Numerical Modelling and Experimental Investigation of Compressed Wood Dowel Connected Laminated Timber Members

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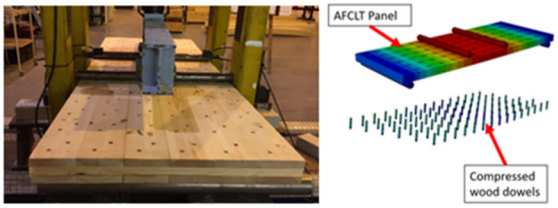
The use of Engineered Wood Products (EWPs) in the construction industry is continuously growing due to a number of reasons, which include their availability in large-sized structural sections, low embodied energy and carbon, as well as more consistent mechanical properties [1]. However, the prevalent use of petrochemical adhesives in EWPs raises safety and environmental issues (e.g. release of harmful gases) and has led to increased research interests around the globe to develop more environmental-friendly EWPs [2]. Hence, the development, experimental investigation and numerical modelling of novel and sustainable EWPs offer new prospects for the efficient utilisation of timber materials, which also contributes to a low carbon economy. This work thereby describes an investigation into the structural response of Adhesive Free Laminated Timber (AFLT) beams and Adhesive Free Cross Laminated Timber (AFCLT) panels. Figure 1 and Figure 2 show the experimental setup and finite element modelling of the AFLT beams and AFCLT panels, respectively. These structural members are made solely from timber lamellas and connected with highly compressed wood dowel fasteners. This is because highly densified wood materials have beneficial spring-back and greater mechanical properties that make them suitable as durable fasteners in structural connections.

Material characterisation of the uncompressed and compressed wood dowels was carried out to determine their mechanical properties. Following that, experimental tests were carried out on the large-sized AFLT beams and AFCLT panels. By using the mechanical and geometric properties of the timber lamellas and compressed wood dowels, the finite element (FE) models (using a commercial code, ABAQUS) were developed to supplement the experimental work. The FE model also incorporates custom written subroutines that allow the representation of the unique properties of highly compressed timber. Thereafter, design optimisation of the dowel laminated timber members is investigated by varying the patterns, sizes, and configurations of the dowels. In summary, this work demonstrates the development and characterisation of innovative adhesive free laminated timber members alongside useful structural analyses, all of which support the delivery of more sustainable buildings and green construction.

(a) (b)

Figure 1: AFLT beam: (a) Experimental setup and (b) Finite element modelling



(a) (b)

Figure 2: AFLCT panel: (a) Experimental setup and (b) Finite element modelling

References

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ISBN: 978-91-88898-64-7