BUILDING WITH TIMBER

A VIABLE AND DYNAMIC CONSTRUCTION MATERIAL

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Cover: Dalston Lane, London.
Europe’s largest cross laminated timber
structure of its kind. Image: Daniel
Shearing
ABOUT RAMBOLL

Our vision: Ramboll is committed to helping create inspirational and long-standing solutions that allow people and nature to flourish.

Unwavering passion for design
We have an unwavering commitment to design and creativity. We marry exquisite design with a comprehensive appreciation of function, buildability and end-user needs. We trust in the power of design to create competitive edge, social betterment and problem mitigation. We combine human ingenuity and self-expression together with technological advancement to solve the most complex challenges and ensure our designs are insightful and progressive.

Complete project focus
On time and on budget. We use our firm grip on commercial realities and whole life costs to ensure that what we design is what gets built. We have nothing short of complete focus on project success.

High ethical standards
Our founders and indeed B. J. Rambøll instilled our strong moral and ethical principles. The high ethical standards, responsibility towards society and happy and content employees are still key elements in Ramboll’s approach to business.

We are a values driven business. Our values exist to guide our decisions in our daily work and define the attitude and culture of our business and how we conduct our relationships.

Our values:
Insight
Integrity
Empathy
Enjoyment
Empowerment

“Our essence is that you have to behave properly and decently as a person... This relates to individual customers, colleagues and society as a whole... It is about treating other people and society right in a longtime perspective.”

- B.J. Rambøll talking about Ramboll’s philosophy.
BUILDING WITH TIMBER

Over the past 70 years we have been at the forefront of timber technology and a leading designer with this natural material. Having designed and engineered some of the UK’s and world’s largest and tallest timber buildings, we have deep understanding of this material and strive to ensure timber is a construction material considered from the outset, alongside steel and concrete.

Combining modern engineering and manufacturing techniques, we can now readily achieve interesting and complex building forms. Through our work with leading universities, including Cambridge University, the University of Bath, Imperial College London and collaboration with industry, including a proactive involvement with Exova BM TRADA; The Timber Research and Development Association, we are pushing the limits and maximising the potential of this dynamic and sustainable material.

Why timber?
Timber is growing in popularity; preconceptions about fire, longevity, mortgages, insurance, and availability are being long forgotten, replaced by the material’s many advantages. Also stacked in its favour are the benefits of shorter construction programmes due to offsite prefabrication, good thermal and fire performance properties, lighter buildings’ requiring smaller foundations and sustainability benefits, where we are often able to create a carbon neutral structure.

Furthermore, when large areas of a cross laminated timber (CLT) structure is left exposed, it can create a striking architectural feature. Not only does this add great aesthetic value to the building, but can also yield many savings in interior wet trades as the large timber panels eliminate the need for a significant quantity of interior blockwork partitioning and plastering.

Open Academy, Norwich
Using CLT, this structure saved 2,900 tCO₂ compared to a steel or concrete frame, equivalent to 8.3 million car miles.

TIMBER CAPABILITIES

In total Ramboll has designed and engineered over 50 timber buildings, totalling 25,000m³ of timber and 85,000m² of floor space.

OUR TIMBER COMPETENCIES INCLUDE:

Services
- Timber member design
- Timber connection design
- Structural engineering
- Services engineering
- Acoustic engineering
- Fire engineering

Sectors
- Education
- Arts & Culture
- Residential
- Public & community
- Temporary structures
- Retail
- Heritage

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MODERN ENGINEERING AND MANUFACTURING READILY ACHIEVE COMPLEX BUILDING FORMS
THE MOST SUSTAINABLE CHOICE

The 19th century was the century of steel, the 20th century was concrete and the 21st will be the century for prefabrication; modular steel, pre-cast concrete and timber, with timber featuring more heavily than ever before.

Building sustainably
Timber is the only truly renewable building material. Using one cubic metre of wood in place of other materials results in 0.8 tonnes of CO₂ sequestration.

