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Shear Traction and Sticking Scope of Frictional Contact between Two Elastic Cylinders

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Abstract

In this study, the frictional contact with partial slide between two dissimilar elastic cylinders is considered. According to the Spence's self-similarity condition, a system of singular integral equations is constructed with respect to the normal pressure and the shear traction in the contacting area. Based on the Goodman's hypothesis, the preceding system is uncoupled. From this, the tangential load in the central sticking zone is possible to be obtained analytically by means of the theory on the singular integral equation. Besides, a nonlinear equation in regard to the ratio of the adhesive and slip zone sizes is derived on the basis of the continuity of the tangential load. The stick zone size can thus be determined by solving the nonlinear equation mentioned above iteratively. The problem in question is additionally solved by utilizing numerical method to make verification and validation of the theory and the related prevision founded in the present paper. Nmerical examples are provided to instantiate the theroy and method proposed.

Key words

Contact mechanics; Integral equation; Friction; Adhesive contact; Numerical quadrature

1 Introduction

The theory laid down by Hertz [1, 2] for normal frictionless contact between two nonconforming bodies stands as a landmark in linear elasticity. It also stimulated the development of a new field of contact mechanics over the following century. The key assumptions in the classical Hertz theory were: (i) absence of friction in the contact, (ii) small size of the contact area compared to the dimensions of the contacting bodies and the radii of curvature of the contacting surfaces, and (iii) the presumed linear elastic material response.