

9. Statistical Method for Evaluating the Energy Response of Structures Exhibiting Nonlinear Hysteresis Subjected to Nonstationary Input Motion

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In energy balance-based seismic resistant design, the energy response of the structure in the event of an earthquake is a key value in evaluating seismic performance. Precise, accurate predictions of future earthquake motions are notably difficult. Evaluating seismic performance requires consideration of seismic motion based on probability theory and statistical evaluations of structural response.

This paper presents a method for evaluating systems characterized by multiple degrees of freedom to evaluate statistical values (mean and variation) of total input energy and damaging energy due to random phases based on random vibration theory. The paper presents, as a contribution to fundamental research on related issues, a method for evaluating energy response based on elastoplastic single-degree-of-freedom systems. Monte Carlo simulations confirmed the validity of the proposed method. The expected value and coefficient of variation of energy response are sensitive to the natural period of the structure and to the shape of the amplitude envelope of the ground motion applied.

Key words: energy response, random response analysis, nonlinearity, non-stationarity