

# Taking timber beyond traditional boundaries

Timber is already known to be a sustainable construction material. But advances in engineering research are proving that timber structures have the capability to challenge preconceived boundaries and deliver enhanced benefits, says Dr Robert Hairstans.



Timber offsite MMC:  
installation in progress.  
Photo: CCG (OSM)

*“CLT is imported to the UK from mainland Europe, primarily Austria and Germany, where production is reported to be increasing at a rate of at least 20% year on year.”*



**T**imber is a natural, hygroscopic, anisotropic material that must be properly understood if it is to be used efficiently within the built environment. With good silvicultural practices timber can be sourced responsibly and converted (with relatively low energy requirements) to provide environmentally sound construction products. Combining timber construction components appropriately through holistic design, informed detailing and quality-assured building practices will result in a highly energy-efficient building fabric that provides user comfort.

Thus there is a growing emphasis on the use and application of timber in construction, with its credentials as a sustainable material often cited as the reason why it should be used more widely. I certainly don't disagree with this, but I do believe that timber should be specified on merit and as part of an overall solution incorporating other materials, as appropriate. Developments in offsite manufacture and modern methods of construction (MMC) mean that there is far more to offsite timber systems than conventional timber frame construction, and with a more strategic approach to research, timber could be used in many more situations – delivering the social, economic and environmental benefits required for sustainable development while being architecturally inspiring.

### Where are we now?

Currently, the dominant form of timber construction in the UK is timber platform frame (with approximately 25% UK market share), mainly for the low to medium-rise housing market. The utilisation of this approach normally means that open panels are shipped to site to be insulated on site and externally clad with masonry or block and render. This is often regarded as both 'offsite manufacture' and MMC, but in fact this is a misrepresentation of the true capabilities of timber offsite MMC.

Simply put, offsite MMC is about achieving more for less, and doing so in less total time by employing a factory-based mass-customised approach using an empowered workforce with a well-developed holistic knowledge base. >>

For timber platform frame to be accurately described as an offsite MMC it must evolve towards a closed panel system solution, manufactured off-site to as high a level as possible – including enhancements such as the provision of services, windows and doors and the application of cladding.

Carrying out these activities offsite by applying MMC will improve efficiency and reduce waste. More importantly, offsite MMC as described above could extinguish ongoing concerns about the fire performance of timber frame construction in the temporary state, because these systems would be robustly detailed and appropriately lined internally and clad externally prior to erection.

A further development would be the adoption of a unified approach to designing and detailing large-scale structural diaphragms (walls, floor and roofs), so that offsite production can move towards larger-scale components for efficient erection processes utilising a growing palette of timber-based materials and advanced connection systems.

## Where could offsite MMC take us?

Timber offsite MMC is not limited to enhanced panelised system solutions: as an example, 'solid laminated timber' products can also be delivered using offsite and MMC.

Solid timber laminated products currently include: interlocking laminated systems or interlocking cross-laminated timber (iCLT); mechanical laminated systems such as nail-lam or dowel-lam (also known as Brettstapel); and bonded laminated systems including glulam, cross-laminated timber (known as crosslam, or CLT) and laminated veneer lumber (LVL).

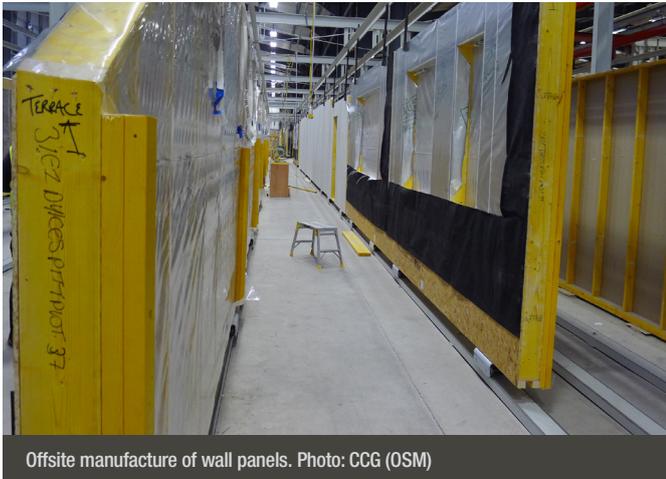
Of the solid laminated timber products, CLT, with its inherent versatility has seen exponential growth in the UK over the last 10 years, with over 270 CLT projects completed between 2003 and 2011, including residential, educational and commercial buildings.

