بسم الله الرحمن الرحيم

King Fahd University of Petroleum & Minerals

DEPARTMENT OF CIVIL ENGINEERING

Second Semester 1432-33 / 2011-12 (112)

CE 203 STRUCTURAL MECHANICS I

Major Exam I

Tuesday, March 13, 2012 7:00-9:15 P.M.

Student Name	Family					First			
ID No. (9 Digits)									

CIRCLE YOUR COURSE--SECTION NO.							
Section #	2	3 & 9	4 & 6	5	7	8	10
Instructor	Hamdan	Altayyib	Khathlan	Suwaiyan	Salah	Ali	Saeid

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.**

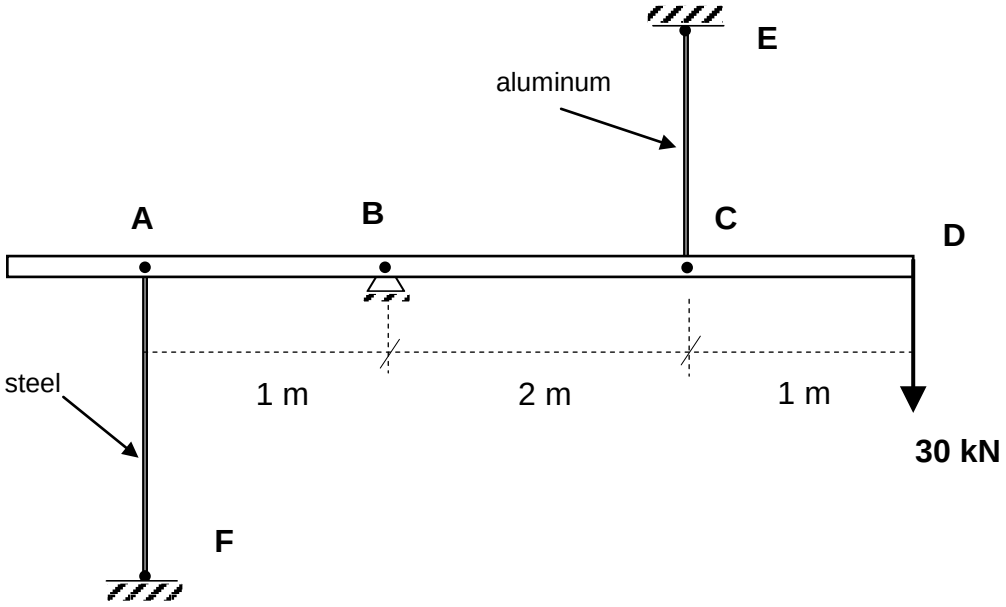
Problem # 4

Rigid member *ABCD*, is supported by the pin and the two cables.

a) Calculate the stresses in the cables due to the application of the shown force.
b) Calculate the vertical displacement of point D.
c) In one **statement**, explain what will happen to the stresses in the cables if the temperature of the steel cable *only* is increased.

E_{steel} = 200 GPa
$E_{aluminum}$ = 70 GPa

Cable	Length	Area (mm^2)	Material
AF	1.5 m	315	Steel
CE	1 m	600	Aluminum

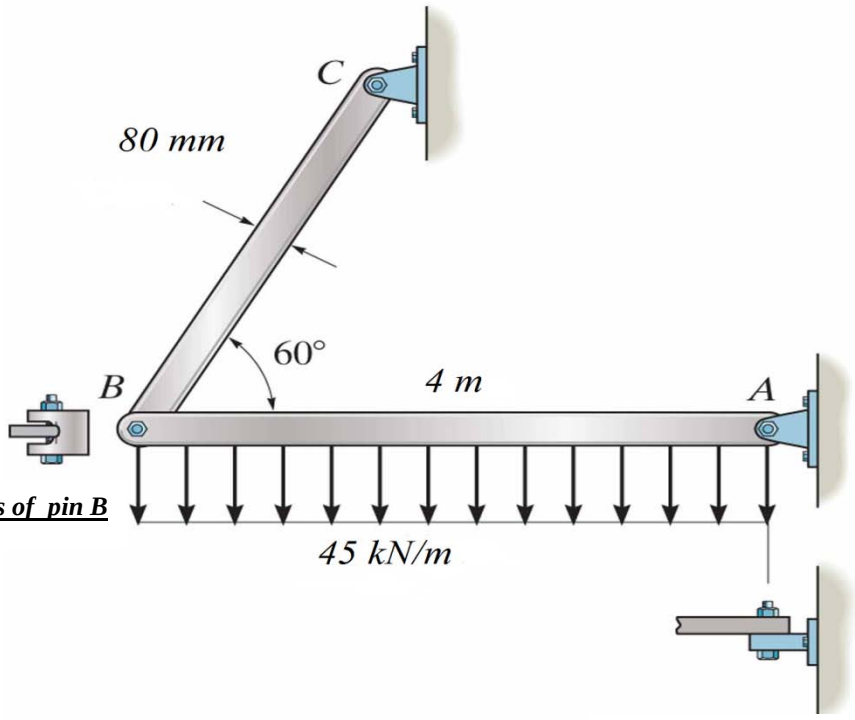


Problem # 1

The beam is supported by a pin at A and link BC. Determine:

a) the average shear stresses in the pins at A and B,
b) the average normal stress in link BC,
c) the bearing stress between pin C and the link.

