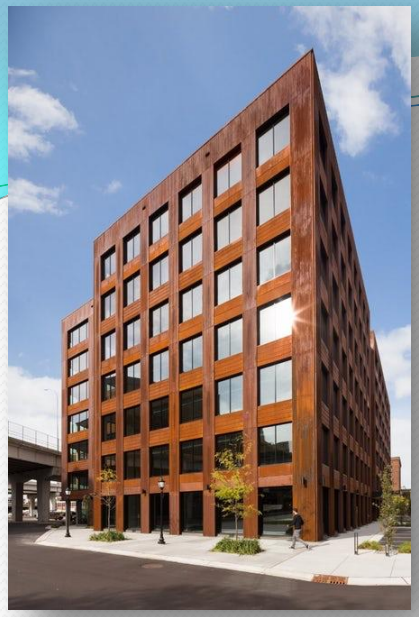
Introduction to the Project VETROLIGNUM

Vlatka Rajčić, University of Zagreb



Contemporary timber-glass hybrid structures

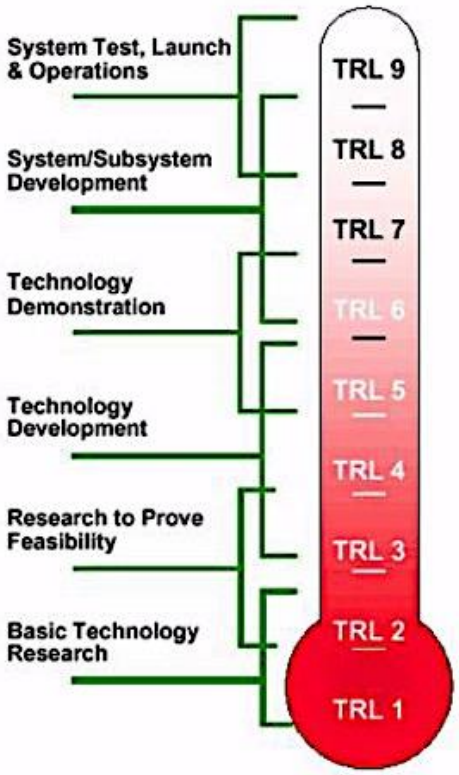
- Contemporary architecture is developing in the direction of construction of timber-glass hybrid structures.
- The main challenge is to design and construct structural system that would resist sudden environmental impacts including heavy storms and earthquakes
- The answer is to be found in experimentally supported research work, which can serve for the development of regulations for the design of structures from the structural glass (Eurocode 11) and wood (Eurocode 5), and in accordance with the requirements for construction regulations in earthquake areas (Eurocode 8)
- University of Zagreb and Ljubljana has started in this direction 10 years ago and the project VETROLIGNUM is a step forward to introduce the research results in construction practice

Brief history of project

- Before the start of VETROLIGNUM project the The Ministry of Education and Science of the Republic of Croatia and the Ministry of Education, Science, Culture and Sport of the Republic of Slovenia financially supported the research.
- Up to now, in the laboratory in Ljubljana, 50 samples in natural size were tested with a combination of constant vertical load and cyclic variable horizontal load to simulate earthquake induced loading.
- A simple box model in natural size was tested at the shaking table at IZIIS Institute in Skopje, which demonstrated the equality of the panel behavior mechanism during the cyclic loading with its response to the earthquake load.

Technology readiness level of hybrid system

Technology readiness levels (TRL) are a method of estimating technology maturity of Critical Technology Elements (CTE) of a program during the acquisition process.



Post VETROLIGNUM full scale building testing ???

