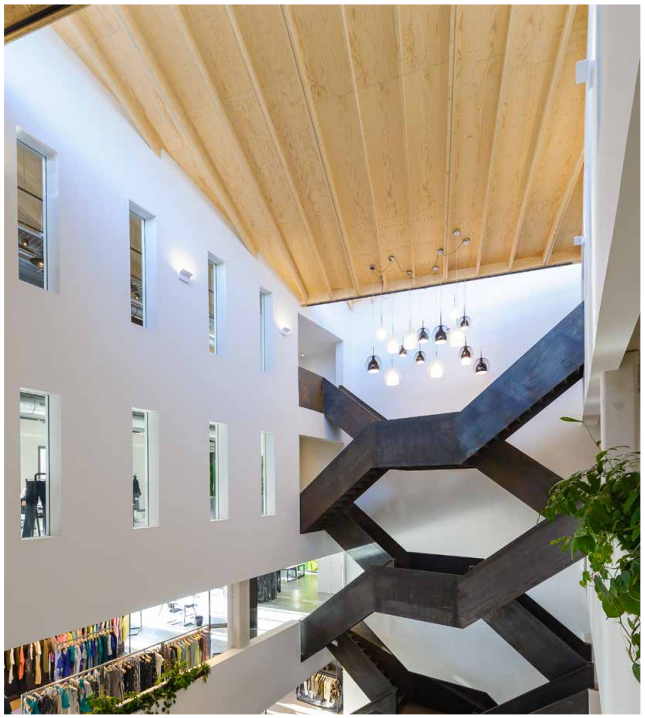
Metsä

Kerto® LVL

Kerto-Ripa

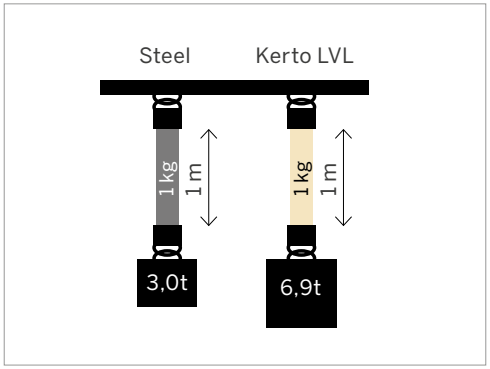
Prefabricated
building elements

Content



Kerto® LVL

Metsä Wood's Kerto LVL is laminated veneer lumber (LVL), CE-marked in accordance with the EN 14374 standard. It is renowned for its exceptional strength, stiffness and dimensional stability, making it ideal for various applications.



By using spruce veneer efficiently, S-beam is already more than twice as strong for its weight as standard construction steel.

Kerto LVL is structural laminated veneer lumber used in all types of construction projects, from new buildings to renovation and repair. Kerto LVL combines excellent technical performance with ease of use. Its essential qualities include strength and rigidity, dimensional stability and light weight.

Kerto LVL is produced from 3 mm thick rotary-peeled strength graded softwood veneers. The veneers are bonded with weather- and boil-resistant phenol formaldehyde adhesive to form a continuous billet. The billet is cut to length and sawn into LVL beams, planks or panels according to customer´s requirements.

Main Kerto LVL products

Kerto LVL S-beam can be used as both horizontal and vertical bearers in various construction applications. The grain direction of all the veneers is the same which provides an excellent strength-to-weight ratio that allows long spans with minimal deflection.

Kerto LVL Q-panel is a load-bearing and dimensionally stable product that can be used in both horizontal and vertical structures. It consists of veneers of which approximately 20 % are oriented in crosswise direction.

Manufacturing

Kerto LVL products are manufactured in Metsä Wood Lohja and Punkaharju Kerto mills in Finland. The commercial production of Kerto LVL started in the 80‘s in Lohja mill. Thus Metsä Wood is the first LVL manufacturer in Europe and yet today has the largest annual LVL production capacity (~300,000 m³) in Europe. By 2027, this will be expanded to a volume of 450,000 m³ annually.

Kerto LVL production starts from Premium Nordic spruce logs which are conscientiously peeled, offering the best yield on raw material for a wood processed product.

Nordic raw materials

Metsä Wood’s main raw material, wood, comes from sustainably managed Nordic forests. Most of the wood we use comes from forests owned by Metsä Group’s 90,000 owner-members. All the used wood is traceable and comes from certified or controlled forests.

Dimensions

Length	2 to 25 m	
Width	Production width 1.8 or 2.5 m	
Thickness	Q-panel	21 up to 75 mm
	S-beam	27 up to 75 mm

Re-gluing multiple Kerto LVL products (GLVL) allows thicknesses over 75 mm.

Products made of rotary peeled veneers are more homogeneous than solid wood due to dispersion of natural defects such as knots.

European LVL strength classes

Kerto LVL products fulfil or exceed the requirements for strength class requirements defined at European LVL producers LVL Bulletin according to the following table:

TYPE	DENSITY 510 kg/m³	DENSITY 440 kg/m³
Beams, joists, studs, formwork	LVL 48 P -> Kerto LVL S-beam	LVL 32 P -> Kerto LVL T-stud
Vertical and horizontal panels	LVL 36 C / 32 C -> Kerto LVL Q-panel	LVL 25 C / 22 C -> Kerto LVL L-panel
Industrial panels and beams	Kerto LVL Qp-beam & D-panel Kerto LVL special constructions	

Source: European LVL Handbook

Kerto-Ripa® elements

Kerto-Ripa combines the performance of Kerto LVL, the strongest and most advanced engineered wood product, with a certified structural gluing technology developed, implemented, and supported by Metsä Wood since the ‘90s.

These high-performance elements can be used as load-bearing components in floors, roofs, and walls, and are optimally customized to meet the requirements of engineers, architects, and contractors. Fire resistance, comfort, safety, thermal and acoustic insulation can be included.

Whether you are designing a new building or need an efficient structure for a renovation or modular concept, Kerto-Ripa elements are suitable for any building type, including houses, apartments, extensions, schools, industrial halls, offices, commercial and public buildings.

Description

Kerto-Ripa is composed of full-span plates (Kerto LVL Q-panel) and ribs (Kerto LVL S-beam), bonded together with PU glue to achieve full composite behaviour. The grain direction of the plates and ribs are oriented in the element span direction, with the cross-grain veneers of the plate distributing loads over the ribs. This combination results in a high-performance product that provides excellent comfort for the end-user.

Depth savings between mechanically fastened elements and Kerto-Ripa glued elements

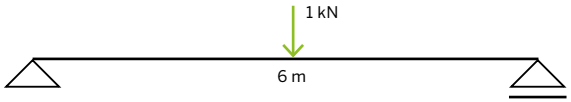
Gluing for efficiency

The gluing technology developed by Metsä Wood over the past 25 years underpins the performance of the structural gluing. The additional stiffness and strength provided by this structural gluing enables long spans and heavy loads with reduced element depths and raw material consumption. This bonding method results in a stiffness far superior to any nailed or screwed solution.

Both plates and ribs are of full length, allowing elements to span up to 24 meters for roofs and 15 meters for floors.

Route to market

Many dedicated and experienced Metsä Wood partners across Europe are certified to produce CE-marked Kerto-Ripa solutions for your project. All elements are manufactured under controlled conditions.



