Template for adverting PhD project on FindAPhD.com

****Please read accompanying guidance notes****

Department	School of Engineering and the Built Environment
Supervisors	Dr Aamir Khokhar (Director of Studies), Professor Robert Hairstans
Funding Status	Funded PhD Project (Worldwide)
Application Deadline	14/04/2022
Project Title	Sustainable Construction with Home Grown Timber - An approach to optimise structural performance of Cross-laminated timber (CLT) by effective use of the UK timber

PROJECT DESCRIPTION

Cross-laminated timber is an engineered wood product, consisted of solid timber boards (lamella) stacked perpendicularly and glued in layers resulting in massive structural floor and wall panels. CLT provides an improved structural and dimensional stability, much better strength and stiffness properties compared to conventional timber and it has become increasingly popular as an alternative sustainable building material to reinforced concrete and steel for low to high-rise buildings. The structural performance of CLT as a building material primarily depends on the strength class and type of timber species used for the lamella, the lay-ups and geometry of the lamella, the type of timber (softwood and hardwood) and the manufacturing process (e.g. finger jointing, bonding strength of glue, beam pressing) [1–3]. Considering the structural applications and to meet the desired necessity of the domestic timber industry, researchers have been investigating the utilisation of home-grown timber for the fabrication of CLT all over the world [2–4]. In this regard, research investigation has been conducted at Edinburgh Napier University [5] to examine the feasibility of Scottish home-grown timber for CLT fabrication primarily focusing on commercially available softwood species. The outcome reported that there is further research required to study the effects of mixed resource, strength grade and geometrical configurations of lamellas to further optimise the structural performance of home-grown CLT. Therefore, this proposed work is working towards this goal. This research work will also further investigate the potential to use home-grown hardwood as there is limited information on its viability for use with a particular emphasis on mixed softwood and hardwood CLT to maximise utilisation.

The aim is to develop and conduct a research investigation, experimental and numerical based, to evaluate and enhance the structural performance of home-grown CLT by optimising the geometrical configurations of the lamella and variations in strength classes of different timber species within the CLT layers.

To achieve the research aim, an intensive laboratory-oriented experimental work will be conducted and influence of uniformity of strength class, symmetrical and asymmetrical strength classes of the same and different species of softwood and hardwood will be determined. The effects of cross-section size, layer thickness and orientations of lamella and width to thickness ratio of laminations will also be investigated. Finite element modelling (FEM) based parametric study will be carried out to understand the key mechanisms for optimising the use of home grown timber of CLT production. Results from modelling and experimental works will assist in developing models of CLT panels that can provide optimised structural performance. Further experimental work will then

be conducted to fabricate the optimised CLT panels and these will be tested to obtain their stiffness and strength properties.

The proposed research intends to provide an in-depth understanding of structural performance of Cross Laminated Timber (CLT) fabricated from Scottish/UK timber. It can be stated that the research has substantial potential and could be very beneficial for the research community of timber engineering as well as the construction industry. The knowledge from this research will assist Scottish /UK industry professionals in fabricating optimised CLT structural members that are manufactured from home-grown timber.

Academic qualifications
A first degree (at least a 2.1) ideally in Civil Engineering with a good fundamental knowledge of Timber structures.

English language requirement
IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University's policy are available online.

Essential attributes:

- Experience of fundamental experimental work
- Competent in structural analysis, structural mechancis
- Knowledge of timber as an engineering material, Eurocodes
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:
Knowledge of structural performance of composite structures, FEM modelling

Indicative Bibliography	[1] Karacebeyli E, Douglas B. CLT Handbook -US Edition. Quebec, Canada: PInnovations and Binational Softwood Lumber Council, Point-Claire; 2013. [2] Sharifnia H, Hindman DP. Effect of manufacturing parameters on mechanical properties of southern yellow pine cross laminated timbers. Construction and Building Materials 2017;156:314–20. https://doi.org/10.1016/j.conbuildmat.2017.08.122.. [3] Pang S-J, Jeong GY. Effects of combinations of lamina grade and thickness, and span-to-depth ratios on bending properties of cross-laminated timber (CLT) floor. Construction and Building Materials 2019;222:142–51. https://doi.org/10.1016/j.conbuildmat.2019.06.012. [4] He M, Sun X, Li Z. Bending and compressive properties of cross-laminated timber (CLT) panels made from Canadian hemlock. Construction and Building Materials 2018;185:175–83. ttps://doi.org/10.1016/j.conbuildmat.2018.07.072. [5] Plowas W. Research into Mass Timber Systems - Cross Laminated Timber. Edinburgh: 2019.

Template for adverting PhD project on FindAPhD.com

****Please read accompanying guidance notes****

Funding notes	This project may be funded by a scholarship of the School of Engineering and Built and Environment. Please see School-funded PhD scholarships - RESEARCH AND INNOVATION (napier.ac.uk) for information on the scholarships and how to apply for them.
Enquiries	For informal enquiries about this PhD project, please contact Dr Aamir Khokhar, Email: a.khokhar@napier.ac.uk
Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process

School RDPL signature	
Date	Click here to enter a date.
School DOR signature	
Date	Click here to enter a date.