Evaluation of hardening model in prediction of residual stress variation after cyclic bending

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ABSTRACT

The cyclic loading process occasionally damages steel products and degrade their mechanical performance. Accurate evaluation of mechanical performance of steel products under the cyclic loading is important for their appropriate design and operation. The residual stress also influences on mechanical performance. It is necessary to evaluate mechanical performance accurately by the simulation using appropriate elastoplastic model which simulates the residual stress variation in the cycric loading process.

Various elastoplastic constitutive equations have been proposed. The subloading surface model has been formulated and applied to the prediction of cyclic loading behavior [1]. The material function prescribing the elastic-plastic transition in the original subloading surface model has been extended so as to describe the inverse and reloading behavior and the strain accumulation in cyclic loading more accurately for steel [2].

In this work, the extended subloading surface model was applied to the prediction of the residual stress distribution after cyclic bending.

The experiment on the four-point cyclic bend was performed to investigate the residual stress variation due to cyclic bending. The residual stress distribution before and after cyclic loading were measured by the X-ray stress measurement method. The compressive residual stress or tensile residual stress decreased after cyclic loading, especially around the edge of the specimen.

The simulation to the experiment was performed by the extended subloading surface model. The stress distribution after cyclic bending simulated by the extended subloading surface model was in good agreement with measured one, and was more accurate than that by other elastoplastic constitutive model, such as the nonlinear isotropic/kinematic hardening model. It is expected to accurately evaluate mechanical performances of steel products under the cyclic loading process by the extended subloading surface model .

REFERENCES

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[2] R.Higuchi, K.Okamura, F.Ohta and K.Hashiguchi, “Extension of subloading surface model for accurate prediction of elastoplastic deformation behavior of metals with cyclic softening”, *Transactions of JSME* (in Japanese), Vol. **80**, DOI:10.1299/transjsme.2014smm0082, (2014).