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Journal of Mechanical Science and Technology
Volume 23, Issue 8, August 2009, Pages 2149-2156

ISSN: 1738494X
DOI: 10.1007/s12206-009-0622-y
Document Type: Article
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Fatigue life estimation of MD36 and MD523 bogies based on damage accumulation and random fatigue theory

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Abstract

Bogies are one of the multifunctional parts of trains which are extremely subjected to random loads. This type of oscillating and random excitation arises from irregularities of the track including rail surface vertical roughness, rail joints, variance in super-elevation, and also wheel imperfections like wheel flats and unbalancy. Since most of the prementioned sources have random nature, a random based theory should be applied for fatigue life estimation of the bogie frame. Two methods of fatigue life estimation are investigated in this paper. The first approach which is being implemented in time domain is based on the damage accumulation (DA) approach. Using Monte-Carlo simulation algorithm, the rail surface roughness is generated. Finite element (FE) model of the bogie is subjected to the generated random excitation in the first approach and the stress time histories are obtained, and consequently the fatigue life is estimated by using the rain-flow algorithm. In the second approach, the fatigue life is estimated in frequency domain. Power spectral density (PSD) of the stress is obtained by using the FE model of the bogie frame and the fatigue life is estimated using Rayleigh technique in random fatigue theory. A comprehensive parametric study is carried out and effects of different parameters like the train speeds and level of the rail surface vertical roughness on the estimated fatigue life are investigated. © KSME & Springer 2009.

Language of original document

English

Author keywords

Damage accumulation; Fatigue life; Monte-Carlo simulation; Rain-flow algorithm; Random vibration

Index Keywords

Bogie frames; Damage accumulation; Fatigue life; Fatigue life estimation; FE model; Finite element models; Flow algorithm; Frequency domains; Monte-Carlo simulation; Parametric study; Rail joint; Rail surfaces; Random excitations; Random fatigue; Random load; Random vibration; Rayleigh; Stress time; Time domain; Train speed; Wheel flat

Engineering controlled terms: Algorithms; Bogies (railroad rolling stock); Estimation; Flow simulation; Locomotives; Monte Carlo methods; Parameter estimation; Power spectral density; Railroad cars; Rain; Simulators; Surface roughness; Wheels

Engineering main heading: Fatigue damage

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Volume 23, Issue 8, August 2009, Pages 2149-2156

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