All pins have a diameter of 20 mm.
Thickness of link BC = 20 mm



Details of pin B

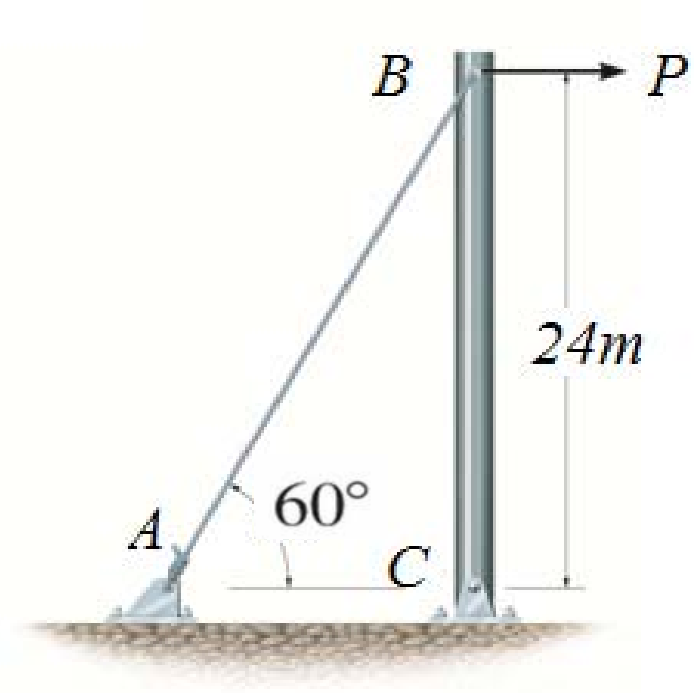
Details of pins A and C

Problem # 2

The rigid pipe is supported by a pin at C and a guy wire AB. The pin has a diameter of 20 mm while the guy wire has a diameter of 10 mm. If the allowable normal stress for the guy wire is $\sigma_{allow} = 255$ MPa and the allowable shear stress for the pin is $\tau_{allow} = 131$ MPa, determine:

a) the maximum P_{max} that can be applied to the assembly,
b) the stretch in length and reduction in diameter of the guy wire AB.

Use E = 68.9 GPa and ν = 0.35.



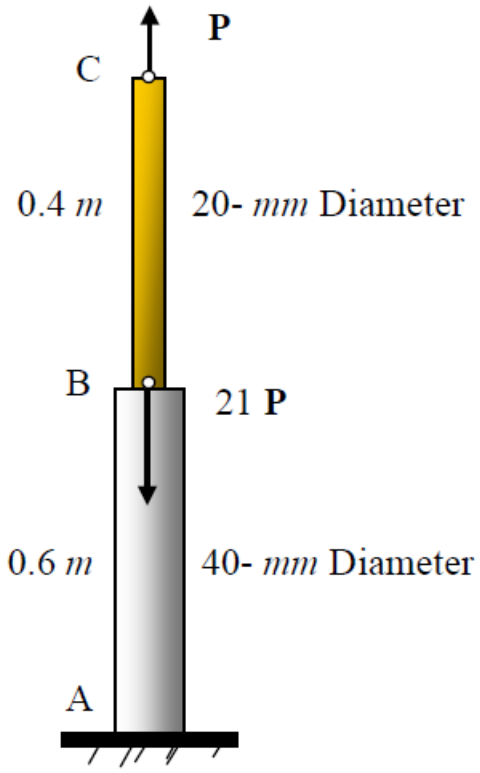
Detail of connection at C

Problem # 3

Rod ABC has a negligible mass and only supports two axial loads P and 21 P as shown. If *only* part BC is subjected to a temperature change $\Delta T = 40\ ^{o}C$, determine:

a. the required value of **P** if the length ABC should remain unchanged,
b. the displacement δ_B of point B,
c. the relative displacement $\delta_{B/C,}$
d. the final length L_{AB}.

Given E = 70 GPa and $\alpha = 24 \times 10^{-6} / {}^{o}C$.



Problem # 5

Block ***A*** rests on block ***B*** as shown. Each block is a cube with initial dimensions 200x200x200 *mm*. The 4 side-faces of block ***A*** are free to displace, while the 4 side-faces of block ***B*** are prevented from expanding (i.e. restrained in the ***x*** and ***y*** directions). Determine:

a) the vertical displacement of the force ***F***,
b) the stress $\boldsymbol{\sigma_x}$ for block ***A,*** and for Block ***B***,
c) the value of the Shear Modulus (***G***) for block ***A***.

Ignore self-weight and any friction.

***E* = 1 *GPa* , and *v* = 0.2**