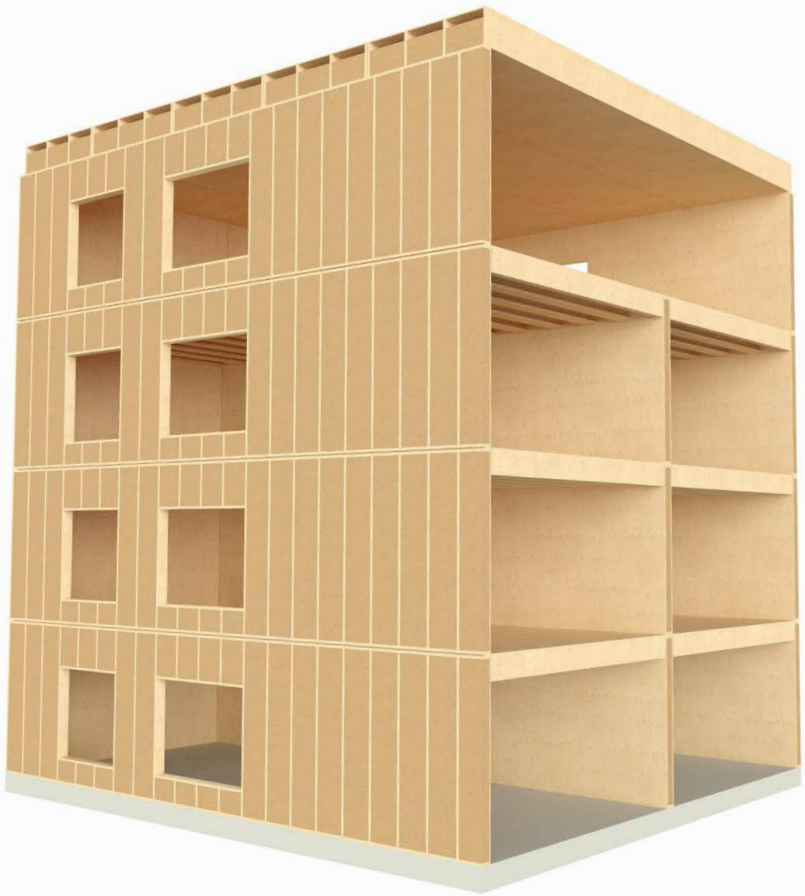
Comparison of deflections between common screwed elements and glued Kerto-Ripa elements.

Ribs made of Kerto LVL S-beams 45 × 300 mm, with a top plate of OSB 22 mm:	**Screwed** →	deflection = **6.3** mm
Kerto-Ripa with Kerto LVL S-beam ribs (45 × 300 mm) and Kerto LVL Q-panel top plate (25 mm):	**Glued** →	deflection = **2.7** mm
Kerto-Ripa with Kerto LVL S-beam ribs (45 × 300 mm) and Kerto LVL Q-panel top and bottom plate (25 mm):	**Glued** →	deflection = **1.4** mm

COMPARED TO MASSIVE SOLUTION, KERTO-RIPA ELEMENTS MAY BRING UP TO
50% MATERIAL SAVING,
BY A GENUINE MATERIAL EFFICIENCY

Unique benefits

Kerto-Ripa is an all-in-one solution which offers the right benefits for an optimal construction.



Flexibility

- Kerto-Ripa elements can be used both in wooden and hybrid constructions, as it easily connects to wood, masonry, concrete or steel structures
- Large openings in ribs (up to 70 % of the height) can be made easily
- Integration of installations

Technical

- Fire resistance up to 120 minutes
- Bracing of the element through smart gluing technology
- Load-bearing structure with a high stiffness and consequently a low vibration degree

Building time

- Fast and easy assembly due to the prefab construction and big sizes (24 x 2.4 m)
- Prefabrication ensures uniform quality and a reduction in defect costs
- A quick covering of large areas keeps the building area below clean and dry

Light in weight

- Kerto-Ripa elements can be up to 5 to 10 times lighter than with equal technical performance
- Consequently lighter load-bearing frames and foundations are needed
- Lighter and cheaper building equipment, such as electric cranes, can be used

Saving space

- Floors and roofs: top-slab support
- Walls : thinner structure due to integration of the installations and insulation within element
- More m² inner space = larger sellable areas

Well-being

- It is well-known that wooden buildings genuinely provides a warmer feeling and have a positive influence on the life living environment.

Benefits by profession

Kerto-Ripa wall, floor, and roof elements are used for new buildings, renovations, and transformations. They are applied in houses, apartments, expansions, schools, halls, offices, and other commercial and public buildings.

THIS SMART BUILDING SYSTEM CAN BE OPTIMALLY SYNCHRONIZED TO MEET THE REQUIREMENTS OF CUSTOMERS, ARCHITECTS, AND CONTRACTORS. THE MODULAR STRUCTURE GUARANTEES OPTIMAL FIRE RESISTANCE, COMFORT, SAFETY, THERMAL AND ACOUSTIC INSULATION, PROVIDING THE NECESSARY COMFORT FOR THE END USER.

Architect

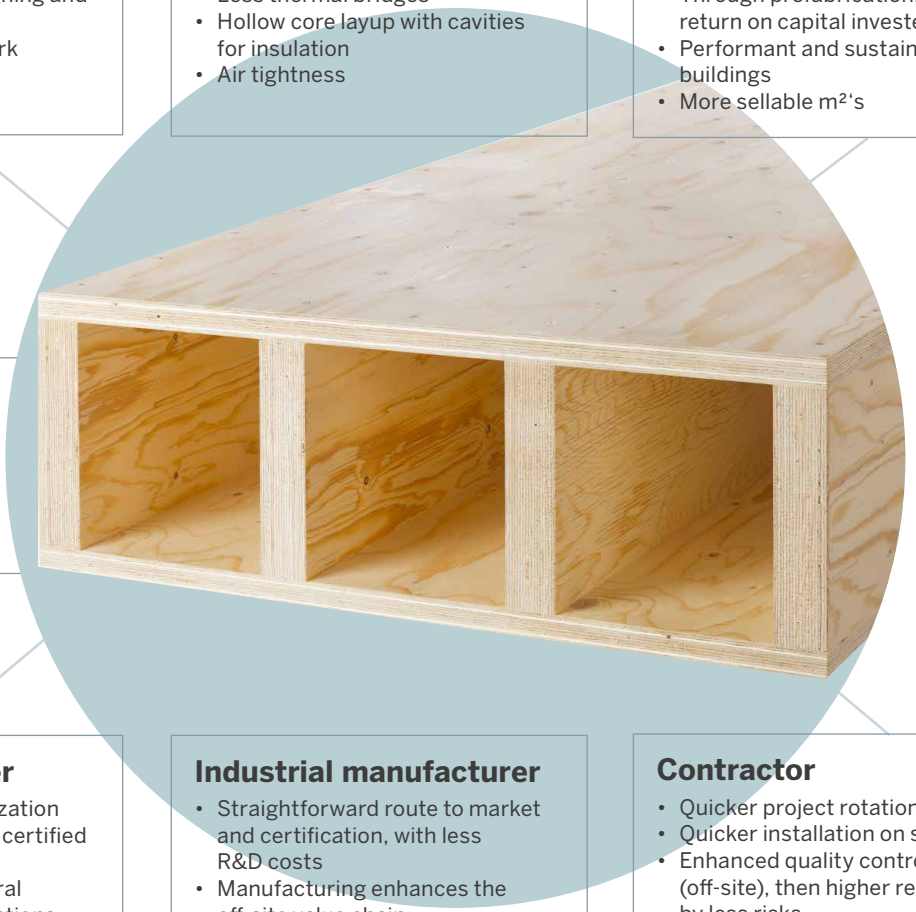
- Sustainable way of designing and building
- Strong producers network
- Certified solutions

Building physics advisor

- Less thermal bridges
- Hollow core layup with cavities for insulation
- Air tightness

Developer

- Through prefabrication, quicker return on capital invested
- Performant and sustainable buildings
- More sellable m²'s



End User / owner

- Comfort and improved leaving climate
- Space adaptability
- Future proof and high quality buildings

Structural Engineer

- In-depth material optimization of a reliable material in a certified solution
- Efficient bracing structural solution with less connections
- Well-known and predictable fire behaviour
- Top-slab support

Industrial manufacturer

- Straightforward route to market and certification, with less R&D costs
- Manufacturing enhances the off-site value chain
- Competitive solution

Contractor

- Quicker project rotation time
- Quicker installation on site
- Enhanced quality control (off-site), then higher reliability by less risks.

