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Effect of temperature and adhesive defect on repaired structure using composite patch

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Abstract
In structural engineering, composite patch repairs are widely used to address cracked structures. However, their behavior under thermo-mechanical loading remains complex and less understood. This study examines the repair of a center-cracked plate subjected to both mechanical and thermo-mechanical environments, using finite element analysis in ANSYS. The repair effectiveness is evaluated using the Stress Intensity Factor (SIF) at the crack tip. Findings reveal that increased temperature substantially elevates SIF values. Boron/epoxy patches are most effective under mechanical loading, yielding the lowest SIF, while graphite/epoxy patches excel under thermo-mechanical loading due to their lower Coefficient of Thermal Expansion (CTE). Patch thickness influences SIF differently based on loading conditions; thicker patches decrease SIF under mechanical loading but increase it under thermo-mechanical loading. Furthermore, adhesive defects, particularly at the crack tip, markedly increase the risk of adhesive failure, especially under thermo-mechanical conditions. This research underscores the significant impact of temperature variations on the efficiency of structural repairs, contributing to a deeper understanding of composite patch repair performance in cracked structures.

Author Keywords
adhesive defect; Aluminium; composite patch; finite element stress analysis; stress intensity factor; thermal analysis

Index Keywords
Adhesives, Aluminum graphite composites, Cracks, Graphite epoxy composites, Hydroelasticity, Pressure vessels, Stress analysis; Adhesive defect, Composite patch repairs, Composite patches, Cracked structures, Finite element stress analysis, Mechanical loading, Stress-intensity factors, Thermal, Thermo-mechanical, Thermomechanical loading; Stress intensity factors

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