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# Using the Neuber Plot to Account for the Effects of Scatter, Corrosion and Welding in Strain-Life Fatigue Test Data

*F.A. Conle and J.J.F. Bonnen*

Ford Research and Innovation Center
Deaborn, MI, USA

ABSTRACT

The Neuber plasticity correction factor has been used to postprocess the linear elastic finite element results to estimate the plasticity in ground vehicle structures for many years. The technique has been a reliable standard tool for prediction of service life in structures subjected to variable amplitude loading for several decades. The equivalence of the calculated elastic stress-strain energy and the material's real cyclic elastic-plastic stress-strain energy, which is the basis of the technique, also provides a convenient tool for quantifying the effects of other material test conditions. The effects of welding and corrosion on the fatigue performance of axial samples can be expressed through the Neuber parameter, which is used here to identify the performance change as a form of additional stress concentration. Similarly the boundaries generated by statistical scatter of life results when merging many strain controlled fatigue tests are described by the same technique. The present study shows how these features are explained using the Neuber approach and how the characteristics of the data may be incorporated into the fatigue software/analysis techniques of engineering design groups.

KEY WORDS: Metal Fatigue; Neuber; Strain; Stress; Corrosion; Statistics; Welds

## 1 INTRODUCTION

Elastic stress analysis has always been a mainstay of engineering design. Since the 1950s it has been recognized that local plasticity concentrated at stress raisers must be quantified for accurate and efficient design of cyclically loaded structures, especially those subjected to variable amplitude loading where a few cyclic loads cause local stresses to exceed the cyclic yield limit and which substantially influence the resulting fatigue life.

Therefore, for fatigue design purposes, methods must be applied which translate the elastic stress analysis of structures into reasonable estimates of elastic and plastic local stress-strain behavior at

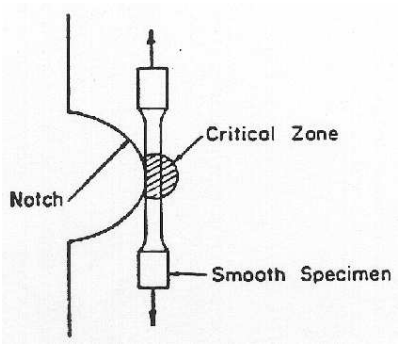


Fig. 1: The local stress-strain approach for calculating the durability at the fatigue critical location.

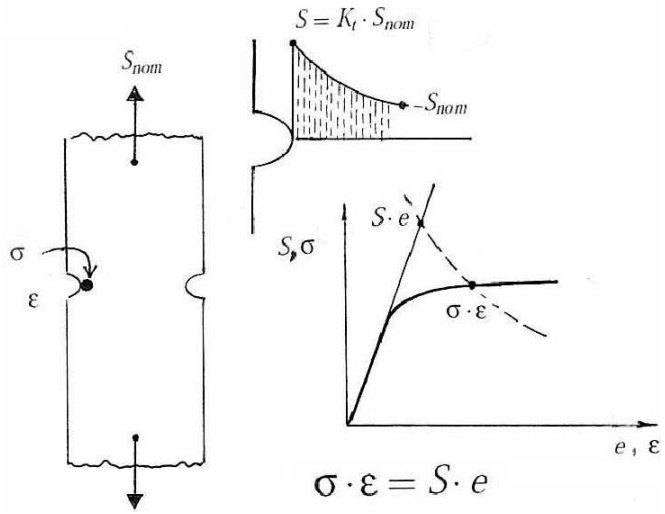


Fig. 2: Transformation of elastic stress calculations into elastic-plastic stress-strain equivalents at fatigue critical locations.