Fracture Mechanics

Good material selection, sound manufacturing procedures and appropriate levels of inspection are all aspects that are used to protect against defects in structures. Whilst this is the goal of modern design codes, the presence of crack like defects, especially in welds cannot always be avoided.

The presence of defects may require costly and time consuming repair or replacement, but this may not always be the case. Fracture mechanics techniques can be employed to assess crack like defects (real or theoretical), in order to provide manufacturing concession or to demonstrate continued structural integrity of the structure or component.

EASL's staff have a wealth of knowledge and experience in fracture assessment built up over many years working in a range of industries, with a particular expertise in the Nuclear power generation industry.

EASL can offer a range of cost effective solutions to problems associated with structures and components with defects, or to demonstrate a tolerance to postulated defects to meet safety requirements and regulations.

What is fracture assessment?

Fracture assessment is a process of using fracture mechanics to evaluate the structural integrity of a structure, system or component with theoretical (postulated) defects or existing defects formed through manufacturing or plant operation. The results of this can provide a client with a clear insight into cost-effective solutions to preventing fractures and defects causing unnecessary and avoidable issues.

Whether for an existing defect or a theoretical one, the approach taken is tailored specifically to each particular subject. For a component or structure with an existing defect, the defect shape will usually be irregular, making assessment potentially difficult. The defect can instead be idealised, using established procedures, as a regular shaped defect that is more easily assessed, allowing for a bounding assessment with consistent reliable results.

In addition to knowledge of the geometry of the component and the idealised defect, the loading and key material properties are needed, the latter normally available via materials standards. This provides a clear environmental context for each assessment, taking into account real world conditions for realistic assessment.

Linear elastic fracture mechanics (LEFM) or elastic-plastic fracture mechanics (EPFM) techniques can then be employed to determine a limiting defect size, the size of defect required to cause failure.

Crack growth calculations can be used to indicate whether the defect will grow to reach the limiting defect size within the required life of the component, informing decisions on whether repair or replacement may be required or whether a justification to end-of-life can be made.

EASL's Fracture Assessment Service

EASL have extensive experience in the use of a wide range of fracture assessment standards and procedures, including:

- R6
- R5
- RSE-M Appendix 5.4
- RCC-M Annex ZG
- BS 7910
- Other now superseded British standards such as PD 6493 and PD 6539

The appropriate assessment approach is always client and problem dependent and is carefully selected, with agreement with the client, to best provide an efficient and cost effective solution to the problem.

We offer a range of solutions and assessment techniques which include the following:

- Simple hand calculations using LEFM theory and classical stress intensity factor (SIF) solutions.
- Assessment using the standards and procedures listed above based on standard SIFs and collapse solutions for simple geometries available directly within the standards/procedures or published literature.
- Assessment using the R6 software R-Code.
- Use of linear elastic uncracked body FEA of more detailed features to provide stress input to assessments using the standards and procedures listed above.
- Use of uncracked body and cracked body FEA (2D axisymmetric or full 3D) to determine SIFs and collapse solutions for more detailed geometries, then used in assessments via the standards and procedures.
- Full inelastic cracked body FEA (2D axisymmetric or full 3D) J-integral analysis.

If you'd like to find out more about our previous work, take a look below at our case studies. If you'd like to find out more about our related services, take a look below at our solutions and other services. To see how EASL can help with your fracture mechanics needs, contact us on enquiries@easl-stress.co.uk.

Related Services

- Corrosion
- Safety Case
- Creep Fatigue Crack Growth