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 II

Tuesday, April 23, 2013 7:00-9:30 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.**

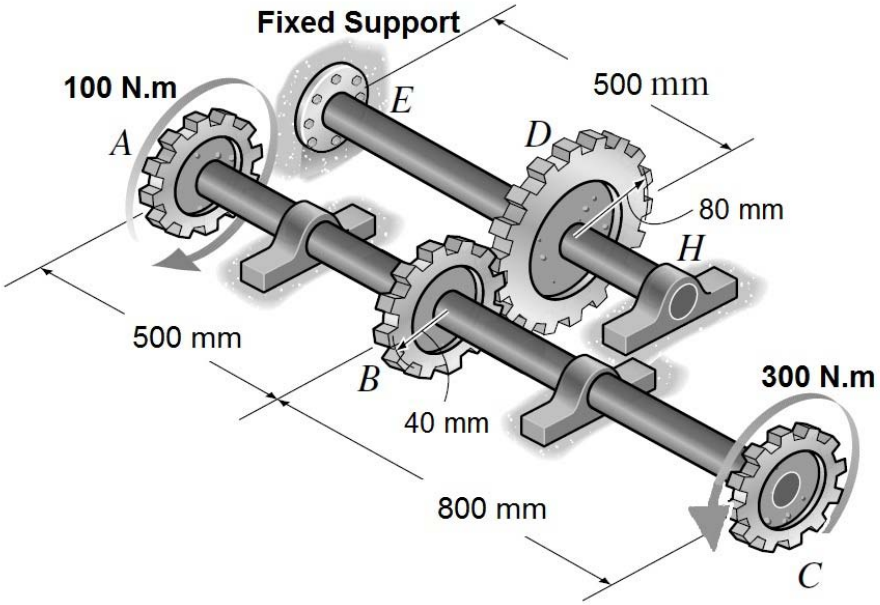
Problem 1: (20 points)

Shafts *ABC* and *EDH* are connected using the shown gear system. Both shafts have circular cross sections **(radius = *20 mm*)** and material shear modulus ***G= 100 GPa***.

a) Determine the magnitude of the maximum shear stress ***in the whole structure***. Also, indicate where this maximum stress is located.

b) Determine the relative angle of twist of point ***C*** with respect to point ***A***.

c) Determine the angle of twist of point ***C***.



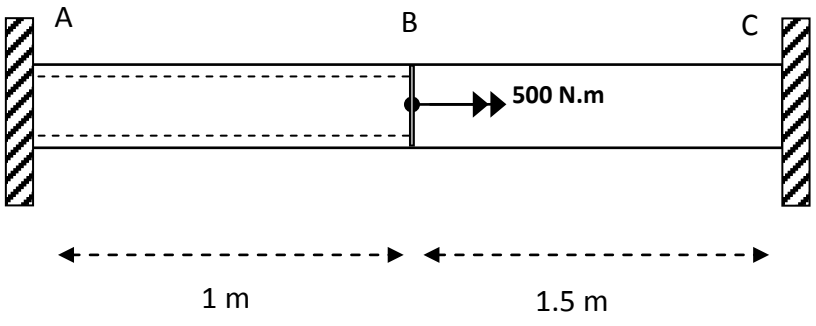
Problem 2: (20 points)

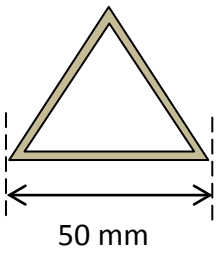
The shown shaft is made by connecting two segments, AB which has an equilateral triangular cross section and BC which has a thin hollow equilateral triangular cross section.

Determine:

a) The maximum shear stress in the whole shaft and indicate its location.
b) The angle of twist of point B.

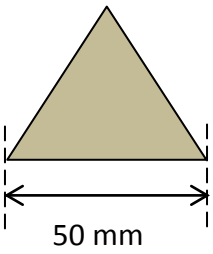
Given:
Side width = 50 mm
Thickness = 2 mm
G= 30 GPa





Cross section between A and B

(t=2 mm)

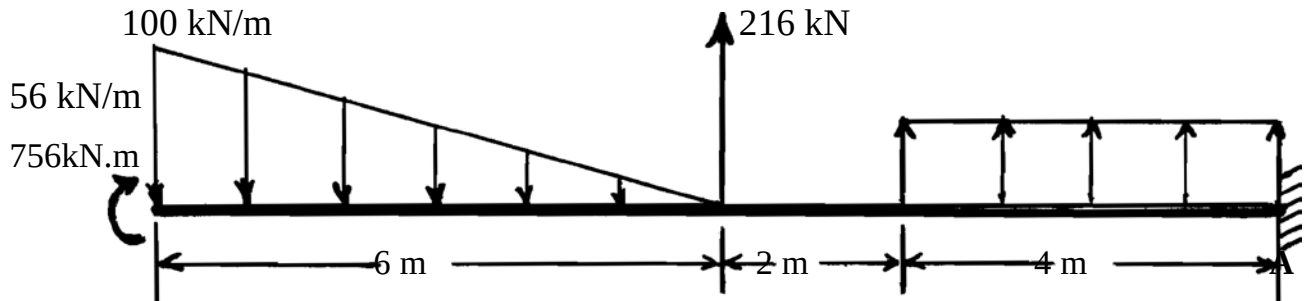


Cross section between B and C

Problem 3 (20 pts.)

