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Multi-Scale Modeling of Timber-Frame Structures

C. Boudaud, J. Baroth, and L. Daudeville*

University Joseph Fourier – Grenoble 1, Grenoble INP, CNRS UMR 5521
3SR Laboratory, BP53, 38041 Grenoble Cedex, France

*Corresponding author: laurent.daudeville@ujf-grenoble.fr

Timber-frame buildings are characterized by the use of metal fasteners in which dissipation phenomena are localized.

Three scales are defined, the joints (scale 1), the structural elements (shear walls, floors, and roofs - scale 2) and the building (scale 3). More than 300 results of tests performed on joints with metal fasteners are used to calibrate the law at scale 1. A detailed finite elements (FE) model of shear wall is developed and validated by means of simulations of 16 quasi-static and 12 dynamic tests. A simplified FE model of shear wall (macro element) is used to generate a numerical model at the building scale. This macro element, calibrated on the detailed FE model, accurately reproduces the dynamic behavior of a shear wall despite its simplicity. The numerical model of timber-frame buildings will be used to study their behavior under seismic.

Keywords: timber-frame structures, multi-scale, finite element, computational modeling, seismic response