

Pioneering the use of hardwood in construction

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Presentation synopsis

For decades our choice of wood species for timber construction has often been determined by price rather than performance. But times are changing and so are the products and construction techniques available to engineers who want to build in timber. These include; long span Glulam, Laminated Veneer Lumber (LVL) and Cross Laminated Timber (CLT). The latter, undoubtedly a game changer, has helped propel large-scale timber construction from the drawing board to the construction site, where it is now increasingly being considered as a first choice option over concrete and steel. Until recently almost all the raw material focus has been on softwood as it provides a cheap source of fibre that offers good strength performance relative to its weight and cost and will continue to do so. However, the possibility of using certain hardwood species to enhance the appearance and performance of timber structures is an exciting new development being welcomed by architects and engineers. Over the last decade, hardwood industries, especially in Europe, have looked to construction as a growth opportunity after years of declining consumption in traditional interior markets such as furniture and flooring. Of course there is much more research and development and product testing needed. But new products are already out there being used: oak glulam, beech LVL, birch and tulipwood CLT. Recent meetings of the European structural committee responsible for updating Eurocode 5 for timber acknowledge that more use of hardwoods will be an important element of future development of timber construction and that new codes and standards will need to reflect this.



Figure 1: Endless Stair by dRMM – American tulipwood CLT

The American Hardwood Export Council's journey to promote the use of American hardwoods for structural applications began back in 2001 with Arup's pioneering use of American white oak beams for the courtyard roof of Portcullis House in Westminster designed by Hopkins architects. Subsequent testing at BRE produced detailed strength values for four hardwood species: white oak, red oak, ash and tulipwood. A series of iconic experimental installations followed; in 2008 David Adjaye's Sclera (tulipwood), 2011 Amanda Levete's Timber Wave (red oak) and 2013 dRMM's Endless Stair (tulipwood); all landmark projects for the London Design Festival. As a result of the Endless Stair we learnt that tulipwood is nearly three times stiffer than spruce in rolling shear and one can achieve the

same strength performance as softwood with thinner panels. Then there is the advantage of more attractive colours and grain patterns, so no need to cover up internal faces.

But it was in 2016 we began to realise tulipwood's full potential as a pioneering species for hardwood CLT, when Zublin Timber produced the first industrial sized panels. The Smile pavilion for the 2016 London Design Festival pushed the boundaries of what is possible in CLT. It was the result of an extraordinary collaboration with award-winning architect Alison Brooks and engineering masters Arup. We knew at the time how important this experimental structure was: with its simple form that belied the incredible complexity of the engineering challenge. Described by engineers Arup as "the most complex CLT structure ever built". The Smile may have been a temporary installation, now recycled, but its legacy is not temporary. It will remain an important marker for what is possible.



Figure 2: The Smile by Alison Brooks Architects – American tulipwood CLT

dRMM's Maggie's Cancer Care Centre in Oldham is the first ever use of tulipwood CLT in a permanent structure. It was a really defining moment and confirms that hardwood CLT is now a viable option for architects and engineers. The opening of Maggie's in June 2017 came just weeks after another defining project for structural hardwood; American white oak featured prominently in the redevelopment of the Warner Stand at one of the world's most iconic sporting facilities, Lord's Cricket Ground in St John's Wood, London. In this pioneering project, designed by Populous architects and engineered by Arup, the roof of the stand is formed from 11 cantilevered glue laminated (glulam) oak beams, the largest in Europe, that radiate dramatically from the corner of the Ground. They were produced in Germany by Hess Timber and according to Arup "the use of American white oak glulam at this scale for the Warner Stand, is amongst the first of its kind in Europe and required extensive testing of its material properties and durability to satisfy European codes and standards,"

These are exciting times and there is real momentum in favour of timber construction. As annual CLT production in Europe nears the million m³ mark, there is a race to build higher and bigger in timber, which in turn has captured the attention of the media. An article last year about the rise of timber construction, in the UK Financial Times, cited CLT as "lighter, faster and greener to build with than steel and concrete". But it's not just about how big we can go, it is also about meeting future challenges and it is in area of prefabricated modular housing, where we are likely to see even more potential realised for timber. AHEC's latest project for this year's LDF in September will focus on modular construction and highlight the role hardwood can play in this development.



Figure 3: Maggie's Cancer Care Centre by dRMM – American tulipwood CLT