The dynamics of a shear band

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A shear band of finite length, formed inside a ductile material at a certain stage of a continued homogeneous strain, provides a dynamic perturbation to an incident wave field, which strongly influences the dynamics of the material and affects its path to failure. The investigation of this perturbation is presented for a ductile metal, with reference to the incremental mechanics of a material obeying the J_2–deformation theory of plasticity (a special form of prestressed, elastic, anisotropic, and incompressible solid). The treatment originates from the derivation of integral representations relating the incremental mechanical fields at every point of the medium to the incremental displacement jump across the shear band faces, generated by an impinging wave [1]. The boundary integral equations (under the plane strain assumption) are numerically approached through a collocation technique, which keeps into account the singularity at the shear band tips and permits the analysis of an incident wave impinging a shear band. It is shown that the presence of the shear band induces a resonance, visible in the incremental displacement field and in the stress intensity factor at the shear band tips, which promotes shear band growth. Moreover, the waves scattered by the shear band are shown to generate a fine texture of vibrations, parallel to the shear band line and propagating at a long distance from it, but leaving a sort of conical shadow zone, which emanates from the tips of the shear band.

References

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