Overview

This special technical publication (STP) includes papers submitted and accepted from the Symposium on the Effects of Product Quality and Design Criteria on Structural Integrity, which was held in St. Louis at the Regal Riverfront Hotel on 5 May, 1997. The first half of the symposium focused on the benefits to be gained (in terms of reduced life-cycle costs and increased performance) from improvements in the initial quality of engineering materials, components, and structures. Today's fatigue-critical structures are being designed closer to design limits than ever before. Small initial flaws or defects in these structures may go undetected in routine nondestructive inspections, and yet they may substantially reduce safe operating lifetimes. Initial quality improvement represents an attractive means for minimizing the high costs associated with nuisance in-service fatigue cracking problems and increasing the reliability of these components within their normal operating envelope.

The first six papers included in this STP address different aspects of product quality as it relates to structural integrity. The paper by Bhansali, et al., shows the influence that changes in production processing had on the susceptibility to corrosion damage and loss in fatigue strength of a laminated high-strength stainless steel assembly. The next paper, by Nikbin, addresses the challenge of achieving structural integrity in high-temperature applications using fracture mechanics methodologies, and in this instance at least, shows the primary sources of variability in crack growth rates to be due to fabrication methods, testing practices, and basic material creep properties. The paper by Rice and Deschapelles describes the marked improvements in fatigue resistance of 7050 thick plate that were achieved through reductions in mid-plane microporosity. The article by Stephens, et al., addresses another quality issue, specifically the influence of density and porosity size and shape on the fatigue properties of a high-strength powder metallurgy steel. Tipton's paper focuses on the complexities of assessing the low-cycle fatigue quality of a coiled tubing product. And finally, the paper by Champagne includes a graphic description of performance problems that can occur in a nickel base fastener system and provides practical guidance on steps that can be taken to alleviate these quality problems.

The last five papers in this STP address the influence of design criteria on structural integrity. The paper by Duffy describes an investigation of the effects of changes in plating and shot peening design criteria on the fatigue properties of 4340 steel plate. The next paper, by Petrou and Perdikaris, examines the influence of design criteria on the fatigue behavior of scale-model reinforced concrete bridge decks subjected to moving loads. The paper by Séméte, et al., describes a fracture mechanics analysis that was completed on cast duplex stainless steel elbows containing surface cracks of varying depth. The article by Watanabe describes some of the design criteria and analysis procedures that have been used to develop and maintain reliable commercial transport aircraft. And finally, the paper by Wiesner and Scheumann addresses the design criteria currently used with low-temperature storage tanks to ensure crack arrest and avoid brittle failure.

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