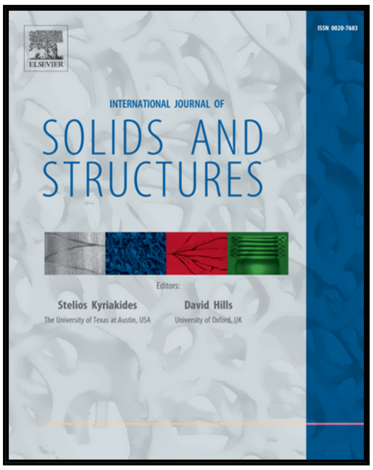
Accepted Manuscript



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PII: S0020-7683(18)30215-4
DOI: https://doi.org/10.1016/j.ijsolstr.2018.05.021
Reference: SAS 10001

To appear in: *International Journal of Solids and Structures*

Received date: 16 November 2017
Revised date: 30 March 2018
Accepted date: 27 May 2018

Please cite this article as: E. Radi , E. Dragoni , A. Spaggiari , ADHESIVELY BONDED DISK UNDER COMPRESSIVE DIAMETRICAL LOAD , *International Journal of Solids and Structures* (2018), doi: https://doi.org/10.1016/j.ijsolstr.2018.05.021

ADHESIVELY BONDED DISK UNDER COMPRESSIVE DIAMETRICAL LOAD

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Abstract. A closed-form full-field solution is presented for stresses and displacement in a circular disk containing a diametrical adhesive thin layer induced by two opposite compressive loads acting along an arbitrary diametrical direction. For the sake of simplicity, the adhesive layer is treated as a tangential displacement discontinuity between the two disk halves. The problem is split into symmetric and skew-symmetric loading conditions. No contribution is expected from the layer for the symmetric problem. For the skew-symmetric loading condition, a general integral solution in bipolar coordinates has been assumed for the Airy stress function in the form of a Fourier sine transform. The imposition of the boundary conditions then allows us to reduce the problem to a Fredholm integral equation of the first kind defined on the half-line or equivalently to a singular integro-differential equation defined on a bounded interval. A preliminary asymptotic analysis of the stress and displacement fields at the edges of the adhesive thin layer shows that the stress field is finite therein, but the rotation displays a logarithmic singularity. A numerical solution of the singular integro-differential equation is then provided by assuming a power series expansion for the shear stress, whose coefficients are determined by using a collocation method. An approximate closed-form solution is also derived by exploiting a perturbation method that assumes the ratio between the shear modulus of the disk material and the shear stiffness of the adhesive thin layer as small parameter. The shear stress distribution along the thin layer turns out to be more and more uniform as the adhesive shear stiffness decreases. In order to validate the analytical results, FE investigations and also experimental results obtained by using Digital Image Correlation (DIC) techniques are presented for varying loading orientation and material parameters.

Keywords: Airy stress function, Bipolar coordinates, Plane elasticity, Singular integral equation, Perturbation analysis, Adhesive bonding, Mode mixity, Collocation method.

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