

Multi-pass Medium Plate Rolling Processes Using Thermo-mechanical FE Analysis

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Summary

Material properties and geometrical shape of rolled products are two of the most important problems in steel product, which are affected by the thermal distribution and deformation behavior during rolling. Analysis of the behavior of medium plate during multi-pass rolling is significant for guiding the production.

Recently years, the finite element method (FEM) has been widely used for analyzing the plate rolling processes, which has become an irreplaceable theory method. Rolling processes is a kind of continuous metal forming technology. Through multi-pass rolling processes, the shape and microstructure of plate could be obtained. However, in mostly works, the researchers focused on analysis of behavior of plates in a single pass, which the deformation of plate in previous passes are neglected. It is obvious that more helpful messages could be obtained to analyze the behavior of plate deformation behavior in continuous multi-pass rolling processes. In this paper, a three-dimensional thermal-mechanical finite element model is established for simulation of the continuous deformation behavior of medium plate during multi-pass rolling processes coupled with explicit dynamic FEM, implicit FEM and updating geometrical method.

Firstly, establish and solve the thermo-mechanical FE model of the i pass. Then obtain the thermal distribution on plate and obtain the plate shape after the i pass using the updating geometrical method. And establish and solve the thermal distribution of plate between the i pass and the $i+1$ pass. The thermal distribution in plate, the plate shape, etc, during rolling in the i pass are obtained. Modify the rolls gap and metrical parameters, the FE model of the $i+1$ pass could be established with the geometrical model and thermal distribution when $i < N$. With the same method, the following passes could be simulated. The plate view pattern, the thermal distribution, the maximum temperature on slab surface, the minimum temperature on slab surface and the mean temperature on slab surface each pass in the rolling processes were obtained. The calculated results are compared with the actual results, which are in good agreement. The model could be used in the hot working process.

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