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Study on shape defects of thin steel sheets caused by steep longitudinal temperature gradient

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In the steel industry, the rapid cooling process, which is suitable for manufacturing high-strength materials, is being increasingly applied. However, the deformation caused by rapid cooling is particularly large, which leads to reduced productivity and yield, so suppressing this deformation is an important issue. In order to suppress deformation, it is first necessary to quantitatively evaluate the shape of the steel sheet during quenching. Possible causes of shape defects in steel sheets during quenching include temperature deviations in the thickness, width, and longitudinal directions of the steel sheet. However, there have been no reports of defects in the shape of steel sheets caused by a steep longitudinal temperature gradient. Therefore, the effects of steel type and operating conditions on shape defects of thin steel sheets accompanied by martensitic transformation due to a steep longitudinal temperature gradient were quantitatively evaluated by FEM analysis. The results showed that, during steel sheet quenching, Dual Phase steel did not generate much compressive stress in the width direction, but full martensitic steel buckled and generated wave shape due to compressive stress in the width direction in the transformation expansion area. It was also clarified that, during the manufacturing of full martensitic steel by the quenching process, the average warping height increased with increasing width, temperature gradient, and initial warping height.

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