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Total No. of Pages : 03

Total No. of Questions : 09

B.Tech.(Aerospace Engg.) (EL-2012 Onwards) (Sem.–7,8)

THEORY OF PLATES SHELLS

Subject Code : ASPE-409

M.Code : 72572

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION–A

1. Write briefly :

a) Write down the differential equation of rectangular plate for combined lateral and in-plane loading.

b) Write down the differential equations for buckling of cylindrical shell under combined internal pressure and uniform axial load.

c) Classification of various types of shell with neat sketches.

d) Curved and shallow shells with coordinate system.

e) Briefly describe the structural behavior of thin shell in the context of bending and buckling strength.

f) Give the physical explanation of the assumption $\sigma_z = \sigma_3 = 0$ adopted in the general linear theory of thin shells. Compare the order of the direct stresses σ_1 and σ_2 and σ_3.

g) Flexural rigidity of shell.

h) Derive the relations between bending moment and curvature for pure bending of plates.

i) Classification of plates with context of transverse shear and normal effects.

j) Distinguish between Synclastic and Anticlastic surfaces with example.

SECTION–B

2. For a simply supported square isotropic plate of side 2.5 *cm*, under UDL and SSL of $10 KN/mm^2$. Find the maximum deflection taking $v = 0.3$, $E = 200\ KN/mm^2$, thickness of plate h= 80mm. Adopt the Navier solution, take only the first term of the series.

3. A simply supported square plate is under the action of a lateral load P at its center C and a uniform in-plane tension N_x. Derive the equation of the deflection surface, using energy method and by retaining the first term of the series solution.

4. A thin-walled cylinder is used to support a reactor of weight W. Find the maximum value of w that can be applied to the cylinder without causing it to buckle. Take $L = 10 ft$, R = 2 *ft*, E = 29000 *ksi*, $h = 0.2$ *in*, $v = 0.25$ and the factor of safety (FS) is 2.5.

5. A horizontal, circular cylinder with rigidity built-in cylinder ends of radius a, thickness t, and length L carries its own weight p. Derive the following expressions for the membrane stresses :

$$\sigma_\theta = -\frac{pa}{t}\cos\theta; \tau_{x\theta} = -\frac{2px}{t}\sin\theta; \sigma_x = -\frac{p}{t}\left(\frac{x^2}{a} - \frac{L^2}{12a} - va\right)\cos\theta$$

6. A rectangular plate has two opposite edges $y = 0$ and $y = b$ simply supported, the third edges $x = 0$ clamped, and fourth edge $x = a$ free subjected to UDL of magnitude p_0 as shown below :

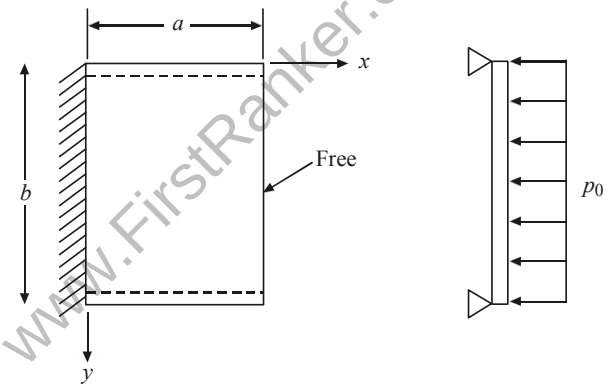

Fig.1

An approximate expression for the deflection surface is

$$w = c\left(\frac{x}{a}\right)^2 \sin\frac{\pi y}{b}$$

where c is a constant. Determine : a) whether this deflection satisfy the boundary condition of the plate; b) the approximate maximum plate strain component at the center, for square plate $a = b$ and $v = 1/3$.

SECTION–C

7. Derive the differential equation for cylindrical bending of plate from fundamental.

8. Determine the critical value of the in-plane compressive forces q_x acting on the plate reinforced by two equally spaced stiffner, as shown below :

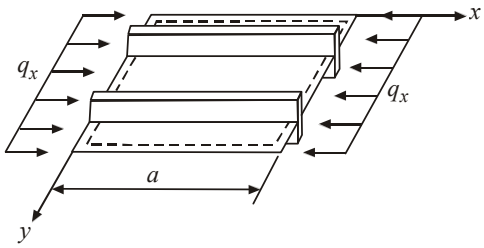

Fig.2

The plate is simply supported on all edges. Let A_i and B_i ($B_i = EI_i$) be the area of the cross section and the bending stiffness of a stiffner, and c_i be the spacing of the stiffeners. Use energy approach.

9. Let a rectangular, simply supported plate of sides a and b be loaded by uniformly distributed compressive q_x and compressive q_y forces. The q_x forces are applied parallel to the side a and q_y forces act in the direction parallel to the side b. Find the nontrivial solution of equation.

$$\frac{\partial^4 w}{\partial x^4}+2\frac{\partial^4 w}{\partial x^2 \partial y^2}+\frac{\partial^4 w}{\partial y^4}+\frac{1}{D}\left(q_x\frac{\partial^2 w}{\partial x^2}+q_y\frac{\partial^2 w}{\partial x^2}\right)=0$$

for this loading and calculate the critical value of the parameter λ if $q_y = \lambda q_x$ and $a = b$. Compare this result with the case when the above plate is equally compressed in two directions $q_y = q_x$.

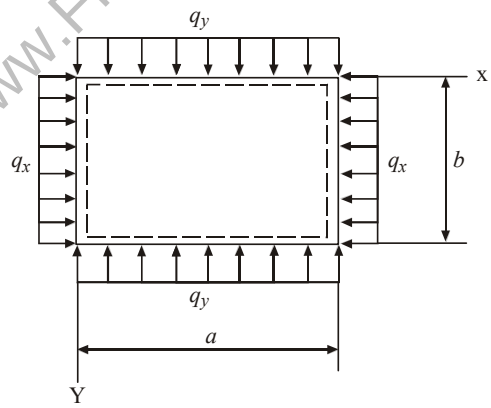

Fig.3

NOTE : Disclosure of identity by writing mobile number or making passing request on any page of Answer sheet will lead to UMC case against the Student.