



Failure analysis and damage prevention

Failure analysis serves to recognise failure causes and, therefore leads to damage prevention. BAM utilises an interdisciplinary approach, i.e., the know-how of all available internal experts / expertise is used. The topic range is from design assessment to production, as well as material selection to operation. It is possible to use the entire equipment and testing technology available at BAM, which is partly unique, for these investigations. In this way, all potential influences on the root cause(s) can be optimally analysed. BAM carries out systematic failure analysis in accordance with VDI Guideline 3822. The independency of BAM ensures a neutral evidence-based failure analysis. BAM also operates as a legal expert / expert witness in this relation. Both commissioning by several parties as well as arbitration and court appraisal activities can be agreed.

Interdisciplinary failure analysis:

- site inspection and local appointments (visual findings, photo documentation)
- define and coordinate required investigations in the BAM
- determine crack types (e.g. fatigue or forced fracture...)
- determine the used materials
- perform microstructural evaluation of the materials
- corrosion effect
- check mechanical characteristics
- evaluate the design principle
- check design for static strength and durability
- evaluate manufacturing and joining technology
- carry out comparative experiments
- comparison with the state of the art and standards
- evaluate the results of the study in its entirety

Presentation of results:

- compilation of interim reports according to agreements
- presentations and discussions with all involved parties
- compilation of detailed approval certificates or test reports
- prepare proposals for damage prevention measures
- creation and further development of relevant regulations
- implementation guidelines for failure analysis
- product standards for the objects being investigated
- research and teaching of failure mechanisms
- publication of anonymous case studies (only with permission of the client)



Fields of investigation:

- mechanical engineering: structural components, roller bearings, mechanical seals, main rotor bearing of wind turbines...
- medical technology: various implants e.g. hip prostheses, hip nails, femur plates etc.
- railway technology: wheelsets and axles ICE3 (2008), cylinder head, connecting rod...
- safety technology: Hazardous goods containers, safety valves...
- power engineering: turbine blades, bearing bushings
- vehicle technology: camshaft, wheel bolts, shafts
- plant construction: piping, heat exchangers, pressure vessels
- steel construction: overhead transmission towers (Münsterland 2005), bridges
- ship technology: MS Estonia (1994)
- ...

How?

Testing methods:

- sampling and sample production
- macro and micro fractography
- materialography (micro-sections etc.)
- chemical analysis
- hardness testing
- mechanical-technological tests, notched bar impact tests, tensile, compression, bending tests (static and cyclic), component comparison testing
- surface topography
- non-destructive testing (ultrasonic, radiation, eddy current, etc.)
- welding and soldering seam evaluation
- stress analysis with finite elements (FEA)

Which technologies are applied?

Testing and device technology:

- light microscopes (various incl. Stereo), Scanning Electron Microscope (SEM) with energy dispersive x-ray spectroscopy (EDX) unit and electron back scattering diffraction (EBSD), Transmission Electron Microscope (TEM), Focussed Ion Beam (FIB), Microprobe (WDX), X-Ray Diffractometer (XRD), White Light Interferometer (WLI)
- optical emission spectrometer (OES)
- corrosion test chamber
- static and cyclic testing machines; force range from 1 kN to 25 MN, with temperature chambers, high-speed tensile testing machine up to 20 kN (15 m/s), pendulum impact tester
- ultrasonic testing devices (manual probes, dipping system)
- various radiological methods e. g. x-ray
- etc.





Who do we work for?

External customers

- industrial companies
- insurance corporations
- investigative bodies, for example detective squads, public prosecutors
- courts
- ministries
- ...

Contact:

Contact Person	phone	emphasis
Dr.-Ing. Christian Klinger: Christian.Klinger@bam.de	+49 30 8104 1533	Interdisciplinary Failure Analysis, Durability, Fatigue, Design
Dr.-Ing. Dirk Bettge: Dirk.Bettge@bam.de	+49 30 8104 1512	Fractography, visual macroscopic and microscopic examinations
Dr.-Ing. Tobias Mente: Tobias.Mente@bam.de	+49 30 8104 3730	Welding technology, hydrogen-assisted cracking