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Simulation of the Temperature, Microstructure, and Stress/Strain Fields during the Quenching

Keywords: Steel Quenching, Residual Stresses, TRIP, Thermo-Plasticity, J_2 -Plasticity, Solid Phase Change

The distortion and microstructure distribution in quenched steel products such as steel profiles, plates, shafts, disks, etc. A complex model for the simulation of the temperature, microstructure, stress/strain, and displacement fields during quenching of steel profiles is being developed. A thermomechanical material model was formulated on the basis of J_2 -plasticity theory with temperature and phase fraction dependent yield limit. Coupling effects such as phase transformation enthalpy, transformation induced plasticity (TRIP), stress dependency of transformation are considered. With this model, it is possible to optimize the quenching conditions in order to reduce the distortions.

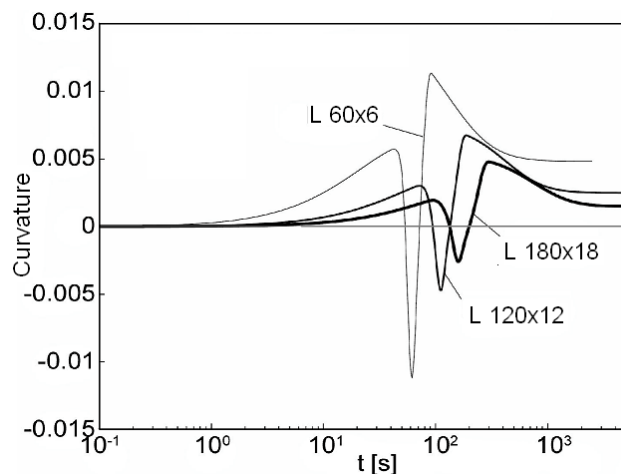


Figure 1 Distortion of different size L-profiles during quenching

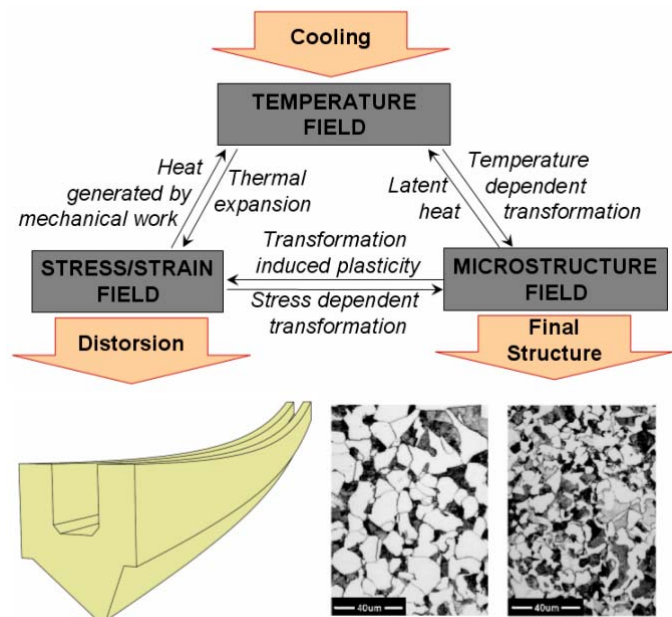


Figure 2 Coupling of fields

Publication:

- M.Sc. Kaymak, Dr. -Ing. Pietzsch, Dipl. -Ing. Brzoza, Prof. Dr. -Ing. Specht, Prof. Dr. -Ing. Bertram, "Minimizing the Distortion of Steel Profiles by Controlled Cooling", Steel Research 2005.