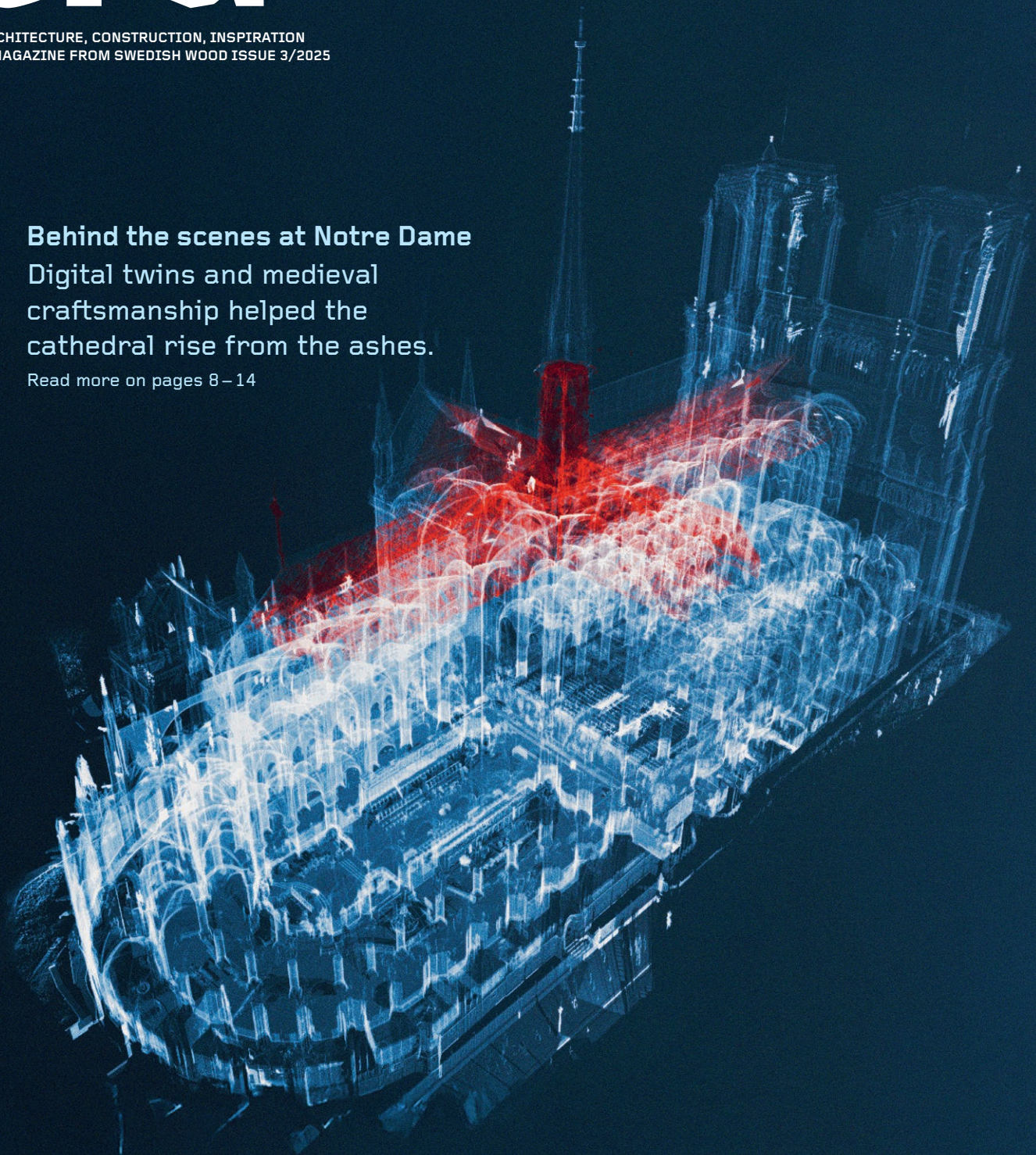
trä

ARCHITECTURE, CONSTRUCTION, INSPIRATION
A MAGAZINE FROM SWEDISH WOOD ISSUE 3/2025

Behind the scenes at Notre Dame
Digital twins and medieval craftsmanship helped the cathedral rise from the ashes.
Read more on pages 8 – 14



Space

~s ~s Noun for the infinite part of the universe that is not near Earth and consists of celestial bodies and the intervening (almost) airless void. The word space can also describe the experience of a three-dimensional area – length, height and width. How these dimensions are balanced and used has a major impact on how a building is experienced.

Glulam, black holes and chisels

PHOTO JOHAN BERGMARK


Malin Age

I don't recall exactly how the words came out. But suddenly at lunch one day, a colleague confessed he had a fear of space. In him, thoughts of infinity and black holes evoked only dread and discomfort.

Personally, I've often wished I knew more about the stratosphere and planets. Then perhaps I'd have a better grasp of those Japanese researchers now discussing the possibility of planting trees on the moon. Maybe I'd also know which type of magnolia would be best suited for building wooden satellites?

Read more about timber in space on page 24.

When Wood Magazine has space as its theme, it's naturally also about space from a more architectural perspective. As a material, timber has many climate advantages. But thanks to glulam technology, we can also build big. The lightweight beams are strong. Large buildings mean that much carbon dioxide can be stored, and that's why it's exciting to follow developments in Jönköping, Bålsta and Landvetter, where large warehouses have been built in timber. Read more on pages 16–23.

Another building with space is Notre Dame in Paris. Made from French oak, the cathedral's roof has now been rebuilt. Read about the fascinating story where our era's digital laser technology has worked side by side with medieval chisels and wooden mallets.

Read about Notre Dame on pages 8-14.

Enjoy your reading,

Malin Age

MALIN AGE
EDITOR

PS! Thank you to all readers. for your thoughts and reactions to the magazine's redesign! It's also wonderful to see so many new subscribers wanting to follow us. Please continue to get in touch with tips and tell us what you think of the magazine. The address is tidningentra@svenskttra.se

Publisher: Arbio AB. **Responsible publisher:** Anna Ryberg Ågren. **Project manager:** Alexander Nyberg. **Editor:** Malin Age. **Editorial office and graphic design:** Intellecta. **Editorial Board for this issue:** Carmen Izquierdo (Esencial), Ivana Kildsgaard (Tengbom), Elzbieta Lukaszewska (Afry), Nadya Toss (LTH Arkitektur), Cecilia Westlund. **Ad booking:** Jon Öst, jon.ost@spmedia.se, tel 072-231 69 08. **Printing:** Trydells **ISSN-number:** 2001-2322. **Paper:** 200 g Amber Graphic and 115 g Arctic Volume. **Cover image:** © V. Abergel/L. de Luca/Map/Vassar College/Gea/Chantier scientifique Notre-Dame de Paris/Ministère de la Culture/Cnrs.
Contact: Swedish Wood, Box 55525, 102 04 Stockholm, tidningentra@svenskttra.se **Swedish Wood** disseminates knowledge about timber, timber products and timber construction to promote a sustainable society and a thriving sawmill industry. Swedish Wood represents the Swedish sawmill industry and is part of the Swedish Forest Industries Federation. Swedish Wood also represents the Swedish glulam, CLT and packaging industries, and has close collaboration with Swedish timber merchants.

SVENSKT TRÄ

SWISSPEARL

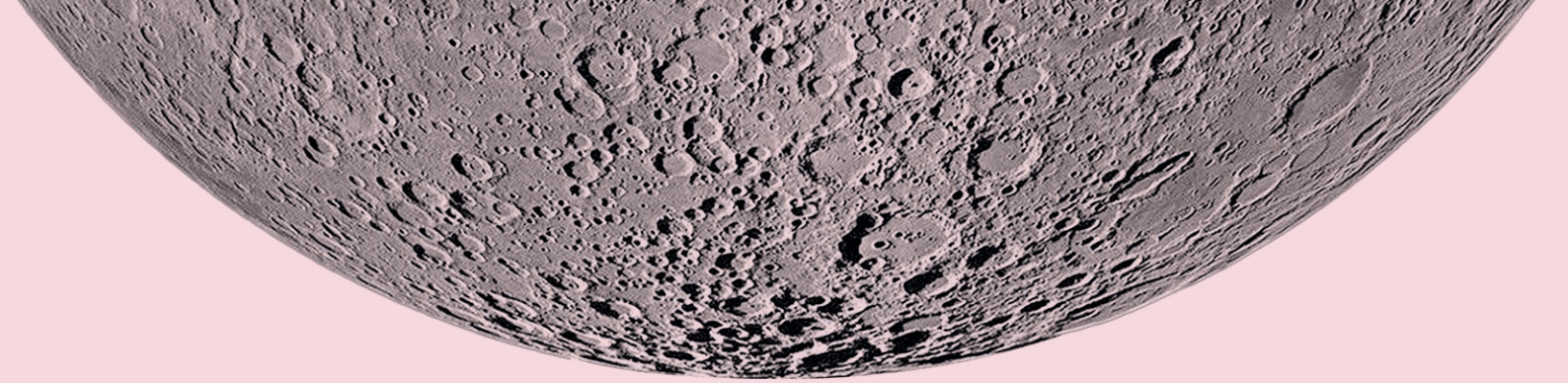
swisspearl.com

Punkthus, Rapperswil-Jona. Sunskin Facade Flat.
Arkitekt : BGS & Partner Architekten Foto: Winterthur

Solenergi har aldrig sett så bra ut.
Nu i färg.

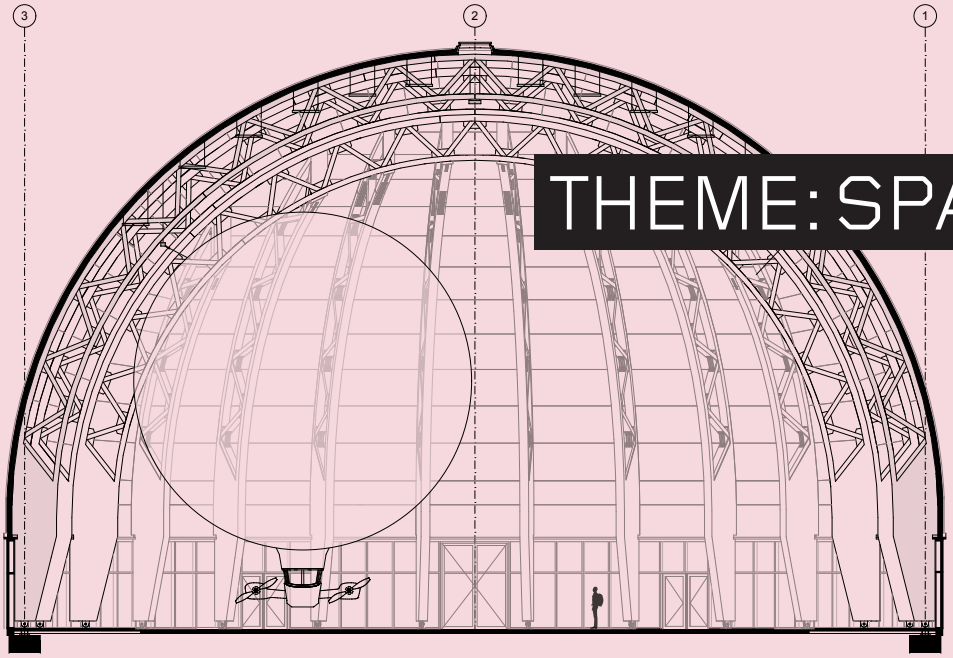
Med Swisspearl Sunskin får du ett fullt integrerat solcellssystem som ersätter konventionella tak- och fasadmaterial. Systemet är utvecklat för att möta höga krav på estetik, hållbarhet och energieffektivitet – i både nyproduktion och renovering.

- Full ytintegration - är klimatskyddet
- Färgade solcellsmoduler
- Arkitektonisk frihet



CONTENTS ISSUE

3 / 2025 THEME: SPACE



THEME: SPACE

Stora Enso's packaging wins prestigious prize

Stora Enso has won the Red Dot Design Award 2025 for Marimekko's gift packaging. Made from certified, renewable corrugated cardboard and featuring Marimekko's classic Unikko pattern, the packaging is foldable and requires neither tape nor packing material. It reduces material consumption and can be reused as a carrier bag. The jury highlighted the flexibility, sustainability and strong visual identity. ●

Student project builds bridges between architects and engineers

A 14.5-metre long footbridge in pressure-treated timber will soon be in place at Björshuvudet nature reserve on Tjörn. The timber bridge is the result of a student project at KTH where 40 future architects and engineers collaborated from sketch to completed construction.

The project, supported by the Swedish Wood Preservation Association, the Swedish Forest Industries Federation and Rothoblaas, aims to give students realistic insight into interdisciplinary working life. "It reflects professional life in a good way," says Roberto Crocetti, Professor of Structural Engineering at KTH. Västkuststiftelsen is the client. ●

British architecture students receive awards

For the fifth consecutive year, Swedish Wood participated in the degree show at the prestigious Liverpool School of Architecture.

Each year, Swedish Wood awards prizes to BA3 and MArch students for the most innovative use of timber. This year's winners included the project Grafting Futures, which examined how migration can breathe new life into parts of southern Italy by building sustainable housing and education centres in abandoned areas.
The project Scalene Shift, which explored possibilities for establishing a youth centre in northern England, was also awarded. ●

IMAGE THE LIVERPOOL SCHOOL OF ARCHITECTURE

Max Dresler receives the Swedish Wood prize for his project "Grafting Futures".

