GOVERNMENT COLLEGE OF ENGINEERING, JALGAON

(An Autonomous Institute of Government of Maharashtra)

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Name of Examination : **Winter 2020** - (Preview)

Course Code & Course Name : **CE205U - Strength of Materials**

Generated At : **18-04-2022 16:37:24**

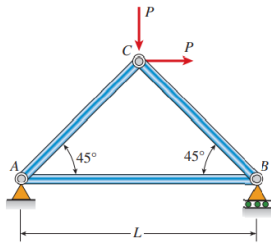Maximum Marks : **60**   Duration : **3 Hrs**

`Edit` `Print` `Close` **Answer Key Submission Type:** No marking scheme and solution
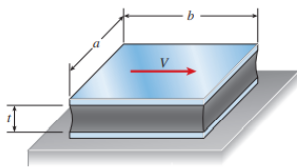
Instructions:

1. *All questions are compulsory.*
2. *Illustrate your answer with suitable figures/sketches wherever necessary.*
3. *Assume suitable additional data and assumptions wherever required.*
4. *Use of logarithmic table, drawing instruments and non programmable calculators is allowed.*
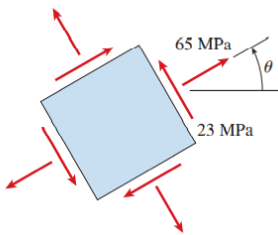5. *Figures to the right indicate full marks.*

1) a) The three-bar truss *ABC* shown in the figure has a span *L= 3m* and is constructed of steel pipes having cross-sectional area A= 3900 mm^2 and modulus of elasticity *E = 200*   [4]
GPa. Identical loads *P = 475 kN* both vertically and horizontally at joint *C* as shown in figure. Find the horizontal displacement of joint B.
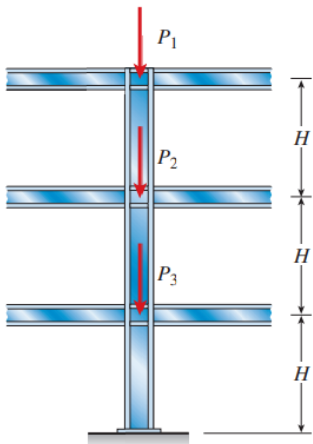

b) An elastomeric bearing pad is subjected to a shear force *V* during a static loading test. The pad has dimensions a = 150 mm and b = 225 mm, and thickness t = 55 mm. The   [4]
lateral displacement of the top plate with respect to the bottom plate is 14 mm when a force *V* equals 16 kN. What is the shear modulus of elasticity G of the elastomer ?
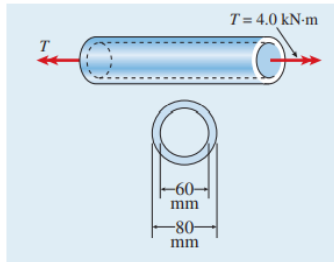

c) A prismatic bar is subjected to an axial force that produces a tensile stress σ_θ = 65 MPa and a shear stress τ_θ = 23 MPa on a certain inclined plane as shown in figure.   [4]
Determine the stresses acting on all faces of a stress element oriented at θ = 30^0 and show the stresses on a sketch of the element.

