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A novel spectral moments equivalence based lumping block method for efficient estimation of offshore structural fatigue damage

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Abstract: This paper provides a novel lumping block equivalence method, termed as *spectral moments equivalenc*e (SME) based method, to improve the efficiency of fatigue assessment in preliminary design stage. In the newly SME method, an equivalent equation of representative sea state's spectral wave energy and original sea state's spectral wave energy is set up in the fatigue equivalence viewpoint. The relations of wave parameters and wave spectral moments are introduced into the SME method to determine the equivalent significant wave height and up-crossing wave period of the representative sea state. A key feature of the SME method is that the effect of S-N curve's slope and quantity of sea state in lumping block is incorporated into the equivalent formulae to make the method applicable to different lumping block partitions and fatigue curves. In addition, the SME method also has advantage of preserving the stochastic characteristics of sea states. Cumulative fatigue damage of fixed and floating offshore platforms are generated to verify the validity and applicability of the SME method. Numerical results indicate that the SME method not only yields the most accurate fatigue assessment but also has robustness to block partitions and offshore structures.

Keywords: offshore platform; fatigue assessment; lumping block method; wave spectral moments; fatigue equivalence principle

1. Introduction

The offshore platforms are exposed to a multiple of sea states during their service life which may cause seriously accumulative fatigue damage and lead the offshore structure to fatigue failure even if the stresses in the critical regions smaller than the elastic limit [1]. Nowadays, the fatigue damage has

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