

HBM AWARD

Prize awarded to

Dipl.-Ing. Olaf Hertel
Dr.-Ing. Elisabeth Herz
Dr.-Ing. Rayk Thumser

for their work at the
Technische Universität Darmstadt, Germany, Fachgebiet Werkstoffmechanik
and
Materials Research and Testing Institute at Bauhaus University Weimar

“Structural durability of high pressure Diesel injection components”

The efficiency of Diesel engines generally increases with the injection pressure. These pressures have now exceeded 2000 bar. Engine components are therefore more and more autofretted to meet the fatigue life requirements. Despite that success there still exist demands for an increase of the fatigue strength which cannot be achieved by conventional actions. Especially for pressurised components it is not possible to significantly raise their strength by simply increasing the thickness. Using higher strength steels fails because this would require autofretting pressures of more than 10000bar. Applying such high pressures is not yet a possible process in mass production. One way out of the trap might be to change from a design for infinite to a design for finite life. This design requires a representative loading sequence for a component and experience with life prediction methods, as they are associated with large inaccuracies sometimes up to two orders of magnitude. Related research has been performed by the honoured team of scientists thus extending knowledge and skills of the industry in the field.

Dipl.-Ing. Hertel was responsible for the life simulations based on the strip yield model of the elastic plastic fracture mechanics. The model is well known for its capabilities to consider load sequence effects in variable amplitude loading. However, the most severe autofretting cycle which causes the highest life enhancing effect was not able to be considered adequately. Dipl.-Ing. Hertel introduced extensions by incorporating initial residual stresses and displacements.

Dr. Herz is among the first scientists who performed finite element based simulations of fatigue crack growth under variable amplitude loading of three-dimensional structures. A full simulation for realistic load sequences is beyond actual computer capacities. Simplifying assumptions had to be introduced without violating the damaging content of the sequence. Having achieved this, the important influence factors were considered in the simulations.

Dr. Thumser performed the experimental investigation improving both the strength of testing equipment and the accuracy of the control technique. Further, he advanced the non destructive inspection techniques for measuring initial fatigue crack growth at usually inaccessible bore intersections. He also carried out all fatigue life calculation based on the linear elastic fracture mechanics. Along the way he developed a new integration scheme for three-dimensional weight functions.

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Darmstadt, May 2011