Building functions

Kerto-Ripa elements proof their value daily in many buildings. In every building type below it was chosen for one or more specific reasons: light-weight, big spans, cost efficiency, excellent performance, more inner space, industrial looks and in all cases: **sustainability was driving factor**.

Image: M. den Besten

Row houses

Image: Toon Grobet/ Lumecore i.o.v. Lava architecten

Schools

Image: Lucas van der Wee

Offices

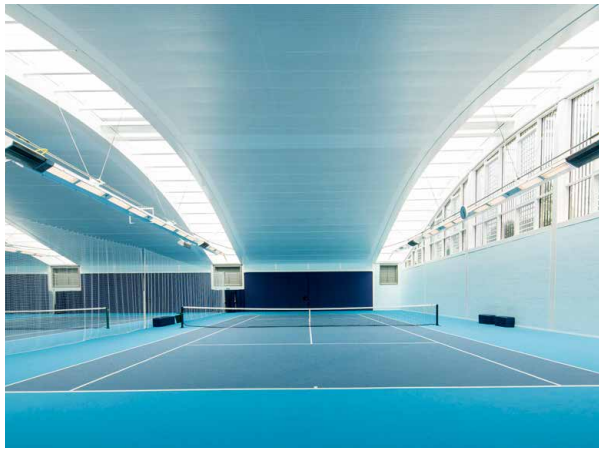


Image: The Hurlingham Club

Sports halls / swimming pools

Image: Schenker

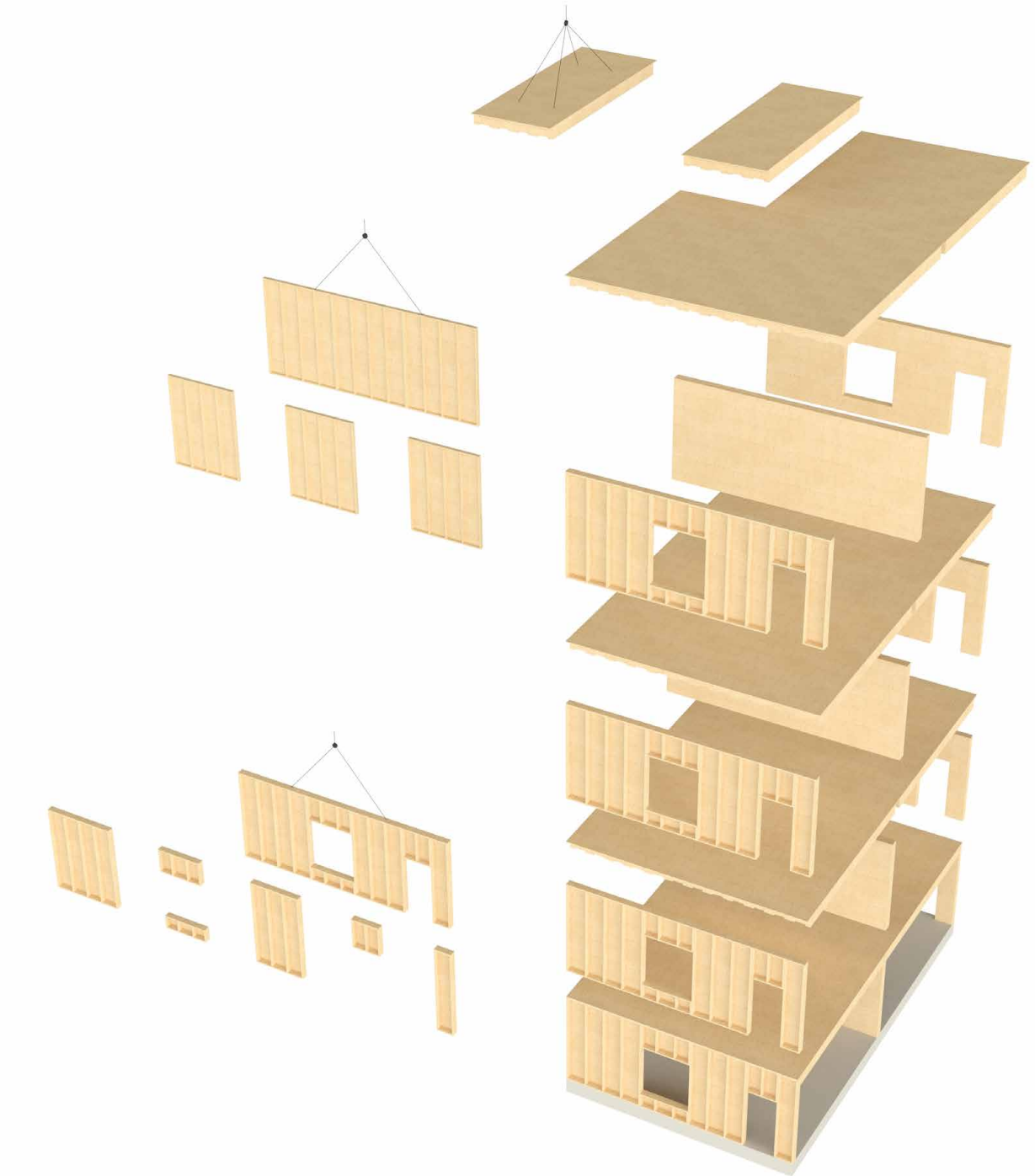
Industrial buildings

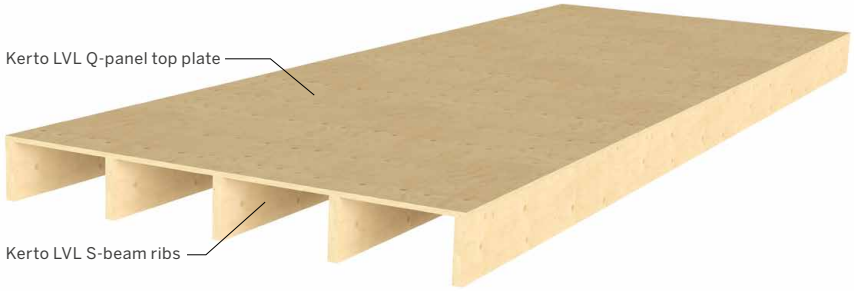
Image: Arca Nova AS

Multi-storey

Different element types

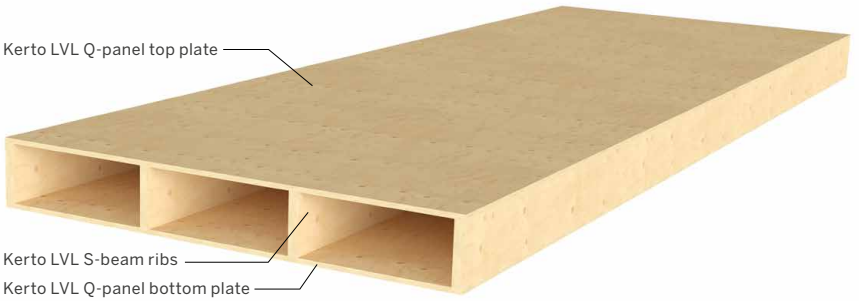
All 4 types of Kerto-Ripa element (T, Box, Open Box and Upsidedown) are genuinely performant as floor or roof bearing element. The high stiffness allows for long-span, rigid and comfortable floors.





