بسم الله الرحمن الرحيم

King Fahd University of Petroleum & Minerals

DEPARTMENT OF CIVIL ENGINEERING

First Semester 1431-32 / 2010-11 (101)

CE 203 STRUCTURAL MECHANICS I

Final Exam

Wednesday, January 26, 2011 7:00-10:00 P.M.

Student Name	Family					First				Class Sections	CIRCLE YOUR COURSE--SECTION NO.				
ID No. (9 Digits)											1 & 2 Hamdan	3 Khathlan	4 Saeid	5 Mesfer	7 Mohamed

Summary of Scores

Problem	Full Mark	Score
1	15	
2	15	
3	20	
4	15	
5	15	
6	20	
Total	100	
Remarks		

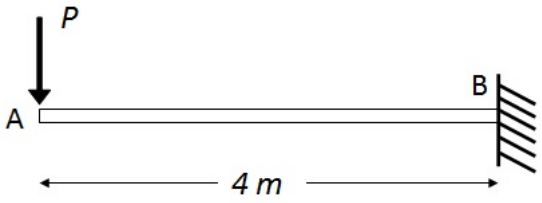
Notes:

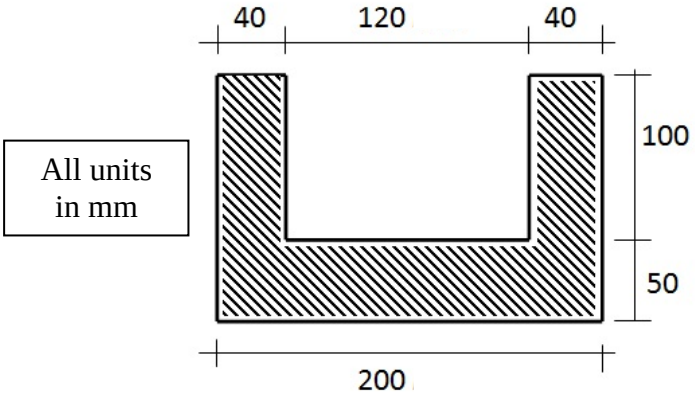
1. A sheet that includes selected Basic Formulae and definitions is provided with this examination.
2. **Write clearly and show all calculations, FBDs, and units.**

Problem # 1 (15 points)

The given cantilever beam has a U-shape cross section as shown in the figures. Calculate the largest value for the load P (downward) that can be safely applied to the beam.

Allowable tensile stress = 20 MPa , Allowable compressive stress =30 MPa





Problem # 2 (15 points)

A beam with the cross section shown below is subjected to a vertical shear force $\mathbf{V_y}$.
$\bar{y}$ **= 42 mm and** $\bar{\mathbf{I}}$ **= 5.416 (10)^6 mm^4.**

