Timber Building in the City of Tomorrow

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1. Why we build in Wood

1.1. Introduction

Waugh Thistleton is committed to the development of architectural solutions using engineered timber as an alternative to concrete and steel, primarily as a response to the global challenge of climate change.

Whereas concrete is responsible for between 6% and 8% of carbon emissions, trees absorb CO_2 during their growth which is then stored in the wood. When the timber is harvested the carbon is then stored for the long term.

Waugh Thistleton pioneers the use of cross laminated timber in medium to high density buildings, invests heavily in research and development in this field and proselytises across the world to encourage increased use of timber in construction.

1.2. Cross Laminated Timber

While cross laminated timber is now in common use, it is worth reviewing what it is. Invented in the early 1990s in Austria, CLT is manufactured timber panels created from sawn planks glued together in perpendicular layers. Varying in depth from 75mm to 350mm the boards are typically made to a maximum size of 16m x 2.9m, which is limited more by transportation logistics than any technical factor. These boards are computer sawn and routed in the factory to create profiles and openings then delivered to site ready to be assembled into buildings.

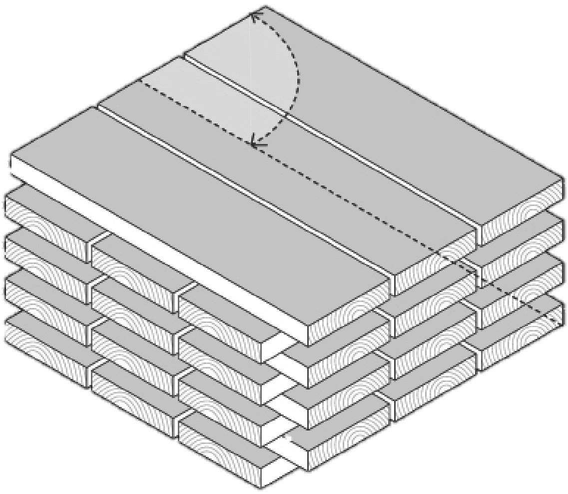

Image 1: CLT diagram

The trees used in the manufacture of CLT we use are generally Spruce or Pine. They tend to absorb CO_2 at a high rate for the first 40 years of life, after which the sequestration dramatically declines meaning that if the trees are harvested at this time, the CO_2 can be locked away in a building and new trees planted which continue to remove CO_2 from the atmosphere. All the material used in the manufacture of the CLT we use comes from sustainably managed forests with FSC or PEFC certification.

Waugh Thistleton uses timber primarily to combat climate change but it has a number of key advantages which mean that once we introduce developers or contractors to the material, they usually continue to use it in future projects.

Image 2: CLT factory

2. Pioneering Timber Developments

2.1. Exton Street

Our first contact with CLT was in 2003 when we built the first CLT structure in the UK, a small extension to a Victorian building near Waterloo Station. The site was very constrained with access only available for one day a week when an adjacent carpark was not in use. The entire three storey extension was craned into place in a matter of hours.

Image 3: 7 Exton Street – under construction

2.2. Murray Grove

Image 4: Murray Grove

In 2008 we built the first urban high-rise housing project to be constructed entirely from pre-fabricated solid timber, from the load bearing walls and floor slabs to the stair and lift cores. At nine stories, this was a World First and the tallest timber building of it's type; a significant step in demonstrating timber as a viable alternative to concrete and steel.

Built in two thirds of the time that a concrete frame building would have taken, the structure is lighter and performs extremely well acoustically and thermally. In many flats, residents have not had to use their heating system as a result of the insulation of the wood and the airtightness.

We demonstrated that the total carbon saved, comparing the carbon stored in the CLT against the embodied carbon of a concrete frame was equivalent to 210,000 tonnes of CO_2. This is equivalent to the 10% reduction in energy use required by the local authority for a period of 210 years.

Image 5: Murray Grove – interior under construction

2.3. Dalston Lane

Our sixth CLT project, this 121 unit, 11-storey development is on site and due for imminent completion. It is the largest CLT structure in the world with a gross floor area of around 12,000m^2 and using 4,050 cubic metres of timber.

The site lies directly above the Channel Tunnel Rail Link with the exclusion zone precluding any deep piles. This would limit the scale of a concrete structure to around 7 storeys, however by using CLT, the structure is less than a fifth of the weight and we can support an 11 storey building using a raft foundation.

As well as reducing the construction period by 8 months, the entire structure was delivered with less than 100 HGV loads as opposed to the 900 that would have been required using concrete. The saving to pollution and traffic is therefore a significant benefit.

The project will save around 7,000 tonnes of CO_2 from being emitted.