Forest scanned with laser

A new supercomputer, the Computational Forestry Lab at Umeå University, will facilitate forestry technology research. It enables rapid analysis of large amounts of data, and the computing infrastructure solves two challenges: allowing companies to share data with researchers without revealing trade secrets, and enabling research results to be tested in practice. The initiative is funded by the Kempe Foundations and Mistra Digital Forest. ●

PHOTO ART GRAPHIQUE & PATRIMOINE

HOW NOTRE DAME ROSE AGAIN

On 15 April 2019, Notre Dame in Paris burned. The cathedral's 96-metre-high central spire collapsed and the roof, which had stood for 800 years, was reduced to ash. Despite heroic rescue efforts, the devastation was enormous. The reconstruction work, where medieval craftsmanship went hand in hand with contemporary measuring and calculation techniques, began immediately.

TEXT CARL JOHAN LILJEGREN
PHOTO TT, ART GRAPHIQUE & PATRIMOINE, REBÂTIR NOTRE-DAME DE PARIS

Notre Dame was classified as a World Heritage Site by UNESCO in 1991. The cathedral is laden with national, religious and cultural symbolism, and is a landmark for Parisians and the millions of people who visit the city annually. Consequently, the fire aroused enormous upheaval in large parts of the world, and led to a feverish reconstruction zeal that engaged all of France. The pattern is familiar from history. Even during the Middle Ages, cathedrals burned, and when new money was injected into half-dormant building projects, new construction techniques and stylistic elements could often emerge. The new was to be higher, bigger and more magnificent than what the flames had taken.

After the fire

Immediately after the fire it was made clear that Notre Dame would be rebuilt. But an intense debate arose about how and to what. There was discussion about whether to reconstruct the medieval roof and the 19th-century neo-Gothic spire with modern materials and a contemporary expression, or to recreate them exactly as they were before the fire. In one camp were those who argued that if nothing

new was added, one would not be looking forward and then the church would lose some of its meaning. Others argued that Notre Dame, after the architect Eugène Viollet-le-Duc's renovation in the 19th century, had become a memorial to history and a central monument to France's cultural heritage, and that if anything were removed or changed, the building would lose its identity and significance.

In the end it was decided that everything with a few exceptions would be recreated as it looked before the fire. The faithful reconstruction of Viollet-le-Duc's spire and the medieval roof structure, known as la forêt (the forest), would furthermore be done with original materials and in some cases old construction techniques, but using contemporary measuring and calculation techniques. These provide a precision far beyond what previous generations had the possibility to achieve, and a much faster and more controlled construction process than would otherwise have been possible.

The first two years were devoted to stabilising the building and clearing after the fire. The restoration began in 2021 and the cathedral was reconsecrated on 7 December 2024. However, the restoration is not expected to be completely finished until the end of 2026. The work was led by Philippe Villeneuve, assisted by Rémi Fromont and Pascal Prunet, all titled chief architects for historical monuments by France's Ministry of Culture. The project involved approximately 2,000 craftspeople and over 250 companies. Initially it was estimated that the reconstruction of Notre Dame would take 10–15 years. But fortunate circumstances meant that the entire gigantic and complex reconstruction work took only five years.

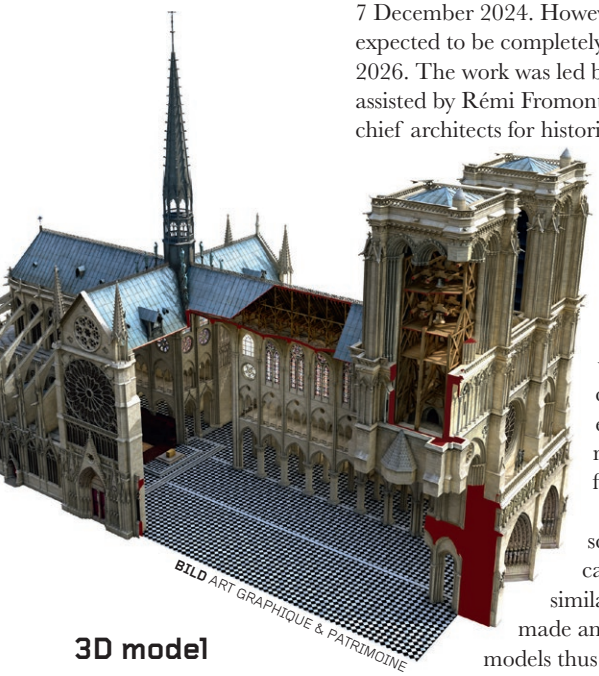


BILD ART GRAPHIQUE & PATRIMOINE

3D model

Technical documents such as plans, elevations, sections, axonometric views, workshop drawings and perspectives, as well as exact material quantities and data, can be retrieved from the BIM model.

In 2010, detailed laser scans were made of the entire cathedral. After the fire, similar scans could quickly be made and the three-dimensional models thus obtained compared with the model of how the cathedral looked before the catastrophe.

This meant that detailed drawings and specifications could be produced in a short time that could be used in the reconstruction work. Crucial for recreating the construction of the famous timber roof, La forêt, were the exact measurements and drawings made as recently as 2014 by Rémi Fromont and Cédric Trentesaux (chief architect at L'École de Chaillot). They discovered that no drawing of the 800-year-old roof structure had actually ever been made. In 2014, Rémi Fromont was a student at L'École de Chaillot, a school that amongst other things specialises in training architects in the preservation of France's architectural cultural heritage. Now he is chief architect for historical monuments and one of those responsible for saving the cathedral.

Recreating the roof structure

The Gothic timber section in la forêt was exceptionally large for its time and extraordinarily well made. The nave's roof structure, above the stone vaults, was 75 metres long, and that above the choir 32 metres. The width was at most 14 metres and the height 10 metres. The construction consisted of hand-hewn slightly conical beams, which were somewhat thicker where they were joined together, which provided increased strength in the joints. Such beams are much harder or impossible to create with modern saws, says Fromont in an interview in the newspaper Les Echos. Hand-hewn beams are also mechanically stronger than sawn ones, because they follow the wood's fibres.

Thanks to the meticulous measurement and drawing, it proved possible to recreate an exact replica of the roof structure. First a model at 1:20 of the entire construction was created. Then a roof truss was built at full scale. Then all the measurements were fed into the digital models that were used to finally confirm that the drawings could be used to recreate the cathedral's roof structure. Finally, 1,300 drawings and 500 templates at scale 1:1 were produced in a very short time. With the help of these, the size of the trees needed was determined and templates were made for each part that was to be hewn. Since they needed to work from fresh timber, the exact dimensions in which all parts should be hewn were calculated, so that after having dried and shrunk in place in the roof structure for 20–30 years, they would become identical to the original roof trusses.

The reconstruction of the roof structure was done in the same way and with similar tools as in the 12th century, with axe and chisel, hand saws, auger and wooden mallet. Each beam was shaped individually and they were joined with wooden pegs. No iron was used. The entire timber construction was recreated by hand in eight months. The ten-metre-high roof trusses were then allowed to dry outdoors for 18 months for the best possible dimensional stability, before they were lifted into place in Notre Dame in January–March 2024. ●

Want to know more about the restoration of Notre Dame?

Come to the Seminar on Engineering Construction in Timber, which takes place on 23 October in Stockholm. There you will learn more about how axes and timber craftsmanship met parametric design in the reconstruction of Notre Dame.

View the full program and register here:

PHOTO ART GRAPHIQUE & PATRIMOINE

Digital twin

Although the craftsmanship performed is traditional, the restoration was heavily dependent on contemporary cutting-edge technology. Even before the fire there was an extremely detailed 3D laser scan of the entire cathedral, carried out by amongst others the art historian Andrew Tallon and the company Art Graphique & Patrimoine. This digital twin has functioned as an exact drawing to recreate every detail with millimetre precision. Drones were used early on to inspect damaged structures and to obtain detailed close-ups of the entire cathedral's surface layer.

The hunt for the perfect trees

When you hew, in the same way as medieval carpenters did, the idea is to keep the log's heartwood in the middle of the beam and remove as little material as possible. To succeed with that, you must choose trees where the diameter and length correspond to the size of the finished beam. Finding the right trees proved, however, to be significantly more difficult than those involved had reckoned with. The requirements were high. The tie beams in the roof trusses were 13 metres long, and to hew out replicas of them, the principal and diagonal struts and the hammer beams required tall, straight, slender completely flawless trees, without knots, twists or the slightest blemish on the bark. Such trees were what the medieval builders had used.

Those responsible for procurement searched a total of 600 hectares of oak forests throughout France. Each tree was selected according to its diameter, its straightness and its length, and it turned out that only one to two trees per hectare were suitable. There are plenty of oak forests in France, where the trees grow significantly faster than at our latitudes. Annually, 2 million cubic metres of oak are felled there. Despite this, debate also arose about whether it was reasonable from an ecological point of view to cut down oaks to rebuild Notre Dame. In total it was about 1,200 oaks that needed to be felled. That corresponds to less than 5 per cent of the oaks that are annually felled in French state forests.

PHOTO ALAIN JOCARD/TT

Notre Dame's roof trusses

We often think of the Gothic cathedrals as primarily stone buildings, but timber construction technology also took significant strides during the 13th century, which the roof trusses in Notre Dame bear witness to. The earliest roof trusses were assembled from many short pieces of timber, which were easy to handle and find timber for, but complicated to assemble. The result was a somewhat too flexible construction. For the subsequent roof trusses, from the beginning of the 13th century, a combination of very long and shorter beams was used, which gave a much more solid construction. But it must also have been substantially more difficult to obtain and transport the timber, and to hoist up and assemble the roof truss parts. The longest beams were 14 metres long. The measurements from 2014 showed, however, that the construction was not completely optimal. Even though the construction was similar, the roof trusses over the choir would have fitted better over the nave and vice versa, something that was not corrected in connection with the renovation. The new "Forest" (la forêt) is thus a historically correct replica that will be able to last for many hundreds of years – especially as it is now equipped with fire protection.

PHOTO SAMEER AL-DOUMY

The spire

Notre Dame's original spire was constructed during the 13th century and functioned as a bell tower. The tower was taken down during the French Revolution for safety reasons. The spire that was destroyed in the 2019 fire looked completely different from the original and was Viollet-le-Duc's neo-Gothic creation from 1859-1860. The 96-metre-high construction was ingeniously designed from 500 tonnes of oak timber, covered with 250 tonnes of lead sheets. Everything rested on an octagonal base that was carried by the transept's four pillars. The drawings still existed, but it was still a considerable challenge to find oaks of the right quality and size, manufacture, transport and lift the spire's parts into place. Just as for the roof structure, traditional hand tools were used together with modern measuring methods for optimal precision. ●

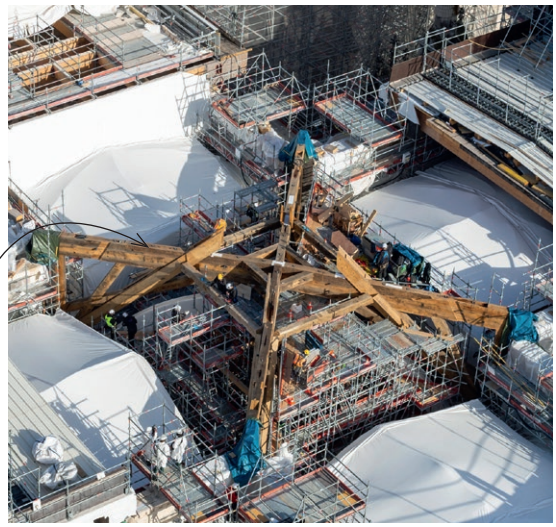


PHOTO DAVID BORDES © REBÂTIR NOTRE-DAME DE PARIS

PHOTO JEAN-FRANCOIS MONIER/ TT

In total, 220 forest owners contributed oaks for the roof structure. The trees were identified and GPS-marked between January and February 2021, and felled in March the same year, before the sap had risen.

885 years of shifting ideals

Notre Dame stands strategically at the heart of Paris on Île de la Cité, the island in the River Seine where Clovis, the first king of the Franks, established Paris as his capital around 496. The island was an early political, commercial and religious centre, home to the great Cathedral of Saint-Étienne from the 4th century, which stood in front of where Notre Dame stands today.

Already around 1140, two new building techniques that characterise Gothic architecture – pointed arches and rib vaults – were being used fairly widely. However, they did not bring about an immediate radical transformation otherwise. Cathedrals did not become airier, brighter and taller overnight. Gothic architecture developed gradually from a series of accidents, ambitions and a vitality that arose in the Île-de-France region, where builders succeeded in exploiting new technical ideas that had emerged in many places.

When construction of Notre Dame began a few years before 1163 by Bishop Maurice de Sully (c. 1120–1196), backed by Louis VII, it was a Romanesque cathedral he was establishing. The high altar was consecrated in 1182, suggesting that the choir was completed in less than 20 years. The famous and innovative light flying buttresses were probably also developed during this time to support the high walls. But it would take another 60 years and probably five master builders before construction was complete.

During this time, significant technical innovations were made and changes in fashion occurred, which clearly influenced the cathedral's appearance as work progressed. The walls became thinner, the clustered piers more slender, the vaults higher and the windows larger. When Notre Dame was completed in 1240, the cathedral was Gothic.

Gothic architecture became "modern" and associated with the French monarchy's aspirations – "a royal French fashion" and France's national architecture – under Louis IX (1214–1270). As the Île-de-France gained increased economic, political and cultural importance, and Paris became the cultural centre of Europe, Notre Dame with its enormous dimensions became a grandiose affirmation of Paris as capital, and a symbol of royal power.