By the end of the VETROLIGNUM Project 2020

Prior to start of the VETROLIGNUM Project 2017

Start of hybrid system development in 2007

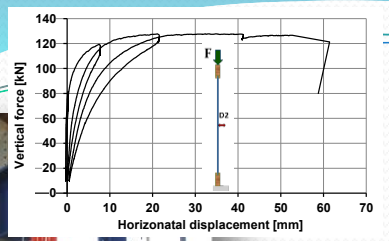
Project VETROLIGNUM

- Title:
  Prototype of multipurpose composite timber-load bearing glass panel
  - Project no.: IP-2016-06-3811
  - Financed by The Croatian Science Foundation
  - Duration of project: 36 months (01.03.2017. - 29.02.2020)
  - Project funds: 749.350,00 HRK (99.800 EUR)
  - Project coordinator: Prof. Dr. Vlatka Rajčić
  - Project team: Prof. Dr. Roko Žarnić, Assoc. Prof. Dr. Adriana Bjelanović, Dr. Mislav Stepinac and Jure Barbalić

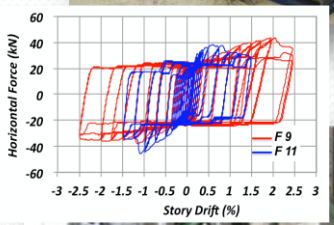
VETROLIGNUM research programme

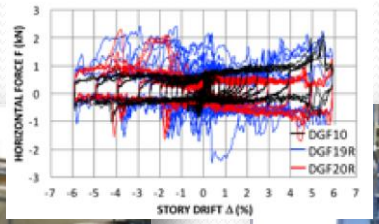
- Detailed analysis of previous research
- Laboratory testing of glued-in rod CLT joints
- Racking test of optimized CLT-laminated glass hybrid panel
- Developing of numeric model of glued-in rod CLT joint
- Developing of numeric model of CLT-laminated glass hybrid panel
- Developing of simplified calculation model for codes
- Testing of CLT-laminated glass segment in thermal chamber
- Energy efficiency mock-up long term measuring campaign

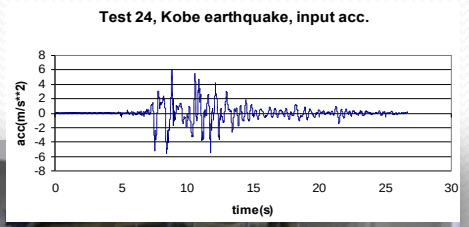
Previous research

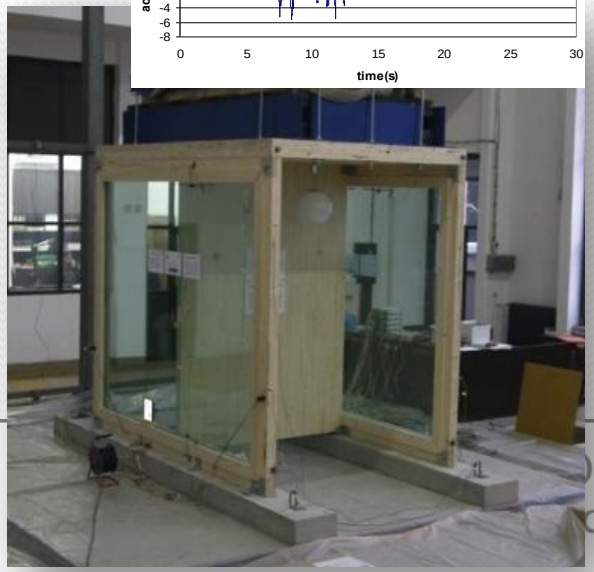


- Load bearing tests of laminated glass (3 tests)
- Cyclic tests of timber frame joints (30 tests)
- In-plane cyclic tests of laminated glass infilled timber frames (49 tests)
- Out-of-plane cyclic tests of laminated glass infilled timber frames (3 tests)
- Shake table test of box type structure (1 specimen, multiple test runs)