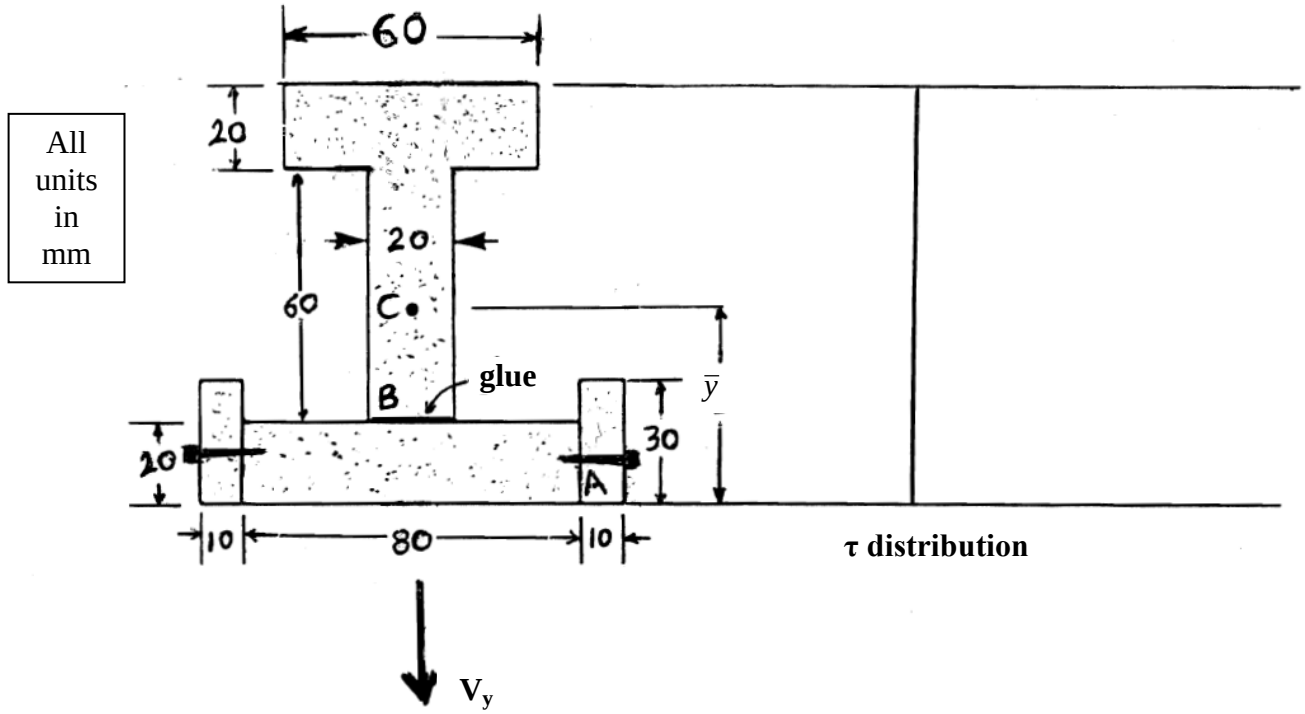
a) *Qualitatively* sketch the **shear stress distribution** along the depth.

b) Determine the value and location of the **maximum shear stress** if the shear force is 50 kN.

c) Calculate the **maximum shear force** which can be applied if the shear resistance of the nail at A is 5 kN and the spacing between the nails is 0.2 m.

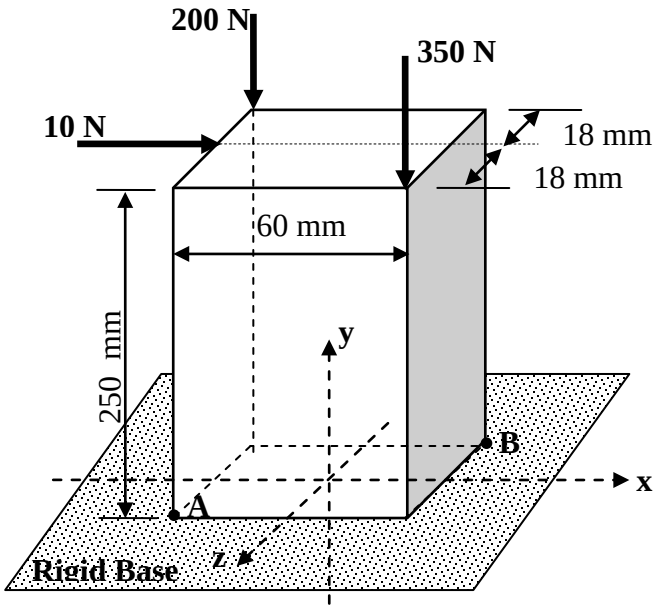
d) If the applied shear force is 60 kN, what is the **required strength of the glue** at B?

Hint: *The parts in the problem are* ***independent*** *of each other. You can get credit for any part of the problem you solve even if you did not do other parts or they are wrong.*



Problem # 3 (20 points)

The solid block is subjected to the loads shown in the figure. Determine **the normal stresses at corners A and B** at the rigid base.
Neglect the weight of the block.