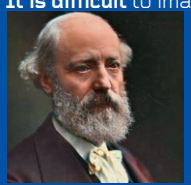
The miniature painter Jean Fouquet's illumination "God's right hand protects the faithful against demons" from Étienne Chevalier's Book of Hours from the mid-15th century is the oldest surviving depiction of Notre Dame.

It is difficult to imagine today, but at the beginning of the 19th century, Notre Dame in Paris was in such poor condition that the cathedral was on the verge of demolition. This was a fate that befell several of France's most important cathedrals in the decades after the French Revolution. Ever since the Renaissance, Gothic architecture had been viewed as crude and barbaric because it deviated from the classical ideal, and after the Revolution, contempt for the Middle Ages was widespread. Through the centuries, harsh renovations had disfigured the building and it had been left to decay. During the Revolution of 1789, many of Notre Dame's sculptures and tombs associated with royal power were destroyed. At the same time, the 13th-century spire was dismantled. Napoleon was crowned in the cathedral in 1804, but a few decades later the decay was so severe that the building risked collapse.

However, Victor Hugo's novels and especially his bestseller The Hunchback of Notre Dame, published in 1831, changed perceptions of the cathedral and France's Gothic heritage, and it was saved along with many other decaying Gothic monuments for posterity.

A central figure in Notre Dame's history is the architect Eugène Viollet-le-Duc (1814–79) who, together with Jean-Baptiste Lassus (1807–57), won the commission to renovate Notre Dame in 1844. Viollet-le-Duc was enormously important and influential through his vast knowledge of medieval buildings, their structure and building techniques. But he also made numerous additions and chose what should be recreated, replaced and removed – something he was harshly criticised for both then and later. Only in the 1980s did opinions of his work improve (he renovated not just Notre Dame). But his spirit hung heavily over the debate that erupted after the fire about how Notre Dame should be renovated, and critics argue that the renovation has effectively cemented Viollet-le-Duc's interpretation of Notre Dame.

Viollet-le-Duc's goal was to achieve his ideal of what medieval architecture was, regardless of whether the building had ever looked that way. ●



»To restore a building is not to preserve, repair, or rebuild it; it is to restore it to a state of completeness that could never have existed at any given point in time.»

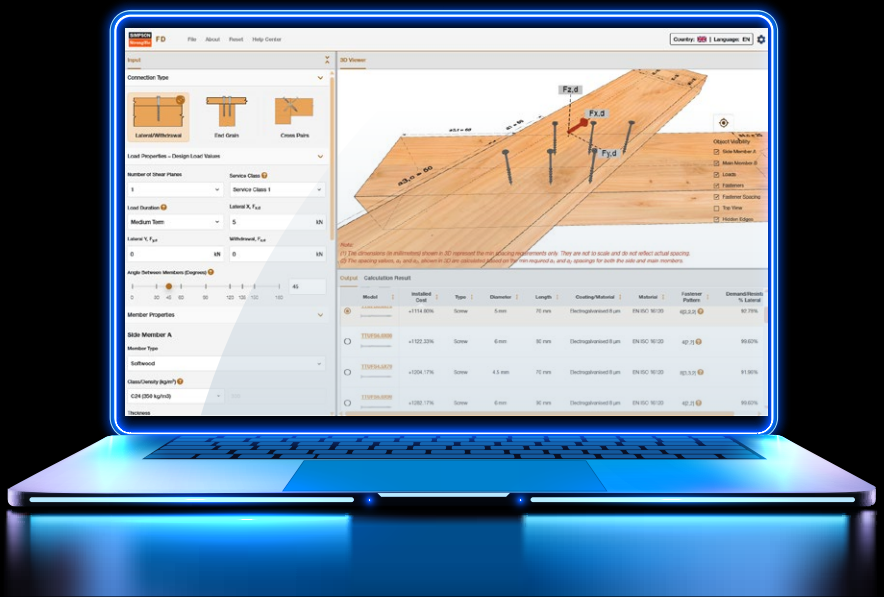
EUGÈNE VIOLLET-LE-DUC

Upptäck Fastener Designer – ditt nya digitala hjälpmedel

Intuitivt 3D-gränssnitt

Lokalt anpassade produkter

Tidsbesparande och kostnadsfritt



Designa smartare – snabbare – enklare. Fastener Designer är vårt nya webbaserade verktyg som gör det enkelt att beräkna komplexa förband.

Med Fastener Designer från Simpson Strong-Tie får du ett kraftfullt, webbaserat verktyg som gör det enkelt att dimensionera och beräkna komplexa skruv- eller spikförband direkt i din webbläsare. Verktyget är utformat för att vara användarvänligt och effektivt, med ett dynamiskt 3D-gränssnitt och inbyggda guider som hjälper dig att komma igång på nolltid.

- Ingen inloggning krävs
- Spara dina beräkningar lokalt
- Återuppta projekt när det passar dig
- Skapa mallar för framtida användning

Fastener Designer hjälper dig att välja rätt infästning från Simpson Strong-Tie som uppfyller dina krav och är tillgängliga på din lokala marknad. När du är klar guidar verktyget dig vidare till vår webbplats för mer information och produktval.

Prova Fastener Designer idag och upplev skillnaden!
strongtie.se/fastener-designer

SIMPSON Strong-Tie

BUILD BIG WITH GLULAM

– from straight beams to curved trusses

Sports halls, industrial buildings, logistics centres and arenas are growing in both size and ambition. Structural engineer Magnus Emilsson explains why the glulam frame is an effective choice when building big – and how common mistakes can be avoided.

TEXT GUSTAV SCHÖN **PHOTO** SWEDISH WOOD

Glulam, typically made from Swedish spruce, is a natural material that binds over 700 kilograms of carbon dioxide per cubic metre. The material is renewable and can be reused, recycled and ultimately utilised for energy recovery. Today, 13 per cent of all structural frames are built in timber. Steel is by far the most common material, accounting for 75 per cent of the market. But interest in building with timber is growing.

"A glulam frame has many of the soft values that are in demand today. It produces approximately 10 times less carbon dioxide emissions than an equivalent structure in steel or concrete and is perceived by many as a more beautiful material," says Magnus Emilsson, CEO and structural engineer at Limträteknik in Falun.

Glulam is one of the strongest construction materials in relation to its own weight. Lamination makes it possible to use timber from smaller trees whilst still creating very long and high beams. This enables clear spans of 30 metres or more without support, and in certain cases up to 40 metres.

"Glulam is unique in its combination of low self-weight and high load-bearing capacity. It enables large clear spans with a minimum number of support points," says Magnus Emilsson.

The material is dimensionally stable – it doesn't warp or bend as solid timber can do – and can be manufactured in almost any shape: straight beams, gentle arch forms, frames, trusses or advanced three-dimensional structures.

"It's possible to deliver millimetre precision from the glulam manufacturer, which gives short assembly times and high precision fit," explains Magnus Emilsson. Prefabrication also makes it possible to integrate fittings and services during manufacture.

MAGNUS EMILSSON, CEO AND STRUCTURAL ENGINEER AT LIMTRÄTEKNIK IN FALUN.

The material also has excellent fire properties. In a fire, the surface chars slowly, which protects the inner core and maintains load-bearing capacity significantly longer than steel, which quickly loses strength at high temperatures.

> *»It's possible to deliver millimetre precision from the glulam manufacturer, which gives short assembly times and high precision fit.»*
>
> **MAGNUS EMILSSON, STRUCTURAL ENGINEER**

"Buildings with special fire requirements that are built with steel trusses also need fire-protective coating, which means they often become significantly more expensive than the equivalent structure in timber."

The right material in the right place

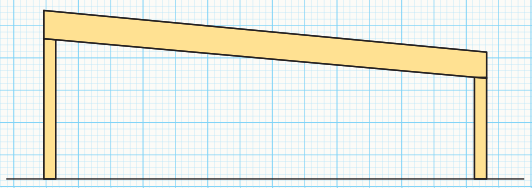
Magnus Emilsson views the increased timber construction positively, but also raises a warning finger.

"It's important to start from the site and what the building will be used for, and then choose the construction material that's most suitable. Perhaps we shouldn't build the tallest skyscrapers with timber frames – steel and concrete are better suited there, as they have less movement in the frame," he says and continues:

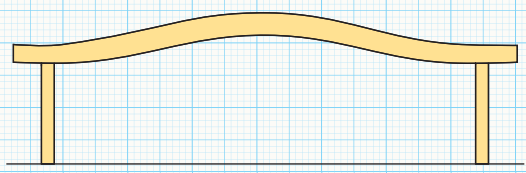
"But skyscrapers are, on the other hand, a rather uninteresting segment, as we rarely build those in Sweden."

Limträteknik in Falun has designed and constructed buildings, primarily in timber, since 1984. They carry out damage investigations for insurance companies and the

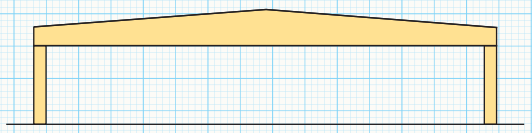
Glulam in larger buildings



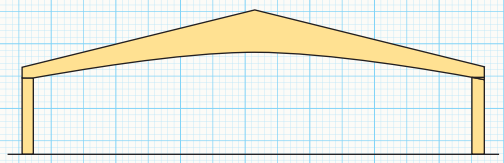
STRAIGHT BEAM ON POSTS
10 – 30 M



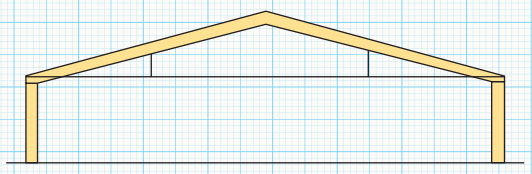
CURVED BEAM ON POSTS
10 – 20 M



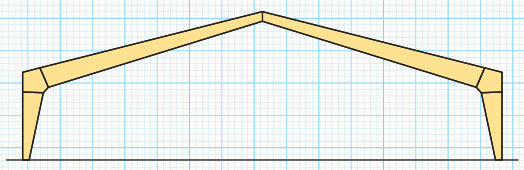
PITCHED BEAM ON POSTS
10 – 30 M



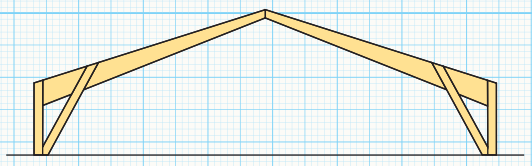
BOOMERANG BEAM ON POSTS
10 – 20 M



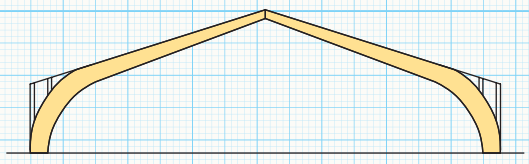
TIED ROOF TRUSS ON POSTS
15 – 50 M



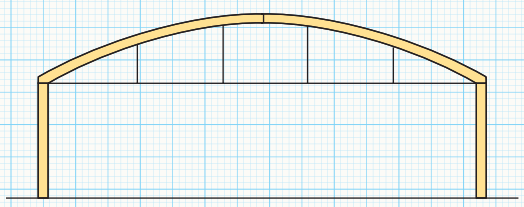
THREE-POINT PORTAL WITH
FINGER-JOINTED HAUNCHES
15 – 25 M



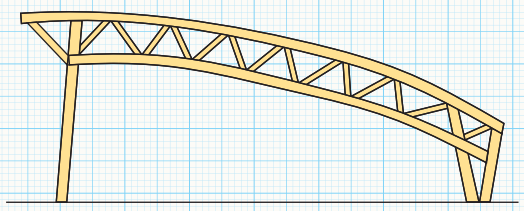
STRUTTED THREE-POINT PORTAL
10 – 35 M



THREE-POINT PORTAL WITH CURVED HAUNCHES
15 – 40 M



THREE-POINT TIED ARCH ON POSTS
20 – 60 M



TRUSS (STRAIGHT OR CURVED)
30 – 85 M

SOURCE: THE GLULAM HANDBOOK VOLUMES 1, SWEDISHWOOD.COM

Swedish Accident Investigation Authority, and conduct research and product development in industry. Development is currently underway to optimise timber beams at connection points.

"We're looking at making glulam beams more material-efficient. Sometimes it's the connections that determine how high a beam needs to be, not what the beam needs to bear. Instead of making the entire glulam beam higher, we're looking at how we can reinforce just the connection points, for example by using timber species with higher strength and density such as birch or oak."

Cheaper to build with timber

That a timber frame always means a higher price is an old misconception that persists, says Magnus Emilsson. When Limträteknik in Falun designed a timber frame for the Swedish Transport Administration's head office in Borlänge, timber was the most cost-effective construction material.

"The building's rounded shape and the choice of timber frame made the project approximately 30 million kronor cheaper. A timber frame has a lower weight than steel and concrete frames, which meant avoiding a piled foundation structure," he says and continues:

"Generally speaking, the differences in price are marginal, and the frame represents only about 10 per cent of the total construction cost. But in the Borlänge project, the difference was exceptionally large thanks to the shape and the fact that we didn't need to do any piling work."

It's easy to forget that glulam is a well-proven material. It had its major breakthrough in Sweden already in the 1920s, when Malmö, Gothenburg and Stockholm's central stations were built with elegant glulam arches that still carry the roofs.

"We've been building large facilities in timber for a long time. Virtually every sawmill in the country is a timber construction."

During the 2000s, timber structures for large public buildings have developed rapidly.

