



School of Computing, Engineering, and the Built Environment Edinburgh Napier University

PHD STUDENT PROJECT

Application instructions:

Detailed instructions are available at :

<https://www.napier.ac.uk/research-and-innovation/doctoral-college/how-to-apply>

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:

- Director of Study: Prof Hexin (Johnson) Zhang (Email: j.zhang@napier.ac.uk)
- 2ND SUPERVISOR: tbc

Subject Group: Built Environment

Research Areas: Engineering: Civil Engineering, Structural Engineering, Architecture, Building & Planning: Architecture

Project Title: Advancement of Innovative Engineered Bamboo, Timber and Hybrid Construction Elements

Project description:

Engineered bamboo, engineered timber, and bamboo-timber composites are emerging as sustainable construction materials due to their environmental benefits and impressive structural properties.

Bamboo, known for its rapid growth and high carbon sequestration capacity, can mature in just 3-5 years, making it a highly renewable resource. This contrasts sharply with traditional timber, which can take decades to mature. Engineered bamboo products like Laminated Bamboo Lumber (LBL) and Bamboo Scrimber are being developed to overcome bamboo's natural limitations, such as its hollow structure, to make it more suitable for construction. These products offer high tensile strength, durability, and flexibility, making them competitive with traditional wood in structural applications.

Furthermore, bamboo and timber composites combine the best properties of both materials. For instance, bamboo's high strength and fast renewability are paired with timber's workability and familiarity, resulting in composites that are both strong and sustainable. These materials are particularly promising in reducing the carbon footprint of the construction industry, which is responsible for a significant portion of global carbon emissions.

As demand for sustainable construction grows, these engineered materials are likely to play a crucial role in meeting global building needs while minimizing environmental impact.

Edinburgh Napier University, a research team led by Professor Hexin (Johnson) Zhang (see profile: <https://www.napier.ac.uk/people/johnson-zhang> , <https://raeng.org.uk/programmes-and-prizes/programmes/meet-the-researchers/dr-hexin-johnson-zhang>) has pioneered the development of various engineered bamboo, engineered timber, and composite construction elements. This innovative work also integrates prestress technology tailored for bio-based materials. Among their notable achievements is the construction of the World's First Bamboo-Timber Composite Gridshell structure, a project highlighted in several demonstration activities (learn more about the project via https://www.turing-scheme.org.uk/turing_stories/edinburgh-napier-university-students-lead-world-first-construction-project-in-china/ , <https://www.pbctoday.co.uk/news/mmc-news/bamboo-timber-composite-construction-china/131214/>)

The research team is now inviting applications from prospective PhD students interested in advancing the development of engineered bamboo, engineered timber, and composite construction elements. The project will also focus on creating supporting structural design tools, utilising parametric design, non-linear bio-based finite elements, and mixed-reality building information technologies. Students will have the flexibility to design their research to be lab-based, numerically focused, BIM-oriented, or a combination of these approaches within the project's scope. For an example of the team's research output, please visit: <https://doi.org/10.1016/j.conbuildmat.2023.132991>

Candidate characteristics

Education:

Minimum 2:1 degree in the following subject areas - Structural Engineering, Civil Engineering, Mechanical Engineering, Architecture

Subject knowledge:

Good knowledge of mechanics of material, structural design, finite element analysis or parametric design

Essential attributes:

- Strong academic foundation, research skills, and technical proficiency, particularly in computational tools and structural testing
- Excellent written and verbal communication skills
- Comfortable working in interdisciplinary teams
- High motivation and resilience are also essential to navigate the challenges of research.