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Discussion

Discussion: "A Mathematical Model for Frictional Elastic-Plastic Sphere-on-Flat Contacts at Sliding Incipient" (Chang, L., and Zhang, H., 2007, ASME J. Appl. Mech., 74, pp. 100–106)

Izhak Etsion
Fellow ASME
Dept. of Mechanical Engineering,
Technion,
Haifa 32000, Israel
e-mail: etsion@tx.technion.ac.il

The authors presented a model for sliding inception that is essentially based on the 1949 Mindlin approach (see Ref. [1]) for frictional contact with extension to elastic-plastic normal loading. According to this concept the interfacial shear stress is assumed to be proportional to the contact pressure until it reaches a limiting value that is related to the shear strength of the sphere bulk (see Eq. (1)). In other words, the Mindlin approach assumes a "local Coulomb friction law" that requires an input of a certain proportionality constant that relates the shear stress distribution to the normal pressure distribution in the contact interface. It may lead to unrealistic situations in which the local equivalent von Mises stress can exceed the yield strength of the sphere material. Another shortcoming of this concept is that sliding inception always occurs in the contact interface regardless of the level of normal loading. This would contradict the well known phenomenon of material transfer, which is associated with high normal loading of adhesive frictional contacts and requires slip below the contact interface.

A completely different approach to frictional contact was recently presented in a series of papers by Brizmer et al. assuming full stick contact condition (see Refs. [2–4]). These three papers deal with all the aspects of the present paper, namely, the critical interference [2], the elastic-plastic loading regime [3], and the sliding inception [4], respectively. The full stick contact condition captures very well the concept of an adhesive joint formed in the contact interface [5]. It does not require any assumption of a proportionality constant that relates local shear stress and local pressure, and therefore it never violates the von Mises yield criterion. Furthermore, it allows analyzing the sliding inception as a failure mechanism and it utilizes first principles to predict the sliding inception and to obtain the resulting corresponding static friction coefficient and junction growth. The full stick contact condition does not impose slip at the contact interface and hence, allows for the possibility of material transfer under severe normal loads. Additionally the results of Ref. [4] correlate well with some preliminary experimental results obtained by Ovcharenko et al. [5].

References

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