Even more impressive is the simplicity of CLT. It is produced by bonding perpendicular timber lamellas of standard stress-graded C16 or C24 materials to form panels that can be cut to the required shape and size in a factory using computer numerical control (CNC) cutting technology.

The vast majority of CLT projects undertaken to date in the UK have been in the south of England, with almost 50% of these being in the London region. However, CLT is imported to the UK from mainland Europe, primarily Austria and Germany, where production is reported to be increasing at a rate of at least 20% year on year. Worldwide, facilities now exist in North American, Russia and New Zealand and projections suggest that production of CLT will have increased to approximately 500,000 m<sup>3</sup> by the end of 2015. >>



Volumetric module in-situ. Photo: Carbon Dynamic



Offsite manufacture of wall panels. Photo: CCG (OSM)

## An expanding market

Given the new approaches to timber construction and the utilisation of offsite MMC there are real opportunities to add value to the UK resource for this market sector: a clear 'win' when it comes to social, economic and environmental sustainability. The technical challenge is ensuring the compatibility of the resource with the controlled manufacturing process. In the case of CLT, for example, moisture content needs to be  $12\pm 3\%$  while still meeting the visual dimensional tolerance override requirements of BS EN 14081-1 for the given strength class. This can impinge on waste and correspondingly cost.

For the timber industry to realise its full potential, it needs to become less fragmented, with technical information centralised and standardised in a manner that facilitates interoperability across a range of software packages. This will assist the specification process and make the design process more transparent. But the lack of available centralised data will become increasingly relevant – particularly given the demand for accessible, robust and quality data sources for modern software applications particularly with the Government Construction Strategy towards building information modelling (BIM). From a timber engineering perspective this is imperative to enable the structural design and analysis to the European codes of practice that are less empirical and far more analytical in approach.

Embracing BIM will enable a vast array of timber construction products to be specified. But in order to ensure correct system selection and corresponding optimal performance in service it is important that design is at the centre of a holistic decision-making process. Future approaches to delivering the built environment will need to achieve a high standard of performance (thermal insulation, reduced cold bridging and acoustic separation), while remaining cost effective and not impinging upon overall structural integrity. Given these drivers for change, timber engineering research needs to be

central to the evolution of solid laminated timber products and closed panel system solutions.

## Putting research into practice

Engineered timber products and structural systems manufactured in the controlled environment of offsite MMC can redefine the image of timber as a construction material, and consequently challenge the default specification of steel and concrete.

But to achieve this aim – and the wider social, economic and environmental benefits of building with timber – we need to rethink research and development in the UK to encompass a three-step approach:

- Utilise more available home-grown timber in added value products and systems through an enhanced level of knowledge of the resource and understanding of the compatibility challenges with modern manufacturing processes.
- Centralise this knowledge in a transparent manner, and create a collaborative platform capable of hosting and maintaining the required environmental, building and structural performance information necessary to facilitate the appropriate design and specification of timber products.
- Enable mass customisation via modern software applications and ensure the compatibility of future timber engineering developments with Eurocode-compliant software platforms, streamlining research into practice via appropriate mechanisms that are backed up with a robust understanding of the materials natural performance attributes.

This research agenda requires investment and a new approach to knowledge transfer in order to underpin the industry with the required skills in order to enable cultural change toward offsite MMC. ■

## About the author

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