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Finite Element modelling of skid marks on steel slabs in a walking beam reheating furnace

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Walking beam furnaces are common for reheating of steel slabs to reach temperatures for hot rolling. Inside the furnace, the slabs are carried on water-cooled skids that support and move them through the furnace. The point contact between slab and skid results in undesired cold spots on the slabs, skid marks, which persist to hot rolling of plate/strip; leading to increased deformation resistance, adversely affecting rolling performance and product quality. Such cold spots are often not considered by process models used by the furnace control system as it requires the temperature of the slab to be modelled in 3D. Therefore, the goal in this study is to develop a fast, 3D model that can predict the temperature evolution/profile of the slab, including skid effects to enable on-line predictions of skid marks. The temperature and heat distribution of the slabs was modeled using finite elements analysis. Boundary conditions were used to include the effect of heat transfer from thermal radiation and convection, including the effect of view factors and shadowing from static and moving beams. The modeled temperatures were validated against empirical measurements from an industrial reheating furnace and compared to the simulation model STEELTEMP used by the furnace control system FOCS. The developed model showed a similar performance in predicting the overall slab temperature in production conditions as the model used in the current FOCS system, while also giving predictions on the skid marks. With the developed model, it becomes possible to simulate the effect of skid layouts, alternative process control and transfer the results to downstream simulation model of the hot rolling to evaluate the effect on the rolling forces and final product quality. This would enable process operators to better assess the reheating process and allow measures to be taken to improve final product quality.

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