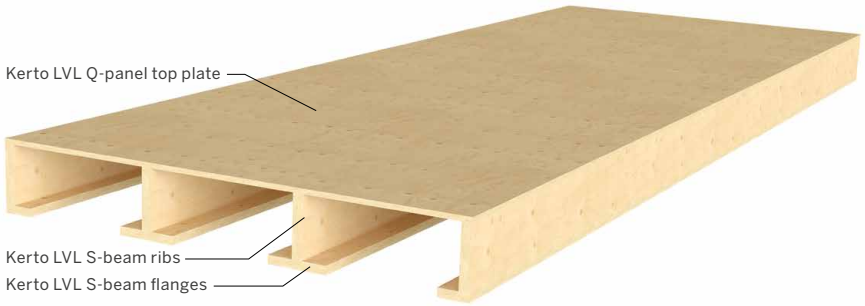
Kerto-Ripa T-element

Light-weight, strong, cost efficient and flexible T-element can be closed by wood-based panels or plasterboards for fire resistance or aesthetical purposes, and can easily be insulated with all kind of material either for acoustical or thermal performance. Holes and installations can easily be integrated which allows flexibility for the future. Ideal for floors from 5–8 m span or roofs from 10–15 m, preferably for light and medium loads.



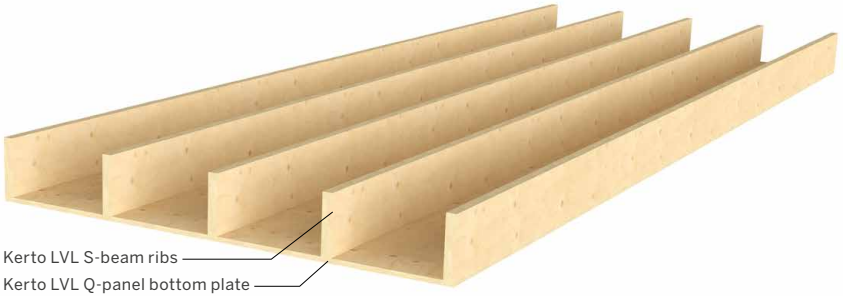
Kerto-Ripa Box Element

A box element consisting of glued ribs on top and bottom plates. Kerto-Ripa Box element offers the most performing combination of stiffness, long span and limited height. The bottom plate can bring up to 90 minutes fire resistance while keeping the wood visible. It can be also protected by additional material layers if needed. Floor span up to 15 m, roof span up to 20 m achievable.



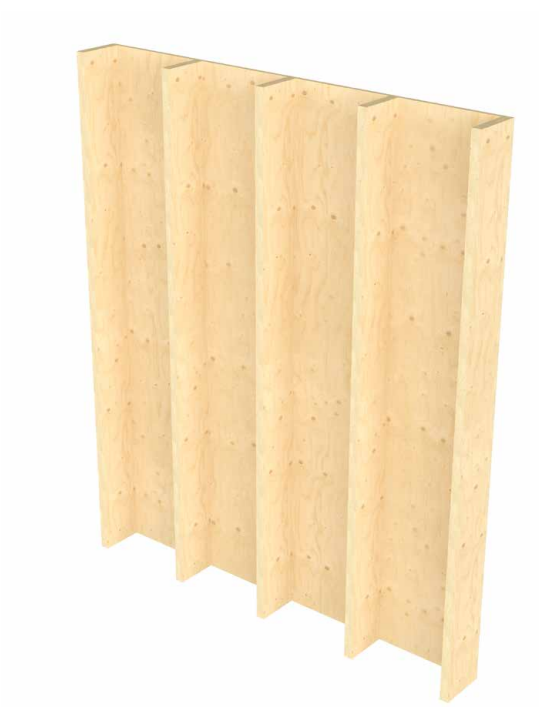
Kerto-Ripa Open Box Element

Kerto-Ripa Open Box element combines the advantages of Kerto-Ripa T-element and those of the Box element. Bottom flanges may be used to support insulation and thus perform against fire, in combination with plasterboard layers.



Kerto-Ripa Upside-down Element

Kerto-Ripa Upside-down element offers the same advantages as the T-elements. The idea to place T-element upside-down allows up to 90 minutes fire resistance directly due to the Kerto LVL Q-panel bottom plate. Thus Kerto LVL can remain visible underneath and installations can be mana-ged from the top. The element suits either for floors or roofs and it can be closed with other standard panels.



INSULATION IS INTEGRATED WITHIN THE WEB/RIB THICKNESS, BRINGING SPACE SAVING ON TOP OF MATERIAL SAVING. ANY PERCENT OF EXTRA SPACE TURNS INTO MORE SELLABLE LIVING SPACE.

Kerto-Ripa T as wall element

By using Kerto-Ripa element in a vertical direction, it can serve as a wall element that combines exceptional load-bearing capacity with material efficiency. This smart wall structure offers significant benefits, particularly as a load-bearing and stiffening exterior and partition wall solution for high-rise residential and office buildings. Structurally glued Kerto-Ripa wall elements can effortlessly support vertical loads up to 10 storeys.

The structurally glued wall elements complement the Kerto-Ripa element concept, which has already proven its efficiency in roof and floor structures. You can use all variants: T-element, Box and Open Box, each with its own unique selling points.

More sellable floor surface

The rational use of raw materials and material efficiency have become increasingly important objectives in the construction industry. For investors and property developers, the Kerto-Ripa wall element adds value by providing thinner wall constructions that offer more sellable floor space for residential or office buildings. According to structural design, the Kerto-Ripa wall construction can save up to 50% in wood materials for the walls of a high-rise building compared to massive wood constructions.

Despite using less material, the load-bearing capacity of the Kerto-Ripa wall element is excellent. An exterior wall element measuring 2.4 meters wide and 3 meters high has been measured to have a load-bearing capacity of up to 119 tons. In exterior walls, the Kerto-Ripa wall has 60% higher buckling strength compared to other massive solutions. This enables the construction of tall and heavily loaded buildings in a material-efficient manner.

Thinner structures and reduced material use

Material efficiency reduces construction costs and conserves natural resources. Although wood is a renewable material, it remains essential to consider the amount of material being used.

Kerto-Ripa wall elements offer property developers, construction companies and designers a cost-effective solution that meets the requirements of modern construction. This innovation helps address future construction challenges by enhancing both material and space efficiency.

Product facts

Kerto-Ripa elements are commonly 2400 mm wide. Smaller widths are possible, preferably divided from a full panel size, i.e. 2500, 2400 or 1820 mm.

Elements can be entirely customized according to requirements, with an optimal balance between dimensions and design assumptions.

Length	≤ 24 m
Top plate sanded thickness	25, 31, 43, 49, 55, 61 or 67 mm
Rib thickness	45, 51, 57, 63, 69 or 75 mm
Rib height/ depth	100-600 mm
Number of ribs	typically 3, 4, 5 or 6

Rib bracing

At both ends of the element, there are Kerto LVL end blocks. These blocks brace the ribs and can be used as supports. Additional inter-mediate bracings can be added to increase torsional stability. For example, they can be used in long and lightly loaded roof elements with high rib depth to improve vibration behaviour or in long elements to stabilize the location of lifting points.

Dimensional changes

Under normal conditions (service class 1 or 2), harmful deformations caused by variations in humidity are not expected.

Kerto LVL products swell when the moisture content increases and shrink when the moisture content decreases. The extent of these dimensional changes depends on the grain direction. Wetting of the product may cause also permanent deformations, problems with the surface veneers and loosening of knots.

Dimensional change ΔL due to variation in moisture content can be calculated as follows:

$$\Delta L = \Delta\omega \, \alpha_H \, L$$

where $\Delta\omega$ is the change in moisture content (in %), L is the original dimension in the considered direction to the grain, and α_H is the dimensional variation coefficient of product, see the following table.

	KERTO LVL S-BEAM (ribs) α_H	KERTO LVL Q-PANEL (plate) α_H
Thickness	0.0034	0.0034
Width	0.0034	0.0004
Length	0.0001	0.0001

These values can be used to determine the moisture deformations of the entire Kerto-Ripa element. For initial design purposes, a gap of 2 to 3 mm per element should be assumed.

