Fatigue life estimation of MD۳۶ and MD۵۲۳ bogies based on damage accumulation and random fatigue theory

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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