THE OPEN UNIVERSITY OF SRI LANKA
Department of Civil Engineering
Diploma in Technology (Civil) - Level 3
CEX 3234 - Strength of Materials

00147

FINAL EXAMINATION - 2009

Time Allowed : Three (03) hours.

Date : 2010 - 03 - 08 (Monday) Time : 0930 - 1230 hrs.

The paper consists of Seven *(07)* questions. Answer question Q1and four (04) other questions.

Q1.

(a)

(i) The Young's modulus for steel, E = 210 GN/m² and Poisson's ratio is 0.3. The steel is subjected to a shear stress of 24 MN/m². Calculate the shear strain in the material.

(ii) A solid circular column of diameter 250 mm, is subjected to an axial thrust. If shortening of column and increase in diameter are limited to 2.5 mm and 0.05mm respectively, determine the allowable thrust. Take, $E = 2x10^5$ N/mm² and $\upsilon = 0.3$.

(b)

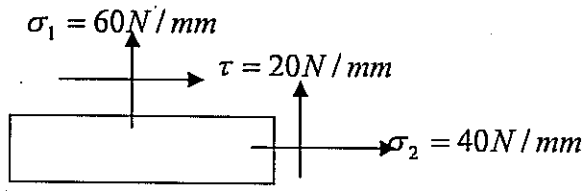
(i) Write down the simple torsion formula applied to shafts having circular cross sections, using standard notation.

(ii) What are the factors affecting fatigue failure?

(c)

(i) State the assumptions made in the theory of simple bending.

(ii) Sketch the Mohr's circle for the stress system given below. Hence determine the principle stress and the maximum shear stress.



(d) Write short notes on,

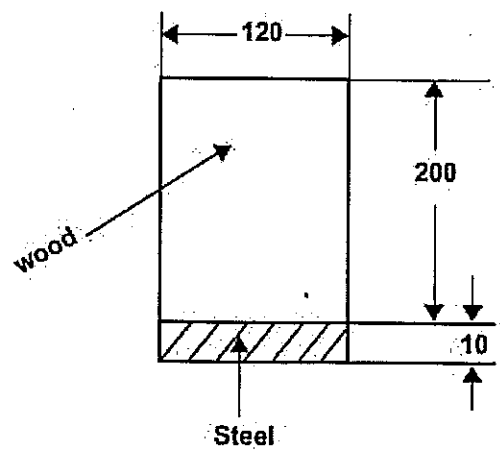
(i) creep

(ii) stress concentration factor.

(30 marks)

Q2.

The composite beam shown in figure is made up of two materials. A top wooden portion and a bottom steel portion. The dimensions are as shown in the figure. Take young's modulus of steel as 210 GPa and that wood as 15 GPa. The beam is subjected to a bending moment of 40 kNm about the horizontal axis. Calculate the maximum stress experienced by two sections.

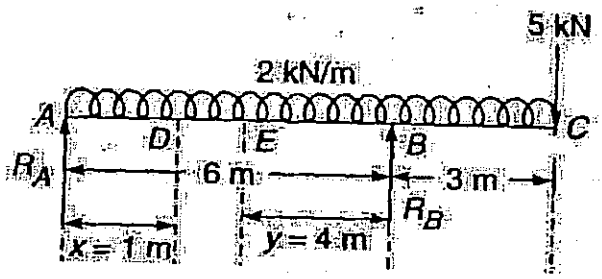


All dimensions in mm

(17.5 marks)

Q3.

Draw the bending moment and shear force diagrams for the overhanging beam carrying loads as sh the figure below. Mark the values of principal ordinates and locate the point of contraflexure.

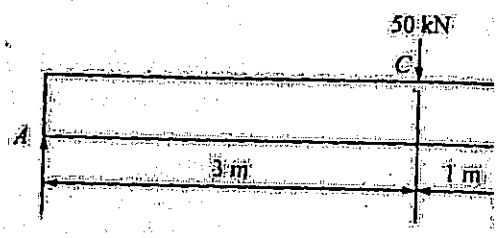


(17.5 r

Q4.

(a) State Castigliano's theorem.

(b) Using Castigliano's theorem, obtain the deflection under a single concentrated load applied to a simply supported beam shown in the figure. Consider EI = $2MN/m^2$.



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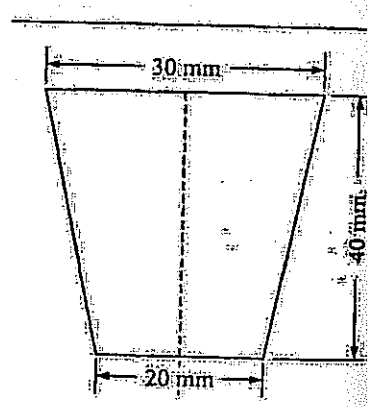
Q5.

(a) Explain what is "statically indeterminate structure"

(b) A curved beam trapezoidal in cross-section as shown in the figure is subjected to pure bending with couple of 400 Nm. The mean radius of curvature is 50 mm. Find the position of the neutral axis and the ratio of the maximum stress.



(17.5 ma

Q6.

(a) Explain what is "Poisson's ratio".

(b) A cylindrical shell 900 mm long, 150 mm internal diameter, having thickness of metal as 8 is filled with a fluid at atmospheric pressure. If an additional $2x10^4$ m^3 of fluid is pumpec the cylinder, find,

(i) pressure exerted by the fluid on the cylinder

(ii) Hoop stress induced. (Take E = 200 GPa and Poisson's ratio, υ =0.3)

(17.5 ma

Q7.

(a) Define

(i) Slenderness ratio

(ii) Bucking load

(b) For a column with both ends pinned, Buckling load is given by, $P = \frac{\pi^2 EI}{L^2}$. Explain te E, I and L in the equation.

(c) A hollow alloy tube 5m long with external and internal diameters 40 mm and 25 respectively was found to extend 6.4 mm under a tensile load of 60kN. Find the bucking for the tube when used as a column with both ends pinned. Also find the safe load for the taking a factor of safety as 4.

(17.5 mar