framatome

Simulation of Weld Residual Stresses

Finite Element Residual Stress Analysis

The numerical simulation of welding processes is an effective tool for detailed planning and optimizing of welding.

Challenge

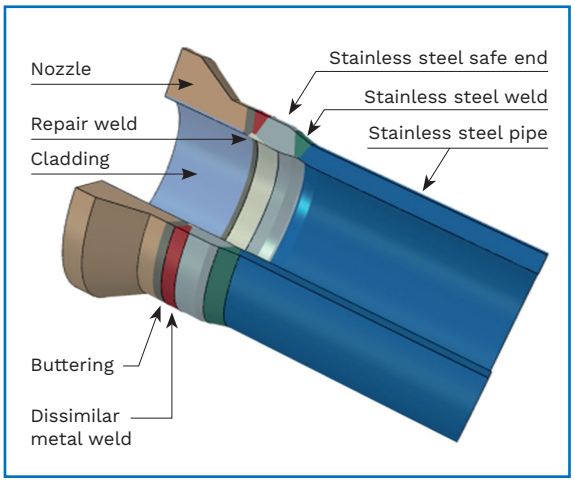
Residual stresses and distortion of components due to welding can significantly influence the components' functionality and life time. The stresses affect the calculation of the static strength of the structure as well as the assessment of fatigue, wearing and crack corrosion behavior. Therefore, the determination of residual welding stresses as well as respective process optimizations are an essential step for ensuring the components' safety and stability.

Solution

Residual stress and distortion in structures caused by welding can be calculated by means of numerical simulation based on the Finite Element Method. Our team at Framatome proceeds as follows:

- Determination of the relevant process parameters and material properties
- Finite Element modeling of the examined structure (2D or 3D)
- Calculation of the temperature distribution in the component during welding
- Calculating the residual stresses and distortion of the component based on the temperature distribution
- Application of loads occurring during operation
- Evaluating the calculations.

The impact of welding on the residual stresses of the component can be determined fast and cost-efficiently compared to experimental test arrangements. Consequently, finite element calculations are the perfect solution for optimizing pending welding as well as for evaluating already performed welding.



Simulation of a dissimilar weld on a reactor pressure vessel nozzle

Customer benefits

- Long-time experience with the Finite Element Method
- Cost savings compared to experimental methods for residual welding stress determination
- Short response times even for complex tasks
- Extensive laboratory infrastructure in associated disciplines
- Integrated solution competence from one source

Your performance
is **our** everyday **commitment**

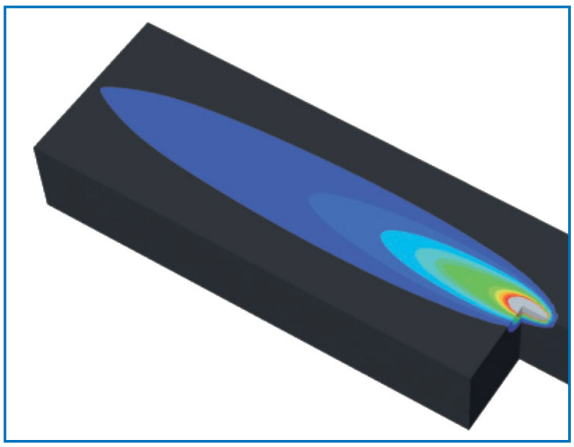
Technical information

Consulting, conducting and evaluating welding simulations according to the guidelines:

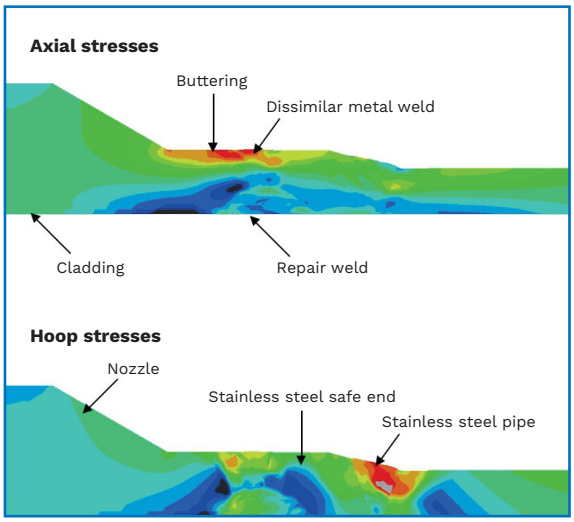
- Preprocessing simulation of (repair) welds and their optimization with regard to residual stress and distortion
- Assessing of welded in service components with regard to stresses
- Determination of the required mechanical properties in our in-house laboratories
- Parameter studies

We offer comprehensive services for the determination of residual welding stress and distortion by numerical simulation. Beyond the scope of the calculation of residual welding stresses, our competence center provides the following additional services:

- Welding consulting
- Fracture mechanics
- Failure analysis
- Metallography
- Mechanical testing
- Corrosion.

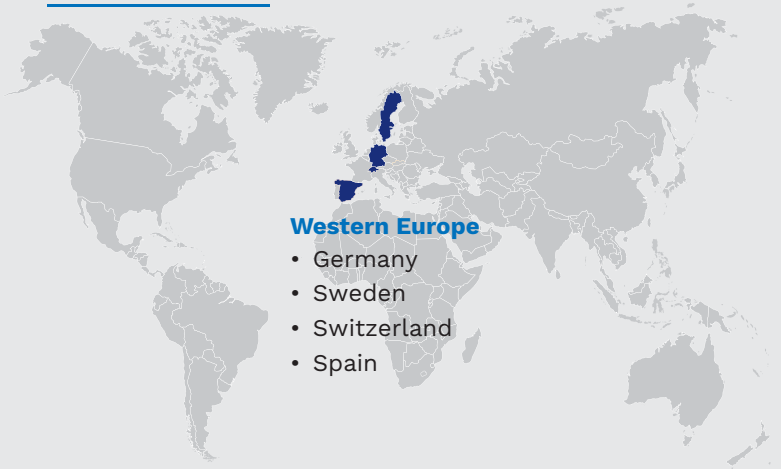


Transient temperature distribution during welding



Stress distribution of a reactor pressure vessel to nozzle dissimilar metal weld (cross section)

References



Key figures

Our **20** years of experience in the field of numerical analysis of weld residual stresses avoids or reduces cost-intensive test welds.

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