By increasing the use of timber in construction, we are contributing to carbon storage in forest products. Couple this with the inherent properties of wood making it thermally efficient and the ability to improve air tightness in CLT construction, makes timber the most sustainable choice for construction.

In addition to the immediate environmental benefits, construction sites building in timber are significantly less disruptive, creating a better working and surrounding environment, with quieter and cleaner site works, fewer trades required on site and fewer deliveries. This results in less noise and congestion, improving air quality.

Not an alternative option – The best option
Over the past decade, we have come across an increasing number of projects whereby a timber building has resulted in the only solution to deliver upon a client’s brief. With sites becoming increasingly complex; existing or proposed underground tunnels that limit foundation depth, increasingly stringent sustainability requirements and a fast construction programme have all played into the hand of timber construction.

Hastings Pier
The transformed Hastings pier is a model for what a pier should look like in the 21st Century. Its new visitor centre uses both CLT and old timber deck that remained in good condition.

1 European Commission’s DG Enterprise 2003
THE PAST DOES NOT DEFINE US; IT PREPARES US FOR THE FUTURE
OUR PORTFOLIO
Open Academy, Norwich
Open Academy in Norwich is testament to how dynamic timber construction can be. This entire curved structure was constructed using flat panels that were either facetted or curved to suit on site.

“Thinking outside the box enabled this building to achieve its curves”

This three storey CLT building saved 2,900 tCO₂, compared with a steel or concrete frame. This is equivalent to 8.3 million car miles! At the time of completion, Open Academy was the UK’s largest CLT panel structure, using 3,600m³ of timber, providing the school with 9,500m² of flexible accommodation.

3D integrated structural modelling software was used to coordinate the structural design with the M&E design concept at an early stage. This enabled an efficient and elegant solution. Prefabrication of the academy’s superstructure resulted in erection taking just 16 weeks, providing programme savings of 14-18 weeks. Furthermore, site waste was cut to just two skips!

Somerset House, London
Somerset House is a major London landmark and grade I listed. The redevelopment of its East Wing created a new cultural hub. The change in use required close collaboration with the design team, research and site investigations to develop a detailed picture of the East Wing. This enabled the development of sympathetic proposals that minimised the structural impact of the proposed alterations to gain approval from English Heritage and the local authority.

“Our approach saved £400,000 and protected the integrity of this major London landmark.”

One vital aspect of the refurbishment was to ensure that the timber floors would be suitable for the change in use. Our experience of timber construction enabled us to identify the best approach to avoid intrusive strengthening of this national gem. A study of the floor resulted in the discovery of approximately 800 complex tusk-tenon connections and calculations identified them as critical to the floor system.

The predicted failure in the normal course of events would have resulted in extensive strengthening works; to overcome this, a three phase physical testing was adopted in which we developed methodologies to minimise disruption to the structure and provide the capacity of the floor. The rationalised, step by step approach resulted in an estimated saving of £400,000 and minimal floor strengthening work.

Watson House, Lymington, The New Forest
Watson House is the result of ambition to create a highly sustainable and ethical private residence, bringing them closer to nature. Working closely with the design team, we developed the concept of a two-storey house with a ground floor and basement. The effect is a house that is long, low and rectangular on plan, with the width of the property spanning one room. A reinforced concrete box forms the basement, tanked externally. Housing the utility suite and cinema room, it extends over the middle third of the overall footprint.

With construction materials a key design consideration, CLT panels form the visible walls and roof above ground. The panels are interspersed with full-height glazing, surrounding much of the house. Fulfilling the client’s brief the house appears to float above the forest floor, achieved by vertically extending the concrete strip footing. The floors project outwards on the east and west elevations and an overhang provides shade to the extensive glazing, mirroring the extended floor plate.

