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Seismic performance of historical composite structures in Asian regions

By Prof. Yohei Endo, Director International Institute for Sustainability and Circular Economy (ISCE), Shinshu University

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FOR INFO: michele.betti@unifi.it

This mini talk introduces my recent research contributions on the seismic analysis of historical structures. As part of the Japanese government-funded projects, I have been involved with the restoration of heritage structures affected by large earthquakes in Nepal and Japan. In Nepal, multi-tier pagodas are built of masonry walls and timber elements. The connections between masonry walls are improved by timber columns and beams placed in the walls.

Nonetheless, they were severely damaged by the 2015 Gorkha earthquake (Mw 7.9). Post-earthquake damage surveys suggested that damage in the pagodas were derived from poor quality materials due to the lack of maintenance, insufficient connections between structural elements and inadequate past interventions. In Japan, few historical structures are built of masonry. However, in Hokkaido, dozens of masonry structures exist and they are often combined with timber elements. Timber columns are placed on the interior side of masonry walls and they were coupled by horizontal timber ties. The connections between the columns and walls are provided by iron pegs. Although the contributions of such timber columns were considered substantial, some of them were severely damaged by the 2018 Iburi earthquake (6.6 Mw).

Considering these backgrounds, in both cases, I carried out numerical analysis with a focus on the interaction between masonry walls and timber elements. Numerical models were discretised based on health monitoring tests and laboratory tests. This talk illustrates the seismic performance of timber-masonry composite structures and discusses appropriate approaches to the implementation of timber-masonry interaction in numerical analysis.

Yohei Endo/ 遠藤　洋平
Head, International Institute for Sustainable Development and Circular Economy Studies (IISDCES), Shinshu University