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Study of load-bearing timber-wall elements using experimental testing and mathematical modelling

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ABSTRACT

Combining timber and glass in the wall elements of the building envelope with the proper orientation of such transparent façade elements enables the utilization of solar energy for heating and internal illumination of the building. However, the asymmetrical layout of timber-glass wall elements in such buildings can result in problems with the horizontal stability of the structure, so their participation to load-bearing capacity of the structure is usually neglected. The study deals with solutions for such elements as horizontal load-bearing members with proper connection details. First, specifically developed timber-glass wall elements were experimentally tested under monotonic and cyclic horizontal point load, and further in combination with classical timber-framed wall elements implemented into special single and two-storey box-house models, which were further experimentally tested on the shaking table. In the second part as the main goal of the study, a quite simple mathematical model of the box-house prototypes is developed using a fictive diagonal element for simulating the racking stiffness of the bracing timber-glass wall element. The calculated results for the 1st vibration period are compared with the previously measured experimental results to prove an accuracy of the developed model. Finally, a linear time-history calculation is done as a sample presentation of the developed mathematical model using Landers acceleration spectrum. The developed mathematical model enables a simple and effective seismic response calculation of timber buildings considering the developed timber-glass wall elements as load-bearing bracing elements against horizontal load actions. The model can also be recommended for using in further parametric numerical academic studies analysing the influence of various parameters.

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