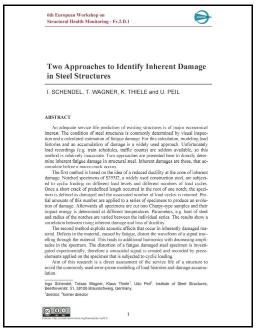
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Two Approaches to Identify Inherent Damage in Steel Structures

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ABSTRACT

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An adequate service life prediction of existing structures is of major economical interest. The condition of steel structures is commonly determined by visual inspection and a calculated estimation of fatigue damage. For this calculation, modeling load histories and an accumulation of damage is a widely used approach. Unfortunately load recordings (e.g. train schedules, traffic counts) are seldom available, so this method is relatively inaccurate. Two approaches are presented here to directly determine inherent fatigue damage in structural steel. Inherent damages are those, that accumulate before a macro crack occurs.

The first method is based on the idea of a reduced ductility at the zone of inherent damage. Notched specimens of S355J2, a widely used construction steel, are subjected to cyclic loading on different load levels and different numbers of load cycles. Once a short crack of predefined length occurred in the root of one notch, the specimen is defined as damaged and the associated number of load cycles is retained. Partial amounts of this number are applied to a series of specimens to produce an evolution of damage. Afterwards all specimens are cut into Charpy-type samples and their impact energy is determined at different temperatures. Parameters, e.g. heat of steel and radius of the notches are varied between the individual series. The results show a correlation between rising inherent damage and loss of ductility.

The second method exploits acoustic effects that occur in inherently damaged material. Defects in the material, caused by fatigue, distort the waveform of a signal travelling through the material. This leads to additional harmonics with decreasing amplitudes in the spectrum. The distortion of a fatigue damaged steel specimen is investigated experimentally, therefore a sinusoidal signal is created and recorded by piezo-elements applied on the specimen that is subjected to cyclic loading.

Aim of this research is a direct assessment of the service life of a structure to avoid the commonly used error-prone modeling of load histories and damage accumulation.

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Ключевые слова:

Содержание.

Abstract
Introduction
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Approach 2 – nonlinear acoustic effects
Conclusions