Magnus Emilsson believes the next step will be a clear increase in multi-storey residential buildings with timber frames.

"The multi-storey residential buildings with timber construction built so far are often high-end projects where nothing is spared. Of course they become expensive to live in. If it's to become more common, perhaps we need to look back to the 1950s and the Million Programme houses. We need to find new standardised type solutions that make it possible to build quickly and cost-effectively. But we must also respect that it's relatively new to build larger residential buildings and schools in timber," says Magnus Emilsson. ●

Magnus's three tips – build big and sustainably with timber frames

1 **A fire engineer keeps costs down**
Use a fire engineer with timber experience and discuss requirements and solutions early. Expensive additions aren't always the only solution.

2 **Involve the structural engineer early**
Have a structural engineer with timber experience involved when the first sketch is produced. The structural engineer can suggest simplifications early in the project. This usually involves just a couple of hours' work.

3 Timber construction is weather-sensitive during the assembly phase, so it's important to carefully plan the assembly sequence and weather protection.

How do others build big?

Check out three examples from Landvetter, Bålsta and Jönköping.

PHOTO CATENA

GLULAM FRAME WITHSTANDS THE COLD

A freezer the size of a football pitch, reduced transport and a glulam frame that withstands the cold. That and much more is what Menigo has gained in its new state-of-the-art warehouse at Landvetter airport.

The glulam structure supports the 300-metre-long facade and the twelve-metre-high warehouse building. But what really stands out in this warehouse are the enormous chilled and frozen areas.

"Prior to construction, we investigated how the glulam might be affected by the cold it's exposed to from inside. What we concluded is that timber performs well compared to steel, as long as the timber isn't exposed to major temperature and moisture fluctuations," says Erik Johansson, head of structural engineering at Moelven Töreboda.

The new logistics facility is 42,250 square metres and the structure consists of two different roof beams. The facility's office section is supported by 80 cambered beams that are up to 23 metres long, and in the warehouse hall itself there are 200 catenary beams that are 27 metres long.

"On the cambered section you get a straight top edge so the roof can slope in one direction, and on the catenary beam the roof slopes in two directions."

The glulam frame is in Swedish spruce and is calculated to reduce the building's carbon footprint by over 3,000 tonnes compared to a frame in steel or concrete. The warehouse is located in the middle of Landvetter's logistics hub, with both the airport and port nearby. According to Menigo, the new warehouse is expected to reduce their routes by approximately 800,000 kilometres per year. ●

Menigo warehouse in Landvetter

Developer: Catena.
Contractor: BRA Bygg.
Glulam frame supplier: Moelven Töreboda.
Construction year: 2023–2024.
Environmental certification: BREEAM Excellent.

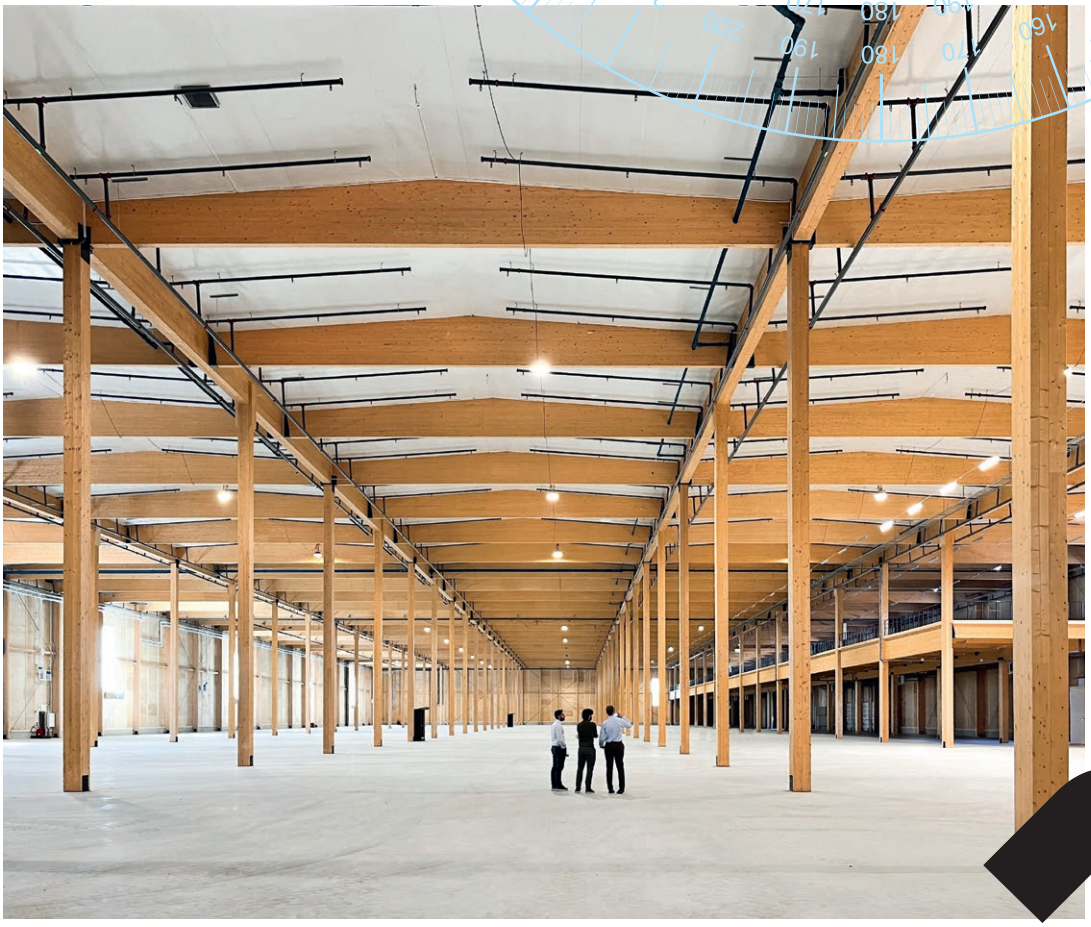


PHOTO NREP/EQUATOR

PHOTO MARTINSONS

»A requirement from the client was that it should be certified timber.»

JONAS KRONOSTRÖM, PROJECT MANAGER, MARTINSONS BYGGSYSTEM

SUSTAINABILITY PROJECT CHALLENGES BUILDING NORMS WITH ***GLULAM FRAME***

The innovation project in Bålsta focuses on sustainability. The glulam structure has helped reduce the facility's carbon footprint by 88 per cent.

At 21,000 square metres, the facility is one of the world's largest industrial buildings with hemp insulation, as well as the first to use bio-based materials throughout its construction on a large scale. The frame itself is manufactured in glulam and the structure consists of 400 columns and 400 roof beams, where the primary beams are 22 metres long and the secondary beams are 16 metres long. A floor structure in cross-laminated timber (CLT) has also been delivered and assembled for the logistics hall.

"A requirement from the client was that it should be certified timber. We delivered glulam based on timber that is FSC-certified. This means that the timber for the glulam lamellae comes from forestry that guarantees both social and environmental values," says Jonas Kronoström, project manager at Martinsons Byggsystem.

The wall panels consist of timber and are insulated with hemp. They have been produced at Svenska Takelement's factory in Västerås. A new industrial process was developed and today the panels are available on the market. The solar panels on the roof are examples of other measures that have been taken to reduce the climate impact.
At the same time, the ground slab has been made as thin as possible and is manufactured from concrete that partly consists of slag from steel production.

The logistics facility has been certified with BREEAM Outstanding, the highest environmental classification, and the logistics hall was named NollCO2 Project of the Year at the Sweden Green Building Awards 2024. ●

Innovation project in Bålsta

Developer: NREP Logicenters.
Contractor: Olofsson Bygg.
Glulam frame supplier: Martinsons Byggsystem.
Construction year: 2022–2024.
Environmental certification: BREEAM Outstanding.

RECORD-BREAKING ***GLULAM STRUCTURE*** IN JÖNKÖPING

In Jönköping, one of the world's largest glulam structures is rising – Elgiganten's new logistics facility. Here, calculating weather and wind has been one of the major challenges.

By the E4 outside Jönköping, property company Catena has completed a new logistics facility of 91,000 square metres, equivalent to 13 football pitches. The load-bearing structure is made of glulam and consists of 500 catenary beams that are 24 metres long and nearly two metres high.

"It's been a fantastically fun and rewarding project. It's not necessarily more complicated than smaller projects. It's about scaling up and drawing everything a bit bigger than usual," says Erik Johansson, head of structural engineering at Moelven Töreboda.

The timber structure provides a modern and bright working environment whilst contributing to a lower climate impact than an equivalent structure in steel. Weather, and particularly wind, have been the major challenges in the project, explains Erik Johansson.

"When the surfaces of walls and roofs become this large, the wind loads also become enormous. That's something we've taken into account when making our calculations."

The spruce timber for the glulam lamellae comes from sawmills in Värmland and Dalarna, and has been glued together in Moelven's factory in Töreboda. The finished structural components have then been delivered to the Torsvik industrial area.

"Logistics has been another major challenge. Both getting everything into the glulam production in Töreboda and delivering it to the construction site."

Elgiganten's new warehouse and logistics hall is expected to create up to 600 new jobs in Jönköping.●

Elgiganten, Jönköping

Developer: Catena.
Contractor: BRA Bygg.
Glulam frame supplier: Moelven Töreboda in collaboration with sister company Moelven Limtre in Norway.
Construction year: 2022–2024.
Environmental certification: BREEAM Excellent.

»When the surfaces of walls and roofs become this large, the wind loads also become enormous. That's something we've taken into account when making our calculations.»

ERIK JOHANSSON,
HEAD OF STRUCTURAL ENGINEERING
MOELVEN TÖREBODA.

PHOTO CATENA

FROM THE FOREST TO THE STARS

Wood might not be the first material you think of when you hear the word ''space''. We often picture gleaming metal and sterile plastic instead. That's something Koji Murata, professor at Kyoto University in Japan, wants to change.

TEXT NELLIE ÖSTMAN **PHOTO** KYOTO UNIVERSITY, NASA

Professor Koji Murata has long researched how biological materials could be used in space. For him, it was a natural choice to test wood's functions in the space environment, and under the leadership of Japanese astronaut Takao Doi, he has worked to develop the world's first wooden satellite. For him, a timber house or forest on the moon is not an unreasonable thought.

"Both tradition and colleagues in the field have inspired me. Among others, Dr Makoto Nagatomo, who introduced the idea of building log houses on the moon using trees grown on the lunar surface. But I also see the use of wood as a possible way to reduce human impact on the space environment," he says.

Koji Murata and his team have worked for many years on the satellite, named LignoSat, and in December last year it launched into space. This marked a major step in exploring renewable construction materials in space contexts – something that could prove more important than previously thought.

Material choices' impact on Earth

In 2014, 241 satellites were launched into space. Just ten years later, the figure was 2,695. The development of commercial spaceflight is a driving factor in the increase in satellite launches, and the number is expected only to grow. When a satellite completes its mission, it often re-enters the atmosphere where it burns up. This might sound convenient, but the substances in the metals that satellites are often made from don't disappear. On the contrary, when the satellite burns, a large amount of metal particles are released. Many of these then remain in the stratosphere, where they have a harmful impact.

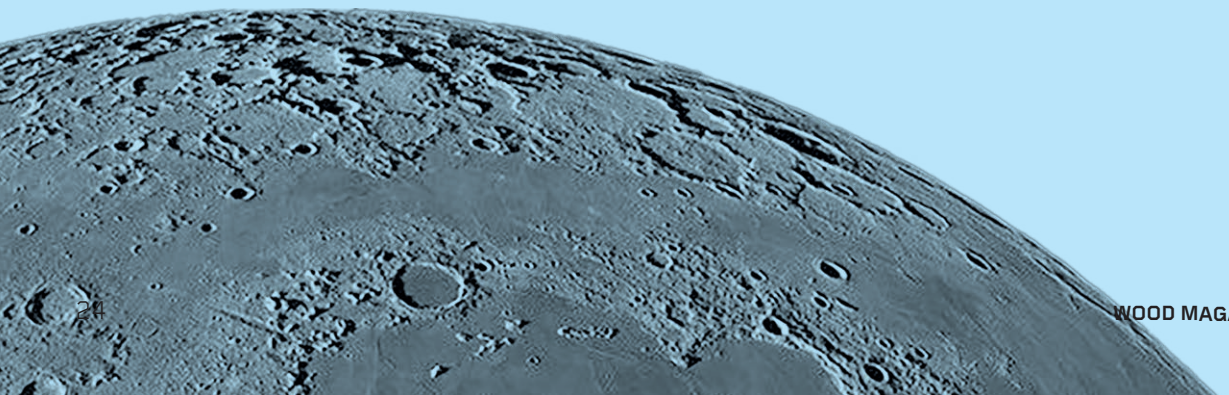
A 2023 study from the University of California shows that over ten per cent of aerosols – tiny suspended particles – in the stratosphere contain particles from spacecraft. The stratosphere is the atmospheric layer where the ozone layer is located, and metals from spacecraft risk acting as catalysts for chemical reactions that could affect ozone depletion and radiation balance. The long-term impact of metal particles on atmospheric chemistry is still unknown, but researchers are concerned they could damage the fragile ozone layer – particularly as the number of satellite launches increases.

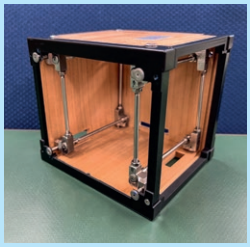
According to Koji Murata, wooden satellites can offer similar functionality to satellites made of metal. But the advantage of using wood is that they could be a better alternative for the planet.

