Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – III • EXAMINATION – WINTER 2012

Subject code: 731504 Date: 26-12-2013

Subject Name: Plates and Shells

Time: 10.30 am – 01.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** For simply supported rectangular plates, subjected to uniform pressure, deduce expression for deflection at centre. **07**

(b) Calculate M_n, M_{nt} and M_t for plate (a x b) subjected to M_x = 300 kN-m/mt width, M_y = 180 kN-m/mt width and M_{xy} = 125kN-m. Calculate also M_n(max) with their inclination w.r.t to one of the axis. **07**

Q.2 **(a)** Find the maximum deflection in a circular plate subjected to a concentrated load 'P' at the centre. The plate is fixed all around the edges. Take radius = 2.5 m, t = 60 mm, $\nu = 0.3$, E = 208 GPa. P = 30 kN. **07**

(b) The equation of the deflected middle surface of the circular plate of radius a is given by the following equation: **07**

$w = C [(5 + \nu) a^4 - 2 (3 + \nu) a^2 r^2 + (1 + \nu) r^4]$

How is the plate supported and what is the nature of the loading?

OR

(b) Show that for a flat circular steel plate subjected to a uniform pressure on one surface, the maximum stress when periphery is simply supported is 1.65 times that when the periphery is clamped. Take poisson's ratio,$\nu = 0.3$. **07**

Q.3 **(a)** Show that **04**

$M_n + M_t = M_x + M_y$

And $1/r_n + 1/r_t = 1/r_x + 1/r_y$

(b) Derive and draw deflected shape for plate under pure bending for given cases: **10**

(i) $M_x = +2M$, $M_y = +2M$, size of plate = 2a x a

(ii) $M_x = +M$, $M_y = -2M$, size of plate = a x a

OR

Q.3 **(a)** Using finite difference method, determine the maximum deflection of a rectangular plate (a x 2a) fixed all along its edges and subjected to a uniformly distributed loading 'q'. Take mesh size,h = a/2. Compare the result if plate edges are all simply supported. **07**

(b) Derive an equation of w-expression of a rectangular plate (a x b) derived from Navier solution for following cases subjected to uniformly distributed load: **07**

(i) Plate without resting on soil

(ii) Plate with resting on soil

Having foundation modulus 'k'.

Write the equations for concentrated load.

Q.4 **(a)** Find N_θ and N_Φ for conical dome due to self weight and live load uniformly distributed. **07**

(b) A spherical roof dome is subjected to its own weight and a live load of 1 kN/m^2. Determine the required cross-sectional area of the thrust ring. Take R = 30m; $\varphi 1 = 50°$ and h_s = 12 cm (thickness of the dome). Assume that the dome **07**

and the thrust ring are constructed of concrete with $\nu = 0.15$.

OR

Q.4 (a) Derive equations of equilibrium for general bending theory of uniformly loaded cylindrical shell. Mark important internal stress resultants. **07**

Q.4 (b) Determine the deflection of a rectangular plate simply supported on two opposite edges y = 0 and y = b, clamped on edge x = 0, and free on the edge x = a, as shown in Fig. 1. The plate is subjected to a uniform load of intensity p_0. **07**

Q.5 (a) Give the classification of shell based on shell curvature with neat sketches. **07**

(b) A simply supported at (x = 0 and x = L) semicircular cylindrical shell is subjected to a snow load 'q' which is uniformly distributed over its plan area. Given the radius of the shell is 'a', thickness is 'h', modulus of elasticity and Poisson's ratio are E and ν respectively, determine the membrane stresses in the shell. **07**

OR

Q.5 The four different dome configurations of the same height, H = 0.5a, are shown in Fig.2. The first dome is spherical with $R_0 = R = 1.25a$; the second dome is parabolic with $R_0 = a$; the third dome has the form of a semi-ellipsoid with $R_0 = 2a$ and $\gamma = 3$; and the fourth dome represents a segment of ellipsoid (the tangents of the dome meridian at its edges are not vertical) with $R_0 = 1.625a$ and $\gamma = 1.5$. All the four domes cover the same areas (of radius a) and they are made of concrete. (a) Find the meridional and circumferential forces distribution over the height of the above domes under their self-weight 'p' in terms of 'a' and 'p'. (b) Determine the cross-sectional area of the thrust ring for all domes if the ring is assumed to be also made of the reinforced concrete. Take the thickness of the shell h = a/50 and $\nu_c = 0.15$. (c) Analyze and compare the states of stress of the four domes and on this basis select a more appropriate configuration of the dome. Justify your decision. **14**

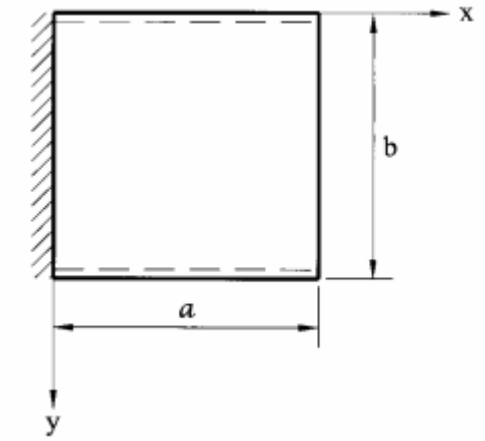

Fig.1 (Q-4B)

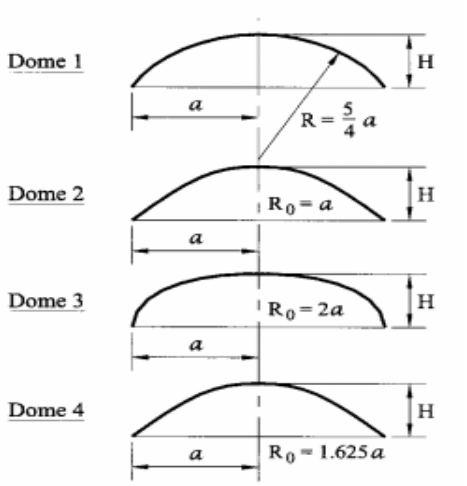

Fig. 2 (Q-5)

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