

21.12.06

B.E. (Civil) 7th Semester Examination, 2007

Theory of Structures III
(CE - 701)

Full Marks - 100

Time Allowed - 3 hrs.

Answer **six** questions, taking **three** from each half.

Two marks in each half are reserved for neatness and to the point answer.

FIRST HALF

1. a) Briefly explain the meaning of the terms (i) Damping Ratio (ii) Logarithmic Decrement

b) A free vibration test on an elevated tank is made by applying a lateral horizontal force of 20 kips and pulling the tank by 2.2 in. The cable is suddenly cut and at the end of five complete cycles of vibration, the time noted is 2.4 sec and the amplitude of displacement is 1 in. Compute the following: (i) damping ratio, (ii) stiffness of the system, (iii) weight of the tank and (iv) damping coefficient.

2. a) What is resonance?

b) Two simply supported beams are used to support a machine which weighs 5500 lbs. The rotating part of the machine is 16 lbs and is located at a distance of 6 in from the centre of rotation.

Span of beams = 22 ft

I_{xx} of each joist = 2096 in⁴

Z_{xx} = 175 in³

Wt. of each joist = 76 lb/ft

Check the stresses in the beam at resonance. Assume the dynamic magnification factor to be 20 at resonance, and take one half of the mass of the beam as equivalent mass at the mid-span.

3. a) State the assumptions of shear building.

b) Two-storied building frames, as shown in Fig. Q-3, are spaced 16 ft apart. Find the mode shapes and modal frequencies and time periods.

Given: $E = 30 \times 10^6$ psi

$I = 106.3$ in⁴ per column

Wt. on each floor = 75 lbs/ft²

Wt. of wall = 20 lbs per ft²

Use shear building assumptions.

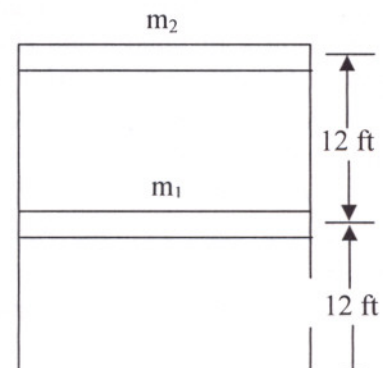


Fig. Q-3

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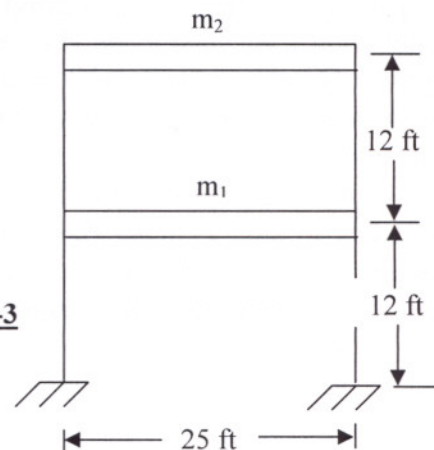
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Fig. Q-3



4. a) Write down the assumptions in small deflection theory of thin plates.

b) Taking
$$M_x = -D \left(\frac{\partial^2 \omega}{\partial x^2} + \nu \frac{\partial^2 \omega}{\partial y^2} \right)$$

$$M_y = -D \left(\frac{\partial^2 \omega}{\partial y^2} + \nu \frac{\partial^2 \omega}{\partial x^2} \right)$$

$$M_{xy} = -D(1-\nu) \frac{\partial^2 \omega}{\partial x \partial y} = M_{yx}$$

derive the differential equation of equilibrium of plate in terms of displacement ω and applied loading $q(x, y)$ per unit area.

5. A spherical dome of radius a , as in Fig. Q-5, is acted upon by its own weight q per unit area. Derive the expressions for meridional force N_ϕ and hoop force N_θ . Are these tensile or compressive? What is the function of the supporting ring at the base?

Take $\alpha = 30^\circ$

$a = 6m$

$q = 2 \text{ KN/m}^2$

Find the values of N_ϕ and N_θ at the crown and at the base.

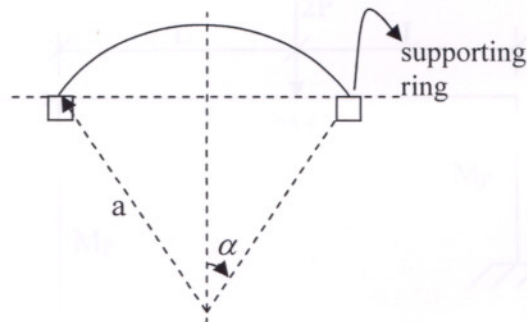


Fig. Q-5

SECOND HALF

6. Five members OA, OB, OC, OD and OE, all lying in a vertical plane, are pin connected at the common joint O, their remote ends are hinged to a horizontal ceiling. The member BO is vertical having a length of 3m. The member OA lying on the left side of OB is inclined to the horizontal at an angle of 45° . The other three members OC, OD and OE lie on the right side of the vertical member OB and are inclined to the horizontal at angles of 60° , 45° and 30° respectively. The extensional rigidity of all the members are 300000 KN each. A load of 300 KN acts as O at an angle of 45° with the vertical, the inclination being towards right. Analyse the truss by stiffness method and find forces in all the members and the displacement of the joint O.

7. A 3-span continuous beam ABCD has support 'A' fixed, 'B', 'C' continuous over simple supports and 'D' fixed. The span AB = 6m, span BC = 8m and span CD = 5m. The beam has uniform flexural rigidity $EI = 9000 \text{ KNm}^2$. If the vertical settlement of the supports 'B' and 'C' are 20mm and 25mm respectively, find the moments at the support and draw the bending moment diagram.
8. A right angle corner frame ABCD with horizontal beam AB of length 4.0m, horizontal beam BC, which is perpendicular to AB, of span 5m and a vertical column BD of length 3m has its supports 'A', 'C' and 'D' fixed. It is subjected to uniformly distributed vertical load of 100 KN/m over the entire span of AB and BC. Take $E = 25000 \text{ N/mm}^2$ and $\mu = 0.15$, cross section of all the members as square of 500 mm and $J = 0.14d^4$, where 'd' is the size of the square cross section. Analyze the frame and draw the bending moment and torsional moment diagrams.
9. Explain Plastic hinge. Find the shape factor of a T - beam made up of 120mm X 20mm flange and 180mm X 20mm web. Also obtain the value of the plastic section modulus for the given section.
10. For the portal frame shown in Fig. Q-10, find the collapse load in terms of M_p and L .