Appearance

Each spruce veneer looks different, expressing a clear identity and reflecting a natural industrial DNA. The peeling of the logs reveals a heterogeneous texture, giving a unique expression to your building.

Spruce veneers are light-coloured and provide a modern feel. Depending on aesthetic expectations, required performance and budget, each panel can be customized with further treatment.

Regardless of your visual expectations, the core function of a Kerto-Ripa element is its load-bearing capacity. The veneers are selected to perform optimally in structural applications.

The second part of this document contains several references illustrating some of the visible choices made by architects and customers. Take time to review it and consider what signature you would like to give to your project.

Living environment

Wooden buildings enhance a healthy living environment in several key ways. The natural warmth and aesthetic appeal of wood foster a sense of well-being and relaxation, improving overall quality of life.

Inherent properties of wood also regulate indoor humidity, creating a comfortable and stable environment. Its excellent thermal insulation boosts energy efficiency and helps maintain consistent indoor temperatures.*

Wood is a renewable material that can be a good choice for allergic people. Kerto LVL products have low emissions that support healthy indoor air. Kerto LVL products have M1 Classification label.

Incorporating wood into building design promotes a healthier, more sustainable living environment, benefiting both occupants and the planet.**

*Alapieti, T., Mikkola, R., Pasanen, P. et al. The influence of wooden interior materials on indoor environment: a review. Eur. J. Wood Prod. 78, 617–634 (2020). https://doi.org/10.1007/s00107-020-01532-x

**Please see more info about Sustainability in pages 13-15.

Off-site construction

Element prefabrication offers many options for building projects and provides the benefit of an all-in-one solution. It results in faster assembly and better construction quality, making advanced industrial construction a reality.

Prefabricated options

In line with fire safety, acoustical, and thermal requirements, Kerto-Ripa wooden elements can be flexibly insulated with various types of insulating materials, either mineral or bio-based, in panels or blown-in within cavities. They can be closed or covered with wooden, plaster or gypsum boards and sealed with temporary or final membranes. Vapor barriers can also be integrated, along with special details like downspouts, all off-site.

Shortened on-site operations

By covering large surfaces per lift and transport, Kerto Ripa minimize the on-site building operations.

Sustainability

Kerto-Ripa elements are setting new standards in sustainable construction. They offer exceptional strength and stability while minimizing environmental impact.

In comparison to most other construction materials, sustainably sourced timber stores CO_2 and contributes directly to increasing artificial carbon storage. Wood is furthermore renewable and a bio-based construction raw material.

Metsä Wood is part of Metsäliitto Cooperative, a cooperation of 90,000 forest owners. The timber of Metsä Wood originates from traceable and sustainably managed and certified Nordic forests. Metsä Wood has environmental (ISO 14001) and quality (ISO 9001) management system certificates and PEFC and FSC chain of custody certificates

Country of origin of the wood material is required and it meets the requirements of PEFC and FSC® Chain of custody certification provides the proof that origin, legality and sustainability is realised throughout the supply chain. By following (PEFC and FSC) chain of custody certification requirements responsible forestry practices.

Metsä Wood mills in Finland have only one roundwood supplier, Metsä Forest which is part of Metsä Group.

Simple supply chain structure helps Metsä Wood also to mitigate risks in wood procurement and helps us to make sure that all wood we use is traceable and from sources that do not cause deforestation.

SIMPLE SUPPLY CHAIN STRUCTURE HELPS METSÄ WOOD ALSO TO MITIGATE RISKS IN WOOD PROCUREMENT.

Metsäliitto Cooperative, Metsä Forest, PEFC Logo Licence Registration number: PEFC/02-31-03
Metsäliitto Cooperative, Metsä Forest, FSC Licence Code: FSC-C014476

Metsäliitto Cooperative, Metsä Wood, PEFC Logo Licence Registration number: PEFC/02-31-381
Metsäliitto Cooperative, Metsä Wood, FSC Licence Code: FSC-C209093

Biodiversity

Metsäliitto Cooperative has a very close cooperation with the forest owners, many of whom are being private individuals and families. This partnership ensures that forests are managed in a way that balances economic, environmental, and social values. By providing fair compensation and support, Metsä helps forest owners invest in sustainable practices and forest conservation.

One example is Metsä Group Plus forest management model that pays increasingly close attention to forest biodiversity and forest nature in the implementation of forest work. The model includes measures that safeguard and improve the state of forest nature more comprehensively than is required by current standard practices. When choosing the Metsä Group Plus model an additional bonus is paid to forest owner.

Biodiversity is a key aspect of sustainable forestry. Metsäliitto Cooperative is committed to the principles of regenerative forestry. In regenerative forestry, the state of forest nature does not deteriorate but rather grows stronger.

Our goal is to ensure that Finnish forest assets are transferred in a more vibrant, diverse and climate resilient condition from one generation and owner to the next. A diverse forest is more vibrant, and most measures increasing the biodiversity of forest nature also promote forest health and make forests more climate resilient, as a diverse forest resists damage better. The implementation of regenerative forestry principles also helps forests remain carbon sinks.

Carbon footprint

Using wood as a building material helps sequester carbon and reduce greenhouse gas emissions. Especially due to Kerto LVL's material efficiency, it can have lower carbon footprint compared to traditional materials such as concrete*. Buildings constructed with Kerto-Ripa elements are even more material efficient thus improving potential for lower overall material usage and carbon emissions, supporting global climate goals.

A various verified Life Cycle Analysis has been carried out for Kerto LVL. The Environmental Product Declaration (EPD) you can find on our website and Environdec's website. In addition, Kerto LVL is available on:

- **The Dutch specific National Environmental Database (NMD) in the category 1 and visible in different applications for walls, roofs, floors, beams and panels**
- **The France's national reference database INIES**

Long service life enhances carbon storage

One of the most important ways to mitigate climate change is to reduce dependence on fossil resources. Wood is a renewable and reusable building material. Above all, wood stores carbon. The carbon storage calculator counts the carbon stored in different Metsä Wood products by volume and helps our customers and designers make more sustainable choices for building products. For example, for the full life cycle of the building, 50 m³ of Kerto LVL S-beams store an amount of carbon that corresponds to 39150 kg of CO_2. You can find the carbon storage calculator on Metsä's website.

With careful design, execution and maintenance, lifespans of even more than 100 years are well within reach with Kerto LVL, reducing the frequency of replacement or repairs. The long service life of Kerto LVL ensures long carbon storage times throughout its lifetime until it is released back to the atmosphere.

Slowing down the carbon flow plays also a role in mitigating climate change. Responsible use of wood means that wood is a limited resource on short-term thus we should pay special attention to material efficiency, and prolonging the service life of wood. By doing this we can improve the responsible way of using wood, enhance the carbon storage in buildings and contribute the sustainable way of using materials in construction.

Bio-based circular economy

Assemble to disassemble, Reduce-reuse-recycle-rewin, minimization of materialization.

A circular economy is one that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles**. When buildings are built with circularity in mind, it allows the same amount of wood to serve more purposes, to truly offer more, and be in use for longer periods of time, ensuring prolonged carbon storage.

Reduce – Wooden floor elements based on the Kerto-Ripa design system, have hollow structures meaning less material is needed and elements are lighter. Compared to other material alternatives, wood materials are lightweight and can be transported in larger quantities at once and lifted with smaller cranes on construction sites. Products are cut-to-size, meaning little to no waste materials at construction sites. This also streamlines processes at the customer's end, as the need to further process the products is reduced.

Reuse – Kerto LVL can be used in demountable construction solutions supporting circularity. Its great strength-to-weight characteristic helps to reduce material consumption in construction but also facilitates easier handling and installation, which is beneficial for circular designing. The Kerto LVL elements can be reused further for other purposes as the elements can be modified and reused, and the entire buildings can be moved to another location if necessary. In addition, reuse slows down the carbon flows in forest-based bio-cycles and thus reinforces the positive climate impacts of wood construction.

