Hanzehogeschool Groningen
University of Applied Sciences

Research assignment – February 2024

Research title

Experience Trust in Timber - Shake table test

Brief description of the research question

Utilizing timber in building structures significantly reduces the carbon footprint, especially in large buildings. However, instilling confidence among clients, engineers, and occupants in constructing sizable timber structures is crucial. To bolster this confidence, we plan to showcase, test, and organize interactive activities to demonstrate the positive outcomes. These activities will be engaging and cater to a diverse audience, focusing particularly on the stability of timber façade panels.

Currently, starting from December, a two-story timber construction is in the design phase and will soon be built at BuildinG. Tests will be conducted to assess the stability of this small-scale building, a part of the 'Bouwen aan Human Capital' project by TKI. The initial design is centered around WEBO timber façade panels, a circular timber host structure, and Posi-tech beams for the floors. This project aims to showcase the stability and viability of timber in construction, contributing to the broader understanding and acceptance of timber as a primary building material.

Main project objectives:

- *To obtain the behaviour of a two-story timber building loaded with horizontal loads*

Following up projects/steps will be:

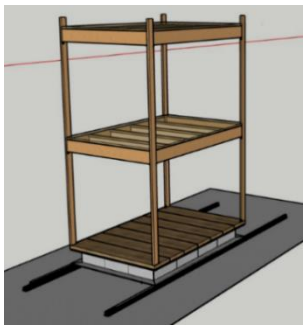
- Alternative bio-based designs (architectural and/or structural aspects).
- Creation of usable BIM model
- Pointcloud comparison before and after tests
- BIM-based demolition and re-use plans

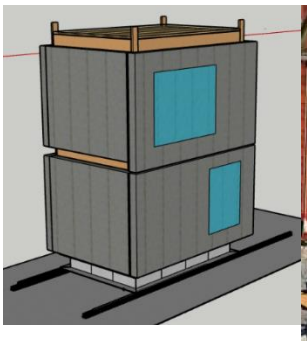
Connection to NoorderRuimte themes

- [x] Earthquake resistance
- [x] Sustainability
- [ ] Health & Well-being
- [ ] Liveability

Images

Concept 3D-model first design





Shake table

Background of the research assignment and the current situation

The construction industry contributes approximately 20% to the total carbon footprint, largely due to materials like steel, concrete, and bricks undergoing energy-intensive industrial processes with high carbon emissions. A potential solution lies in the industrial control and production of timber materials, which can significantly reduce this environmental impact. However, to make a substantial societal impact, timber construction needs to extend into larger and taller structures, allowing for the delivery of significant volumes and ensuring feasibility and profitability. A primary obstacle to achieving this lies in the structural engineering challenges associated with tall and large timber constructions. Even notable projects like HAUT had to adopt a hybrid approach, incorporating a significant amount of steel and, in some cases, concrete. This project seeks to address this challenge by promoting the use of timber material in larger and taller constructions. The key objectives include raising awareness and trust among structural engineers and enhancing human capital in this domain. By overcoming these hurdles, we aim to pave the way for more sustainable and environmentally friendly practices in the construction sector.

The central question of the project is:

- How does a two-story timber building, along with its connections, behave when subjected to horizontal loads on its elements?

As previously stated, the initial design, construction, and testing phase for the first design will conclude in February. However, this project will lead to subsequent inquiries, such as exploring options for dismantling the building to facilitate the reuse of its elements. Additionally, we will delve into alternative designs concerning bio-based or timber materials. These follow-up questions aim to further enhance sustainability and address broader considerations related to the life cycle and environmental impact of the construction.

Desired situation regarding the research question

The students will actively participate in the design and construction of various alternative designs for two-storey timber/bio-based buildings. Their focus will be on alternative materials, emphasizing aesthetic appeal while considering environmental aspects, construction time, technical details, assembly, and disassembly. Following the design and build phase, the testing stage will commence, with students receiving training and support to utilize the testing equipment at BuildinG.

Post-testing, students are expected to draw conclusions, with the primary goal of creating awareness among experts, engineers, producers, and fellow students. This involves conducting component tests, providing comparative results, and organizing activities involving students and engineers based on these tests. For example, evaluating the strength of a new bio-based composite material in comparison to a traditional natural timber element.

Integrating point cloud scans taken before and after the test is a crucial aspect of this experiment. The goal is to compare point cloud data to explore new methods of measuring permanent displacements of components. To effectively handle, store, and visualize the substantial amount of data generated by the scanner, an information model (BIM) will be established in an open format accessible to all project partners. This holistic approach aims to advance both practical knowledge and digital capabilities in timber construction research.

Types of assignment possible

The assignment is suitable as:

- [x] Graduation project as part of bureau NoorderRuimte: one semester in year 4
- [x] Internship (possibilities/requirements to be discussed)
- [x] Research assignment as part of the curriculum in other year
- [x] Honours research assignment
- [x] Buitenwerkplaats (2nd year Built Environment SOFE)
- [ ] Vastgoedlab (3rd year Real Estate Management - one semester)
- [ ] Transition student: part of transition year to RUG (schakeltraject).
- [ ] Other,

Vacancies for students of the following studies

Study programs:

Study	Number of students	Discipline
Built Environment (BE)	1	Civil Engineering
Built Environment (BE)	1	Architecture
Built Environment (BE)	1	Building Technology
Various possible	1	ICT, engineering

The following knowledge/skills are necessary and/or desired

Students, representing various perspectives like structural, building technology, architectural, and information technology, are encouraged to contribute. While interdisciplinary collaboration is sought, it's not mandatory. Structural engineering students may focus on design loads and mechanical properties, while others explore material use, BIM, point cloud scans, data comparison, visualization, or questions related to reuse/circularity.
Collaborating with field experts, students will organize events to raise awareness and connect their findings with education. This interdisciplinary approach fosters a comprehensive exploration of timber construction, encouraging innovative solutions and a holistic understanding of challenges. Through these collaborations, students contribute to advancing knowledge and actively engage with real-world applications and industry professionals.

External partner/client

Company/organisation: Kenniscentrum NoorderRuimte (project 'Bouwen aan Human Capital')
Contact person: Prof. Ihsan Engin Bal, MSc
Contact details: i.e.bal@pl.hanze.nl
Website: https://tki-bouwentechniek.nl/nieuws/programma-bouwen-aan-human-capital-regionale-aanpak-van-start/

Internal client

Contact: ir. Rozemarijn Veenstra, MSc
Contact details: c.r.a.veenstra@pl.hanze.nl
Professorship: Earthquake Resistant Structures and Promising Groningen
Research program: Human Capital
Website: https://www.hanze.nl/nl/onderzoeken/centers/kenniscentrum-noorderruimte/bureau-noorderruimte/studentenopdrachten-september-2023

Contact: Dipl.-Ing. Boris Bähre
Contact details: b.bahre@pl.hanze.nl
Professorship: Earthquake Resistant Structures and Promising Groningen
Research program: Human Capital
Website: https://www.hanze.nl/nl/onderzoeken/centers/kenniscentrum-noorderruimte/bureau-noorderruimte/studentenopdrachten-september-2023