

Research assignment – February 2024

Research title

Experience Trust in Timber – Floor vibration test

Brief description of the research question

Using timber in construction is great for the environment, especially in large buildings. However, people like clients, engineers, and occupants need to feel more confident about using timber for big structures. To build this confidence, we'll showcase examples, run tests, and organize interactive activities to show positive results. These activities are meant for a diverse audience. The tests will focus on things like how strong the floors are and how stable the timber walls are. In this project, we're looking closely at how stiff and how often different timber floors move.

Right now, from November to December 2023, we're working on various timber floor systems with different finishes at BuildinG. These are part of the 'Bouwen aan Human Capital' project by TKI. We're testing how these floors behave under different conditions. We're looking at three types: Posi-Tech beams, CLT beams, and Kerto Ripa elements.

Main project objectives:

- To obtain dynamic behaviour of timber floor systems
- To obtain vibration behaviour of timber floors systems

Following up projects/steps will be:

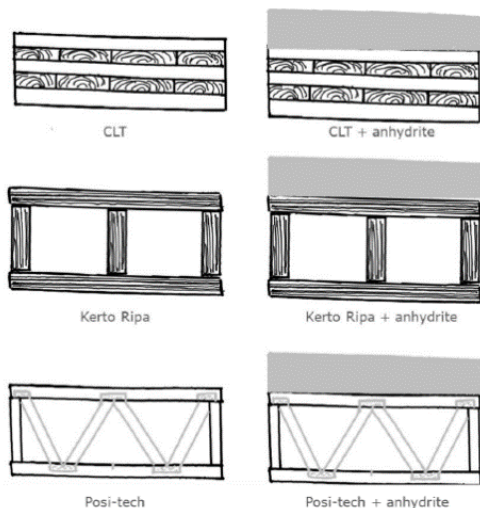
- Alternative bio-based toppings
- Alternative floor system designs
- Creation of BIM model
- BIM-based demolition
- BIM-sensor integration

Connection to NoorderRuimte themes

- Earthquake resistance
- Sustainability
- Health & Well-being
- Liveability

Images

Concept 2D model of the floor systems



Background of the research assignment and the current situation

The construction industry contributes about 20% to the overall carbon footprint, with materials like steel, concrete, and bricks requiring energy-intensive industrial processes, leading to a high environmental impact. Industrially controlled timber, however, offers a more sustainable alternative. To make a significant impact on society, timber construction needs to be large and tall to deliver substantial volumes while remaining feasible and profitable. The major challenge lies in structural engineering when constructing tall and large timber buildings. Even notable projects like HAUT (<https://hautamsterdam.nl/nl/>) had to resort to hybrid construction, incorporating significant amounts of steel and concrete. This project aims to address these challenges and promote the use of timber in larger and taller constructions, enhancing awareness and trust among structural engineers and advancing human capital in this field. The primary objectives of this project include:

- *Enhance understanding of the dynamic behaviour exhibited by various timber floor systems featuring different finishes.*
- *Provide the market with the chance to directly experience and evaluate the vibration behaviour of timber floors.*

As mentioned before, the design, build and test phase for the first designs will be finished in February. This project will offer an important base for following up questions such as: What are alternative designs for timber floors in relation to the floor system, what possible finishing layers would improve the overall performance of the system and what are options to disassemble the floor in relation to a better circular reuse of the floor system elements?

As previously mentioned, the initial design, construction, and testing phase for the first designs will conclude in February. This project will establish a crucial foundation for addressing subsequent inquiries, such as exploring alternative designs for timber floors concerning the floor system. Additionally, we will investigate potential finishing layers that could enhance the overall system performance. Moreover, we aim to explore options for disassembling the floor, contributing to a more circular reuse of the floor system elements. These follow-up questions will play a key role in advancing the understanding and sustainability of timber construction practices.

Desired situation regarding the research question

The involvement of students in designing and constructing various alternative floor systems and finishing layers is a key aspect of this project. Students will prioritize aesthetics while considering environmental impact, construction time, technical details, assembly, and disassembly. Upon successful construction or procurement from suppliers, the testing phase will commence, with students receiving training and assistance in using BuildinG's testing equipment.

Following the tests, students will draw conclusions, with the primary goal of raising awareness among experts, engineers, producers, and students. This will involve conducting component tests, presenting comparative results, and organizing activities involving students and engineers based on these tests. For example, we can assess the strength of a new bio-based composite finishing layer in comparison to a traditional cement layer, and compare different floor systems with and without toppings.

To enhance the precision of our experimentation, digital sensors will be integrated to measure component displacement or vibration. Establishing a digital information model (BIM) will be a major objective to analyse, simulate, and optimize the collected data. This model will serve as the basis for visualizing sensor data in open formats (such as browser/viewer-based platforms), ensuring accessibility 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:

- Graduation project as part of bureau NoorderRuimte: one semester in year 4
- Internship (possibilities/requirements to be discussed)
- Research assignment as part of the curriculum in other year
- Honours research assignment
- 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, sensor technology, engineering

The following knowledge/skills are necessary and/or desired

Students are encouraged to contribute from diverse perspectives, including structural, building technology, architectural, informatic, and electric-mechanic viewpoints. While the project aims to integrate groups of students from various disciplines, it is not mandatory. Structural engineering students may focus on calculating design loads and mechanical properties, while other disciplines can delve into material use, information models (e.g., BIM), sensor data, usable database design, data visualization, or questions related to reuse/circularity. Collaborating with field experts, students will organize workshops or similar events to raise awareness in the market and connect their findings and developments with education. This interdisciplinary approach fosters a comprehensive exploration of timber construction, encouraging innovative solutions and a holistic understanding of the challenges involved.

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-bouwentechiek.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>

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Research program: Human Capital

Website: <https://www.hanze.nl/nl/onderzoeken/centers/kenniscentrum-noorderruimte/bureau-noorderruimte/studentenopdrachten-september-2023>