Thermal and mechanical analysis of a galvanizing pot

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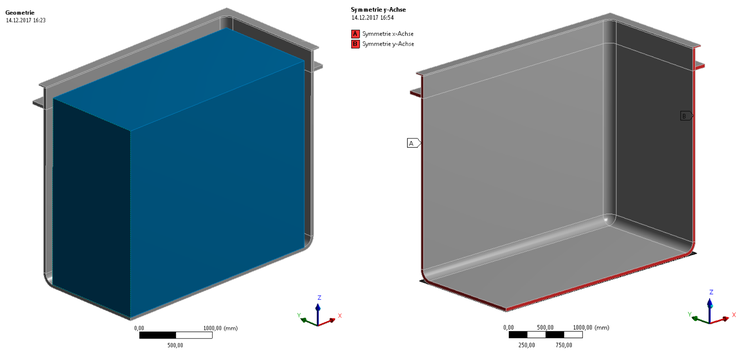
Major challenges

- Thermal stress is induced during the heating process
- The current heating rates are based on experiences
- Actual stress distribution and intensity are mostly unknown
- Generating a temperature profile according to measurement data
- Deriving a stress distribution allowing recommendations for strain tests in real experiments
- The longterm goal is to optimize the heating rate

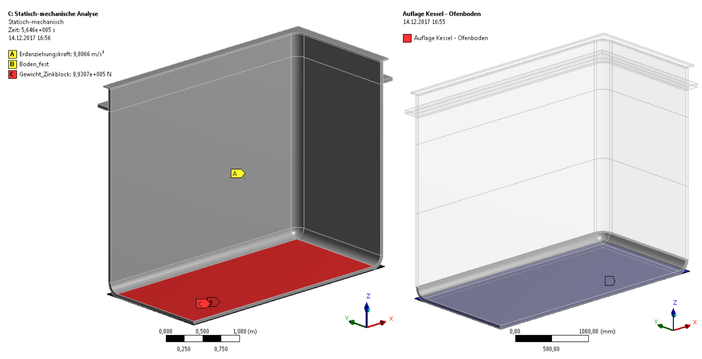
Zinc coating pot

- Dimensions: $7000 \times 1700 \times 2950\mathrm{mm}$
- Simulation of a quarter model using symmetry planes
- No parapet, furnace ground is assumed to be rigid



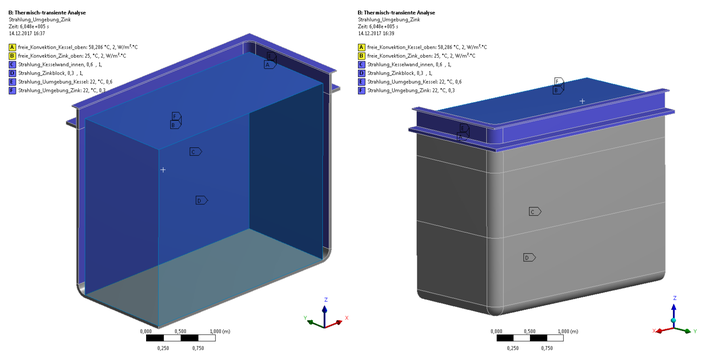
Structural boundary conditions

- Acceleration of gravity $g = 9,81\mathrm{m/s^2}$
- Bottom and symmetry planes fixed in normal directions
- Contact conditions are enforced by an Augmented-Lagrange-Method with small penetration tolerance $(0,1\,\mathrm{mm})$
- Zinc block modeled as a defined load
- Applying the temperature profile for defined time steps

