Aalto University
School of Engineering (ENG)
Department of Civil Engineering Final Exam 10.12.2020

COE-C2001 - Foundations of Solid Mechanics

Please write in every paper: -the name and the number of the course
-the date of the examination
-your name and the student ID
-the name of the department

Note: (1) Closed-book exam. Feel free to use calculator.
(2) Remote exam, as an assignment at MyCourses.
(3) Examination time: 17:30-20:50. 3 hours for the exam, and 20mins reserved for submission.
(4) Questions during exam: you may ask through Zoom chat.
(5) If you cannot submit through MyCourses, please submit by email to rui.hao@aalto.fi and weiwei.lin@aalto.fi, before the deadline.
(6) Q1(15 marks), Q2(15 marks), Q3(20 marks), Q4(15 marks), Q5(15 marks), Q6(20 marks)

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1. For the given state of stress, as shown in **Fig. 1**, determine
   (a) the principal planes;
   (b) the principal stresses;
   (c) the maximum shearing stress and the corresponding normal stress.

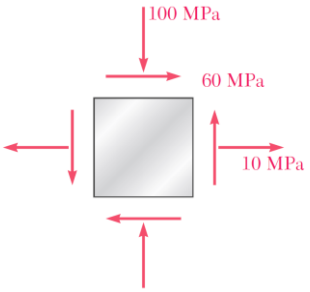

Fig. 1 for Q1

2. Shaft AB has a *d* diameter and shaft BC has a 2*d* diameter, and they are welded at section B and fixed at their ends A and C. Both are made of the same material with a shear modulus *G*. If they are subjected to a torques *T* at sections B as shown in **Fig. 2**, determine the absolute maximum shear stress in the shaft.

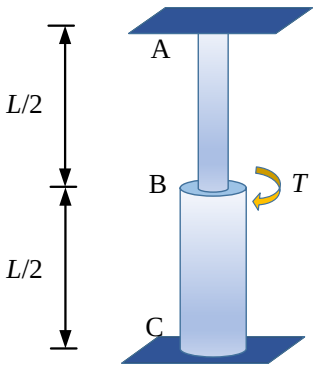

Fig. 2 for Q2

3. As shown in **Fig. 3**, if the bearing plates at A and B support only vertical forces, a uniform distributed loading w=6kN/m is applied to the beam, determine
   (a) the maximum and minimum normal stress;
   (b) the maximum shear stress.

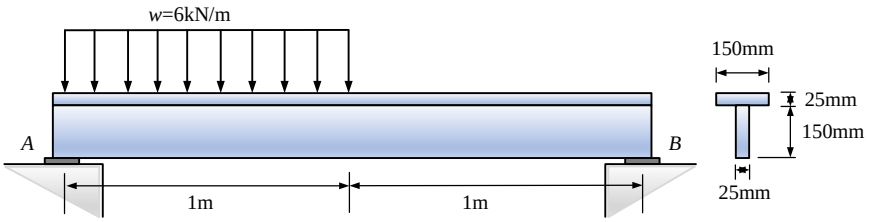

Fig. 3 for Q3

4. At room temperature (20℃), a gap δ exists between the ends of the two rods shown in **Fig. 4**. Later when the temperature has reached 120℃, determine the normal stress in the rod A when (a) δ =1mm; (b) δ =0.6mm.

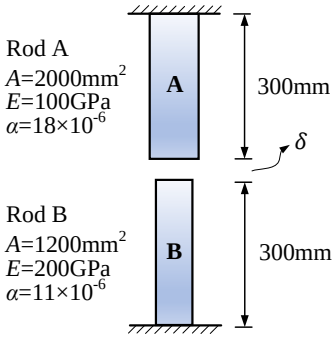

Fig. 4 for Q4

5. Determine the maximum load P that can be applied for possible buckling failure of member AB and tension failure of member BC. Use E=200 GPa for both members AB and BC, the cross section of two members are shown in **Fig.5**. The allowable tensile stress of member BC is 1800 MPa.

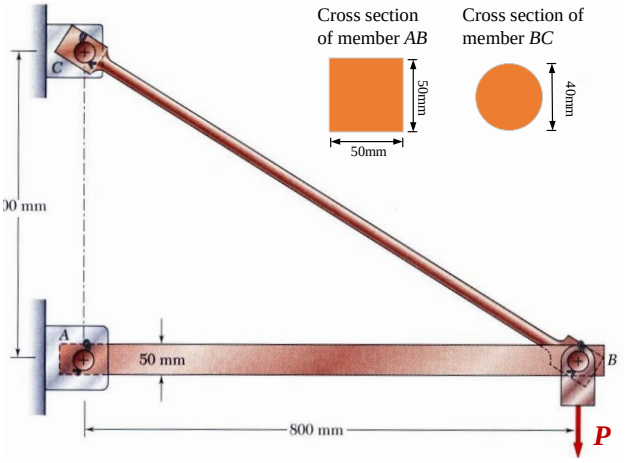

Fig. 5 for Q5

6. For the beam and loading shown in **Fig. 6**, determine the reaction at the roller support.

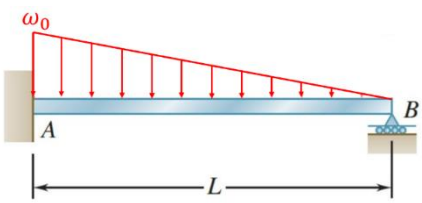

Fig. 6 for Q6