"We don't believe wood will completely replace metal, but it has its applications. For example, there are reports suggesting that organic materials offer superior protection against cosmic radiation. This could mean wood has similar potential. That was among the things we wanted to explore with LignoSat," says Koji Murata.

But wood's primary advantage as a construction material in satellites lies in its combustibility.

"It's a renewable material that can disappear after achieving its purpose. Wooden satellites like LignoSat will largely burn up in the atmosphere and turn into gas instead of releasing particles. This makes wood well suited for contributing to more sustainable space use."





Dovetail joint technique

Dovetail joint technique, or dovetail joints, is a type of joint used to create strong and durable connections between two pieces of wood. The parts have a pattern that locks them together, resembling a salmon's tail fin – hence the technique's name.

Earth tradition meets space

LignoSat is a small satellite measuring 10 x 10 x 10 centimetres. It holds one litre of liquid, like a standard milk carton. One of the key technologies in the construction is the use of thin wood panels with a thickness of four millimetres, joined together with traditional dovetail joint technique to form a small box. Dovetail joint technique is used to create strong and durable connections between two pieces of wood, which proved central to the satellite's functionality.

"Because both moisture levels and temperature change rapidly in outer space, the construction needed to handle dimensional changes in the wood. To protect the joints from external effects, such as ultraviolet radiation, traditional joinery techniques are used. This has proven effective, as the techniques allow some flexibility in the joints," says Koji Murata.

Of the many wood species considered for the project, Japanese bigleaf magnolia (Magnolia obovata) became the final material choice for the satellite.

"For traditional joints, it turned out that a homogeneous wood species – that is, wood with uniform cells – was suitable. Japanese bigleaf magnolia is also crack-resistant and passed the vibration tests, making it a good alternative."

LignoSat was deployed into space from the International Space Station ISS in December 2024. It was to remain there for six months while Koji Murata and his team collected data. But everything didn't go according to plan.

"We couldn't establish communication with LignoSat after it was launched. This meant several missions, such as measuring how the wood deforms in space, couldn't be carried out. The result wasn't entirely satisfactory, so to speak," says Koji Murata.

Three small CubeSats, including LignoSat, were deployed into orbit from the International Space Station on December 13, 2024.

However, the mission wasn't a total failure. Passing the checks from Japan's space agency JAXA and successfully deploying the satellite from the ISS was an achievement in itself. And now there are big plans for the future.

"It was a significant achievement, and we believe we met the mission's minimum goals. The next step is to manufacture a wooden satellite that's twice as large. By doubling the size, we'll have enough room (for more payload/equipment – Ed.) to carry out the mission effectively."

Wood takes its place in space

Koji Murata emphasises that wood, both here on Earth and out in space, is an important material with many positive properties. He's convinced it will gain greater significance for space research going forward:

"The greatest advantage we see with wood as a construction material in space lies in the potential possibility of establishing space forests. Growing trees on the moon would enable sustainable material supply. We want to explore the possibility of circular societies in the closed living environments of space."

With NASA's plans for a long-term human presence on the moon within our lifetime, materials research is becoming increasingly important. Wood is still a relatively unexplored material in space contexts, but Koji Murata's research has shown good results regarding wood's resistance in extreme conditions.

"Wood is durable yet light, which is important for space constructions, and its excellent insulation properties make it suitable for extreme environments."

Makoto Nagatomo's dream of a timber house on the moon is thus still alive. And perhaps it's less science fiction than one might think. ●

»We don't believe wood will completely replace metal, but there are reports suggesting that organic materials offer superior protection against cosmic radiation. This could mean wood has similar potential.«

KOJI MURATA, PROFESSOR AT KYOTO UNIVERSITY

WHY DO THEY MAKE IT SO DIFFICULT TO BUILD IN TIMBER?

Many architectural practices want to design more in timber. But conflicting incentives, limited dialogue and lack of knowledge put obstacles in the path of decision-makers. So say Ola Kjellander and Monika Jachimowska from architectural practice Kjellander Sjöberg.

TEXT MATTIAS BOSTRÖM **PHOTO** KJELLANDER SJÖBERG

Timber construction is certainly on the rise in Sweden. But the increase could be even greater. And it's not just conservative material preferences standing in the way – Swedish bureaucracy is also acting as a brake on development. This was something architectural practice Kjellander Sjöberg experienced first-hand when working on the Tile House multi-family housing project in Stockholm.

Thanks to committed and ambitious clients, Fokus Nordic and Invesco, there was a shared goal to build in timber. However, this proved to be a significant challenge, primarily due to the building's planned total height. It risked exceeding the maximum height permitted by the detailed development plan.

Additionally, the building was to be constructed on an existing parking deck, which in turn rested on a tunnel system. This meant the structure had to be as light as possible, which initially led to the choice of a post-and-beam system in glued laminated timber.

However, several technical problems arose during the project. To achieve sufficient load capacity, floor slabs of over 500 millimetres per storey were required. But thicker timber structures meant the building's ceiling height became too low. Higher ceiling heights in turn meant an entire floor had to be scrapped, otherwise the detailed plan's height requirements couldn't be met.

As a solution to the problems, a hybrid system was considered, with concrete floor slabs and party walls in CLT. But then fire protection required extensive cladding with plasterboard. This reduced the efficiency of usable space and counteracted the desired feeling of the genuine material – that the house should breathe and smell of timber.

"The hybrid solution also required so much concrete and plaster that the life-cycle assessment ultimately showed the climate benefit of building with timber in this case would be marginal," says Monika Jachimowska.

The result was that Kjellander Sjöberg was simply forced to replace the timber frame with a traditional system of steel columns and concrete floor slabs, combined with ceramic cladding.

"In our current projects in Stockholm, Uppsala and London, for example, I see increased timber construction – but the transformation is still happening too slowly. However, it's very positive that more detailed development plans now enable timber construction, and that both authorities and developers show a genuine will to reduce climate impact," says Monika Jachimowska.

According to Ola Kjellander, the slowness is not just due to a lack of updated building regulations. The actual process among decision-makers also plays a part.

"They don't talk enough to each other. This leads to extra legwork for us architects, and thus increases the risk of losing the plan's intentions among the regulatory details. First we have to anchor our idea with the planning architect, then with the head of building control and the city architect, and once again with the building permits architect. The planning department's own architects need to have the same values as the development side to create an opportunity for flexible detailed plans for timber frames."

On 1 July 2025, new building regulations came into force in Sweden, which include relaxations for building in timber. Focus shifts from how something is built to what the building must achieve, allowing certain departures from detailed rules in favour of function. At the same time, documentation requirements are increasing. As a developer, you must be able to prove that the building is safe, durable and meets all requirements.

Monika Jachimowska and Ola Kjellander agree that the new statutory instruments will facilitate timber construction, and that more detailed plans are opening up for timber construction, but they also believe it's not enough.

»We must be self-critical and find even more intelligent ways to communicate and explain the advantages of building in timber.»

OLA KJELLANDER, ARCHITECT AT KJELLANDER SJÖBERG

"An effective way to promote timber construction would be to introduce binding limit values for buildings' life-cycle CO_2 emissions, as they do in Denmark, rather than just requiring a climate declaration as we do today," says Monika Jachimowska.

She believes such a regulatory framework would need to include the entire life-cycle perspective – from material extraction and production to operation and demolition – and thereby create clear incentives for choosing materials and construction methods with lower climate impact.

"It's crucial for us as designers, advisors and system coordinators to drive solutions with timber construction. We need to focus on explaining that besides sustainability and production advantages, it's also about material experience and architectural quality, and that this too has bearing on the revenue side."

Ola Kjellander agrees.

"The rapid material development highlights the problems our regulations and planning processes have. The new regulations facilitate today's timber construction, but how do we avoid the new rules hindering the next technological step? The solution perhaps lies not in further regulation but instead in better values-based dialogue between all parties in the planning and building process." ●

LUFTSCHIFFHANGAR MÜLHEIM

SPACE FOR

Luftschiffhangar Mülheim

ARCHITECT: Smyk Fischer Architekten PartG mbB, Mülheim an der Ruhr (design, planning permission), Gronau plan GbR, Wegberg (detailed design, construction drawings).

CLIENT: Westdeutsche Luftwerbung – Theodor Wüllenkemper GmbH Co & KG, Mülheim an der Ruhr.

STRUCTURAL ENGINEER: Ripkens Wiesenkämper Beratende Ingenieure PartGmbB, Essen with Marx Krontal Partner, MKP GmbH, Hannover.

AREA: 3,400 m².

CERTIFICATION: German Sustainable Building Council.

AWARDS: BDA Architekturpreis Mülheim an der Ruhr 2023, BDA Architekturpreis NRW 2024 Gold, Holzbaupreis NRW 2024, Ernst & Sohn Ingenieurbaupreis 2024, Deutscher Ingenieurbaupreis 2024 Staatspreis, EUmies Awards 2026 (nominated).

INNER SPACE

When the 75-metre-long airship Theo needed a permanent home in the city of Mülheim an der Ruhr, an extraordinary building was required. The result was Luftschiffhangar Mülheim – an innovative timber construction that unites function, aesthetics and sustainability, with a striking design.

TEXT MATTIAS BOSTRÖM **PHOTO** SMYK FISCHER ARCHITEKTEN BDA, ANNIKA FEUSS

How do you design a space that can both accommodate a 75-metre-long airship whilst simultaneously creating an experience for visitors? The solution for the Düsseldorf-based architectural practice Smyk Fischer Architekten BDA was a semi-cylindrical timber structure, inspired by the zeppelin itself – where form, function and construction work in harmony. Luftschiffhangar Mülheim was completed in just ten weeks, despite a complex construction. (Read more on the next page).

"The choice of timber as a building material enables a high degree of prefabrication and therefore rapid assembly. The timber construction company that carried out the work and the mechanical engineers were involved early in the design phase to be able to influence the subsequent construction process in decisive ways. We used BIM-supported planning, which enabled model-based communication," says Patrick Fischer of Smyk Fischer Architekten BDA.

In accordance with the Cradle-to-Cradle principle, which sees all material as a resource, all building materials are sortable and therefore recyclable. The materials used are registered in a digital building resource passport in the Madaster materials registry. The floor covering of concrete slabs comes from a former logistics centre and is a good example of circular thinking in new construction. The substructure for the slabs consists of the old hangar floor from the previous building, which was crushed and reused on site.

The Luftschiffhangar in Mülheim is not only technically impressive, but also an example of how sustainable building with timber can be combined with industrial functionality and architectural requirements. With its cathedral-like expanse and glowing aluminium skin, the hangar today stands as a symbol for the future of building – anchored in the site's history and focused on future needs.

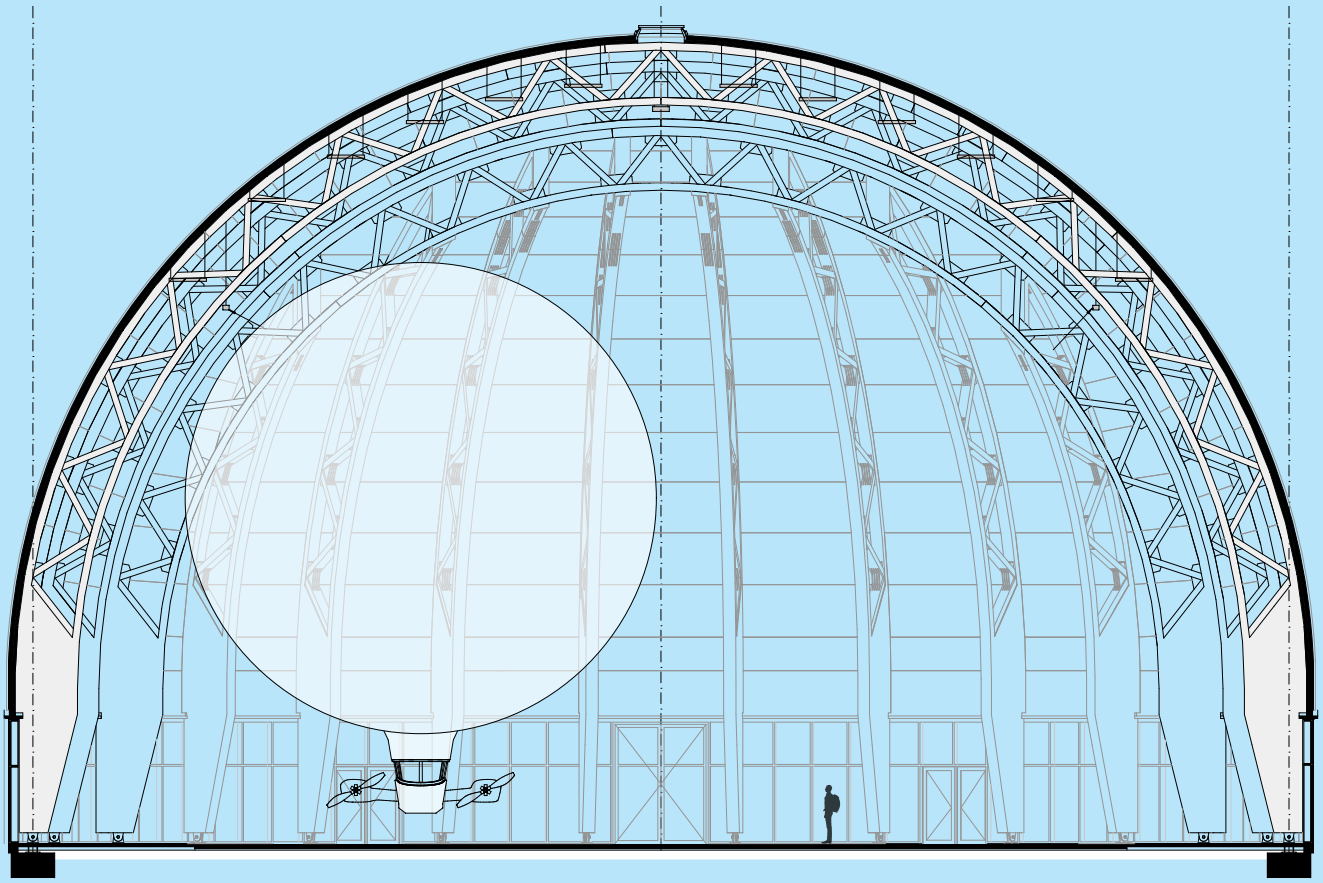
The hangar functions as a flexible venue for concerts, conferences and other public events – with the airship as both installation and brand carrier. ●

Architects Martin Smyk and Patrick Fischer from Smyk Fischer Architekten.

