P R E F A C E

This thesis consists of five chapters of which the first four chapters are devoted to some linear and non-linear problems of thin elastic plates and shells whereas the last one deals with the vibration of thick shells. In plate problems particularly the normal deflections which are vitally important to expose the behavior of the plates subjected to different types of loading and boundary conditions are presented. In almost all the shell problems the stresses as well as the displacements are obtained in detail.

The first chapter contains one paper on rectangular plates all the edges of which are built-in. In this paper the deflection of a clamped rectangular plate under parabolically varying load in one direction is obtained. The results for uniform loads which are due to Morley, (1963) [21] may be deduced easily as a particular case.

The second chapter contains three large deflection problems. It may be noted that in solving the large deflection plate problems one has to encounter the non-linear differential equations which can not be exactly solved. However, the relevant differential equations may be obtained as a fourth order differential equation coupled with a non-linear second order equation when the same is deduced from the total strain energy of the system in which the strain energy due to second strain invariant is neglected. This method has been adopted first by Berger (1955) [7] who has successfully solved the equations for circular and rectangular plates under uniform load, boundary being clamped or supported for circular plates and supported for rectangular plates. Though no justification has yet been given for such type of approximation, the results obtained in this process tally with those wherever available from more exact theories or from experiments. This approximate method has been extended to the various problems of plates and shells by many authors. An application of this technique to the case of orthotropic plates has been given by Iwinski and Nowinski (1957) [16]. Next Nash and Modeer (1960) [22] have applied the method to the problems of large amplitude free flexural vibrations of plates, equilibrium of shallow spherical shells, finite deflections and to buckling of shallow spherical shells with a consideration of finite deflections. The large deflection plate problems in presence of heating has been developed by Basuli (1968) [6]. The first paper of this chapter considers the axisymmetric large deflection of a thermo-elastic circular plate subjected to lateral load and heating. The load function is any function of the radius of the plate and the temperature varies in the directions of the thickness and the radius of the plate. The normal displacements of the plate under different boundary conditions are obtained in simple forms. The second paper of this chapter is devoted to a more complicated problem which deals with the large deflection of a thermo-elastic circular annular plate in which the thickness of the plate varies as any power of the distance from the centre. The last paper of this chapter deals with the large deflection of a shallow spherical shell loaded by variable normal pressure on the concave face. The finite axisymmetric deflections of the thin shell with the clamped edge are obtained. The results obtained by Nash and Modeer (1960) [22] for uniform load are also deduced as a particular case.

The third chapter consists of one paper on buckling of a heated circular plate of variable thickness. The buckling and the curling of heated plates of uniform thickness have been discussed by Mansfield (1962) [19], Klosner and Forray (1958) [17], also by Boley and Weiner (1962) [8] for different boundary conditions. The buckling of a heated circular annular plate, the thickness of which varies linearly or inversely as the distance from the centre in presence of uniform compression in the plane of the plate has been discussed. The critical buckling temperature and the critical value of the compression are obtained for a clamped plate under a particular temperature distribution.

The chapter four is entirely on shells. One should take note of the fact that during the last twenty years a large number of valuable and profound ideas in the theory of shells have been developed by the intellectuals throughout the world. Credits must go to them who can combine light weight with high strength in their constructions. Through proper design and careful analysis one can achieve this dual effect in shell constructions, which, as a result of fact, have wide application in naval, aeronautical and boiler engineering. The reinforced concrete roof design is wholly based on this theory. Economy and architectural showmanship play important roles in building construction. To serve these practical purposes we must have thorough knowledge of different shells.

The first paper of this chapter is devoted to calculate the membrane stresses and displacements in non-circular cylindrical shells with the directrices as cardioide and lemniscate under different types of loads in the case of symmetrical deformation of the shells. A comparative study has also been made for the various stresses of these shells and a circular shell of same span. The second paper of this chapter is also concerned with the membrane stresses and displacements on shells in the form of surfaces of revolution, loaded symmetrically with respect to their respective axes where the meridian curves are cardioide, lemniscate and equiangular spiral. A table has been furnished for comparison of stresses in different types of shells covering the same horizontal area. The last paper of this chapter is written on the bending of thin shells of revolution of variable thickness. Here the Love-Meissner's equations for the bending of thin shells have been solved approximately for all shells of revolution in general, assuming that the wall thickness decreases exponentially from the edge. The method of obtaining the solutions of a specific problem with prescribed surface loads and boundary conditions has been discussed from the standpoint of superposition. Numerical results are given for a clamped spherical shell subjected to different types of axisymmetrical loads. The same problem for other types of variations in wall thickness has been discussed by spotts (1939) [29], Rygol (1960) [25] and Basuli (1963) [5].

The concluding chapter of this thesis i.e. the fifth chapter contains only one paper on time-hardening and time-softening thick elastic shells. The Young's modulus is assumed to be a function of time of the asymptotic type — a very recent idea in elasticity introduced by Paria (1966) [24]. The transient displacements and stresses in thick elastic cylinders and spheres of time-hardening and time-softening elastic material in which the elastic modulus varies with time have been obtained when the surfaces are subjected to dynamic loads internally as well as externally for the following problems —

(A) pure radial motion of an infinitely long circular cylindrical shell,

(B) radially symmetric motion of a spherical shell.

A new Finite Hankel Transform which is due to Cinelli (1965) [9] has been applied to solve the problem in the above mentioned paper.