The Institution of Structural Engineers

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2011 MSc Research Grant Scheme

Project title: Feasibility of structural timber welding

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Aims of research: Bonding of timber can be achieved by melting lignin contained within the timber under pressure and allowing the matrix of timber cells and lignin to become interlocked. Currently this process is not well understood and the bond formed can be weakened by the presence of water, thus limiting the possible applications. The project aims to achieve a greater understanding of the nature of the bond. It is also expected to assess the strength of the bond formed and investigate and understand the performance of the bond in high moisture conditions, thus enabling the method for use in structural timber applications.

Description of method: The project has been split into three separate parts to enable an MSc student to achieve the aims and allow a degree of flexibility within the research.

The first step will require the student to investigate methods of creating the bond within the university laboratory. It is envisioned that the student will use a hydraulic actuator to force two pieces of timber to slide past each other along the plane of the timber while a force is applied perpendicular to the plane of the timber. The friction and heat generated is expected to allow the bond to form. There are two possible machines that could be used; static and dynamic test rigs both of which the university have, however it is likely that a simple piece of equipment will need to be manufactured to allow accurate control of the perpendicular force.

Once the method has been successfully achieved, the strength of the bond will be optimised by altering test variables: duration of bond formation, loading force, perpendicular force and time required for bond to achieve maximum strength after formation. All tests will be conducted on softwood of constant cross sectional area.

The final aspect of the test will be to compare the nature of the bond using a digital optical microscope to look at surface effects. Thin sections will also be produced to consider the differences between a strong and weak bond. To investigate the performance of the bond within moist conditions, strongly bonded specimens will be placed within an environmental cabinet owned by the university at high humidity. The strength of the bond will be tested against time to determine the rate of degradation of the bond and they will also be investigated visually using microscope and thin sections to observe the change in the nature of the bond.

Benefits to structural engineering: This technique provides the opportunity for structural quality joints in timber without the need for mechanical fasteners or the use of artificial glues. Both current methods of bonding require expensive materials and careful control of quality and potentially hazardous substances.

The joints formed would be neat in appearance with no obvious evidence of how it was formed. The method offers the advantage of spreading the load over a large area, thus reducing stresses, which requires expensive intrusive devices such as split rings to achieve mechanically.
It is timely offering a highly sustainable approach to structural timber connections.

Proposed finish date: 09/11