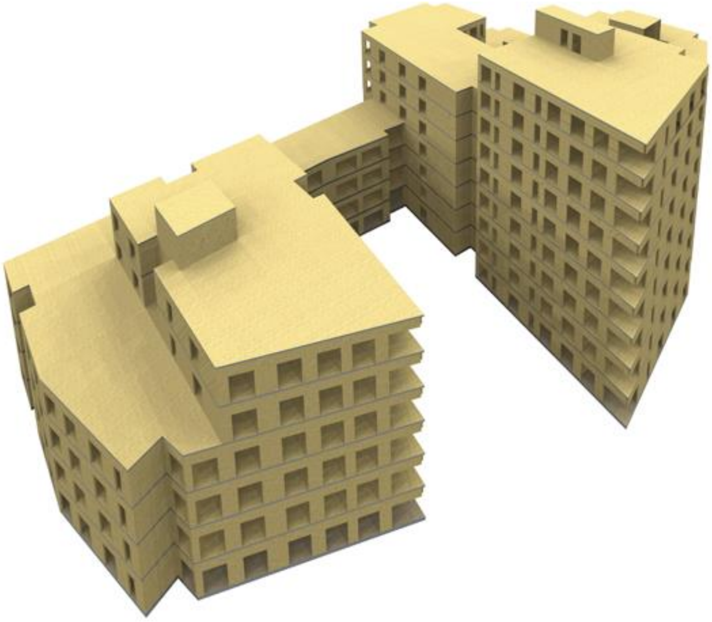

Image 5: Dalston Lane – diagram of timber frame

Image 6: Dalston Lane – photo under construction

Image 7: Dalston Lane – visualisation of project

2.4. Aubervilliers

Our next timber project in France will start on site this summer and is located in Aubervilliers, North of Paris. It incorporates six low and medium rise blocks, providing in total 58 apartments.
This small-scale residential masterplan is built from a combination of CLT and prefabricated timber frame walls. The entire external envelope will be assembled on site after its prefabrication in our timber contractor’s factory, including built-in windows.
Encouraging this type of off-site construction method was logical as it is perfectly suited to the narrow and dense nature of the site and its surrounding environment.