Construction

The building's structure consists of 15 glulam arches with a span of 42 metres, joined entirely without steel in over 590 connection points. The roof consists of cross-laminated timber of spruce, which gives the entire volume stability.

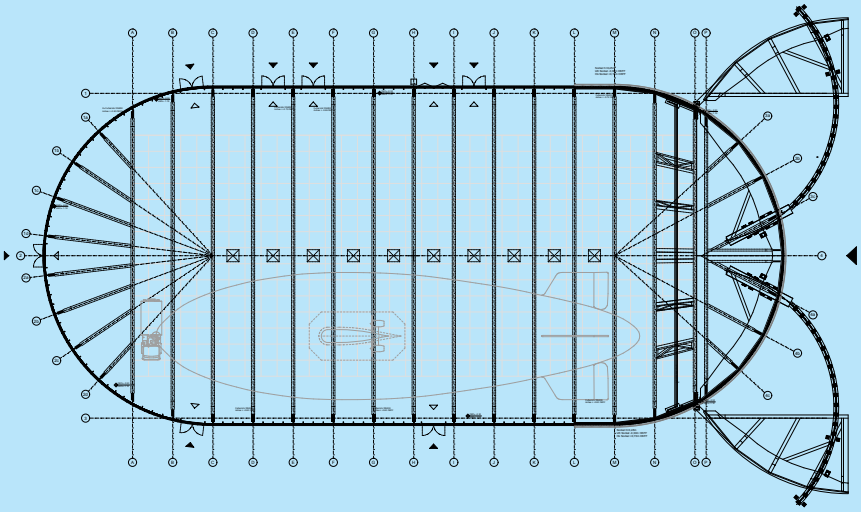
The 92-metre-long, 42-metre-wide and 26-metre-high hall is additionally clad in 7,000 m² of aluminium sheet, whose conical panels enabled a seamless surface despite the building's unique form.



Enormous doors

The two enormous doors with an area of 400 m² each and a total weight of 72 tonnes presented a particular technical challenge.

"They can be opened in less than five minutes using electric motors and rotating hinges that are designed with the same precision as a bridge construction," says architect Martin Smyk.



Because the building would also be used as an event venue, there were also specific requirements for fire, acoustic and thermal protection.

It takes approximately five minutes and requires three people to open the doors to the hangar.


Baseco Slätspont Antik Brun.

Fjällnära trä.

Golv och paneler av rejält norrländsk trä är ett naturligt val i alla miljöer där kvalitet, karaktär och en genuin känsla står i fokus. På Restaurang Hovde i Jämtland skapar 800 kvm slätspont en varm inramning av det mäktiga fjällandskapet. Upptäck hela utbudet av golv och paneler på baseco.se.

baseco.se

BASECO

FRACTAL STRUCTURES

In the Finnish town of Kuhmo, an impressive timber stage rises – designed by international architecture students on the Wood Program at Aalto University. One of them is Swedish student Olle Björkebaum.

"It's the first time I feel I've actually been part of truly changing a place," he says.

TEXT GUSTAV SCHÖN **PHOTO** AALTO UNIVERSITY, MALIN AGE

Kuhmo, with its 8,000 inhabitants, lies in eastern Finland on the border with Russia. Surrounded by forest and with a long tradition of timber industry. Every summer a music festival is held in the town centre, but the location has long lacked a proper outdoor stage. This became a task for students at Aalto University – to design and build a timber stage for both everyday use and events.

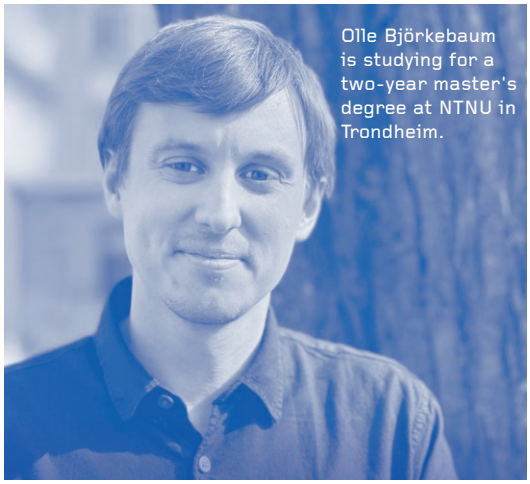
"It was important for us and the municipality, who commissioned the project, that the stage would become a functional and social space, not just an attractive decoration in the town," says Olle Björkebaum.

The project began during the autumn term of 2023, and the following summer the stage was inaugurated. The class, consisting of 17 students from nine different countries, each submitted their own sketch. Japanese student Meina Kobayashi's proposal, Kide, was considered to have the most development potential.

"Her sketch proposal can best be described as a structural concept. Developing it together with my classmates into a functioning stage was intensive but rewarding work," says Olle Björkebaum.

Kide, which means ice crystal in Finnish, reflects the square geometry with eight interwoven glulam trusses – inspired by the fractal form of the snowflake. The nine-metre-high construction rests on two corners and is clad in semi-transparent metal mesh that allows the inner timber structure to be visible. The roof consists of laminated veneer lumber (LVL) whilst the stage floor and staircase are built in local pine.

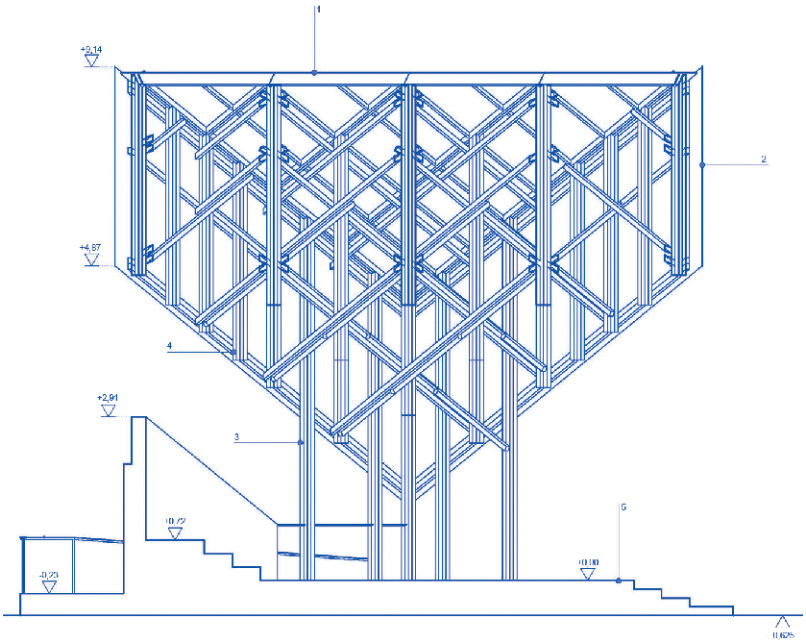
"Halfway through the process, the client requested a clear backdrop to be able to hide, for example, stage crew behind the stage. That's when the staircase emerged to mark a rear side," says Olle Björkebaum.



Olle Björkebaum is studying for a two-year master's degree at NTNU in Trondheim.

»It was important for us and the municipality who commissioned the project, that the stage would become a functional and social space, not just an attractive decoration in the town.»

OLLE BJÖRKEBAUM



The connection surface between the vertical columns and the diagonal beams became a hard nut to crack for the students.

During the project, he was responsible for, among other things, assembly templates for the glulam trusses – but also helped solve a crucial construction error. It turned out that the connection surface between diagonal and vertical beams was too small, meaning not all screws would fit.

"It became a precarious situation, but also very instructive. We needed many screws on a very small connection surface for the structure to hold together. At the same time, the screws needed to have a certain distance from each other to prevent the timber from cracking. It was initially an impossible equation, but we solved it by carving grooves into the beams so they could be fastened to each other with fewer screws, but with the same load capacity."

When Olle Björkebaum first heard about the Wood Program at Aalto University, he had no thought of living in Finland. After three years on the architecture programme at KTH Royal Institute of Technology, however, the idea of deepening his knowledge in timber architecture arose and the Finnish education appealed to him. A scholarship from the Lennart and Alfhild Gabrielsson Foundation made it possible.

"Without it, I would probably have had to decline the education. So I'm very grateful for the help I've received," says Olle Björkebaum.

At the same time, he takes the opportunity to praise the small municipality of Kuhmo, which made the decision to let students design and build an advanced timber construction in the middle of the town centre.

"It's been very rewarding to be part of a real project; you learn a great deal about interaction and collaboration. What has appealed to me in this project is that little Kuhmo dares to invest in outstanding architecture. I sometimes think there's too much metropolitan focus within architecture." ●

GRAND RING:

OSAKA'S INVITING TIMBER RING

Timber construction takes centre stage at this year's world expo, Expo 2025 in Osaka, Japan. The exhibition grounds are framed by the world's largest timber structure, the Grand Ring, whose architect Sou Fujimoto draws inspiration from Scandinavian tradition.

TEXT AND PHOTOS
JOAKIM RÅDSTRÖM

EXPO 2025

Location: Yumeshima Island, Osaka, Japan.

Dates: 13 April – 13 October 2025.

Theme: Designing Future Society for Our Lives.

Area: Approximately 155 hectares.

Participating countries: Nearly 160 confirmed nations.

Architectural focus: Sustainability, reuse and new technology.

Swedish participation: Sweden is participating alongside the other Nordic countries through the joint Nordic Circle pavilion, also built in timber.

Expected visitors: Approximately 28 million.

This year's world expo in Osaka, Japan celebrates timber in many ways – both as a stylish material and as an essential piece of the puzzle in solving the climate crisis. The entire site is framed by the enormous, eye-catching Grand Ring timber structure, with a circumference of two kilometres, an outer diameter of 675 metres and a width of 30 metres.

"With Expo 2025, building materials have shifted dramatically from steel and concrete to natural materials, particularly timber. And I believe in some ways it could have the same impact that Crystal Palace once had," says architect Sou Fujimoto during an online interview.

What the star architect Fujimoto is referring to is that at the world exhibitions at Crystal Palace in London in 1851, and at the Paris exhibition with the Eiffel Tower in 1889, steel was showcased as a revolutionary new building material. These global events have historically served as launching pads for new architecture – and Sou Fujimoto now hopes his creation Grand Ring can become the starting point for a similarly major building trend in timber.

Of course, such a growing trend already exists in many countries, where Sou Fujimoto particularly highlights northern Europe's timber building traditions.

"In the Scandinavian countries, large-scale timber structures are common," he says, continuing: "But I perceive a major difference with the global market, and also the Japanese market, which don't use timber in such an obvious way."

Sou Fujimoto, whose practice has offices in Tokyo, Shenzhen in China, and Paris, thinks that large-scale timber construction in particular has developed more in Europe than in Japan. And for anyone travelling through the Japanese megacities of Tokyo, Osaka and Yokohama, with a total of approximately 16 million inhabitants, it becomes clear how building materials like concrete, steel and glass dominate. At the same time, Fujimoto's homeland has a strong tradition of timber house building, but primarily for smaller buildings – for example single-family homes, teahouses and small temples. The hope is that this can be extended to larger structures over time.

A world record ring

We visit Expo 2025 and are impressed by the vast timber ring around the exhibition site. Long promenades and parks have been laid out on top of the building, and crowds of visitors stroll along the top of the structure at sunset. A sort of public space in mega-format, on the border between forest and city.

The timber framing beneath the Grand Ring is undeniably impressive. Through openings in the robust columns, timber beams have been threaded through and then wedged in place with wooden pegs – all in classic domestic style, repeated almost infinitely. This too has its explanation. It's not clear what will happen to the giant structure after the exhibition ends, but the Grand Ring will unfortunately not be able to live on in its current form.

"That's why it's based on traditional Japanese timber frame construction that's easy to erect and dismantle. The timber is assembled without screws. I thought about that, in case we need to take down the building afterwards without destroying it."

Could become furniture

Osaka's city authorities have said that the entire exhibition site will be returned to the city as flat, undeveloped land when the event has concluded. In time, the area will be used for new housing and other properties – Japan's second city Osaka has a population of 2.8 million inhabitants and is constantly searching for new areas to develop.

"As a temporary event, it's not particularly sustainable in itself. But we're thinking of using the timber again, perhaps as new buildings or even furniture," notes Sou Fujimoto regarding the future of his record-breaking building.

But why a ring specifically? The idea behind the circular form was that it should symbolise harmony and unity, according to Sou Fujimoto, with all national pavilions housed within the giant ring.