“Thinking outside the box enabled this building to achieve its curves”

“A multi award winning project and nominated for the highly coveted Manser Medal”

Reflecting the sustainable aesthetic achieved outside, CLT walls partition the rooms, parts of which were left exposed. Watson House also boasts a ground source heat pump, rainwater recycling and high levels of insulation.
02 Somerset House, London
03 Open Academy, Norwich
Formby Pool, Formby
This new single storey timber frame public swimming hall is located on a site with a high water table in Formby. The client was keen to produce a low maintenance building using sustainable construction techniques. We worked closely with the architects on the timber frame design, which used lumber sourced from a managed forestry scheme.

“The asymmetrically curved roof was an enjoyable engineering challenge”

The pool hall roof, a twisted plane posed interesting engineering challenges. The asymmetrically curved surface was created using Kerto elements supported on bow string trusses with 1200mm centres. The bow strings were supported by steel trusses, heavily galvanized to resist damp.

Q3 Academy, Birmingham
Specialising in design and technology, Q3 Academy caters for 1,200 13-19 year olds and staff. Ramboll was an integral part of the design team, which worked to meet the vision, and where possible, exceed the requirements of the client brief - to deliver a value for money, user-friendly, innovative, sustainable building on a challenging site.

“The timber diagrid roof represents 21st century modernism”

At the heart of the academy is a three-storey atrium, which includes dining and reception areas as well as space for exhibitions and lectures. This hub needed to be light and open-plan. A timber planar diagrid was employed for the roof as this not only simplified the connections, but also provided the contemporary free span system that was integral to the vision for this space. This allowed elements to be fabricated, transported and craned in manageable lengths and weights with the main area of the roof assembled within a tight time frame.

Creative engineering arose from a number of material and site constraints

The connection system designed was adaptable, allowing for adjustment for different angles and prevented the need for prohibitively expensive bespoke steel plates. To continue the sustainable aspirations of the project and ensure the structure had a lifespan beyond that of most pavilions, it was designed to be demountable and flat packed.

Furthermore the architect had other aspirations to be achieved if possible; as few bespoke components as possible, assembled by a non-skilled work force, economical, aesthetically pleasing with simplicity reminiscent of furniture connection.

KREOD, London
The KREOD Pavilion is made up of three timber gridshells that implement a number of geometrical optimisation and fabrication algorithms that have not been previously applied to a real structure. The first three pavilions were built in the Greenwich Peninsular site and were widely publicised. The structure pushed digital fabricators and materials suppliers to new limits, requiring a highly creative approach to structural design, as well as the application of novel digital modelling techniques.

Pavilion Architecture’s proposal was for a hexagonal mesh generated by applying a ball-packing algorithm to the surface. Our experience of similar complex three dimensional structures meant we were able to quickly identify the connection design as critical to unlocking the efficiency of the structure.

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KREOD Pavilion provided an eye catching space to compliment the London 2012 Olympics and garnered many architectural and structural accolades.
OnGreening Pavilion, Ecobuild
OnGreening is a new web-based platform devoted to the research and profiling of green building technologies. The organisation required a pavilion and lecture theatre that would make them stand out from the crowd at the world’s largest event for sustainable design at the ExCel centre in London. The look of the structure is intended to echo Ongreening’s goal of capturing and filtering the world’s knowledge of green data. The pavilion succeeded in attracting a lot of attention.

“The plywood ‘egg’ stole the show”

The pavilion’s egg-like geometry was generated using form-finding techniques pioneered on previous computational design projects. The structure itself is unique in that it uses thin 6.5mm birch plywood timber laths which were bent into shape, creating a so-called ‘bending active’ structure which is incredibly stiff and acts like a monocoque, enabling the shell to carry most of the stresses.

Dalston Lane, London
On course to be the tallest building of its kind, Dalston Lane is a 121 unit residential development in Hackney, UK. Estimates show that it will use more timber than any other scheme in the world, making it, by volume, the largest CLT project globally.

High Speed 1 and Crossrail pass under the building site, making the choice for CLT unequivocal with its lighter construction weight that enabled smaller foundations and a further two stories of accommodation on to the building.

