MPM Technologies, Inc.

Finite Element/Fracture Mechanics

INTRODUCTION

MPM offers a wide range of analytical and experimental services in the fields of applied mechanics and fracture mechanics. In addition to finite element and elastic/elastic-plastic fracture analyses, MPM's laboratory capabilities can be used to verify model predictions and to test theories by building prototypes.

THERMAL AND STRESS

MPM employs a variety of numerical and analytical methods for the thermal and stress analysis of equipment and structures. General purpose commercial software such as ABAQUS or ADINA can be used or, when appropriate, special purpose proprietary software such as WELD3 and DYN3D can be used. Linear elastic, elastic-plastic, and visco-plastic material behavior can be analyzed. Loading can be thermal, static, or dynamic.

FRACTURE MECHANICS ANALYSIS

Fracture mechanics analysis is used to understand crack growth and fracture behavior. Crack growth behavior due to fatigue, stress corrosion, creep, or some combination thereof can be simulated and predicted with the appropriate software and experimental data. Fracture occurs when a crack reaches its critical size. The critical crack size depends on the material's temperature dependent fracture toughness, the location and orientation of the crack, and the applied loads. Fracture can involve very little plastic deformation (brittle fracture) or very significant plastic deformation (ductile fracture). If the material has very high fracture toughness properties, the final failure may be due to plastic collapse rather than fracture. Due to the inherent complexities, fracture mechanics analyses often involve the use of more than one software tool. Simulation of crack growth via fatigue, stress corrosion, or creep typically requires the use of special purpose software. On the other hand, general purpose finite element thermal and stress analysis software can often be used to calculate critical crack sizes. However, special purpose

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proprietary software such as ALT3D can sometimes provide significant advantages over general purpose finite element software, even in the critical crack size calculations. With the wide range of analysis capabilities available, MPM can tailor the analysis approach to the special requirements of the problem. This results in greater accuracy and efficiency.

WELDING ANALYSIS

Many equipment and structural failures occur in or near weld joints. These failures can be due to poor weld design but are more often due to weld defects and/or a sensitivity of the weld material to fatigue or stress corrosion cracking. A common third factor in weld failures is that weld materials often exhibit lower fracture toughness than the neighboring base metal. Fatigue and stress corrosion cracking behavior are affected by residual stresses as well as applied service loads. Since the welding process typically leaves residual stresses that are on the order of the material's yield stress in or near the weld, any analysis of crack growth must include the effects of these stresses. MPM can use the proprietary WELD3 finite element software to simulate the welding process and to calculate residual welding stresses. These residual stresses are typically a key input to weld fracture mechanics analysis.

FOR MORE INFORMATION

If you would like a price quotation or additional information concerning MPM's services or products, please contact us at the below listed address:

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