"So the master plan shows how even during these difficulties with the fragmented global situation, we can nurture hope that the world can come together and unite," explains Sou Fujimoto. ●

Timber in focus in the Nordic pavilion too

Sweden is participating at Expo 2025 in Osaka alongside the other Nordic countries. They are highlighting the Nordic spirit of innovation, sustainability work and culture under the theme "Designing Future Society for Our Lives" and, like the Grand Ring, the Nordic Circle pavilion is also built in timber.

Italian architect Michele De Lucchi and the practice Amdl Circle, with Rimond as implementation partner, have designed the Nordic pavilion. The 1,200-square-metre, 17-metre-high timber structure is intended, according to the design description, to "embody timelessness and sustainability". The façade is clad in dark timber with a distinctive surface reminiscent of traditional Japanese wood protection methods such as shou sugi ban – where the outer layer is burnt to create protection against weather, insects and rot. The building thus connects to both Nordic and Japanese timber building traditions. The base material for Nordic Circle has been treated with a mixture of persimmon fruit pulp and pine charcoal, which both protects the material and gives it a grey tone. ●

»Grand Ring is based on traditional Japanese timber frame construction that's easy to erect and dismantle. The timber is assembled without screws.»

SOU FUJIMOTO, ARCHITECT

BILD DAVID VINTINER

Grand Ring

What? The world's largest architectural timber structure, according to Guinness World Records.

Materials: Approximately 70 per cent of the building material is Japanese cedar and Japanese cypress. The remaining approximately 30 per cent is pine from Scotland.

Timber volume: 27,000 m^3. The aim is for the timber from the Ring to be reused after the world exhibition ends.

Inner diameter: Approximately 651 metres.

Outer diameter: Approximately 675 metres.

Height: 12 metres, 20 metres on the outside.

Architect: Sou Fujimoto

BIG ART IN A SMALL SPACE

In the tiny lift at Stockholm's Stadshotell, artist Klara Knutsson has recreated scenes from the city with meticulous precision. She is one of few who uses the intarsia technique to build her motifs with thin wood veneers.

TEXT SUSANNE GLENNEGÅRD **PHOTO** JOHAN LINNANDER

In a historic building from the 1870s, Stockholm's Stadshotell opened on Södermalm in December last year. By then, the property had stood empty for decades. The interior and design are inspired by the Arts and Crafts movement, which emerged in Britain during the latter part of the 19th century. Instead of mass-produced, cheap, soulless objects, the movement sought to highlight craftsmanship, beauty and nature's forms. And that's precisely what the hotel has done through collaborations with architects, designers and artists. One of them is Klara Knutsson, who has clad the lift with Stockholm images in intarsia—the term comes from the Italian "intarsio", meaning "inlay" or "fitting". The technique involves creating patterns or pictures by laying in pieces of different materials, usually wood, and creating a smooth surface.

To produce and build up her motifs, Klara Knutsson uses thin wood veneers. "Sometimes I cut with a scalpel, but this time I used a small scroll saw that looks like a sewing machine. The saw blade is angled—that's needed to achieve all the details and fitting."

We step into the lift and Klara Knutsson says there were certain challenges because it's so small, approximately 3.5 square metres. To create a sense of space, the starting point was views—rather like a window onto Stockholm. "I also knew I didn't want to include only the most well-known landmarks. Those, for instance, are the tower blocks up on Danviksklippan where I live. I think they're so beautiful. And that's the district heating plant at Henriksdal."

It's an unusual sensation to stroke the flat surface whilst the eye perceives different levels and dimensions. The attention to detail is impressive. There are roses, where each petal has been sawn out, and people who have literally been puzzled together bit by bit. The work looks like a whole, like one large picture, but actually consists of eight separate panels that have been joined together with thin wooden strips. Getting everything to fit together was a challenge.

"You have to be a bit clever," says Klara Knutsson, adding that she likes to play with scale and perspective. "As you can see, the people are far too large. I've been given great freedom to interpret and use my own frames of reference—it's been a wonderful process."

Klara Knutsson has worked with intarsia for three years; her interest began during her furniture-making training at Malmstens. "Everyone who's studied carpentry programmes at Malmstens (Linköping University) or at Capellagården (Vickleby, Öland) learns the basics of intarsia. But vanishingly few choose to continue working with the technique."

She herself feels there's much left to learn and explore—whilst simultaneously preserving cultural-historical value in a technique that has existed since medieval times. In more modern times, the craft experienced a revival in the 1920s–1930s, but from the 1970s it began to fall into obscurity.

»Interest in intarsia is growing, as it is for other traditional woodworking techniques. I think that in turn is connected to growing sustainability thinking.«

KLARA KNUTSSON, ARTIST

"I run some courses, and it feels like interest in intarsia is growing, as it is for other traditional woodworking techniques. I think that in turn is connected to growing sustainability thinking."

Do you see yourself as a pioneer?

"Well, I wouldn't use that word. I'm just incredibly happy to be able to contribute to the technique and craft continuing to exist. I rather see that the Stadshotell are pioneers who chose to let me do this." ●

Detail from the intarsia.

TELLUSBORGSHALLEN'S

SPACES FOR MOVEMENT

On an almost forgotten gravel pitch, next to Stockholm's busiest motorway, now stands Stockholm's largest sports facility – Tellusborgshallen – which is also a tribute to one of the 20th century's foremost architects.

TEXT GUSTAV SCHÖN **PHOTO** ANDREA EKMAN/AIX ARKITEKTER

Tellusborgshallen's austere forms harmonise well with the neighbouring buildings in Midsommarkransen's cultural quarter. But behind the red brick facade awaits something entirely different: A bright and modern sports facility with high ceilings, generous timber surfaces and long sightlines.

Right from the entrance you're met by large south-facing windows, a distinct scent of timber and a freestanding staircase leading up to a balcony bathed in sunlight.

"When the light hits it, there's a very embracing and pleasant feeling. It should feel nice to sit there with a cup of coffee and wait while the children finish training. And that's probably what stands out most about the hall – that you constantly have contact with both the inside and outside," says Klas Eriksson, architect at AIX Arkitekter.

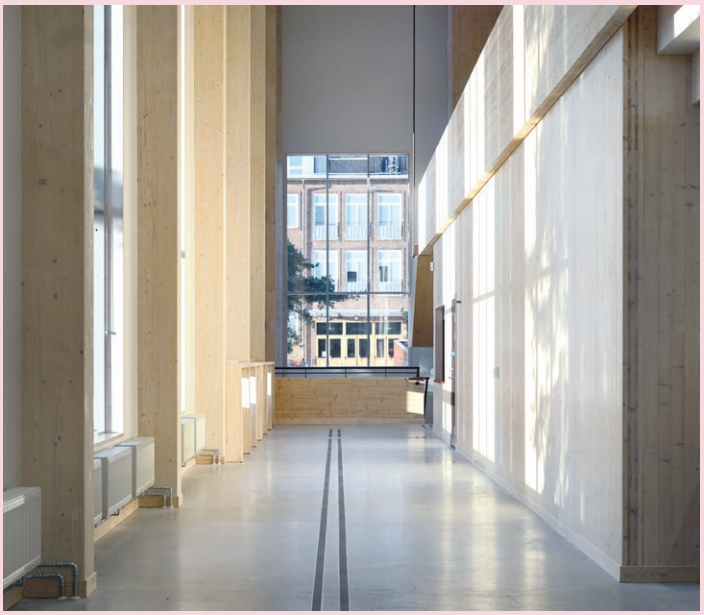
The interior is dominated by timber – walls, exposed trusses and in many details. The structure on the upper floors is mainly glulam and many of the walls are in solid timber. Wall sections above three metres are clad with wood wool cement board to create pleasant acoustics in the sports halls.

"The timber contributes to better acoustics, which is partly why we've chosen to use it in much of the interior. To further reduce reverberating sound, we installed angled timber panels around the playing field, rather like overlapping acoustic panels," says Klas Eriksson.

"These timber panels are an acoustic solution we developed in another project in Kungsbacka in 2021. It's an effective way to create good acoustics for the athletes," says Niklas Skerfving, project manager at developer Nystad, and continues:

"Almost all interior elements in Tellusborgshallen in terms of material choices, such as the polished concrete floors, the board-formed concrete walls, the wood wool cement board on the ceilings, the timber panels on the walls and the lighting design, we've designed and developed in previous projects and refined further here."

The 8,300 square metre L-shaped sports facility is well-planned. It contains three full-size sports halls, movement rooms, a café and 29 changing rooms.



Since two of the halls are stacked one above the other, every square metre of the plot's surface area is maximised. Many windows are positioned low to avoid glare risks.

"Whether to have windows in sports halls or not is always a divisive issue. On one hand it should be a pleasant environment, on the other hand those training shouldn't be dazzled. In Denmark they often have large window sections – and they're the best in the world at handball. So I don't know how much it really affects things," says Klas Eriksson with a smile.

The spacious balcony lets in indirect light onto the court and also provides ample standing room.

"There's a small gallery with seating along one long side. If you go up to the balcony instead, a significantly larger audience can fit, and from there you get a good overview of the whole hall," says Klas Eriksson.

To make the changing rooms a calm and safe environment, shower facilities have been designed with individual cubicles. In each shower room there are four cubicles with walls and a door that can be locked, and one of the cubicles is accessible.

»The timber contributes to better acoustics, which is partly why we've chosen to use it in much of the interior. To further reduce reverberating sound, we installed angled timber panels around the playing field, rather like over-lapping acoustic panels.»

KLAS ERIKSSON,
ARCHITECT AT AIX ARKITEKTER

Halls needed

Tellusborgshallen is a much-needed addition for the city, which is in desperate need of sports facilities. According to Stockholm City's needs analysis from 2022, approximately 25 new sports halls are needed by 2031 to meet population growth. The hall also has good transport connections with the underground station a couple of hundred metres away.

Next to the hall, Nystad has also developed and built a new school building, designed by Liljewall architects. The concept is well-proven.

"Both from an operational and property management perspective, it's often optimal to combine a school with a sports facility," says Niklas Skerfving.

Both Tellusborgshallen's and the school's red brick facades are a tribute to architect Paul Hedqvist, whose architecture has significantly shaped Stockholm's cityscape. He designed, among other things, Västerbron, DN-skrapan, Skatteskrapan and the heritage-listed townhouses in Ålsten. During the 1950s and 60s, Paul Hedqvist designed Midsommarkransen secondary school and Brännkyrkahallen, which is not far from Tellusborgshallen.

"Part of the brief was also to relate to the surroundings and the existing buildings. Therefore red facade brick became a natural choice, we've also tried to relate the sports halls with similar windows," says Klas Eriksson.

The proximity to the heavily trafficked Essingeleden motorway means special requirements are placed on the building design. The northern exterior wall is therefore built in reinforced concrete and the timber structure is dimensioned for increased requirements.

"It's affected the facility's construction. Apart from a couple of emergency exits on the ground floor, the north side is a solid facade and with very large trusses in the roof," says Klas Eriksson.

At the same time, the facility together with the school building functions as noise protection for the school playground. That there's a busy road right next to it is probably something few people think about.

DRÖMMEN: MONTERA UTAN ATT MONTERA

Behöver du hjälp med att montera limträ- eller KL-trästommen i ditt byggprojekt? Det är lugnt, vi fixar det.
Vi erbjuder en helhetslösning för stommontering där vi tar ansvar för personal, utrustning och genomförande. Våra erfarna medarbetare säkerställer en effektiv och kvalitetsdriven byggprocess.

En fördel för dig som kund är också att vi har all vår kompetens under ett tak. Hela vägen från konstruktion, planering, tillverkning och slutligen montage. Visst låter det tryggt och enkelt? Vi lovar, det är det också.

Martinsons utvecklar, konstruerar och levererar stomsystem i limträ och KL-trä. Som drivande kraft i projektsamarbeten skapar teamets experter hållbara värden för samtliga berörda. martinsons.se

MARTINSONS
POWERED BY HOLMEN

The roller shutters above the windows are a detail that picks up the district's brick history.

Certified building

Tellusborgshallen has been certified with Miljöbyggnad Gold, which means the use of sustainable materials and energy-efficient solutions. In addition to timber, climate-improved concrete has been used, and solar panels have been mounted on the roof, making the facility partly self-sufficient in electricity.

"Besides solar panels, we've installed sedum on the roof. It's both beautiful and practical, and this way the stormwater management is handled," says Niklas Skerfving.

During spring the hall was nominated for Stockholm Building of the Year. But for all involved, the long-term perspective weighs heaviest:

"We usually say that we build for a hundred years," says Niklas Skerfving.

Klas Eriksson agrees.

"What makes me most proud is that the hall is both functional and pleasant. It's built to last for many decades and to be a part of the district." ●

»The collaboration with everyone involved has worked very well and the local plan was produced in record time.»

NIKLAS SKERFVING
PROJECT MANAGER AT NYSTAD

Stockholm City conducted preliminary studies in the area as early as 2017. At that time it concerned the nearby Brännkyrkahallen, but the plans were put on ice. A few years later, developer Nystad began studying the site and worked out a development idea together with AIX Arkitekter, which was presented to the City. Nystad then submitted a land allocation application which led to local planning work, land purchase and lease agreement.

