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Relaxation and creep in hot coiled steel strip

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A hot rolled steel strip that seemingly comes out as flat after the final rolling pass might potentially end up with flatness issues after it has been coiled. It is not easily understood which mechanisms in the coiling process are causing flatness issues. It is known from a material perspective that a combination of high stresses and temperatures can cause stress relaxations and creep deformations when the time in this state is long enough. A hot coiled steel strip at 600°C with a mass of 27 tonnes will long time to cool down and it is uncertain whether stress recovery and creep behaviour have an impact on the final flatness. To investigate this, a three-dimensional thermo-mechanical finite element model with a creep material model is used to simulate the influence of creep deformations on final shape. It is, on one hand found that a relatively complex stress profiles are developed through the strip thickness when coiling, with compressive and tensile stresses beyond the yield stress, and that the tensile stresses recover unsymmetrically on one side of the strip midplane. On the other hand, is it also found that the creep deformations are only a fraction of the plastic deformations caused by the mechanical work during the coiling process. Hence, it is concluded that creep mechanisms play no, or possibly a marginal role in the shape of the final shape. Whereas stress relaxations result in a stress neutral profile in the coiled state, which may cause shape variation after uncoiling and post processing.

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