



Seismic Reliability Analyses of Timber-Steel-Hybrid System

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Summary:

Reliability analyses are of great importance in performance-based seismic structural design as there are inherent uncertainties in both the actions (earthquakes) and the reactions (properties of the structural systems). In this paper, reliability analyses are performed on the “Finding the Forest Through the Trees” (FFTT) system, a novel timber-steel hybrid system. The FFTT system utilizes engineered timber products to resist gravity and lateral loads with interconnecting steel members to provide the necessary ductility for seismic demands. An improved response surface method with importance sampling is used to perform reliability-based seismic analyses. Peak inter-storey drift is selected as the main performance criterion as it is typically an indicator of overall damage to the structure. Uncertainties involving ground motions, weight (mass), stiffness and connection properties of the lateral load resisting system are considered in formulating the performance functions. A series of nonlinear dynamic analyses is run to generate the response database and the reliability index is evaluated using first-order reliability method (FORM) and importance sampling (IS) methods. The results show that the ductility reduction factor does not significantly influence the reliability index, while the structural weight and the hold-down stiffness play significant roles.

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