Sheet Metal Forming Simulation and Induced Fatigue Life Prediction

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Résumé

Based on thermodynamics of irreversible processes with state variable framework, an advanced Anisotropic Fully Coupled (**AFC**) model dedicated to sheet metal forming simulations is formulated with the assumption of total energy equivalence. An anisotropic elastoplastic model fully coupled with isotropic ductile damage is developed. The model takes into consideration the initial plastic anisotropy as well as induced anisotropies caused by kinematic hardening and distortional hardening at room temperature.

Based on the same framework, an incremental fatigue damage model dedicated for prediction of the fatigue life of a mechanical component obtained through sheet metal forming is formulated. It is based on two-surface formulation that consists of plastic flow with damage derived from a plastic yield function with a plastic flow potential (non-associative formulation) and a fatigue damage flow fully coupled with plastic flow and hardening. The assumption of a small total strain (elastic and plastic) is made. Under arbitrary periodic loading paths, the model ensures the activation and the deactivation of both surfaces. Similarly, the model takes into account the initial plastic anisotropy and induced anisotropies, which are strongly coupled with isotropic fatigue damage generated by the arbitrary cyclic (periodic) loading paths.

Furthermore, parametric studies on the combined model for various in-phase and out-of-phase loading paths are carried out to investigate the predictive capabilities of the model. Applications using the model to industrial examples via numerical simulations are compared to the experimental results.

Mots-Clés: yield surface distortion, induced anisotropy, isotropic ductile damage, fatigue damage, life prediction

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