PREFACE

The present thesis deals mainly with some problems of practical interest in the field of structural, mechanical and aerospace engineering. The topic covers a wide area in theoretical conception which is beyond the expectation of one's objective to investigate into every aspect of the topic. Hence, the present author restricts himself mainly to some problems related to static and dynamic behaviour of structures, to be more precise, plate and shell structures are considered for illustrative examples.

Moreover, there is a vast wealth of papers considered for static problems in the existing literatures and hence a main thrust has been aimed at the investigation of dynamic response of plates and shells so far as possible.

Considering the importance of vibrational characteristics of structures with non-homogeneous materialistic properties with constant and variable thickness, attempts have also been made to investigate into some of such problems under a mechanical or a thermal load besides considering free vibrations in some cases. As regards the approaches

to the non-linear static or dynamic analysis, the present thesis is confined to a couple of selective approaches for a better representation of the comparative study. The results of the present investigations have always been compared to known available results so far as possible. Illustrations of the present studies have been considered to cover those problems which are either new investigations or treated with new approaches to previously investigated problems.

The first chapter concerns with the comprehensive study of the early researches in the area under investigation and with an introduction of the basic need of such problems arising out of the future demand of the tweentyfirst century. A review of the early investigations is cited chronologically so far as possible.

The second chapter mainly contains the basic theories of the boundary value problems with reference to the present context. It also includes a couple of additional existing theories which have been developed during the last couple of decades. These theories constitute the main frame of operations for the present investigations under consideration.

Some important methods for solving linear and non-linear problems have been discussed with their merits and demerits.

The third chapter is devoted to the derivation of governing differential equations related to different structures and to different system of coordinates under various boundary conditions, examples of which will be discussed in details in the following chapters.

The fourth chapter contains four different problems which involve both simplified and original basic theories.

The first problem aims at finding the static and dynamic behaviour of rectangular and square plates of variable thickness using von Karman field equations extended to a dynamic case, while the second aims at analyzing the static behaviour of non-homogeneous elastic-plastic plates using the concept of iso-deflection contour lines.

The third problem deals with some points on Berger's approach and on modified Berger's approach with their applications. The main feature of this problem is to make a comparative study of the referred approaches with suitable illustrations.

The fourth problem deals with non-linear damped oscillations of elastic-

plastic shallow shells using the idea of constant deflection contour lines in conjunction with Ilyushin's theory of small plastic deformation (1948).

Problems on structures on an elastic foundation are of much importance to structural engineering. The fifth chapter deals with such a problem, in which large deflection of thin elastic plates of arbitrary shape placed on elastic foundation under both uniform load and a concentrated load at the centre of the plates is investigated using a more simplified and accurate approach and exact solutions of the problem are obtained.

Shell structures are often opted for in various modern structures. The chapter six comprises of studying the dynamic responses of the shell structures with two illustrations of practical interest. The first one deals with the free vibration of the elastic plastic shallow shells using the concept of iso-deflection contour lines in conjunction with Ilyushin's theory of small plastic deformation(1948). The second illustration deals with the non-linear damped oscillation of a doubly curved shallow shell on an elastic foundation using von Karman-Donnell type non-linear differential equations by the method

of constant deflection contour lines.

Modern structures are often subjected to high temperature, mainly due to ever increasing present day need and due to the rapid development and safety of the nuclear reactor structures. Hence, it has become a necessity to study the dynamic responses of structures under a thermal gradient or at an elevated temperature so far as the present day trend of investigations are concerned.

In presence of a temperature distribution not only thermal stresses are developed but even changes in elastic properties of material are also observed. This undoubtedly has an effect on the fundamental frequency of the structures.

The seventh chapter is devoted to the analysis of a thermoelastic plate. The only illustration deals with non-linear analysis of a thermo-elastic rectangular plate with special reference to a square plate under a thermal gradient. The present author attempts to investigate both static and dynamic behaviour of thermo-elastic plates.

The chapter eight comprises of two problems. One of which deals with the non-linear free vibrations of a doubly curved orthotropic shallow

shell under a thermal gradient and in which thermal effects on material orthotropy, curvature ratio, shear ratio and circumferential modulus have been investigated.

The second problem concerns with temperature effect on the dynamic response of a spherical shell. In the present investigation an attempt has been made to test the validity of the modified Berger's approach to the non-linear analysis of shell structures vibrating at large amplitude under a thermal gradient.

In chapter nine, a critical review of the three new simplified approaches out of several existing methods to the linear and non-linear analysis of plates and shells has been presented with a couple of illustrations. The merits and demerits of these approaches have been discussed.

Chapter ten focuses on the future need for further studies and to identify the sphere on which investigations are essential for future demand and which are yet to be investigated.

We have referred very few of numerous references and works of several authors. However, it does not mean that those which are not referred

to here are of less worthy. Instead, they are either of high standard compared to the present work or they have little relevance to the present context or may be hitherto unknown to the present author.

English being the second language of the author, he begs apology beforehand for any linguistic error or absence of any proper expression of the text that may creep-in in the preparation of the work.

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Subhash Chanda