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Construction of heat treatment analysis model considering transformation plasticity and accuracy verification

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In manufacturing of steel products, demand for thermo-mechanical controlled processing (TMCP) is increasing steadily to satisfy various properties. However, defect of shape occurs when the temperature distribution of steel products becomes uneven during the cooling process. As a result, productivity and product yield are decreased. Predicting thermal deformation with high accuracy is essential for optimizing cooling condition and increasing productivity. But it is difficult to predict thermal deformation after cooling process because thermal deformation is complex phenomenon interacting between strain, heat transfer, phase transformation. Especially, transformation-induced plasticity is known to act an important role as it affects the final product quality such as shape and residual stresses. In past studies, there are some analysis cases considering transformation plasticity through single-phase transformation such as bainitic and martensitic transformation. On the other hand, there are few analyses considering transformation-induced plasticity through multi-phase transformation.

In this study, thermal deformation prediction model considering transformation-induced plasticity through multi-phase transformation was developed to predict thermal deformation with high accuracy. And analysis accuracy and validity were evaluated by comparing between experiment and simulated camber of SUS304 and S25C plate samples after spray cooling one-side of them.

It found that experiment and simulated camber without transformation-induced plasticity were difference. In contrast, they were in good agreement by considering transformation-induced plasticity. Newly established thermal deformation predict method contributes to a deeper understanding of TMCP.

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