Ramboll has carried out full structural engineering and the design of the 33m CLT structure, which necessitated the development of bespoke tools, details and techniques, where Ramboll engineers drew on their decade of experience in pushing the boundaries of this dynamic material. Working with specialist timber subcontractor B&K Structures, a series of technical challenges were overcome, to ensure an efficient, buildable and highly coordinated solution.

Rudolph Steiner House, London
Designed by architect Montague Wheeler and built in two phases, the first in 1924 and the second in 1931, Rudolf Steiner House is a Grade II listed Germanic expressionist building.

An asymmetrical four storey structure with a theatre/two-storey changing room at the rear and a number of local basements, the house contains the Anthroposophical Association’s offices, library and bookshop plus lecture and conference facilities.

“The modern timber brings the building into the 21st century”

Intended to increase the Association’s income and open up the building to the public, the distinctive new café now sits in an irregular shaped courtyard incorporating complex timber design to the rear of the house. Inspired by the Chapter House at Wells Cathedral, architect Nicolas Pople produced sketch designs, which were translated by Ramboll into working drawings. Our 3D computer models also aided visualisation during the design process and fabrication.

Bishop Centre, Taplow, Maidenhead
The Bishop Centre in Taplow is a high quality retail development that challenges conventional retail design. The project consists of 10 single storey retail units with an option for internal mezzanine floors and a 5,000m² food store, totalling 12,200m² of retail floor space, parking for 449 vehicles and 118 cycles.

“Yes not all retail buildings need to be a conventional steel frame”

The scheme provides attractive lettable units for high quality retail tenants. With The Bishop Centre the only out of town shopping facility in the district, it provides large format retail units, unavailable elsewhere in the district’s town centres.

The key design objective was to adopt a strong material and structural strategy using glulam timber and other timber cladding systems for the entire development, inspired by the immediate Green Belt context.
**Crome Court, Norwich**

Crome Court is a new student residences at the University of East Anglia in Norwich. The state-of-the-art CLT building’s sustainable design has a much reduced carbon footprint. Furthermore 69% of its energy, comes from renewable sources. Ramboll’s multidisciplinary team provided geotechnical, civil, structural and fire engineering expertise to ensure the design met the client’s sustainability requirements and was completed within the fast-track programme.

The eight-storey 231-residence building, on the east side of campus is one of the highest CLT structures in the UK. We worked closely with the architect on BIM, and modelled the structure in 3D with Revit.

The superstructure’s concrete foundation rests on 150 piles, each 11-12m long and were all installed in just five days. Apart from a concrete podium over part of the first floor level, the building is of European Spruce CLT and contains a total 1,520 cubic metres of timber.

The floors are 140mm thick, five-layer CLT spanning 3m, walls are 100mm three-layer CLT and the CLT roof is covered with an impervious waterproof membrane. The ‘plug and play’ bathroom pods arrived to site prefabricated and were then simply craned into place and connected to the services, continuing the fast construction programme.

Aside from the CLT, other sustainable aspects include extra thermal insulation, triple glazing, arrays of photovoltaic panels and grey water recycling. The project achieved a BREEAM ‘Excellent’ rating and is a RICS award winner.

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**The Tortoise, Cambridge**

Ramboll supported the Papworth Trust by building an interesting external structure adjacent to the front entrance of their Cambridge centre. The result was The Tortoise, a seating area with a shell canopy.

The plywood shell geometry was determined using our skills in computational design. A finite element analysis informed the plywood design. Detailed fabrication drawings were produced for CNC cutting, including all the holes for 216 hinge fixings.

Involvement of the centre users was instrumental to the final structure. The clients chose the design, and each canopy panel was individually decorated by the users at the Trust.

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**Temple Lodge, London**

Temple Lodge in Hammersmith has been home for the past 50 years to The Christian Community, a church and movement for the renewal of religious life. The new chapel seats a congregation of 80, and has an associated foyer, meeting space, kitchen and toilet facilities.

**“An oasis in the heart of London”**

The main work included the construction of a large chapel extension utilizing prefabricated CLT panels, cork insulation and self-coloured render that matches the original house. The new roof is in quartz zinc, with light flooding into the chapel through purpose designed roof lights at high level and filtered between the sidewalls and two rows of sculptural timber columns set out on gentle curves.