Recycle – Re-use and recycling of Kerto LVL by utilizing it in other applications should be always preferred. Instructions for Kerto LVL's waste handling are available on Material Safety Data Sheet.

* Assessments follow the procedural and methodological requirements of ISO 14025 and EN 15804 and are consistent with ISO 14040 and 14044 standards. The selected system boundary for the study was cradle-to-grave, and selected climate change impact methodology was fossil climate impact, thus the study excludes the carbon storage of wood. Climate change impacts for A1-A3 and A5 utilize data from EPDs. Impacts for A4 and C1-C4 were evaluated by Afry. 3rd party critical review was done for the Kerto LVL case study by RISE, Research Institutes of Sweden. The technical background report and the verification statement are available on request.

**Source : https://www.ellenmacarthurfoundation.org/circular-economy

Regulated substances of Kerto LVL

Phenolic adhesives that are cured at high temperature and wood raw material both contain small quantities of free formaldehyde.

Determined according to EN 717-1, the formaldehyde emitted by Kerto LVL falls far below the Class E1 requirement of ≤ 0.100 ppm and also fulfils the most stringent requirements in the world (≤ 0.030 ppm). The formaldehyde emission of Kerto LVL is approximately 0.016 ppm.

For volatile organic compounds (VOCs) different classification systems are used in different countries either voluntarily or based on legislation. For example, in Finland, Kerto LVL products are certified to show that they fulfill the M1 emission classification requirements of the Finnish Building Information Foundation RTS for building materials.

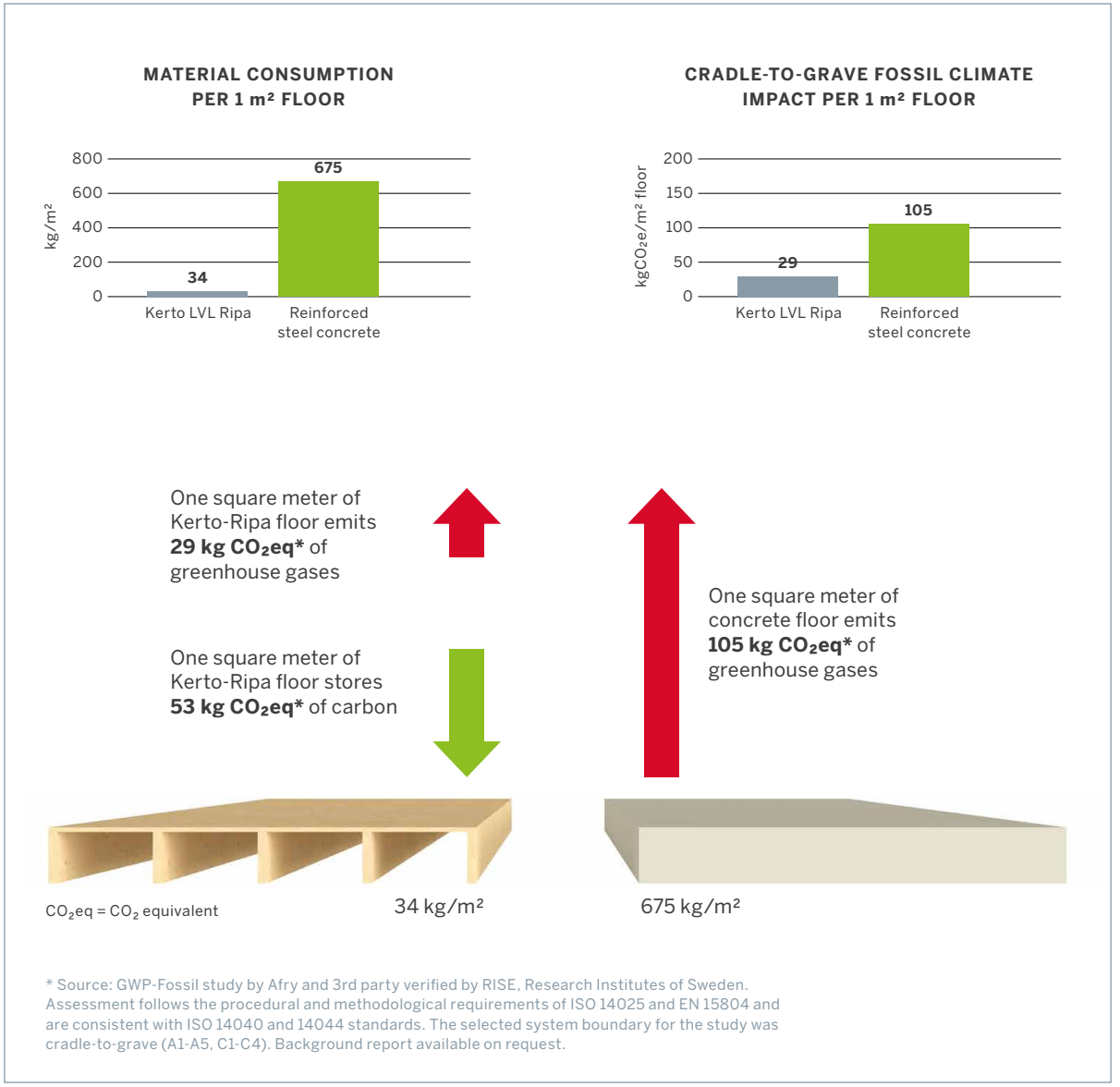
After curing at high temperature, the adhesive bond between the LVL veneers becomes an inert polymer that does not dissolve or react with other materials in the surrounding environment. It is safe and non-hazardous to humans and animals.

Kerto LVL products do not contain more than 0,1% of any of the Substances of Very High Concern (SVHC) listed in the Candidate List of the European Chemicals Agency, as these substances are not intentionally added to the products. Kerto LVL also does not contain anything classified as hazardous waste.

Fossil climate impact

Fossil climate impact of Kerto-LVL produced in Finland and transported to Central-Europe, was compared to reinforced steel concrete produced locally in Central-Europe in a verified study made by Afry. Due to Kerto-Ripa technology, material consumption of Kerto LVL in floor applications is over 90% lower, meaning that the fossil climate impact from the whole life-cycle of Kerto LVL are over 70% smaller compared to steel reinforce concrete *.

* Assessments follow the procedural and methodological requirements of ISO 14025 and EN 15804 and are consistent with ISO 14040 and 14044 standards. The selected system boundary for the study was cradle-to-grave, and selected climate change impact methodology was fossil climate impact, thus the study excludes the carbon storage of wood. Climate change impacts for A1-A3 and A5 utilize data from EPDs. Impacts for A4 and C1-C4 were evaluated by Afry. 3rd party critical review was done for the Kerto LVL case study by RISE, Research Institutes of Sweden. The technical background report and the verification statement are available on request.



* Source: GWP-Fossil study by Afry and 3rd party verified by RISE, Research Institutes of Sweden. Assessment follows the procedural and methodological requirements of ISO 14025 and EN 15804 and are consistent with ISO 14040 and 14044 standards. The selected system boundary for the study was cradle-to-grave (A1-A5, C1-C4). Background report available on request.

Weights and fossil emissions of Kerto LVL and concrete per one square meter. In addition Kerto LVL stores carbon.