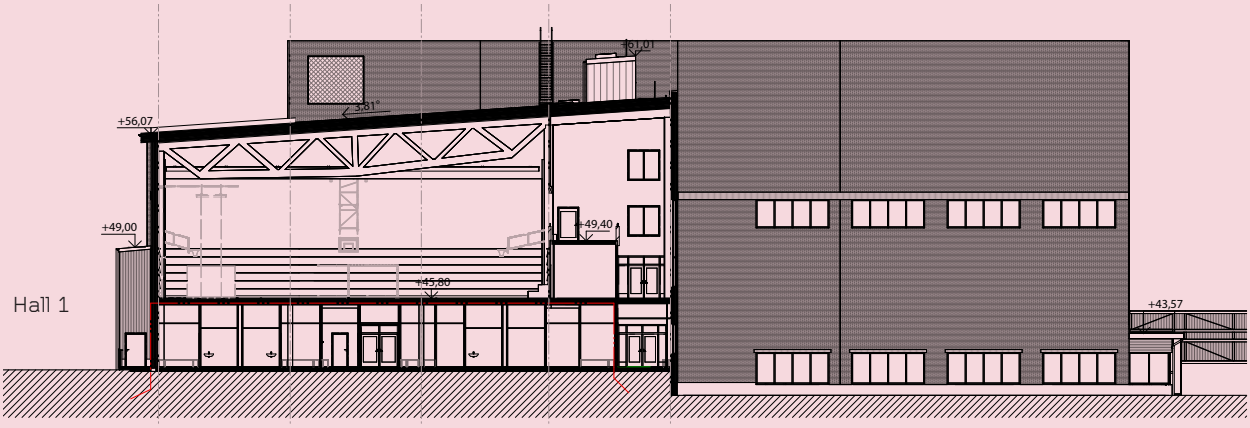
In 2022 Nystad took possession of the land, directly after the new local plan was approved. Veidekke was engaged as main contractor and construction began in 2023. A year and a half later, in December 2024, the hall was inaugurated.

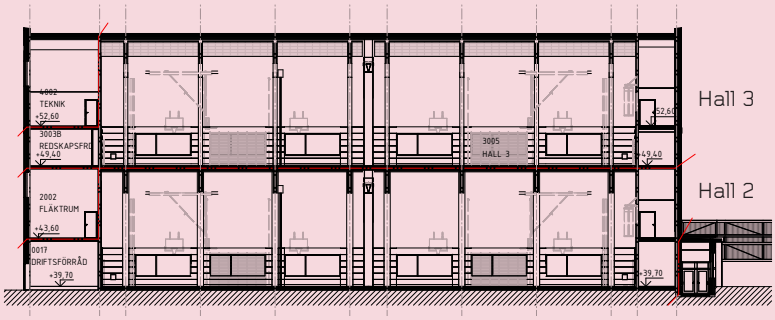
"The collaboration with everyone involved has worked very well and the local plan was produced in record time. We had a good and close dialogue with the planning and development departments and also with the sports department, who are our tenant," says Niklas Skerfving, project manager at Nystad.

Map: OpenStreetMap

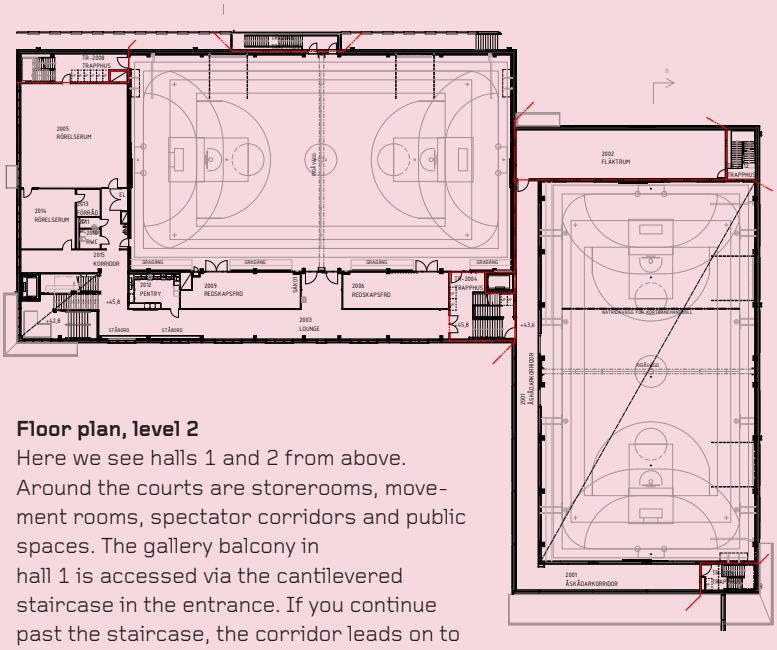
TELLUSBORGSHALLEN

ON THE DRAWING BOARD





Three halls, three different beam systems
Each hall is built with different beam systems to meet the specific requirements and needs placed on the building. Hall 1 has an exposed glulam truss that stands on glulam and steel columns. In hall 2, heavy concrete beams rest on concrete columns to dampen vibrations from the hall above. Hall 3 is in turn supported by massive glulam beams that give a warm and robust feeling. Like the first hall, the beams stand on glulam and steel columns.



Floor plan, level 2
Here we see halls 1 and 2 from above. Around the courts are storerooms, movement rooms, spectator corridors and public spaces. The gallery balcony in hall 1 is accessed via the cantilevered staircase in the entrance. If you continue past the staircase, the corridor leads on to the changing rooms and to hall 2.

Tellusborgshallen

Location: Midsommarkransen, Stockholm

Developer: Nystad

Architect: AIX Arkitekter

Contractor: Veidekke

Structural engineer: Kåver & Mellin

Timber: Glulam structure and solid timber from UPB Group, Latvia

Certification: Miljöbyggnad Gold

Awards: Nominated for Stockholm Building of the Year 2025

Inauguration: December 2024

Size: approx. 8,300 m², 4 floors

Capacity: Three full-size halls, 3 movement rooms for dance and martial arts, 29 changing rooms. Tellusborgshallen is used by schools during the day, and by sports clubs in the evenings and weekends. In total it is estimated to offer more than 20,000 sports hours per year.

Audience capacity: Approximately 525 spectators, approximately 175 per hall

Shoot for the moon

– you never know where you'll land!

Many in our country might associate "timber building" with a little red cottage with white trim. That's why I found it interesting to follow artist Mikael Genberg's work. For 25 years, his goal has been to place a little red house with white corners on the moon. While waiting for this to become reality, he has placed a house on the Avicii Arena in Stockholm. This year, it was finally time to send the little red house into space. Even though the landing on 6 June didn't go as planned – the spacecraft crashed, and it's therefore unclear how and where the house landed – I think there's something truly remarkable about having such clear goals and working towards them. Even if the project didn't go exactly as planned, other goals were reached along the way. Things that would never have happened if the artist hadn't dared to dream of the moon!

I let myself be inspired by his focus. When you look in the rear-view mirror, it's easier to see the importance of taking small steps. I see clear parallels to timber building. The goal must be that the choice of structural material shouldn't be determined by what type of building is being erected, or that special timber building strategies shouldn't be needed to consider timber as an alternative in every project.

For more than a hundred years, it was forbidden to build more than two storeys in timber. It wasn't until 1994 that it became possible again. Since then, large-scale timber construction has developed, and now both larger and more complex timber buildings are being built than we perhaps envisaged back in 1994. Who could have imagined that a 20-storey Sara Cultural Centre would become reality, just 30 years after it again became possible to build more than two storeys in timber? Because even if there were surely those who already in 1994 had the goal of one day building really tall with timber frames, that's not where they started. The four-storey Orgelbänken building in Linköping, with a timber frame, from 2003 is an early project. Portvakten and Limnologen in Växjö, each eight storeys, are two other projects that were ready for occupancy in 2008 and 2009 respectively.

Similarly, development regarding large sports and industrial halls with timber frames has progressed. I'm a rider myself, and from my upbringing I'm used to riding halls with steel frames. Now glulam frames are becoming increasingly common. It's not just the climate benefit. The experience becomes warm and welcoming – it's as if you bring the peaceful feeling you get when riding out in the forest inside. Magical, I dare say.

But we still haven't reached the moon. There are still things to do to ensure that the choice of structural material isn't limited by what type of building is being erected. The more people who choose timber, the greater the benefit for the climate.

Now Boverket has presented its proposal for limit values and an expanded climate declaration. The introduction of limit values is postponed until 2030. I think this is unfortunate given that emission reductions in the coming years are crucial. The proposed limit values aren't particularly ambitious either. The law requiring all new buildings to be climate declared has existed for more than three years. I amused myself by requesting all climate declarations for apartment buildings that have been submitted since the law came into force and note that the climate impact for about 40 per cent of all these would already today meet the strictest of the three proposals. So considering that the limit values are intended to be introduced only in five years' time, the proposal could have been much sharper.

On the other hand, it's good that Boverket chooses to maintain that the limit value should apply to the construction phase itself and not the entire lifecycle. It's urgent, and it's for construction that there's the greatest potential to reduce climate impact.

ANNA RYBERG ÅGREN
DIRECTOR, SWEDISH WOOD

Three things to keep an eye on!

1 Building big in timber!
Hospital buildings are complex buildings where demands on function and flexibility are high. As Sweden's largest hospital building, parts of Karlstad Central Hospital are now being built in timber.

2 Forest policy!
In 2024, the government appointed a forestry investigation. The final report contains several important proposals for securing the growth and competitiveness of Swedish forestry – a prerequisite for timber construction. Biodiversity!

3 In the report "Timber vs Concrete"
from Svea Fastigheter (the first in a series of five), two apartment buildings that are to be built are compared – one with a timber frame and the other with a concrete frame. In a life-cycle assessment, the impact on biodiversity has been studied, among other things. Unsurprisingly, the building with the timber frame has the least impact. I look forward with excitement to the coming parts! Read the report here:

28 →28 APRIL

Expo 2025

Statens konstråd, Stockholm

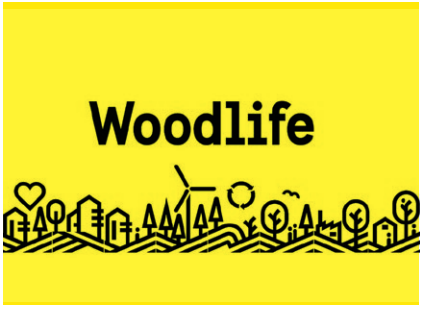
On 14 September, Statens konstråd opens the doors to the exhibition The Tree Speaks. It brings together some 50 artists exploring timber as material, method and motif. The exhibition is generally open on Tuesdays. See Statens konstråd's website for exact opening times.

13 13–16 OCTOBER

Woodlife at Chalmers

Volvofoajén, Göteborg

The Woodlife Sweden exhibition will be shown in Volvofoajén at Chalmers Student Union. See some 50 innovative timber projects pointing the way towards a greener future. The programme features lectures, workshops and study visits.
Places are limited. Registration via Swedish Wood's website.



21 21 OCTOBER

Boverket's new building regulations

Webinar

Since 1 July, Boverket's new building regulations have been in force. In October, the authority is arranging a webinar for structural engineers focusing on provisions for load-bearing capacity, stability and durability.

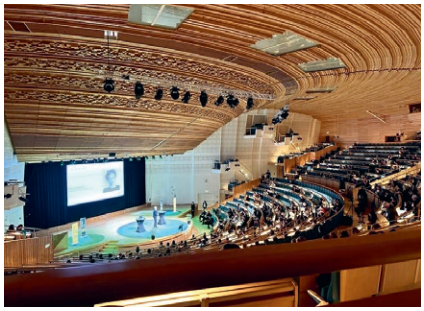
PHOTO BOVERKET/CHARLIE JOLIN

23 23 OCTOBER

Seminar on Engineered Timber Construction

Aula Magna, Stockholm University

In October, it's once again time for a full day dedicated to timber construction when Swedish Wood hosts a seminar at Aula Magna, Stockholm, featuring lectures, a mini-fair and closing drinks reception. Registration via Swedish Wood's website.



23 23 OCT–23 NOV

Young Swedish Form 2025

Katrinetorp Landeri, Malmö

This autumn, the Young Swedish Form exhibition comes to Malmö and Katrinetorp Landeri. From hundreds of applications, the jury has selected 25 winners to participate in the touring exhibition.

19 19 NOVEMBER

Trädgårdsstadsdagen

ArkDes, Stockholm

Politicians, researchers, architects and land development engineers will share perspectives and practical examples of how the garden city can take shape. The event is organised by, amongst others, TMF, Sveriges Arkitekter, SKR and the Single-Family Housing Commissioner.

ARCHITECT PACE ARKITEKTER, PACE.NU

SETRAS LIMTRÄ I SYSTEMET bARK

Bild: Krook & Tjäder

I Habitat 7 vid Masthuggskajen har limträ ersatt aluminium och stål som bärande struktur i glasfasaden – ett tidlöst och klimatsmart val. Det innovativa fasadsystemet bARK är utvecklat av Fasadglas Bäcklin och minskar klimatpåverkan med över 40 procent. Setra har producerat allt limträ till bARK och levererat noggrant bearbetat virke med millimeterprecision – anpassat för att uppfylla högt ställda krav på design, hållbarhet och teknisk kvalitet.

Tillsammans med NCC och Fasadglas Bäcklin har Setra bidragit till ett byggprojekt som visar hur trä kan ta plats även i de mest teknikkrävande delarna av en glasfasad. En grönsam affär som alla tjänar på. Upptäck fler möjligheter med våra produkter och grönsamt byggande på **setragroup.com.**

bARK
TIMBER FACADE SYSTEM

Setra
Vi vill vara grönsamma.