Draw the **shear force and bending moment diagrams** for the beam shown below using the ***summation (graphical) method***. *Write the degree (2, 3, etc.) of the* ***curve on each one***.Put all values on the diagrams.*Use appropriate scale.* ***No credit will be given if another method is used.***

The reactions are:R_A = 140 kN ↓ M_A = 500 kN.m ↺



SFD

(kN)

BMD

(kN.m)

Problem 4: (20 points)

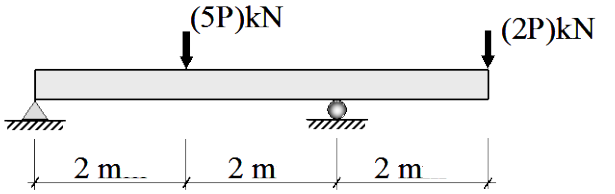
Beam ABCD is shown with the bending moment diagram and the cross-section details.

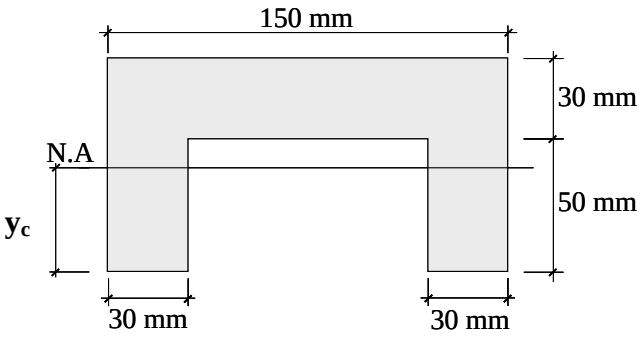
If for the used material

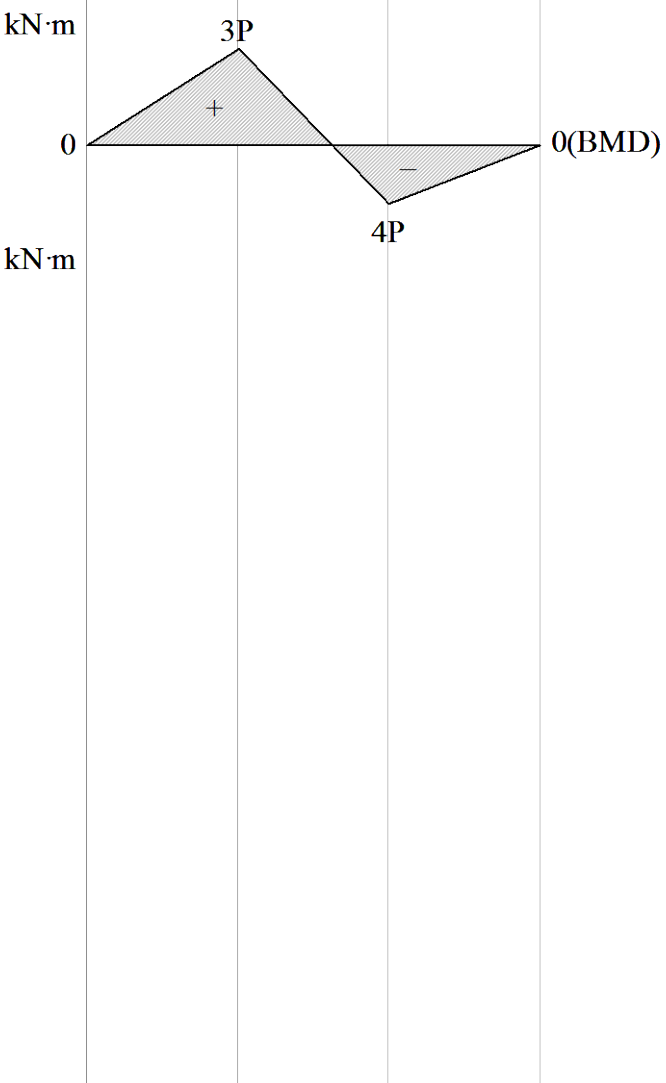
$(\sigma_{allowable})_{Tension}$ = 20 MPa and
$(\sigma_{allowable})_{Compression}$ = 15 MPa.

a) Verify that y_c = 49 mm from the bottom of the cross-section and that $I_{N.A.} = 3.8425 \times 10^6$ mm^4.

b) Using the values of y_c and $I_{N.A}$ given in part (a) and the given bending moment diagram, compute the maximum load P that can be safely applied to the beam.







Problem 5: (20 points)

The The vertical shear force in a beam, with the cross-section shown below, is 500 kN.

a) *Qualitatively* (without numbers), **draw the vertical shear stress distribution** (τ) on the section (*to the right of shown section*).

b) Determine the **shear stresses** at points A and B (just above and just below line LL).

c) Determine the **value and location of the maximum shear stress**.

The Centroidal Axis* (C.A.) *is located as shown on the cross section and $I_{C.A.} = 9.884(10)^7$ **mm**^{4}**.**