StressCheck

Providing Industry-Leading Crack Modeling and DaDT Analysis Capabilities

When 3D surface flaws of any shape, size and orientation must be simulated in complex parts, and high-quality fracture mechanics parameters at any location along one or more crack front profiles must be computed, StressCheck® is the logical choice.

The Fracture Mechanics Analysis module provides the most reliable and robust methods in the industry for the computation of Stress Intensity Factors (SIF) and Energy Release Rates (ERR). StressCheck incorporates a superconvergent extraction, known as the Contour Integral Method[1], to compute SIFs, and calculates ERR modes using the J-integral. It is well known that a small error in the computed SIF can lead to a large error in the predicted crack growth life. Therefore, accurate and reliable computation of SIFs is of major importance whenever requirements for damage tolerance and residual strength must be met.

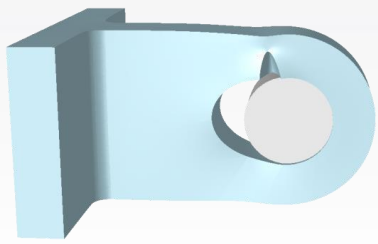
From automatic meshing of 3D cracks of any profile to point-and-click extraction of SIF's with automatic convergence information, StressCheck provides essential feedback to support crack growth analysis and advanced DaDT calculations. Once you solve a fracture mechanics problem with StressCheck, you won't want to use another FEA tool for that purpose again.

"When performing parametric structural analysis, ESRD's p-element StressCheck® FEA software is always my preferred choice due to the excellent solution quality, parametric framework, and superior computational efficiency. In fact, I recently used StressCheck® to generate stress intensity factors along a parametrically defined elliptical crack-tip across 3,000 unique geometric configurations. Considering multi-body contact was present and all simulations were performed using a laptop, this was a task well suited for StressCheck®."

-Dr. Lee Zambino, Villanova University

"Through the use of StressCheck® the A-10 Aircraft Structural Integrity Program's (ASIP) Analysis Group is able to model more accurately the physics of fatigue crack propagation in critical aircraft structure. Through this tool we are able to model, analyze and predict failure of aircraft structure and then develop crucial inspection and maintenance plans to ensure the safety and sustainability of our nation's warplanes. Without the analysis capability provided to us through StressCheck® we would not be able to provide accurate assessments of the A-10 structure to top USAF leadership."

-SWRI Research Engineer, Southwest Research



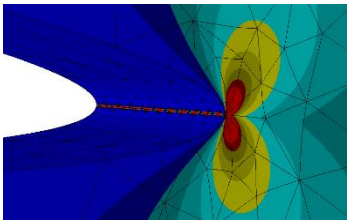
FRACTURE MECHANICS ANALYSIS

[1]*Computation of the amplitude of stress singular terms for cracks and reentrant corners*, Szabó B and Babuska I., Fracture Mechanics: Nineteenth Symposium ASTM STP 969. T. A. Cruse, Ed., American Society for Testing and Materials, Philadelphia (1988) 101–124.

StressCheck

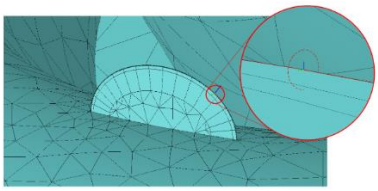
StressCheck® offers the most reliable and robust methods for SIF computation in the industry. From unique modeling capabilities, to advanced analysis technology, to powerful post-processing functions, StressCheck is the tool for reliable, detailed stress analysis. See why the Fracture Mechanics Analysis module can be one of the most important tools in your design and analysis toolbox.

FRACTURE MECHANICS ANALYSIS MODULE

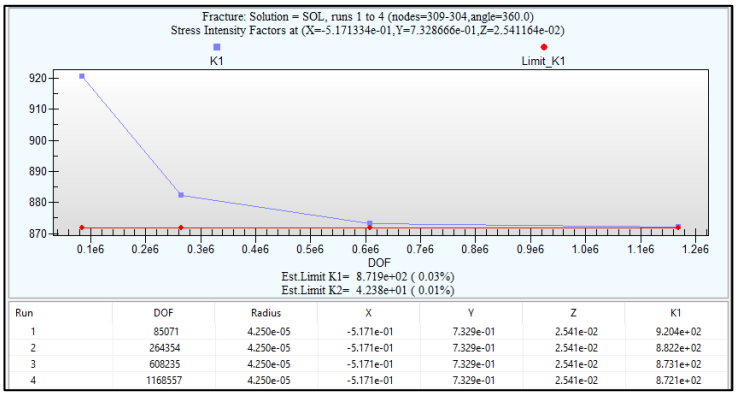


The Fracture Mechanics Analysis module offers unique features that clearly set StressCheck apart from other FEA products. These include automatic meshing of 2D and 3D components with embedded thru- or part-thru cracks, and powerful post-processing capabilities such as point-and-click extractions of SIF/ERR at the crack tip for 2D models and along the crack front for 3D models, all with feedback regarding solution quality. This feedback is essential when the predicted crack growth life is highly sensitive to small errors in the SIF/ERR.

