World Construction Forum 2019
BUILDINGS AND INFRASTRUCTURE RESILIENCE
Ljubljana, Slovenia
8 – 11 April 2019
WFEO / FMOI
IZS
Univerza v Ljubljani
Fakulteta za gradbeništvo in geodezijo

OPTIMIZATION TEST STUDY OF CONNECTIONS AND JOINTS BETWEEN ELEMENTS OF THE HYBRID TIMBER-STRUCTURAL GLASS PANEL

Authors: Vlatka RAJCIC[1], Roko ZARNIC[2], Nikola PERKOVIC[3], Jure BARBALIC[4]

[1] University of Zagreb, Faculty of Civil Engineering, vrajcic@grad.hr; [2] University of Ljubljana, Faculty of Civil and Geodetic Engineering, roko.zarnic@gmail.com; [3] University of Zagreb, Faculty of Civil Engineering, nperkovic@grad.hr, [4] University of Zagreb, Faculty of Civil Engineering, jbarbalic@grad.hr

Forum topics		
	☐ Energy in 21st Century	☐ Cultural Heritage in Digital World
	☐ Engineering Capacity Building	☐ Disaster Risk Management & Governance for Resilient Communities
	☒ Construction 4.0	☐ BIM Lifecycle, Facility & Asset Management

Abstract:

Problems - Issues / Challenges-Needs	The hybrid timber-structural glass panel, which authors are Zarnic and Rajcic, is innovative building element suitable for adaptive façade or as load bearing element. This multifunctional system is merging and overlapping transparent building envelope and constructive element purpose into one – with the goal of creating not only architectural quality, sustainable and inexpensive, but also smart, interconnected and customized product. In development of the panel, two main problems have been imposed: • unknown effect of friction between timber and glass, which proved to be a significant factor in energy consumption due to lateral loads • unknown behavior and bearing capacity of laterally loaded joint in corner of timber frame made with glued-in rod Challenges that relate to the need to investigate these unknowns and at the same time to find optimized panel characteristics.
Solutions - Methods / Results - Findings	As there is no European standard for direct friction test, alternative solution is provided. Glass panel was placed between two timber beams, whereby slats offset from glass prevented displacement out of plane. Sample was compressed by two springs of known stiffness and glass was sliding on beams by a controlled shift. Various types (IZO glass and sheet glass), thicknesses (12 or 20 mm) and number (1 or 2 pcs) of glass panels were varied as well as three force values (from 1 to 3 kN). The results proved to be expected and gave a friction factor value of 0.4. The bearing capacity of joint with glued-in rod which connected column and girder made of cross laminated timber was tested according to the European standard EN 383:2007. The sample size was defined by dimensions of the cross section of timber frame elements which is an integral part of the hybrid panel. Three different rod diameter were used (M10, M14 and M20), all with nominal strength of 8.8. Position of the rod was also varied, parallel or perpendicular to the fibers. The results showed a bearing capacity which could be corresponded to one calculated according to the European design code EN 1995 for joints with steel bolts.
Novelty - Value / Relevance to …	This research provides instructions for testing of friction between glass and timber, whereby the highest contribution is nominal value of coefficient of friction which is not dependent on the thickness and type of structural glass panel. Significant contribution was also made to examine the bearing capacity of joint with glued-in rod, which has not been sufficiently processed in the literature so far. This investigation has given the conclusion that laterally loaded joint with glued-in rod can be considered as any other joint in timber construction made with steel bolts. Such research is not only directed to the scientific public, it is also the precondition for introduction of this type of bearing element into real constructions as well as the basis for development of further standards which should be used in practice.
Forum statement	Effect of friction between timber frame and structural glass in hybrid panel is same for all type of structural glass. Laterally loaded joint in corner of timber frame made with glued-in rod should be considered as end grain connection with laterally loaded steel bolts.

Keywords:

laboratory tests; timber; structural glass; friction; glued-in rods joint

Graphics: