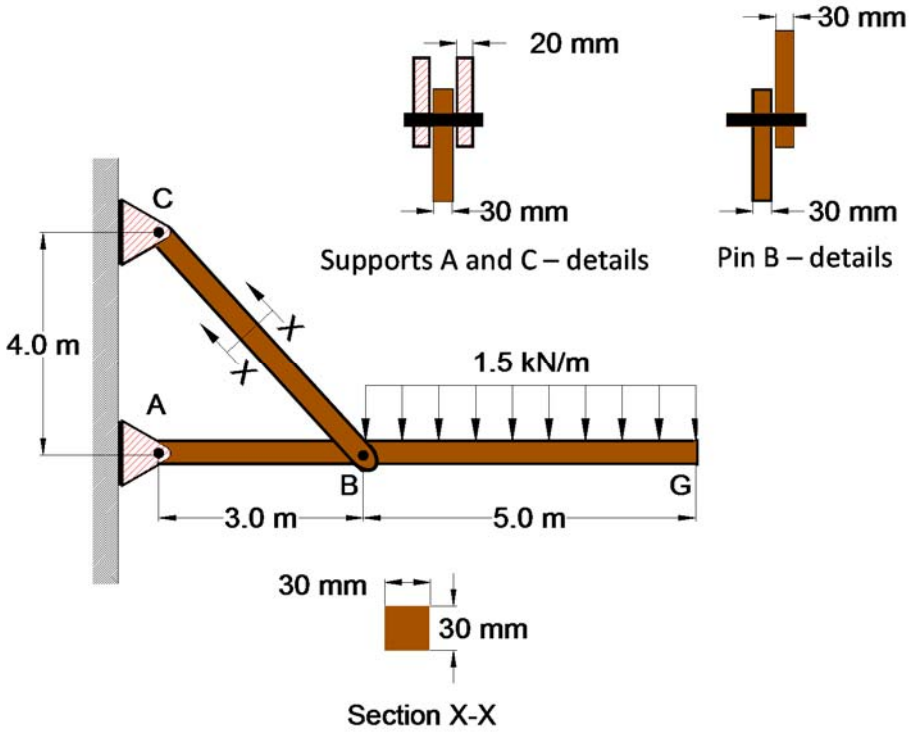
1. **A sheet that includes selected Basic Formulae and definitions is provided with this examination.**
2. **Write clearly and show all necessary calculations, FBDs, and units.**

Problem 1 (25 points)

For the frame shown in figure below, the beam AG is supported by a link BC and a pin support at A. Both members (AG and CB) have a square cross-section of 30X30 mm.

a- Determine the average normal stress acting in the section X-X.
b- Determine the required (minimum) diameter of the pin at A.
c- Determine the required (minimum) diameter of the pin at B.

All parts of the structure are made of the same material. The failure bearing stress is $(\sigma_b)_{fail}$ = 400 MPa, and the failure shear stress is $(\tau)_{fail}$ = 200 MPa. Use a factor of safety (F.S.) = 1.80.

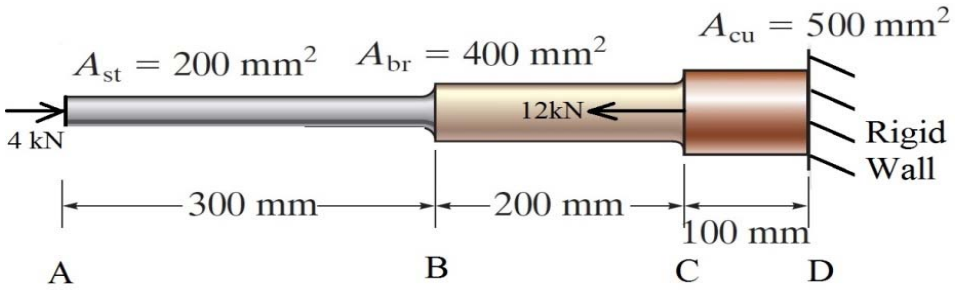


Problem 2 (20 points)

The rod ABCD is subjected to a temperature increase of 10° C, in addition to the given loads.

a- Determine the largest normal stress in the whole rod (ABCD).
b- Determine the magnitude and direction of the displacement of point A.
c- Determine the magnitude and direction of the relative displacement of B with respect to C.

Steel	Brass	Copper
$E_{st} = 200$ GPa	$E_{br} = 100$ GPa	$E_{cu} = 120$ GPa
$\alpha_{st} = 12(10^{-6})/°C$	$\alpha_{br} = 21(10^{-6})/°C$	$\alpha_{cu} = 17(10^{-6})/°C$

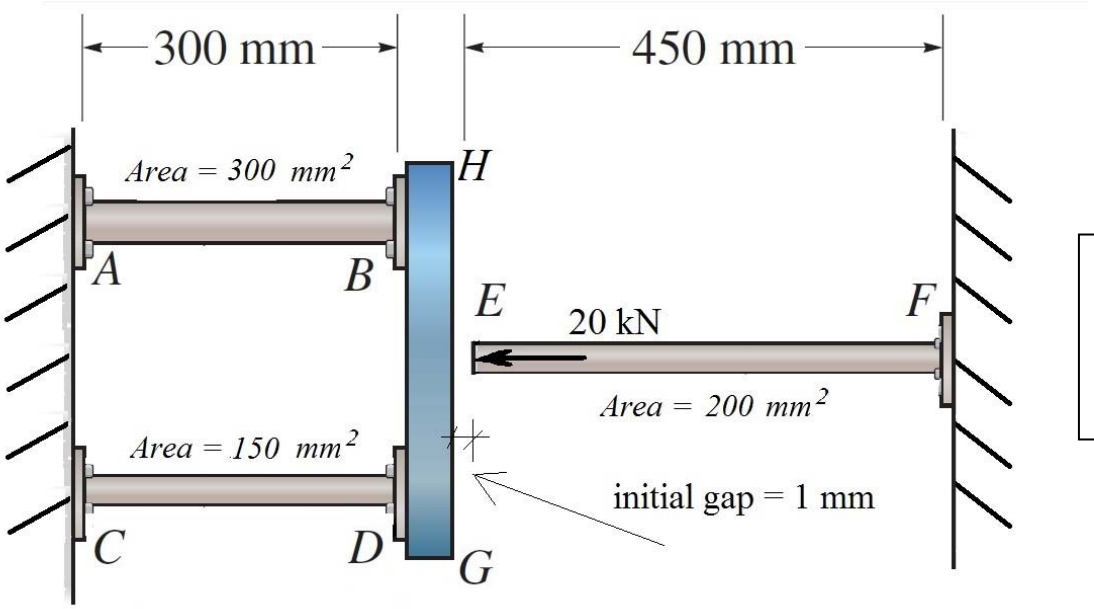


Problem 3 (30 points)

Before the application of the given force at point E, there was an initial gap between point E and the **rigid beam GH**.

a- Show (i.e. prove) that the gap will close after the force is applied.
b- Determine the final stress in rod EF.

Cross sectional area for each rod is given below. Use $E = 20$ *GPa* for all rods.



Point E is in the middle between points B and D

Problem 4 (25 points)

A *solid-block* is subjected to forces P_x and P_y as shown below. The deformations in the ***x*** and ***y*** directions are : δ_x= +0.25 mm and δ_y = −0.15 mm , due to the loads $\boldsymbol{P_x}$ **= 1000 kN** and $\boldsymbol{P_y}$ **= 2800 kN.**

a. Determine the values of the material constants, ***E*, *v***, and ***G***
b. Determine the deformation in the z-direction (δ_z)
c. Determine the change in the volume (δ_V)