StressCheck supports computation of the following DaDT quantities:



- Mode 1 and mode 2 stress intensity factors, K1 & K2, and the T-stress for cracks in linear-elastic materials (2D, 3D, axisymmetric).
- J-integral for cracks in elasto-plastic fields (2D) and orthotropic materials (2D and 3D).
- SIFs for cracks growing from filled holes. Use multi-body contact analysis to simulate the effects of interference-fit fasteners and press-fit bushings.



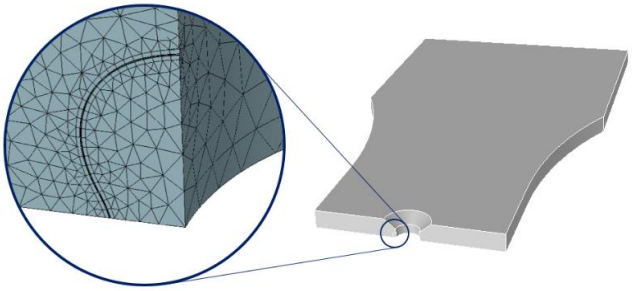
Run	DOF	Radius	X	Y	Z	K1
1	85071	4.250e-05	-5.171e-01	7.329e-01	2.541e-02	9.204e+02
2	264354	4.250e-05	-5.171e-01	7.329e-01	2.541e-02	8.822e+02
3	608235	4.250e-05	-5.171e-01	7.329e-01	2.541e-02	8.731e+02
4	1168557	4.250e-05	-5.171e-01	7.329e-01	2.541e-02	8.721e+02

Figure 1. SIF convergence at a selected crack front location

ADVANCED CRACK FRONT AUTOMESHING AND MODELING OF ARBITRARY CRACK SHAPES

With StressCheck you can embed a crack in a solid CAD body and invoke the automesher to recognize the crack face and generate a graded mesh refinement towards the crack front to ensure an adequate number of degrees of freedom in the extraction zone. Additionally, StressCheck utilizes a mixed element boundary layer mesher to apply pentahedral and hexahedral elements to the crack front to minimize element distortion and maintain a high-quality solution in the vicinity of the crack. This leads to a high degree of accuracy in SIF calculations.

The crack is modeled as a parametric body unioned into the solid body. When the user updates a parameter value to change the crack dimensions, the body is automatically remeshed. This facilitates the simulation of crack propagation from a corner crack to a though-the-thickness crack using a single model.



Extraction of SIFs by the contour integral method is made easy with StressCheck's automatically calculated mesh and extraction parameters. Based on the local geometry of the crack, StressCheck calculates the optimal meshing parameters for efficient calculation of high-accuracy results. During extraction, StressCheck will automatically calculate the necessary radius of integration for best results based on the provided mesh inputs.

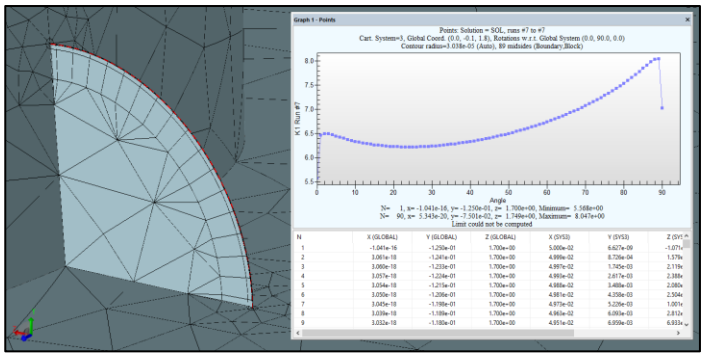


Figure 2. SIF distribution along the selected crack front

COM API AUTOMATION CAPABILITY

For enhanced fracture mechanics analysis and to further integrate these capabilities into your environment, you can connect StressCheck's COM API and the Fracture Mechanics Analysis module with your own or third-party crack initiation and crack growth programs, or automate DaDT solutions via Python/Microsoft Excel VBA scripting.

www.esrd.com esrd 314-744-5021

Engineering Software Research & Development, Inc. • 111 West Port Plaza, Suite 825 • St. Louis, MO 63146