Chapter 11
Stress Analysis of Bonded Joints by Boundary Element Method

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Abstract Boundary element method (BEM) has proven to have very good resolution of large stress gradients such as in front of cracks and in regions of stress concentration, yet its application in analysis of bonded joints is practically non-existent even though large stress gradients exist in the bonded region and bonded joints are one of the critical technology in modern design. This is because application of BEM to bonded joints is not simple or straight forward.

This chapter describes the commonality and differences between BEM and other approximate methods, advantages of BEM application to bonded joints, the research challenges, BEM formulation, the discretization process and the sources of errors, the mesh refinement techniques, and some numerical results.

11.1 Introduction

Finite Element Method (FEM), Finite Difference Method (FDM), and Boundary Element Method (BEM) are the three major numerical methods for solving partial differential equations in science and engineering. Unlike FEM and FDM, which are very versatile and general, BEM is a more specialized numerical tool that can yield significant advantages for a class of problems such as bonded joints.

There are three features of BEM that makes it attractive for analysis of stresses in bonded joints:

(i) It has proven to have very good resolution of stress gradients such as those that appear in front of cracks or in regions of stress concentrations and thus possibly will do the same with strong stress gradients in bonded joints;

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L.F.M. da Silva, A. Öchsner (eds.), *Modeling of Adhesively Bonded Joints*,