Source: Metsä Wood, Punkaharju mill

Structural design

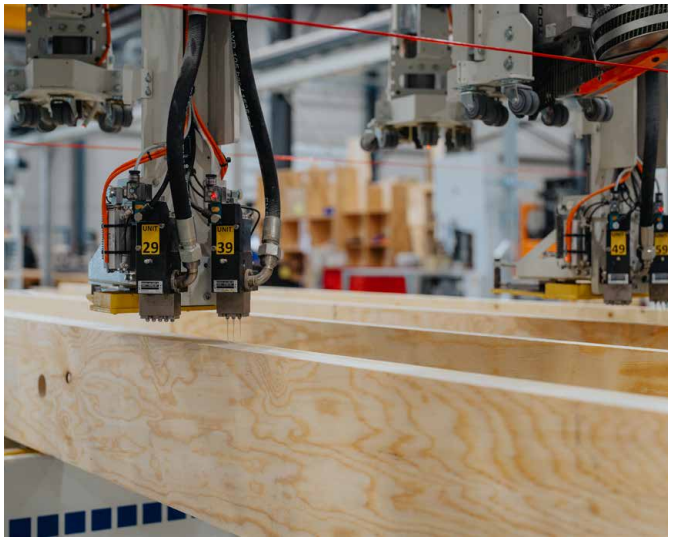
Due to its superior technical properties, Kerto LVL enhances the built-in material efficiency of ribbed elements.

Kerto LVL is known for its high strength-to-weight ratio, dimensional stability and versatility in various construction applications. The manufacturing process, which uses 3 mm-thick softwood veneers, results in a highly homogeneous, predictable and reliable product, a unique feature among engineered wood products.

Thanks to its high modulus of elasticity (MOE), Kerto-Ripa elements perform exceptionally well over long spans with excellent stiffness properties, making them ideal for floors, roofs and even wall elements. This also minimizes vibrations, an essential asset in floor design.

Moreover, Kerto LVL product strength is due to its veneer lay-up where all or majority of the veneers have their grain direction longitudinally oriented, optimizing its load-bearing capacity. This feature is particularly valuable in Kerto-Ripa elements, where weight efficiency and load transfer are critical. High compressive and tensile strength of the Kerto LVL products allow engineers to design more efficient, lightweight structures that require less material without compromising safety.

Finally, the dimensional stability of Kerto LVL Q-panels ensures the integrity of Kerto-Ripa elements. This combination of high strength, stiffness and material efficiency makes Kerto LVL a smart choice for sustainable and high-performance structural designs.



Full automatic gluing for advanced production.

Holes & installations

All types of Kerto-Ripa elements offer the possibility to integrate installations in longitudinal and crosswise direction. It is important to integrate such systems at an early stage in the plans. The holes in the beams may be circular (up to 70% of height) or rectangular. The influence of these holes can be calculated with Finnwood software and must always be checked by a structural engineer.

Floor and roof openings

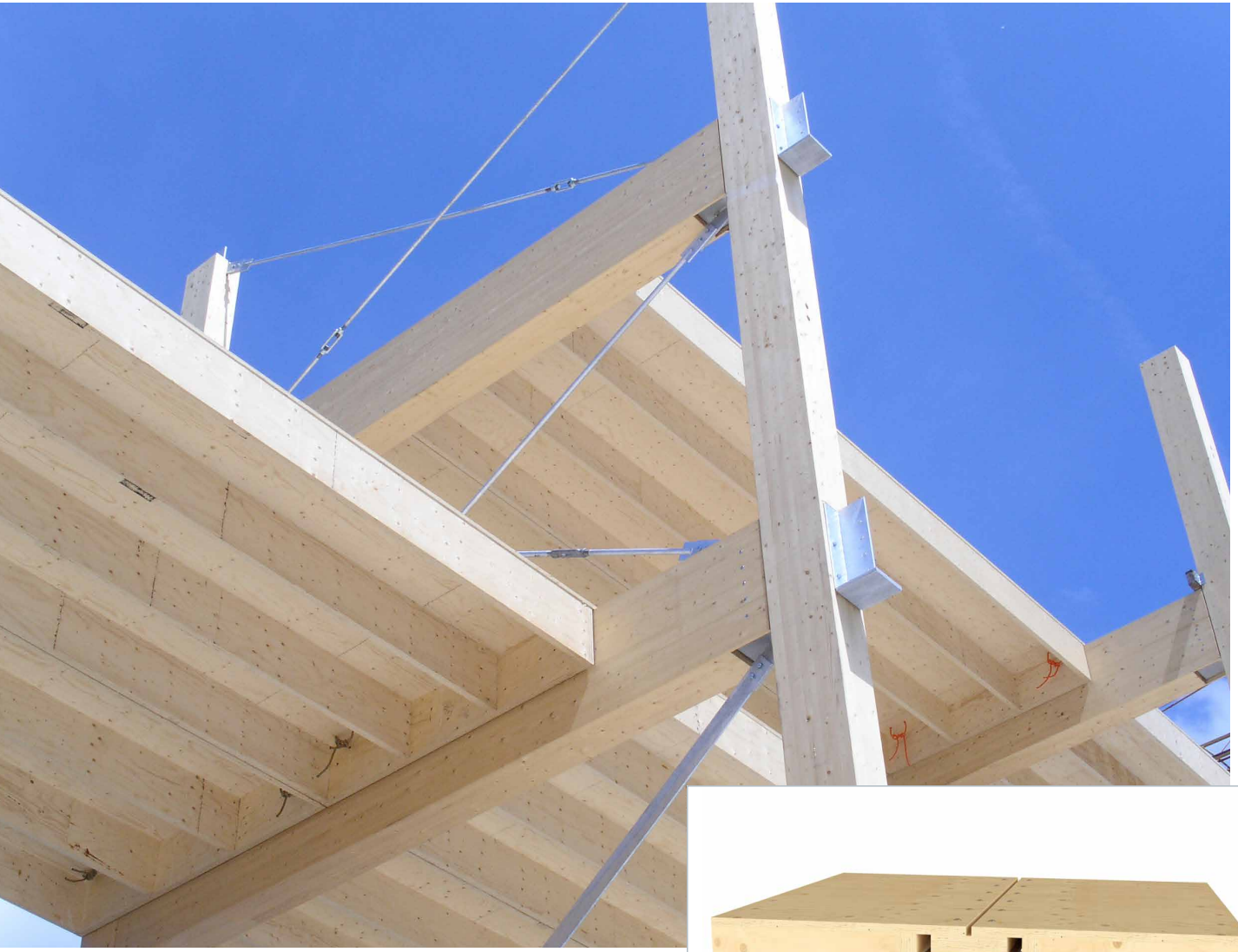
Kerto-Ripa elements are designed with a high level of flexibility. Openings can be easily made in floor and roof surfaces without heavy reinforcement. Wider or double ribs can be applied where required in order to support other elements. These other elements can often be connected onto the main beam using joist hangers. Thereby a staircase cavity can be designed easily.

Window & door openings

Incorporating openings in Kerto-Ripa wall elements is a well-engineered process that combines structural integrity with design flexibility. Kerto-Ripa wall elements offer high strength and dimensional stability for buildings, including high-rise structures. These elements can easily accommodate openings for windows, doors and service ducts without compromising structural integrity.

This ability to include openings without extensive additional materials enhances the overall material efficiency of Kerto-Ripa wall elements, reducing waste and optimizing the use of resources. Factory-prepared openings reduce on-site labor and installation time, leading to faster project completion. The precision of factory-cut openings ensures a perfect fit for windows and doors, further speeding up the construction process.

Using lintels, to create openings for windows and doors, ensures that complete elements do not need to be produced first and then cut out later. A practical example of minimizing material waste.



Top-plate support

Kerto-Ripa elements can be seamlessly integrated into building's load-bearing structure by utilizing the top plate as a supporting element. The supporting structure can be steel, concrete or wood. This integration offers significant benefits, including simplified detailing for adjoining elements and substantial height gains. As a result, the floor support can fit within the allowable height constraints of the building permit or even allow addition of an extra floor. Additionally, this method is effective for transferring forces due to diaphragm action.