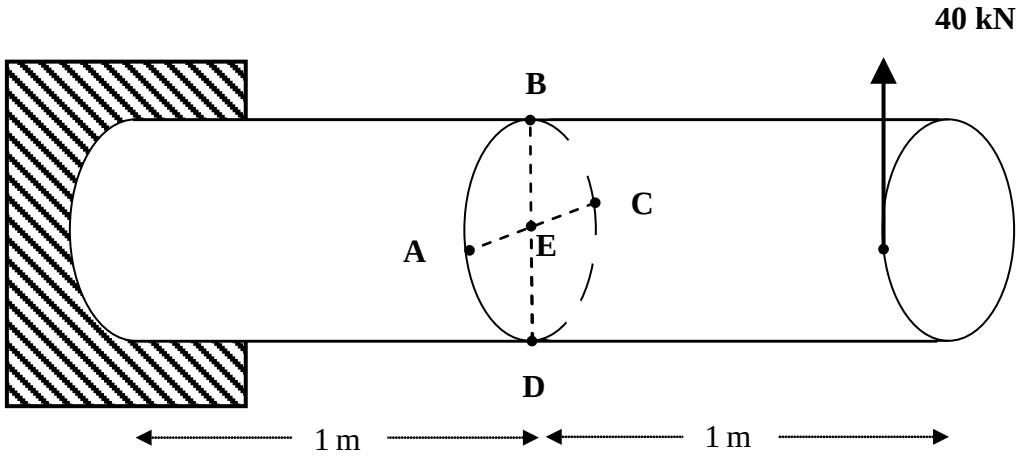


Problem # 4 (15 points)

A horizontal shaft having a solid circular cross-section (diameter= 100 mm) is fixed on the left and subjected to a vertical force as shown.

a) Calculate the shear stresses at points A, B, C, D and E.

b) Determine the state of stress at point A and show it on a differential element.



Problem # 5 (15 points)

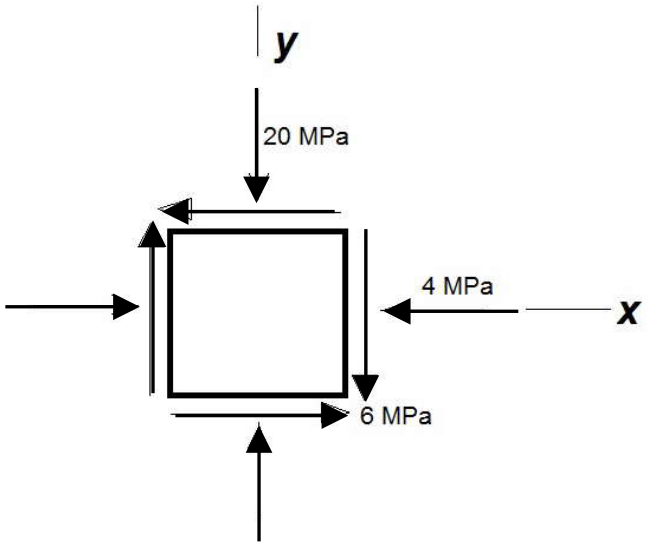
For the given element:

a) Construct Mohr's Circle. (*Make sure that the circle is big and clear enough.*)

b) **Use the circle** to calculate the principal normal stresses and their orientations. Show the stresses on a properly-oriented element.

c) **Use the circle** to calculate the normal and shear stresses obtained if the given element is rotated by 60 degrees counterclockwise. Show the stresses on a properly-oriented element.

The use of Transformation Equations is NOT acceptable



Problem # 6 (20 points)

The beam ABCD (shown below) has a uniform cross-section. Use the singularity functions method to determine

a) the magnitude and direction of the slope θ_C (radians) at support C;

b) the magnitude and direction of the deflection v_B (cm) at B.

Given: EI = 7.47 x 10^4 kN.m^2 ; A_y = 12 kN(↓); C_y = 21 kN (↑).