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# SEISMIC PERFORMANCE OF STRUCTURES MADE IN KLH SYSTEM

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| **General Project:** | **EVALUATION OF RACKING STRENGTH OF KLH SYSTEM** |
| **Contract:** | **KLH - UL FGG, No. 622-2004 – Industrial project with Annexes** |
| **Investor:** | **KLH Massivholz GmbH**<br>**A-8842 Katsch/Mur 202, Austria** |

KLH Massivholz GmbH, A-8842 Katsch/Mur 202, Austria, has agreed by Contract No. 622-2004 dating 1. November 2004, to a project titled "Evaluation of racking strength of KLH system" carried out at University of Ljubljana, Faculty of Civil and Geodetic Engineering (UL FGG), Jamova 2, SI-1000 Ljubljana, Slovenia.

The task of this contract and its annexes was experimental evaluation of racking strength of KLH wall panels that are the basic elements of KLH building structural system together with their connecting elements as screws, anchors in RC foundations and KLH floors. Testing was performed using the test set-up constructed at the UL FGG structural laboratory and specially designed for racking testing of panels under different boundary conditions and different constant vertical loading. Construction parts representing connection between KLH elements and with RC foundation were tested with dynamic servo-hydraulic actuator Roell Amsler HA100. The main purpose of testing was to study the mechanism of behaviour of anchored panels exposed to monotonous and cyclic horizontal loading and to obtain the necessary data needed for design of earthquake resistant buildings composed of KLH wall panels and KLH diaphragms. The original testing program, as defined in Contract, was greatly extended in number of tested specimens in order to obtain the complete insight in influence of different parameters on racking behaviour of wall panels. Test results are explained in number of partial reports.

Wall panels of dimension 244/272/9.4 cm and 320/272/9.4 cm have been tested by monotonous and cyclic horizontal load in combination with constant vertical load. Monotonous horizontal load was applied following the EN 594 protocol, where testing by cyclic load followed EN 12512. The influence of anchoring systems on shear stiffness and strength of timber wall panels was studied.

Wall panels with door and various window openings have been tested by monotonous and cyclic horizontal load in combination with constant vertical load. Cyclic horizontal load was applied following the EN 12512 and SAC protocol. The influence of opening size and shape on shear stiffness and strength of timber wall panels was studied.

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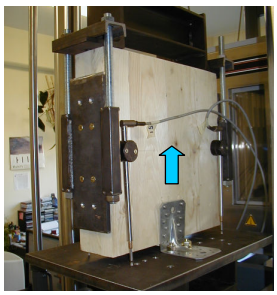
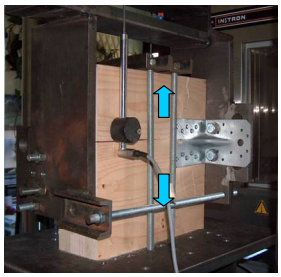
Seismic and dynamic tests on two KLH models were performed at Institute for Earthquake Engineering (IZIIS) in Skopje, Macedonia. The scope of dynamic research on KLH wall panels was experimental determination of the natural frequencies of the model, sinusoidal dynamic tests with lower amplitudes, seismic tests-earthquakes with low and high acc. peaks, sinusoidal dynamic tests with higher amplitudes, random vibration tests after each seismic excitation and inspection of damages of the model.

Evaluation of cyclic response of wall-to-foundation corner connection in KLH construction system - uplifting due to tension force; quasi-static half cyclic test method according to European Standard EN 12512 for derivation of parameters which are required in seismic design of timber structures.



Evaluation of cyclic response of wall-to-foundation corner connection in KLH construction system – horizontal sliding due to shear force; quasi-static cyclic test method according to European Standard EN 12512 for derivation of parameters which are required in seismic design of timber structures.



Evaluation of cyclic response of wall-to-wall screwed connection in KLH construction system; quasi-static reversed-cyclic test method according to International Standard ISO 16670 for derivation of parameters which are required in seismic design of timber structures.

The tested wooden panels have relatively high stiffness and load-bearing capacity. Therefore, the critical elements that govern the KLH structure response to earthquake excitations are fasteners connecting KLH panels together and anchors connecting all building structure with foundation. The test results provide the basic data on stiffness and strength of all tested construction parts and differences between monotonic and cyclic response.

**All these experimentally obtained mechanical properties of entire KLH structure make possible the seismic design of KLH system according to EC8.**

Investigator in charge:
Dr. Bruno Dujič

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