Extensive use of CLT for the construction of the new build elements achieved two of the clients key aims: to accommodate the complex geometry of the chapel within the confines of a very tight site, and the ambition to maximise carbon sequestration in the structure.

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**“CLT facilitated this fast track residential building”**

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Members of the Cambridge office, friends and family, donated their evenings and weekends to carry out all the construction works over four weeks.

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**Temple Lodge, London**

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Images:
01 Temple Lodge, London
02 Temple Lodge, London
03 Crome Court, Norwich
04 The Tortoise, Cambridge
City Academy, Norwich. A timber and steel hybrid construction created this new secondary school that achieved an 'Excellent' BREEAM rating. Combining the carbon benefits of timber with the ability to create long-span open spaces with steel, the school has a flexible floor plate, that is adaptable for future uses. Working in close collaboration with the design team, Ramboll’s comprehensive design service reduced risk and optimised the programme. The superstructure was erected in just 17 weeks.
DESIGN IS NOT ONLY WHAT IT LOOKS AND FEELS LIKE, DESIGN IS HOW IT WORKS
PEOPLE AND RESOURCES

We are 1,300 strong in the UK and 13,000 internationally. As well as experts in specialist markets such as Oil and Gas and Energy, we also have:

- 285  Building structures experts
- 170  Building services experts
- 285  Environment & health experts
- 280  Transport experts
- 40  Project managers

Our 16 strong timber network in the UK is dedicated to research & development and knowledge sharing. They extoll the virtues of timber construction and pioneer its use in larger more varied and dynamic schemes, helping to secure its place as a mainstream construction method.

13,000 PEOPLE
300 OFFICES
35 COUNTRIES
KEY TIMBER CONTACTS

GAVIN WHITE, DIRECTOR
Gavin leads the Cambridge structural engineering team, and the timber engineering within Ramboll. Passionate about ensuring timber is considered as a mainstream construction material, he has written papers and presented internationally on the subject. He has worked on over 50 timber buildings ranging from church buildings and museums, to schools and conference centres.

A driven engineer with a keen eye for detail, he relishes problem solving and the opportunity to develop innovative engineering solutions. He has pioneered the use of timber by working in collaboration with a number of universities on research projects. He has a proven ability to deliver large projects, working collaboratively to deliver the best outcome for clients, end users and society as a whole.

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ALAN DOWDALL, ASSOCIATE
Alan has over 10 years' experience as a structural engineer, working in a wide range of sectors, including education, residential, commercial and heritage. His experience spans new build and refurbishment projects from multi-million pound new-build developments to small scale residential buildings. He has a passion for engineering, with a focus on details and works closely with the design team and contractor to ensure smooth project delivery.

Alan is an expert in the design of timber structures, a specialist in CLT construction and timber connection design. He has worked on over 40 timber buildings and leads Ramboll’s technical timber design group. He has also developed Ramboll’s in-house design programs for glulam, CLT and timber connections, which have been instrumental in Ramboll becoming one of the UK’s top timber designers.

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OLIVER NEVE, PRINCIPAL ENGINEER
Oliver is enthusiastic about creative design and collaborating with other disciplines to deliver holistic solutions. He has experience in both complex restoration and new build projects from scheme design through to final construction. He is a pioneer in the use of CLT, with broad knowledge of timber construction having delivered several timber schemes.

Oliver has developed innovative engineering solutions including a CLT concrete composite floor systems. In 2012 Oliver was awarded the Institution of Civil Engineers medal for his work involved with CLT concrete composites. He has presented his work involved with CLT at several international conferences. His passion for low carbon design contributed to software development that determines the embodied carbon of structures, enabling more sustainable designs.

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PIONEERING RESEARCH AND INDUSTRY COLLABORATION (DRIVING SUSTAINABLE CONSTRUCTION MATERIALS INTO THE MAINSTREAM)