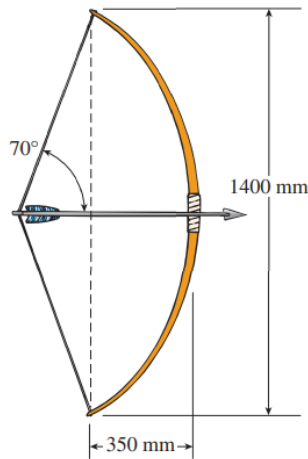d) A three-story steel column in a building supports a roof and floor loads as shown in the figure. The story height *H* is 3 m, the cross-sectional area A of the column is 7500   [4]
mm^2, and the modulus of elasticity E of the steel is 200 GPa. Calculate the strain energy U of the column assuming *P$_1$= 150 kN* and *P$_2$ =P$_3$ = 300 kN* .
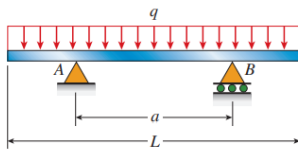
e) A circular tube with an outside diameter of 80 mm and inside diameter of 60 mm is subjected to torque *T= 4.0 kN-m* as shown in figure. The tube is made of aluminium   [4]
  alloy 7075-T6. Determine the maximum tensile and compressive strains produced in the tube and show these strains on sketches of the deformed elements.
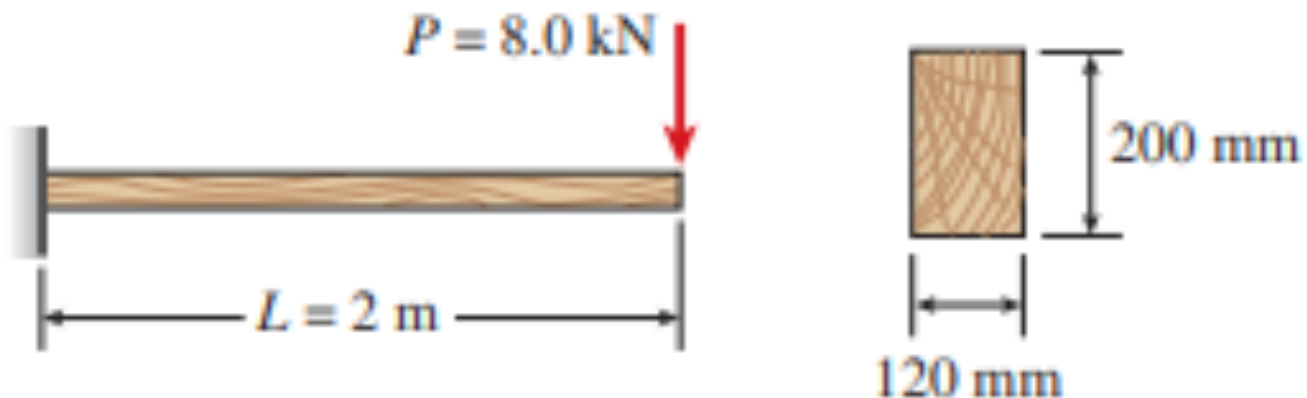

f) At full draw, an archer applies a pull of 130 N to the bowstring of the bow shown in the figure. Determine the bending moment at the midpoint of the bow.   [4]
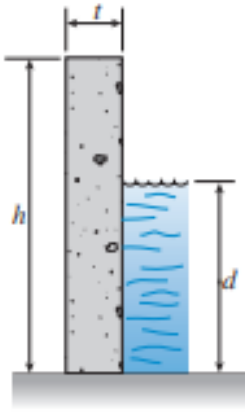

2) A beam of length L is being designed to support a uniform load of intensity *q* (see figure). If the supports of the beam are placed at the ends, creating a simple beam, the   [8]
maximum bending moment in the beam is $qL^2/8$. However, if the supports of the beam are moved symmetrically toward the middle of the beam, the maximum bending
moment is reduced. Determine the distance "*a*" between the supports so that the maximum bending moment in the beam has the smallest possible numerical value.
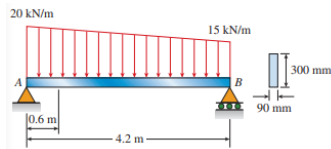Draw the shear-force and bending-moment diagrams for this condition.

3) A cantilever beam of length *L = 2m* supports a load *P= 8.0 kN* (see figure). The beam is made of wood with cross-sectional dimensions120 mm x 200 mm. Calculate the   [8]
shear stresses due to the load P at points located 25 mm, 50 mm, 75 mm, and 100 mm from the top surface of the beam. From these results, plot a graph showing the
distribution of shear stresses from top to bottom of the beam.

4) A plain concrete wall (i.e. a wall with no steel reinforcement) rests on a secure foundation and serves as a small dam on a creek (see figure). The height of the wall is $h = 2$ m and the thickness of the wall is $t = 0.3$ m. Determine the maximum tensile and compressive stresses σ_t and σ_c, respectively, at the base of the wall when the water level reaches the top ($d = h$). Assume plain concrete has weight density $\gamma_c = 23$ kN/m^3. [8]

5) A simple beam with a rectangular cross-section (width ,90 mm ; height, 300 mm) carries a trapezoidally distributed load of 20 kN/m at A and 15 kN/m at B on a span of 4.2 m (see figure) . Find the principal stresses σ_1 and σ_2 and the maximum shear stress τ_{max} at cross section *0.6 m* from the *left-hand support* at *50 mm* above the neutral axis. [12]

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