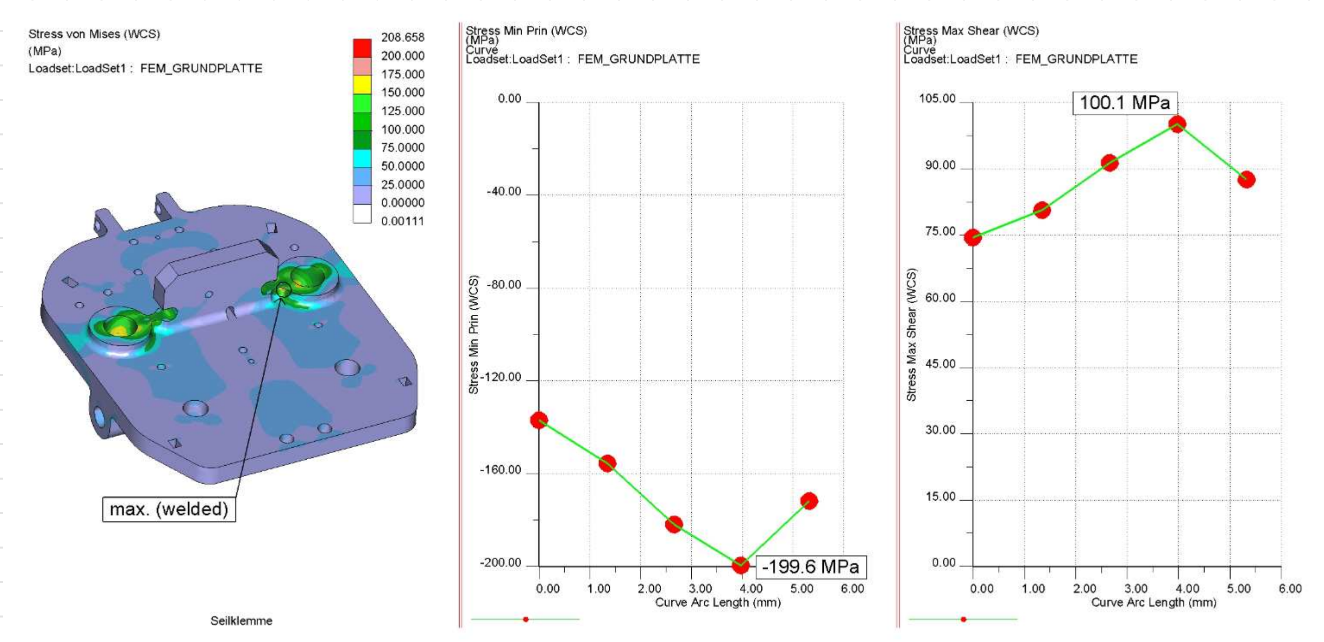
Example / FE-analysis



Contents

1. General information

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2. Parameters and constants

$\gamma_G = 1,35$ safety factor dead weight

$\gamma_Q = 1,5$ safety factor person weight

3. Calculation of forces

$F_{max} = 10$ *kN* maximum of static load

4. Static stress analysis

The static strenght analysis based on structural stress occurs in accordance with FKM-instruction: Analytical Strength Assessment 6.th Edition