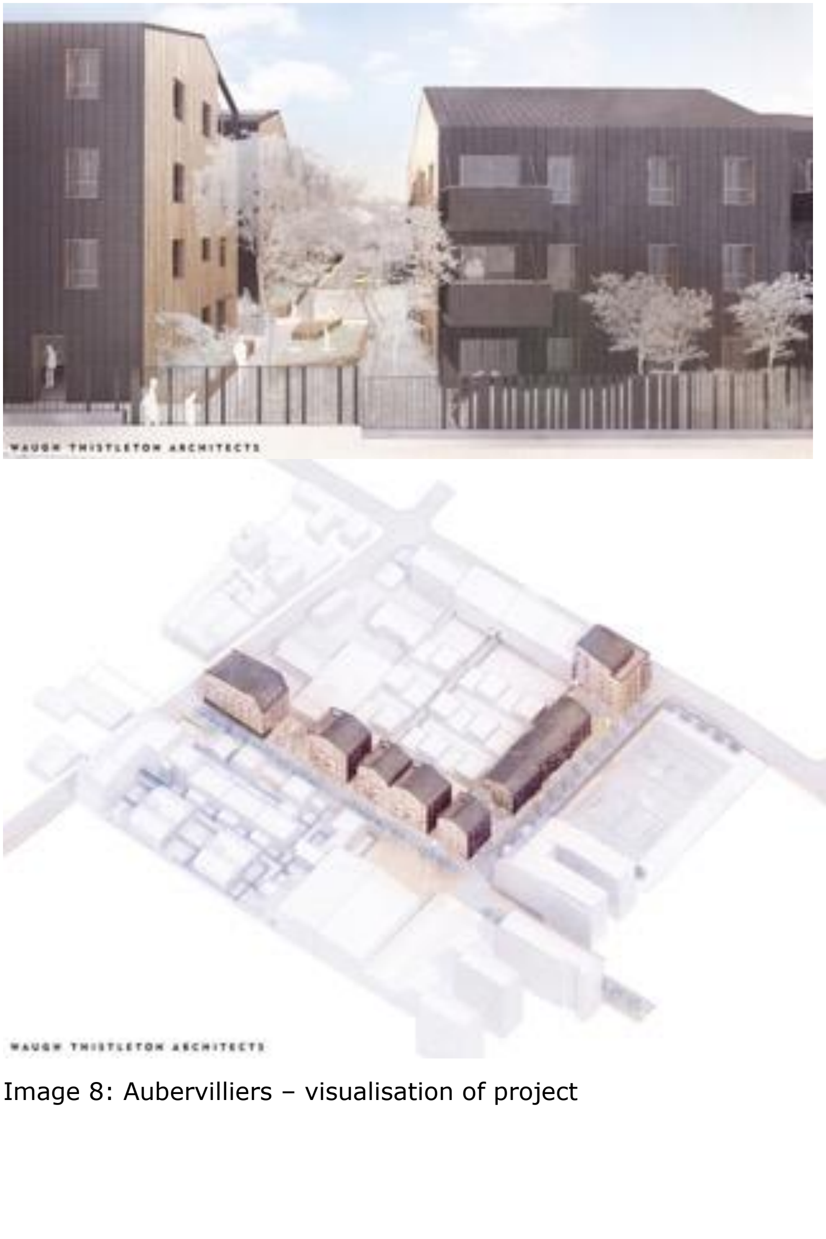

Image 8: Aubervilliers – visualisation of project

3. Future Timber Developments

3.1. The Timber Age

At the turn of the last century, an ancient material was brought into the modern age through a new way of using it. The first practitioners of concrete initially used this new material to reproduce traditional architectural forms however as the technical understanding of the capacity of this material was developed, a new architecture emerged, followed by a new urbanism, both of which characterise the buildings and cities of the twentieth century.

The use of concrete became emblematic of the relationship humanity had with the environment – that the natural world was to be exploited for materials and our buildings and cities would dominate nature. As our relationship with our planet changes, so we enter a new era.

Image 9: Théaˆtre des Champs Élysées, 1913

Image 12: Madrid Hippodrome, 1935

One of the earliest and most ubiquitous building materials has been repurposed through engineering. We have shown our initial forays into building with cross laminated timber which have proved its potential with the architectural forms achieved being those that we would expect from concrete. However, a new architecture is emerging as we embrace the new technology and we start to define the Timber Age.

As we start to appreciate the exciting architectural possibilities of this new era, we look to define the question of what will be the urbanism that follows.

3.2. Development House

Last year we were instructed by the owner of a site near our office to develop a design for a new office building to maximise the site value. The plan was to obtain initial feedback from the local planning authority which would assist with the sale.

We proposed an all timber structure, the first of it’s kind for a commercial building. Our scheme was welcomed by the local planning authority who allowed a greater density on the site for a timber building. It was also welcomed by the market, selling for 40% above the agent’s estimates, in part due to it’s unique design.

Image 10: Development House - visualisation

One of the greatest challenges for London businesses is staff retention. Where we can offer our clients office interiors like those possible in timber, they understand the value.

Image 11: Development House – interior visualisation

3.3. Building Beautiful

While we continue to work to encourage the use of timber on the basis of commercial factors, the world is now waking up to an architecture of timber and the new possibilities are becoming manifested. Beautiful expressions of the possibilities of timber are now proliferating around the world.

Image 12: Tameida Office Building Image 13: French Pavilion, Milan Expo

3.4. Building Tall

While Murray Grove retained the title of the tallest engineered timber building for 5 years, there is increasing potential for tall timber buildings driven by the development of better engineering understanding, tools and methods.

Last year the 14 storey Treet Apartment Building was completed in Bergen, Norway. In Amsterdam, the 21 storey HAUT building is due to start on site later this year and plans for a 34 storey building in Stockholm, the Våsterbroplan, are under development.

We are working on plans for the 21-storey Fore St. Building, where the form of the building is inherent to the material. The lightness of the structure means that overturning forces becomes a consideration – in this instance a ziggurat form with a wider base, addresses this issue.

Image 14: Fore St. - visualisation

3.5. Building Volume

We are currently working on three prefabricated housing solutions in the UK that are all using CLT as the primary structure. This illustrates a huge endorsement of engineered timber within the housebuilding industry and clearly identifies timber as the future of mass housing solutions.

With almost all of the work being undertaken in a factory, the advantages in terms of speed of construction and finish quality are further enhanced.

As more providers move into this approach, the opportunity of a substantial increase in suppy gives us optimism that the UK may finally build to meet demand.

4. Counting the Carbon Cost of the Housing Crisis

4.1. Grow London - The UK Housing Challenge

The chronic shortage of housing is now a significant political and social issue. Transformations to delivery of housing, like the modular solutions we are now investigating, can do much to bring supply up to the levels required. In this context, the carbon cost of housing delivery – the embodied carbon, becomes significant. The embodied carbon of a traditional built house is around 80t CO_2, for a concrete framed block of flats this impact is typically 55t CO_2 per unit. For a CLT flat these emissions can be substantially reduced with the frame itself having a negative embodied carbon.

Comparing the primary structural frame, a traditionally built reinforced concrete residential block has emissions of around 20t CO_2 per unit. Conversely, the embodied carbon for an equivalent CLT scheme would typically be -20t CO_2 per unit. Thus, by using CLT as an alternative to concrete we can save 40t CO_2 per dwelling.

With the challenge to create 200,000 homes each year, this could result in a total annual saving of 8million tonnes of CO_2 – 12.5% of the UK's Paris targets for the next five years.