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Analysis of the crack propagation in modern, integrally stiffened aluminium structures

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ABSTRACT

It is the objective of this presentation to show the development of assessment methods for the crack growth in integrally stiffened aluminum structures, which have been manufactured by means of Highspeed cutting (HSC), Laserbeam welding (LBW) or Friction Stir Welding (FSW). The idea is to use engineering methods for this purpose. Finite element results are just used for comparison.

The application is clearly directed to new metal structures. Due to the highly efficient manufacturing methods named above, the production of integrally stiffened structures becomes quite interesting. The main problem is the damage tolerance behaviour. This leads to the need to look more carefully at both, appropriate methods of calculation and phenomena which may occur in practice. This may lead to a wider application of such structures.

The result of the work is an engineering method which needs a relatively low computational effort compared to finite element methods etc. The method is based on existing procedures from literature expanded by additional routines for integrally stiffened cases as well as residual stresses (see fig. 2).

In principle the method is based on complex stress functions and an equation system, which is used to comply with compatibility of displacements. Cracked stiffeners are one of the main points which have to be included. The results show that the used approach is a successful way to handle the problem. Comparison with both, finite elements (see fig 1) and experiments are used to validate this point.

The influence of materials and residual stresses will be the focus of further work.

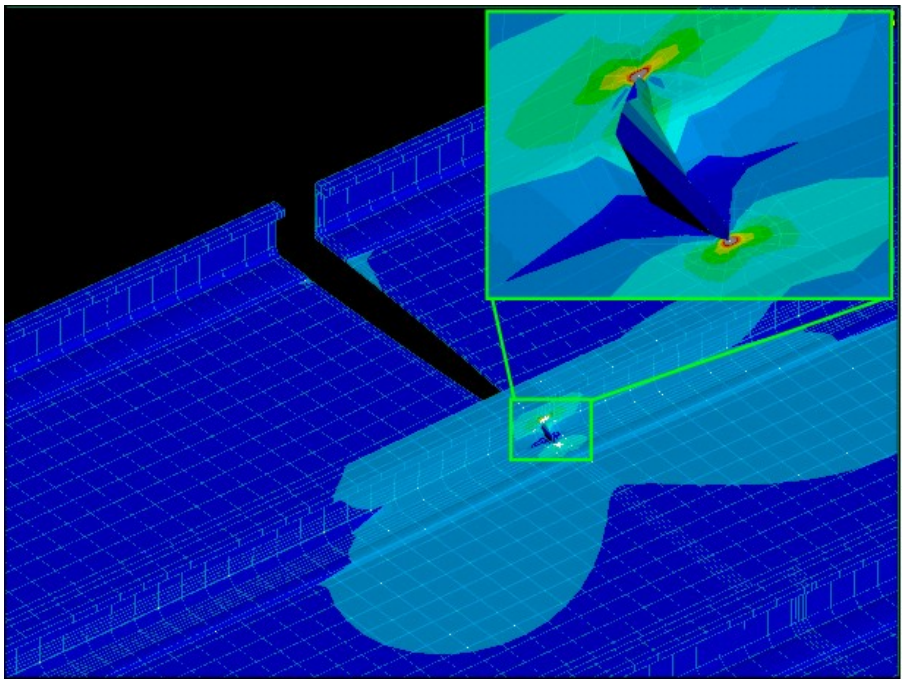

Figure 1 : Cracked Stiffener and Basic Sheet Material

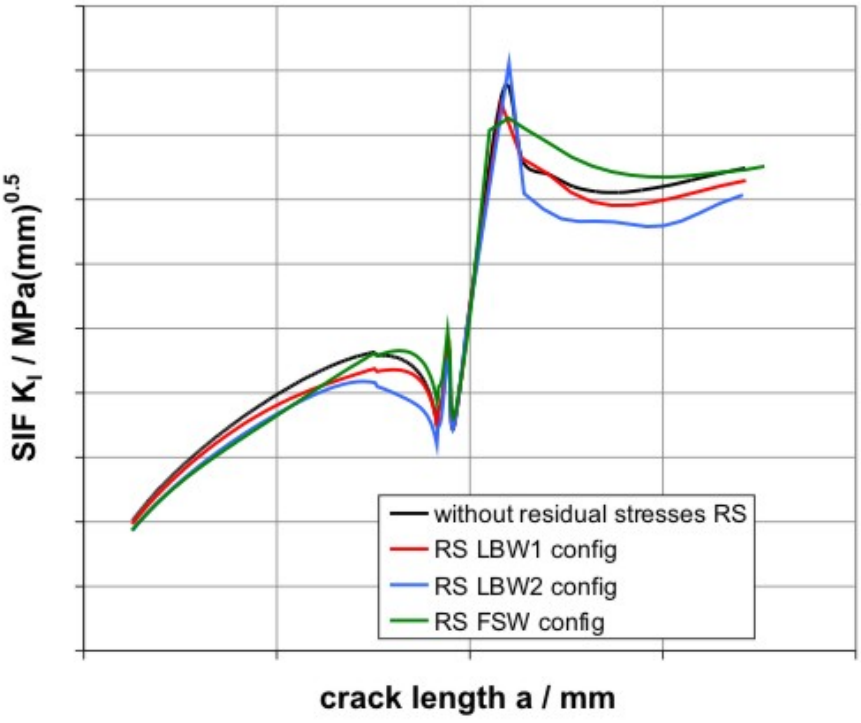

Figure 2 : K-Factors in the vicinity of a stiffener at different residual stress levels