Z 6405

M.E. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Elective

Structural Engineering

ST 1633 — STABILITY OF STRUCTURES

(Regulation 2005)

Time : Three hours

Maximum : 100 marks

Stability functions Chart/Table is permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why stability of structures problem is called as an eigen value problem?

2. Write down the differential equation for a column on elastic foundation.

3. What do you mean by imperfections in columns?

4. What is the difference between double modulus theory and tangent modulus theory?

5. Draw the load-deflection curve of Stanley's model.

6. State the conservation of energy principle.

7. What are the assumptions (main) involved in buckling of thin plates?

8. How will you obtain the stress-stiffness matrix of a column element?

9. Differentiate between flexural buckling and torsional buckling.

10. Draw the buckling mode shapes of rigid portal frames with and without sway.

PART B — (5 × 16 = 80 marks)

11. (a) Determine the limiting values for the symmetric and sidesway buckling loads of the frame shown in Fig. 1. The moment of inertia for the beams and columns are equal. (16)

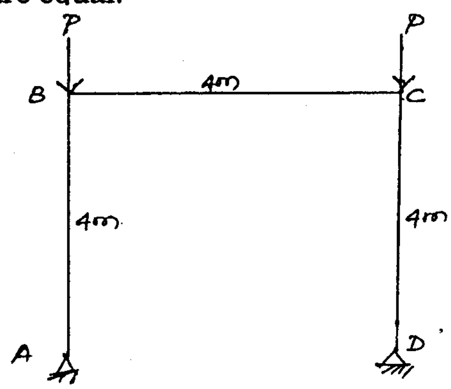

Fig. 1

Or

(b) Determine the maximum deflection and maximum moment of a beam-column shown in Fig. 2. Assume EI to be constant. (16)

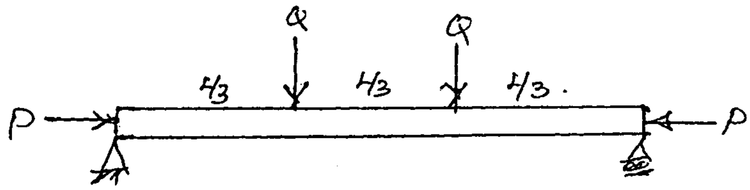

Fig. 2

12. (a) (i) Derive the fourth order differential equation for buckling of columns, stating clearly the assumptions made. (6)

(ii) Hence obtain the critical load of a column whose one end is fixed and the other free. (8)

(iii) What do you understand by equivalent length of an axial member? (2)

Or

(b) (i) Briefly explain southwel plot and mode reversal. (6)

(ii) A bar pinned at both ends is initially curved so that its axis has the shape as (10)

$$v_0 = a, \sin\frac{\pi x}{L}$$

If the bar is axially compressed with a force P at one end, show that the deflected shape is

$$v = \frac{1}{\left(1 - \frac{p}{p_{cr}}\right)} a, \sin\frac{\pi x}{L} \quad \text{where } p_{cr} = \frac{\pi^2 EI}{L^2}.$$

Determine the critical load of the column shown in Fig. 3 by energy method. (16)

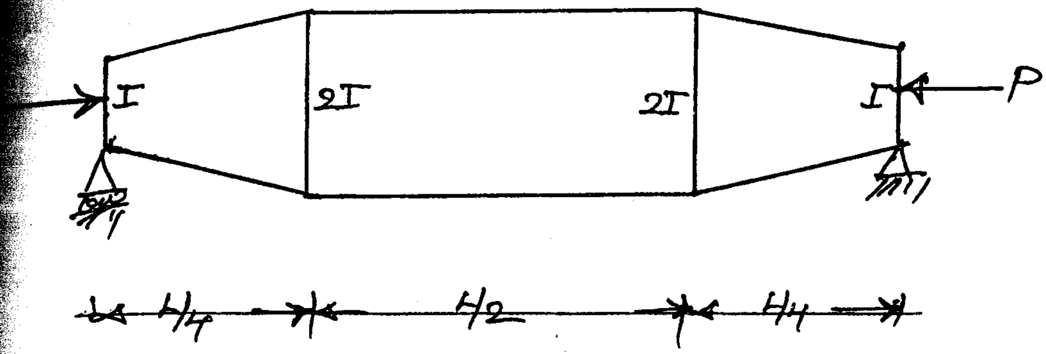

Fig. 3

Or

(b) Solve the above problem by any numerical technique. (16)

(a) A rectangular plate of size $(a \times 2a)$ is simply supported at all the edges. It is subjected to in-plane line load Nx/m. along the shorter direction. Find the critical value of Nx. (16)

Or

(b) A square plate is simply supported at all edges and subjected to compressive load along X and Y directions. Determine the critical compressive load using finite difference method. (16)

(a) (i) Determine the critical value of end moment M acting in the plane of the web of a narrow rectangular simply supported beam of span L. (8)

(ii) Deduce the value of the critical value of u.d.l. spread over the entire length of beam q kN/m at which the beam will buckle from the result already derived. (8)

Or

(b) Write short notes on the following : (4 × 4)

(i) St. Venant's torsion and warping torsion.

(ii) Flexural-torsional Buckling.

(iii) Large deflection theory.

(iv) Post Buckling behaviour.

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