$E = 210000$ *MPa* Young's modulus, table 3.3.3

$R_e = 360$ *MPa* yield strength for sheet thickness up to 40 mm, table 5.1.24

$R_m = 470$ *MPa* tensile strength, table 5.1.24

$\varepsilon_{ertr} = 0,05$ tolerable elongation, table 3.3.3

4.1 Characteristic values of stress calculated with FEA

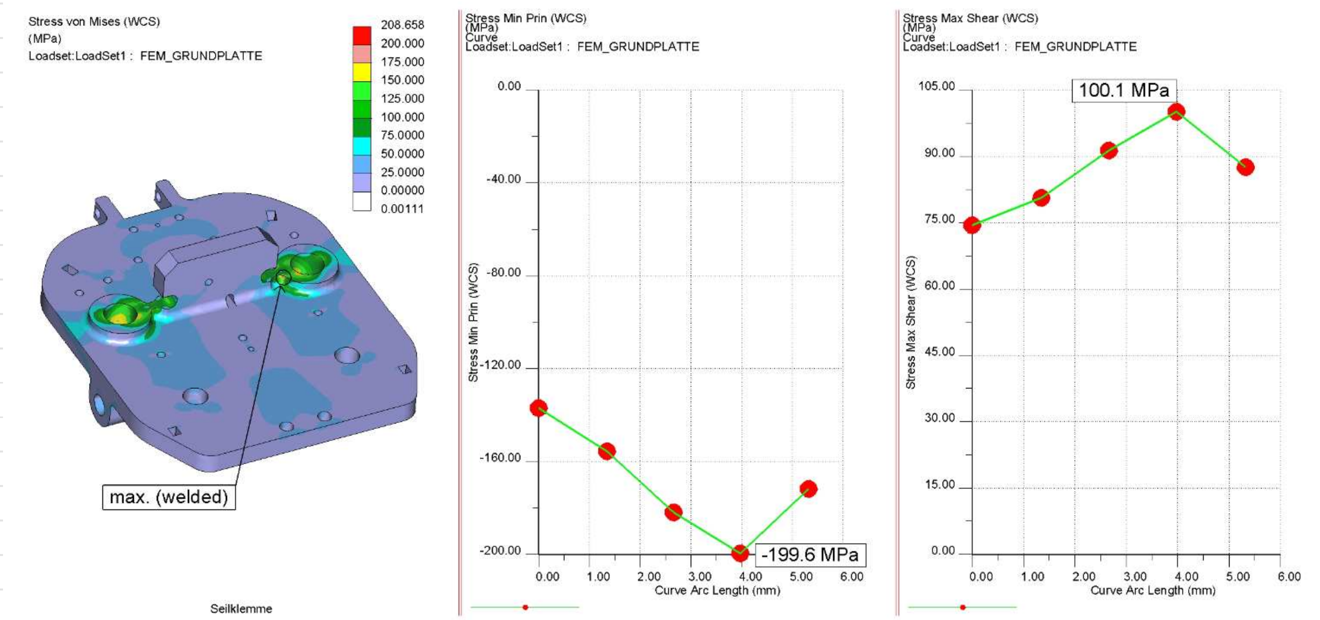

Figure 1: Color plots of the maximum stress

$\sigma_v = 208,7$ *MPa* maximum von-Mises equivalent stress in basis material

$\sigma_q = 199,6$ *MPa* maximum normal stress lateral to weldseam (according to amount maximum main normal stress)

$\tau = 100,1$ *MPa* shear stress along the weldseam at the same point

equivalent stress (3.1.14) at weld toe:

$$\sigma_{vw} = \sqrt{\sigma_q^2 + \tau^2} = 223,29 \text{ MPa}$$

4.2 Material parameters

$R_p = R_e = 360$ *MPa*

$R_m = 470$ *MPa*

4.3 Construction characteristic values

$n_{pl} = \sqrt{\frac{E \cdot \varepsilon_{ertr}}{R_p}} = 5,4$ malleable support factor, 3.3.13 (local failing)

$\alpha_w = 0,8$ weldseam factor of the fillet weld, table 3.3.5

4.4 Component strenght

$\sigma_{SK} = R_p \cdot n_{pl} = 1944,22$ *MPa* local in basis material, 3.4.2

$\sigma_{SK,w} = R_p \cdot n_{pl} \cdot \alpha_w = 1555,38$ *MPa* local in weldseam, 3.4.4

4.5 Safety factors

$j_s = 3,5$ safety factor for components (GB 8408)

$j_m = 1,85$ basis safety factor against breaking,
middle demage result,
high probability of occurrence of the stress,
table 3.5.1

$K_{T,m} = 1{,}0$ common temperature, 3.2.20

$\frac{R_p}{R_m} = 0{,}77$ high yield strength ratio (>0,75)

$j_z = 1{,}0$ additional partial safety factor, table 3.5.2, 3.5.3

$j_{ges} = j_s \cdot j_z \cdot \frac{j_m}{K_{T,m}} \cdot \frac{R_p}{R_m} = 4{,}96$ derived from 3.5.5

4.6 Proof

in non-welded area:

$a_{SK} = \frac{\sigma_v}{\frac{\sigma_{SK}}{j_{ges}}} = 53{,}24\ \%$ in basis material, 3.6.14

The strength proof has been provided.

at weld toe:

$a_{SK} = \frac{\sigma_{vw}}{\frac{\sigma_{SK,w}}{j_{ges}}} = 71{,}2\ \%$ in the weldseam, 3.6.16

The strength proof has been provided.