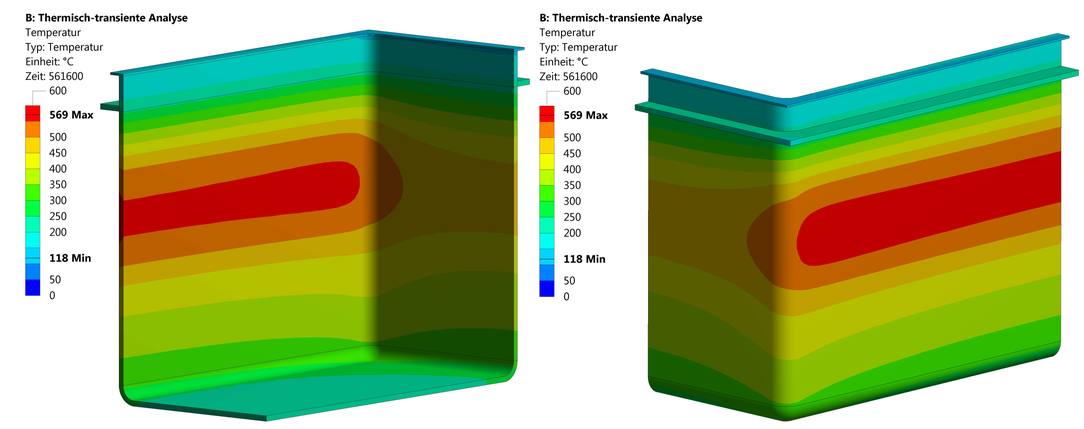


Thermal boundary conditions

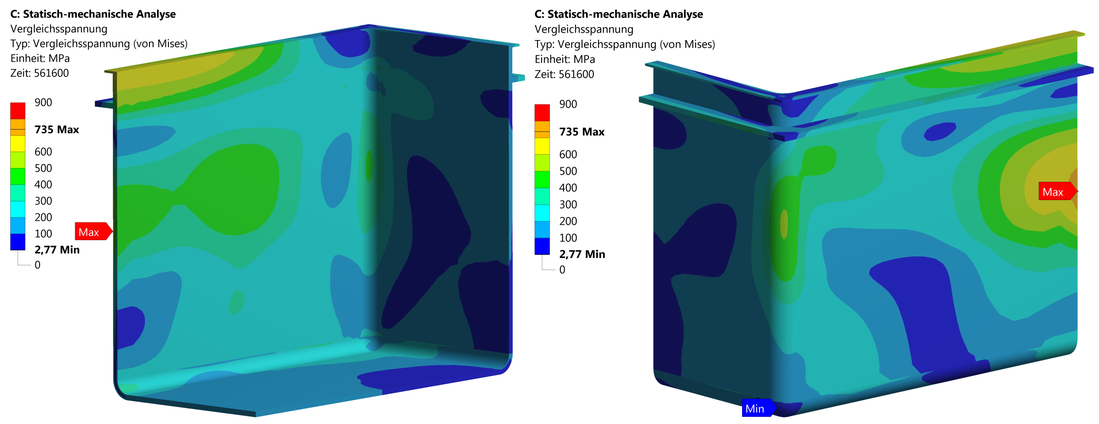
- Reference temperature $295.15\mathrm{K} \approx 22°\mathrm{C}$
- Free air-convection on the surface (flags A & B)
- Emission coefficient of a metallic, rough and slightly dirty surface
- Slow increase of the surrounding air temperature
- Furnace burners as energy inputs on multiple heating spots



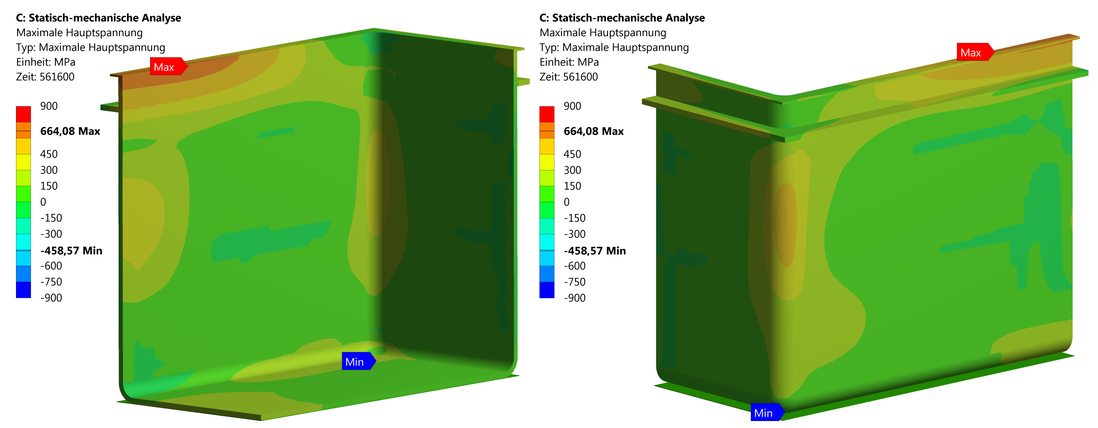
Temperature profile



Von Mises stress

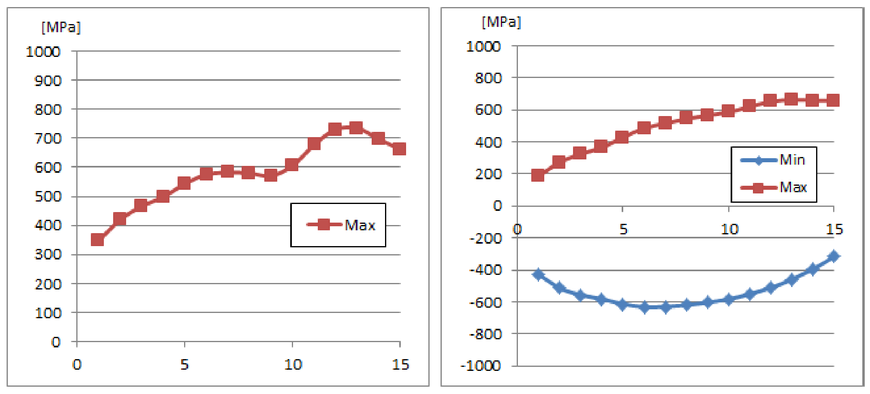


Maximum principal stress

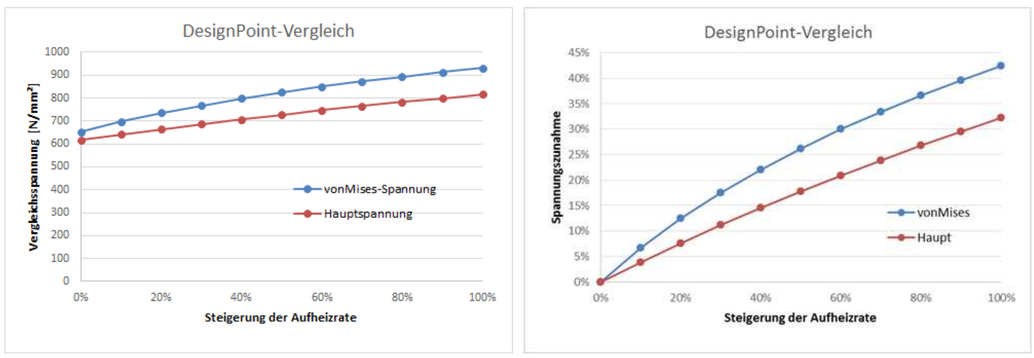


Variation of heating rate

- Development of von Mises and principal stresses



- Comparison for different simulated heating rates



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