

Constitutive Contact Laws in Structural Dynamics

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1 INTRODUCTION

The main source of damping in built-up structures is frictional dissipation due to microslip in joints. Here, microslip refers to partial slip of the contact area while other parts are sticking. However, since every engineering surface is rough at least on a microscopic scale, one has to distinguish between the nominal area of contact and the real area of contact where the latter is formed by microscopic contact patches at the scale of the surface roughness. Now, microslip occurs at both scales: At the scale of the structural joint and on the scale of the microscopic contact patches. To model this behavior a two level approach is chosen. The structural scale is resolved by the Finite Element Method such that the contact traction distribution on the nominal area of contact can be resolved. The micro-scale is taken into account by appropriate constitutive contact laws which are obtained from a halfspace model resolving the traction distribution on a representative surface area on the micro scale.

2 CONTACT LAWS

As shown in [2,3], a typical isotropic engineering surface can be characterized as fractal-regular surface by three intrinsic parameters, the RMS-value of the height distribution, the fractal dimension, and the transition length between the fractal and the regular behavior. Now, by employing a halfspace contact model based on the method developed by Kalker and van Randen [1] one can obtain constitutive contact laws for the normal contact [2,3] and the tangential contact [4], as shown in Fig. 1.

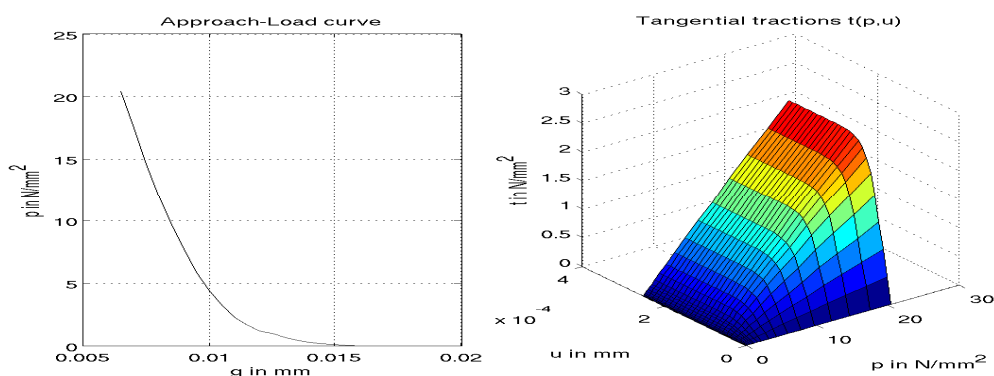


Figure 1: Typical constitutive contact laws.

3 DYNAMICS

The constitutive contact laws have been implemented as a user subroutine into the commercial finite element code Abaqus, where the normal contact behavior has been approximated by an exponential pressure-gap law and the tangential behavior by a multi-radial-return-mapping algorithm employing an Iwan series model with pressure dependent tangential stiffness at each integration point. The performance of this model is compared to experimental results from a double-beam set-up, as shown in Fig. 2. As shown in Fig. 3, the proposed microslip model captures the dissipation behavior quite well.



Figure 2: Experimental set-up.

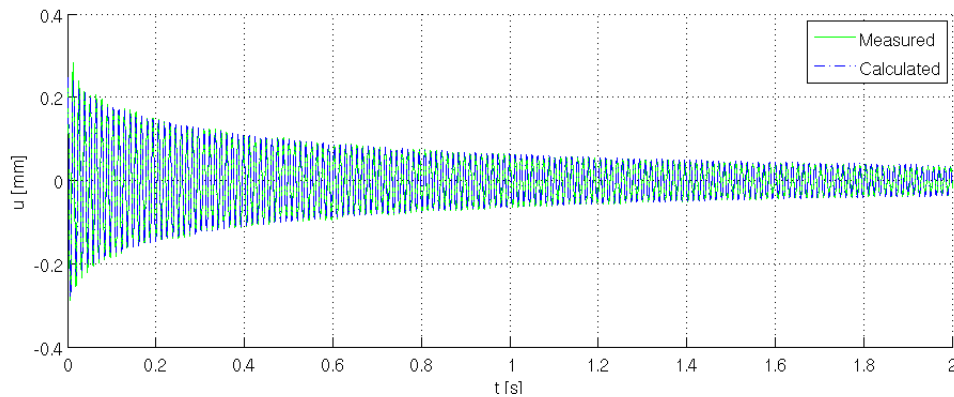


Figure 3: Experimental and numerical results.

REFERENCES

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