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Pure Bending Analysis of a Natural Fiber Composite Beam

X.Y.Tang

Department of Mechanical Engineering, College of Engineering, Nanjing Agricultural University, Nanjing, Jiangsu, 210031, China. txy32@tom.com

Abstract

Using the elasticity and singular integral equation method, an analysis of a natural short fiber composite beam is carried out under pure bending and Saint-Venant's approximation. The interface stresses on the two sides of the short fiber and the stress intensity factors at the fiber tips are obtained. The method proposed here may be generalized to analyse more complicate composite problems, such as the multiple natural fiber or nano-composite mechanics.

Key words: *Straight beam containing inclusion, Pure bending, Interface stress, Stress intensity factor*

1. Introduction

In practice, there are many structures and mechanical components to exist some different material in the local part because there are some fibers of composite material, welding line or rib etc in it. These inclusions will arise the disturbing stress and produce the stress concentration and stress singularity in the local area. How to estimate the stress concentration and stress singularity, in order to scheme out the appropriate safety factor and to make the design more safe and reliable, it is very significant.

This paper used (Zhang and Tang, 1995) given the basic solution, to have systemically researched the disturbing stress of beam with short natural fiber of composite material under pure bending in the Saint-Venant's approximate precision range. After deducing the integral equation of the problem and to solve it, the accurate interface stresses on the two sides of the short fiber and the stress intensity factors at the fiber tips are obtained. The method proposed here may be generalized to analyze more complicate composite problems, such as the multiple natural fiber or nano-composite mechanics. The results given in this paper are useful for the strength design of the machine parts containing inclusion.

2. Basic solution

According to (Zhang and Tang, 1995), the basic solution of the disturbing displacements by the short fiber on the infinite plane in the Figure 1 is given below:

$$u(x,y)=\frac{1}{4\pi G(1+\kappa)}\int_a^b\left[\kappa\ln\frac{1}{(x-t)^2+y^2}+\frac{2(x-t)^2}{(x-t)^2+y^2}\right]q(t)dt+\frac{1}{2\pi G(1+\kappa)}\int_a^b\frac{(x-t)y}{(x-t)^2+y^2}p(t)dt \qquad (1)$$

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