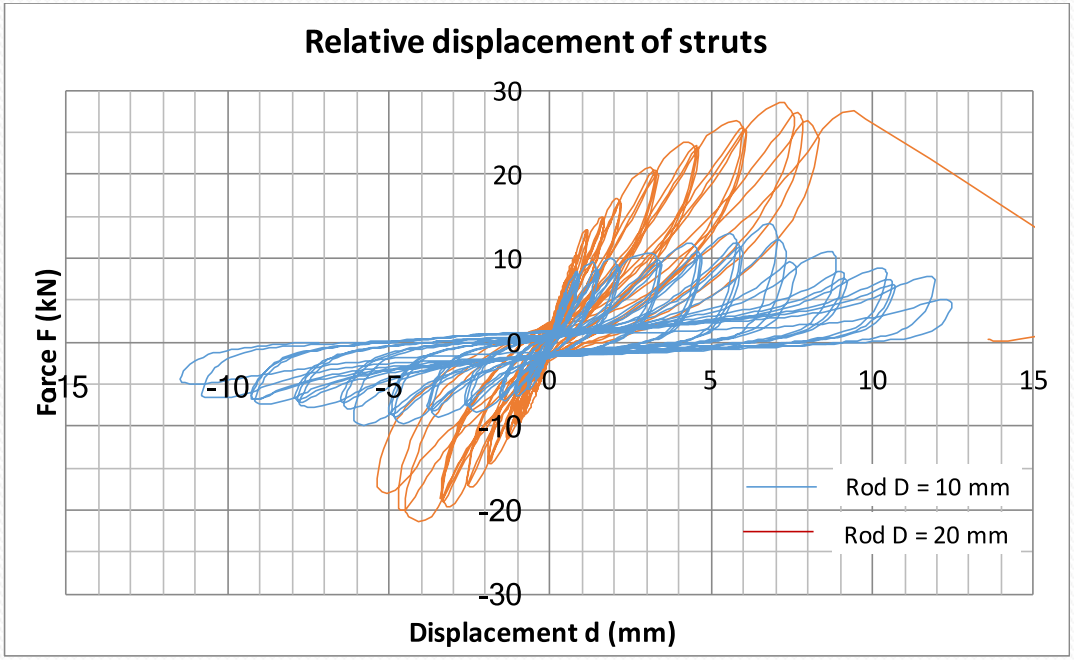




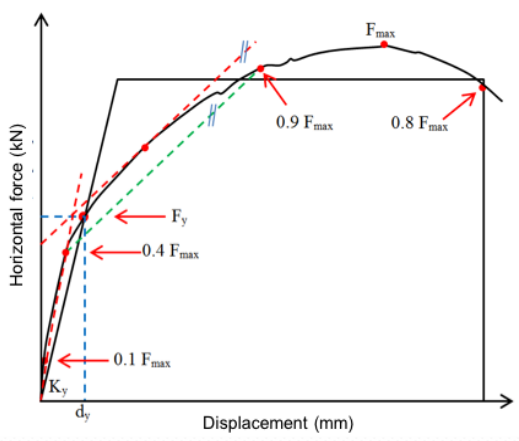


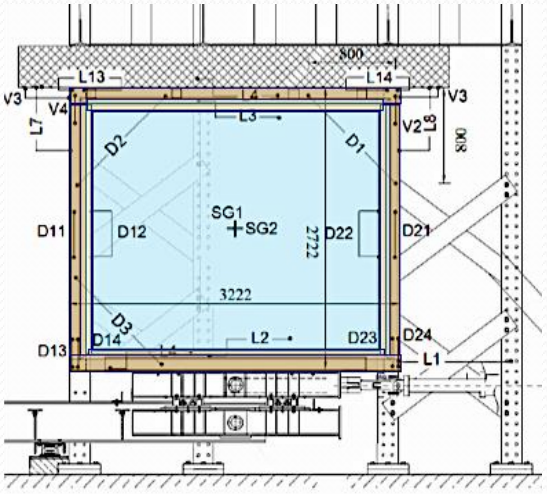
Laboratory testing of glued-in rod CLT joints

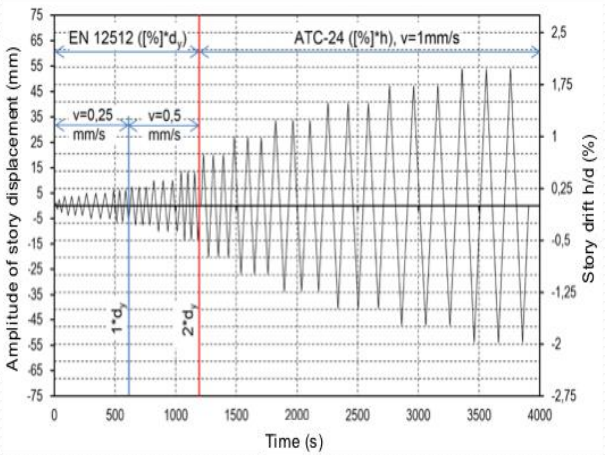
- Three rod dimensions: ϕ10, ϕ14, ϕ20
- Two stud support option

