

Accelerated Structural Reliability Analysis under Earthquake-Induced Tsunamis by Advanced Stochastic Simulation

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Abstract : Recent earthquake-induced tsunamis in Padang, 2004 and Tohoku, 2011 brought huge losses of lives and properties. Maintaining vertical evacuation systems is the most crucial strategy to effectively reduce casualty during the tsunami event. Thus, it is of our great interest to quantify the risk to structural dynamic systems due to earthquake-induced tsunamis. Despite continuous advancement in computational simulation of the tsunami and wave-structure interaction modeling, it still remains computationally challenging to evaluate the reliability (or its complement failure probability) of a structural dynamic system when uncertainties related to the system and its modeling are taken into account. The failure of the structure in a tsunami-wave-structural system is defined as any response quantities of the system exceeding specified thresholds during the time when the structure is subjected to dynamic wave impact due to earthquake-induced tsunamis. In this paper, an approach based on a novel integration of the Subset Simulation algorithm and a recently proposed moving least squares response surface approach for stochastic sampling is proposed. The effectiveness of the proposed approach is discussed by comparing its results with those obtained from the Subset Simulation algorithm without using the response surface approach.

Keywords : response surface model, subset simulation, structural reliability, Tsunami risk

Conference Title : ICRSS 2014 : International Conference on Reliability and Structural Safety

Conference Location : Venice, Italy

Conference Dates : November 13-14, 2014