

Seismic Performance Degradation of Inclined Asymmetric Ancient Timber Structures

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Abstract

Severely inclined ancient timber structures require immediate and scientifically informed reinforcement. Prior to designing such reinforcements, it is essential to clarify their seismic performance, as this aspect has not been thoroughly documented. To simulate the inclined state, the floor beam surface was cut into an inclined plane. Quasi-static tests were performed on three asymmetric timber structures with varying degrees of inclination. The influence of inclination was evaluated based on rotational deformation, slip, embedment, uplift, bearing capacity, lateral stiffness, and energy dissipation and storage capacities. The results revealed that inclination reduced the safety margin for rotational deformation. Additionally, the distribution and magnitude of slip and embedment were significantly altered, diminishing the seismic isolation effect at the column bottom, while increasing slip at the LuDou. Furthermore, the deformation state and load transfer path were modified, leading to reduced safety redundancy. The effectiveness of the high-level energy storage mechanism gradually declined, and the self-centering capability was severely compromised. It is recommended to intensify monitoring of column and LuDou deformations. Reinforcement designs should prioritize enhancing bearing capacity, stiffness, and deformation capability.