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B.Sc. Engg. (CEE)/ 4th Sem. 17th February, 2023 (Group B: Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester: Mid Semester Examination **Summer Semester: 2021-2022**
Course No.: CEE 4413 **Full Marks: 75**
Course Title: Mechanics of Solids II **Time: 1.5 hours**

There are **4 (Four)** Questions. **Question 1 is compulsory. Answer any 2 (Two) questions from remaining 3 (Three).** All questions carry equal marks. Programmable calculators are not allowed. Do not write on this questions paper. The symbols have their usual meaning. Assume reasonable values for any missing information.

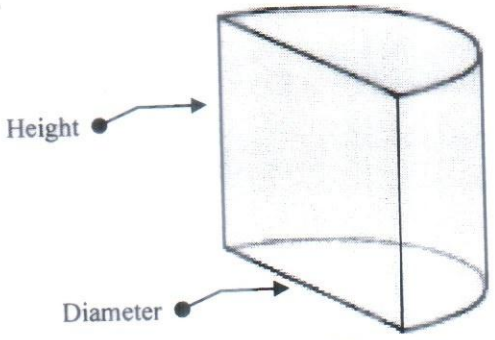
1(a) A steel compression rod is a 3m long tube with an outer diameter of 60 mm and a wall thickness of t = 5 mm, pin connected at both ends. Determine critical buckling load if it acts on the top of the rod. What will be the critical buckling load if both ends are welded to make it fixed? E = 210 GPa. **(10)** [CO3 PO2]

(b) A hollow steel industrial boiler has a half circular cross-section, diameter of 2 m, wall thickness of 10 mm, and height of 3 m (when unpressurized) as seen in Figure 1. For steel, E = 200 GPa, Yield Strength = 480 MPa, and Poisson's ratio ν = 0.30. **(15)** [CO3 PO2]

(a) If the contained pressure is 600 kPa, determine the change in length of the cylinder from its unpressurized (unloaded) state.

(b) For a factor of safety=3, check for yielding of the tank walls.

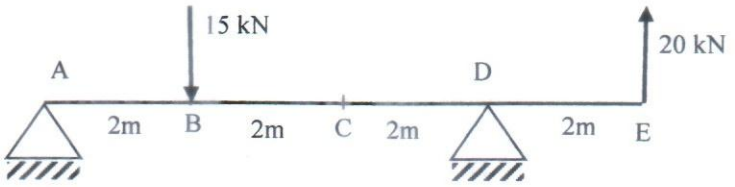
(c) If the flat rectangular side of the tank is connected to the rounded parts of the tank via 20 steel rivets of same strength around the perimeter, find the diameter of the rivets considering yielding of rivets only. Note: rivets do not require reduction of diameter (due to absence of threading).



(Figure 1)

2(a) Write down the shear and moment singularity functions for point 'x' on the beam if there is either: i) a concentrated load, ii) an uniformly distributed load, iii) a triangular load, on the beam which acts/starts at 'a' distance of the beam from the left support. **(5)** [CO1 PO1]

(b) An 8-meter beam has two loads acting on it as shown on Figure 2. Find deflection at point C. E = 200 kN/mm^2. I = 4000 × 10^4 mm^4. **(20)** [CO2 PO2]



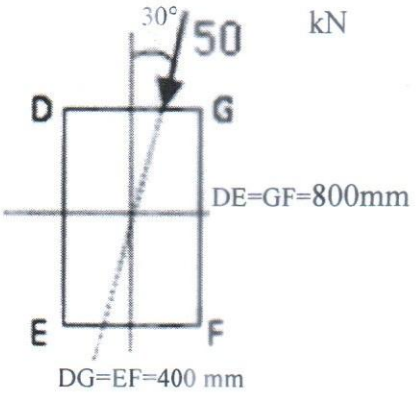
(Figure 2)

3(a) Prove for a gas-filled flat-top flat-bottom cylinder of uniform thickness, hoop stress is twice that of logitudinal stress. **(5)** [CO1 PO1]

(b) A 5-m long simply supported beam is supported at two ends and carries a trapizoidal load of 5 kN/m (at left end; lowest value) and 10 kN/m (at right end; maximum value). Find the maximum deflection *using direct integration method* as well as rotations at both ends. **(20)** [CO2 PO2]

4(a) Compare the Maximum Shear stress and Maximum Normal Stress Failure Theory using the concept of Mohr circle. Explain why failure envelope of a cohesionless material is usually linear. **(5)** [CO1 PO1]

(b) A uniformly distributed load of 50 kN works at an angle of 30° with the vertical axis of the beam as seen in Figure 3. The beam has 10m span which is fixed supported at one end while the other end is free. E=20000 MPa. Measure both horizontal and vertical deflections at the beam's mid-span. Use any method for finding deflection. **(20)** [CO2 PO2]



(Figure 3)