framatome

Numerical and Analytical Fracture Mechanics

Structure Mechanical Calculation on the Basis of the Finite Element Method

Fracture mechanical calculation of complex structure and load configurations, which are inaccessible to an analytical approach, by means of numerical methods

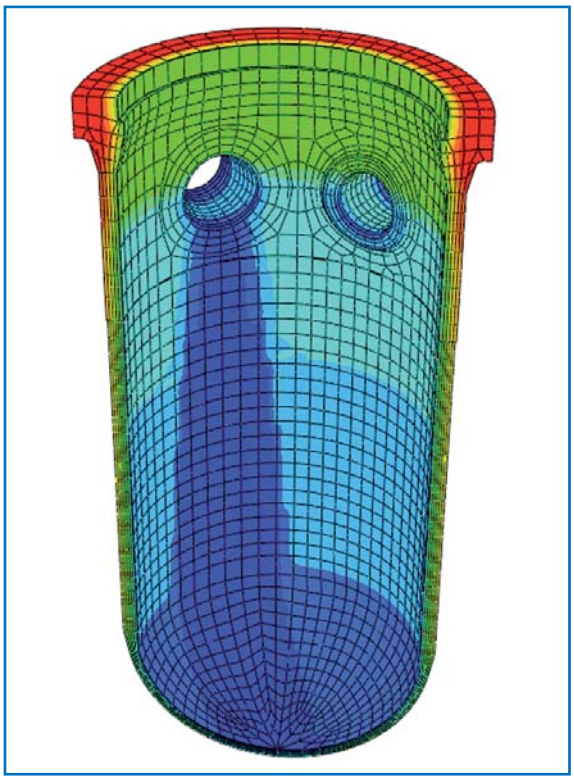
Challenge

Safety-relevant components whose integrity has to be proven fracture mechanically often have complex geometrical shape or are subject to a combined load. Analytical calculation methods provide conservative results with passable effort but are only applicable to a certain extent. Numerical calculations based on the finite element method can, with corresponding effort, realistically depict very complex scenarios and produce precise results. In addition, probabilistic approaches help to quantify the risk and to determine margins of deterministic analyses.

Solution

Framatome has long-time experience in modeling structure and fracture mechanical problems. Powerful computing capacities are available to efficiently calculate even large-scale and sophisticated models. This, for example, enables the application of computationally intensive damage models which help to simulate the crack growth in a component.

Besides numerical fracture mechanics, we also offer services in analytical (deterministic and probabilistic) and experimental fracture mechanics. This allows us to solve challenging and extensive problems efficiently and “from one source”.



Simulation of a reactor pressure vessel during a loss-of-coolant accident

Customer benefits

- Long-time experience in terms of numerical, analytical, probabilistic and experimental fracture mechanics
- Substantial knowledge as a result of numerous successfully performed fracture mechanical safety analyses

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

Technical information

We give advice, we carry out structure mechanical calculations focused on fracture mechanical problems and we evaluate them.

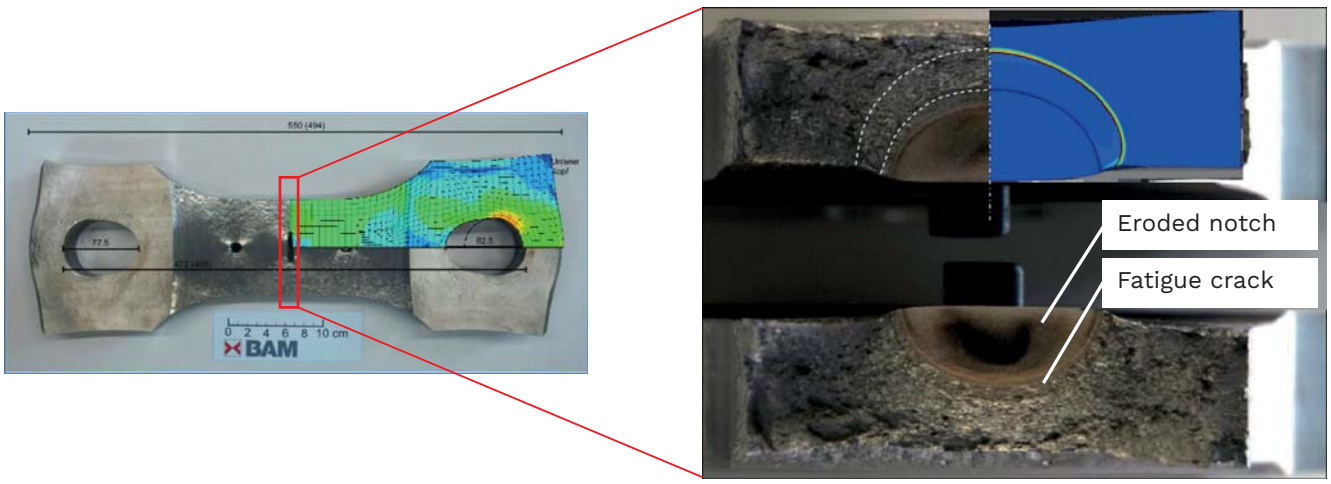
- Calculation for targeted preparation of fracture mechanical tests
- Calculations for safety-related evaluations of findings detected in components
- Calculations of crack growth for lifetime evaluation
- Consultation regarding fracture mechanical aspects in engineering and manufacturing issues
- Execution of all necessary experimental work in in-house laboratories
- Application of advanced calculation and simulation systems in the field of brittle and ductile fracture flaw analysis (ASME, KTA, RCC-M, RSE-M and R6)
- Leak-before-break analysis
- Support to qualification of non-destructive examination by calculation of component-specific allowable crack size at the beginning of the inspection interval
- Probabilistic fracture mechanics approaches for risk quantification and margin assessment

Fracture mechanics test specimen after testing

Key figures

More than **40** years experience in terms of numerical, analytical, probabilistic and experimental fracture mechanics

Numerous successfully performed fracture mechanical safety analyses in more than **25** power plants



Simulation of ductile crack growth compared to a real center cracked tension sample

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