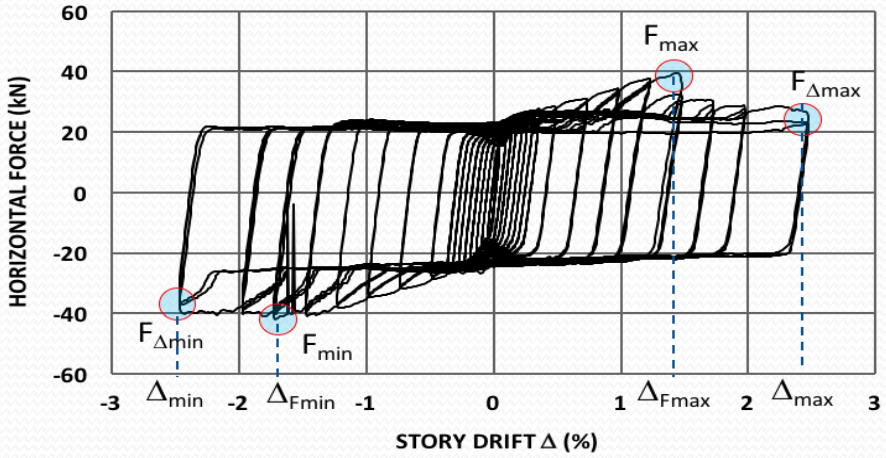


Racking test of the optimized CLT-laminated glass hybrid panel

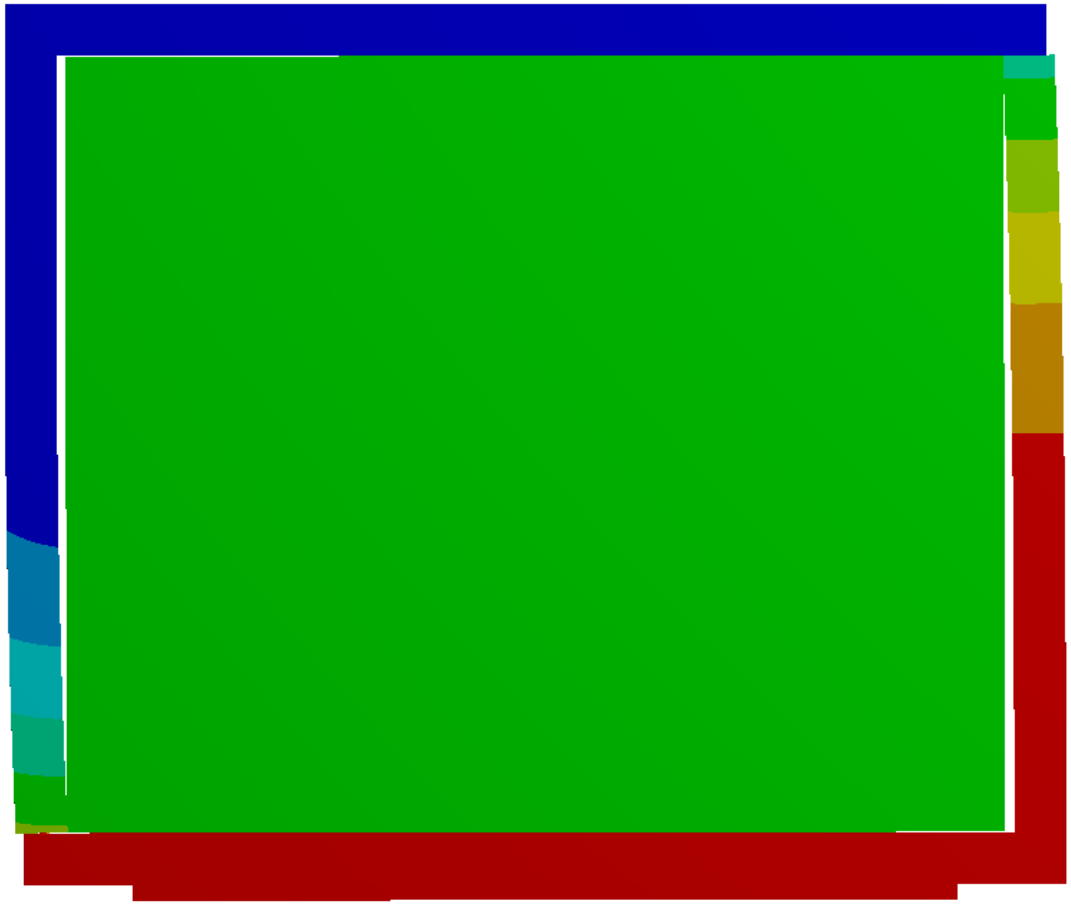




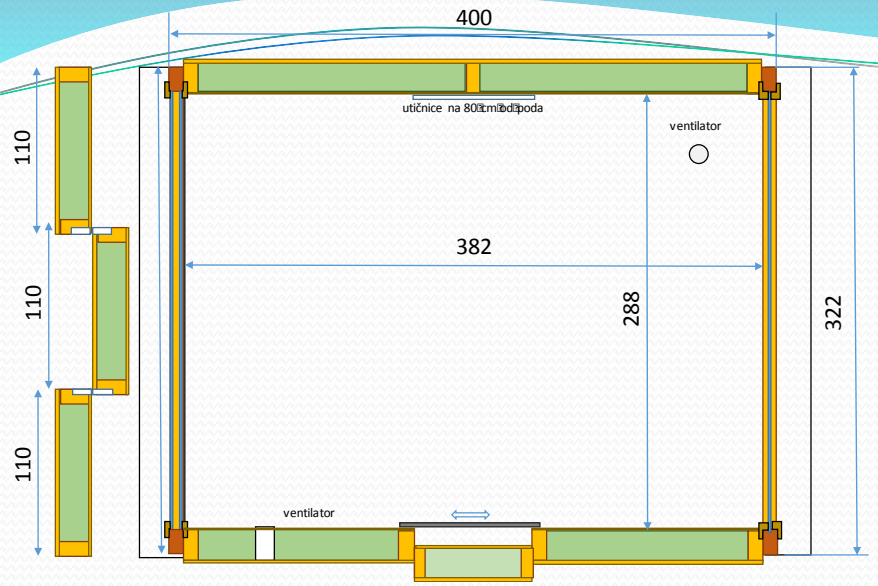


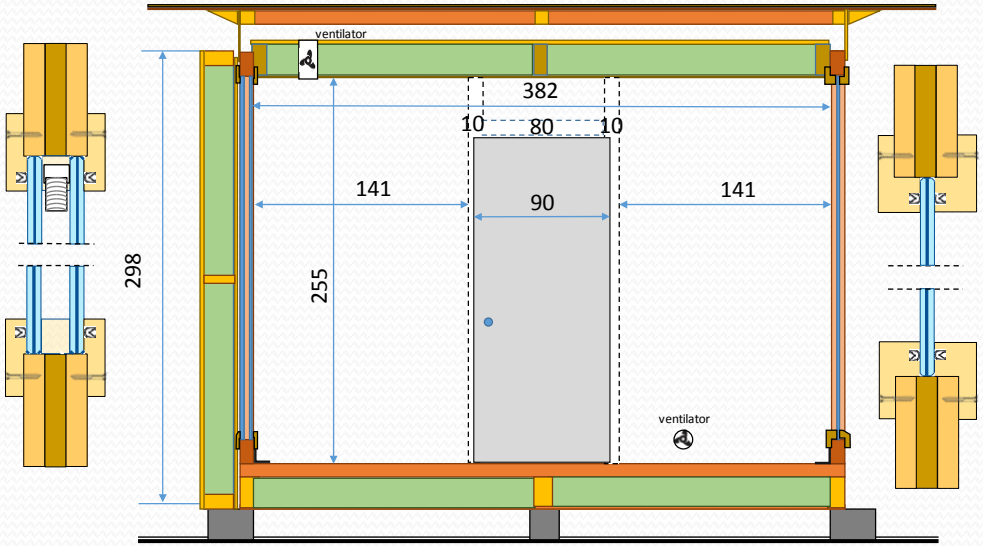


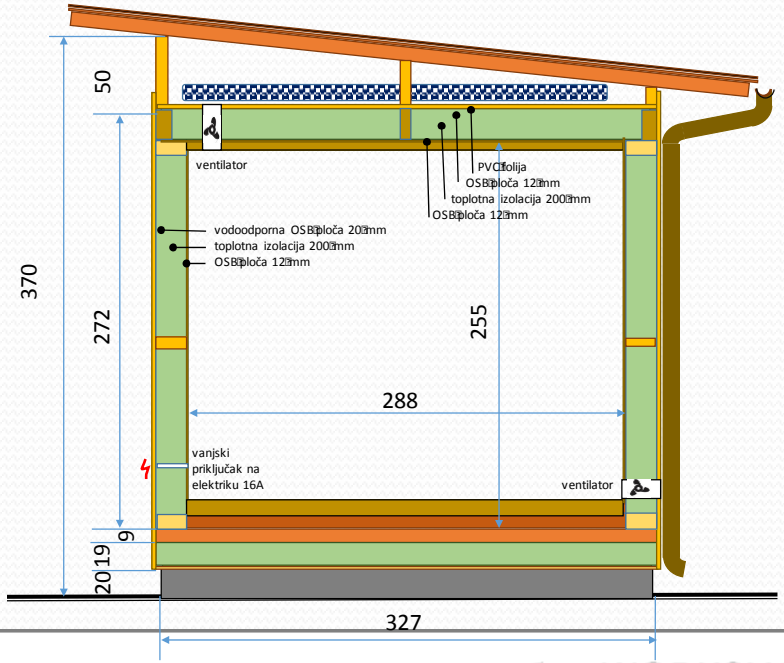
Developing of numeric model of the CLT-laminated glass hybrid panel



Energy efficiency mock-up







SENSO – Intelligent platform for IEQ Assessment and Control

The built environment has profound effects on human health and surrounding environment. At their best, our buildings are powerful promoters of health and well-being; however, at their worst, buildings contribute to some of the key health concerns of modern society, from asthma to cancer to obesity. **Indoor environmental quality (IEQ) encompasses the conditions inside a building - air quality, lighting, thermal conditions, acoustics - that can have direct or indirect effects on the quality of our living spaces, health, and well-being.** Studies have shown that inadequate lighting, thermal conditions and acoustics levels are correlated with adverse health and well-being outcomes and impaired productivity.

One of the most common and important issues is **that indoor air pollutant levels often surpass outdoor levels**. Exposure to elevated pollution concentrations is correlated with impaired productivity and detrimental or even lethal health outcomes. **Yet, very little is known about the quality of air that people are exposed to. The problem could be amplified because we cannot always smell or feel the content of the air. Therefore, the task is absolutely essential to provide a real-time solution to have a better understanding of invisible part** of the indoor environment which is centered on humans.

Through proposed SENSO solution, **intention is to collect, process, and understand real-time IEQ data, to enable improved human health and well-being in an energy efficient manner to improve the IEQ performance and quality of life**.

Energy efficiency mock-up

Imapact

Research results will have a powerful impact on:

- **providing high-quality data and actionable insights that can be directly used by the building user of control system to improve IEQ;**
- **promoting a high level of environmental awareness by developing intelligent and internet-connected SENSO platform;**
- **encouraging and supporting the building industry stakeholders and tenants interested in optimizing employee productivity and effectiveness.**

https://www.youtube.com/watch?v=VxDqI3dAWSw

Thank you for attention!

Developing of numeric model of glued-in rod CLT joint