Chapter 3

STROH-LIKE FORMALISM FOR GENERAL THIN LAMINATED PLATES AND ITS APPLICATIONS

Chyanbin Hwu
Institute of Aeronautics and Astronautics
National Cheng Kung University
Tainan, Taiwan, R.O.C.

Abstract

If laminates are unsymmetric they will be stretched as well as bent even under pure in-plane forces or pure bending moments. The coupled stretching-bending theory of laminates was developed to study the mechanical behavior of thin laminated plates. Since this theory considers the linear variation of displacements across the thickness direction, by separating the thickness dependence it is easy to get general solutions through the complex-variable approach. An elegant and powerful complex-variable method called Stroh formalism is well known for problems in two-dimensional linear anisotropic elasticity. In this chapter, its counterpart, generally called Stroh-like formalism, will be introduced to deal with the coupled stretching-bending theory of laminates. Moreover, its extension to hygrothermal problems and electro-elastic composite laminates, and its applications to the problems of holes and cracks in laminates will all be presented. Some representative numerical examples are then shown to illustrate the advantage and necessity of the analytical closed-form solutions obtained by the Stroh-like formalism.

3.1 Introduction

The virtually limitless combinations of ply materials, ply orientations, and ply stacking sequences offered by laminated plates considerably enhance the design flexibility inherent in composite structures. In practical applications, to take advantage of the designable characteristics of composite laminates, there is always the option of designing an unsymmetric laminated plate.