Metsä Wood has developed a design method specific to this top-plate support, where the load-bearing capacity relies on the shear and bending resistance of the plate and screws. The indicative capacities are as follows:

- **Plate 25 mm –> Fv,Rk = 22 kN/m**
- **Plate 31 mm –> Fv,Rk = 27 kN/m**
- **Plate 37 mm –> Fv,Rk = 32 kN/m**
- **Plate 43 mm –> Fv,Rk = 37 kN/m**

By implementing top-plate support, architects and engineers can fully leverage the superior structural properties of Kerto-Ripa in an efficient support solution. This approach not only simplifies the detailing for stacking but also saves vertical space, as beams are integrated into the post-and-beam structure.

Bracing elements

Plates of the Kerto-Ripa elements consist of one Kerto LVL Q-panel. With high strength and stiffness, it may be efficiently used as bracing element transferring diaphragm actions, with a limited number of connections required.

Horizontal

In horizontal applications, i.e. floors or roofs, the plate works as a slab, distributing the loads (e.g. wind) among the shear walls. Loads parallel to the span can require the individual plates to be connected to each other.

In the figure below long steel stripes, nailed down to connect the Kerto LVL Q-panel top plates, transfer tensile forces from in-plane 'bending' action from plate to plate. Shorter stripes transfer the shear forces along the span from plate to plate as well.

Vertical

Kerto-Ripa elements are also used as shear walls. The long lengths, high strength, and stiffness of these elements can reduce the number of walls required to adequately brace a structure, maximizing spatial flexibility. Ideally, structures are designed so that the bracing Kerto-Ripa wall elements span multiple stories (2 to 5 floors).

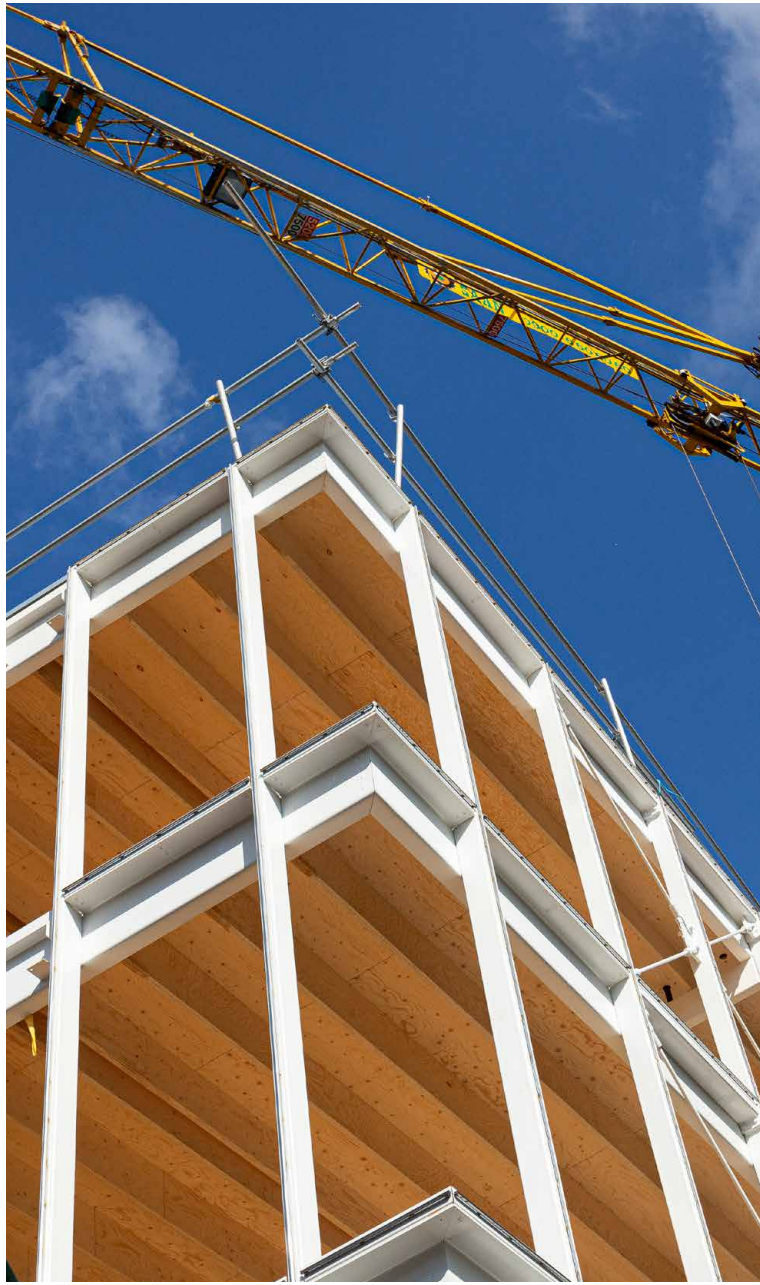
As with all timber frame buildings, special attention is needed for the vertical connections at the bottom of a Kerto-Ripa shear wall. In slender and light buildings, the forces to be transferred to the foundation can add up to many tons. Fortunately, connections for Kerto-Ripa are easily made using standard timber connectors. The high density of Kerto LVL means that screws or nails used in these connections provide more strength than when used in standard sawn timber, resulting in stronger connections.

Vibration

Wooden floors are generally lighter than traditional alternatives, which requires extra attention regarding vibration. However, this aspect can be effectively managed with the right detailing and design parameters. Thanks to the optimized stiffness and strength of Kerto-Ripa elements, the floors can be designed to meet the highest performance level, even those of the new Eurocode requirements. This ensures not only aesthetically pleasing but also comfortable and safe floor constructions.

When designing, it is essential to consider the natural and own frequencies of the structure to prevent resonance and unwanted vibrations during normal use. By applying suitable materials and connection techniques, vibrations can be further reduced, enhancing the user experience (e.g. use of damping materials). These methods allow for an optimal balance between lightweight construction and proper management of vibration aspects, which is crucial in modern construction practice.

The new Eurocode 5 will set precise requirements for the vibration performance of floor systems, which is essential for the comfort of residents and structural safety. Kerto-Ripa floors are designed to minimize vibrations from foot traffic and other dynamic loads, making them particularly suitable for multi-storey buildings. Kerto-Ripa elements can meet the Eurocode requirements for highest vibration levels, ensuring that the floors achieve the highest standards for vibration performance. This creates a stable, comfortable environment free from excessive vibrations, thereby enhancing the overall quality of the building.



Fire safety

Kerto-Ripa elements are well-suited for solutions where fire design is required. With a well-known and predictable charring rate, they can achieve significant fire resistance requirements (REI) and comply with international fire safety standards. These properties make them suitable for use as structural floor or roof elements where fire safety is a critical concern.

Fire performance requirements can be met by combining the excellent fire behaviour of Kerto LVL with one or more layers of plasterboard. This allows a choice between a visible Kerto bottom plate or a standard plasterboard ceiling, without compromising performance.

Kerto LVL reaction to fire class is D-s2,d0. To further enhance fire performance, Kerto-Ripa floor elements can be treated with fire-retardant coatings or impregnations. These treatments improve the material's ability to resist ignition and slow down the spread of flames.

Fire resistance

By using a bottom plate of 25, 37 or 61 mm you can keep the natural look of Kerto LVL visible and still achieve a fire resistance class REI of respectively 30, 60 or 90 min. Kerto-Ripa floor elements are tested under load-bearing configurations, and the ETA* provides the parameters for a calculation-based performance assessment. REI 120 min can be achieved by adding plasterboard to the wall or floor elements.

Charring rate

The one-dimensional charring rate of LVL is 0.65 mm/min which allows precise calculation of the residual thickness of the elements.

The charred layer (bottom plate) acts as a protective layer, significantly slowing down the heat transfer to the inner, uncharred parts of the elements, which may be filled with insulation or not. Insulation may help to maintain the structural integrity of the floor elements for a longer period during fire.

*ETA 07/0029, Annex 2

ASK YOUR FIRE SAFETY ENGINEER FOR CORRECT SOLUTION IN YOUR PROJECT

Building physics

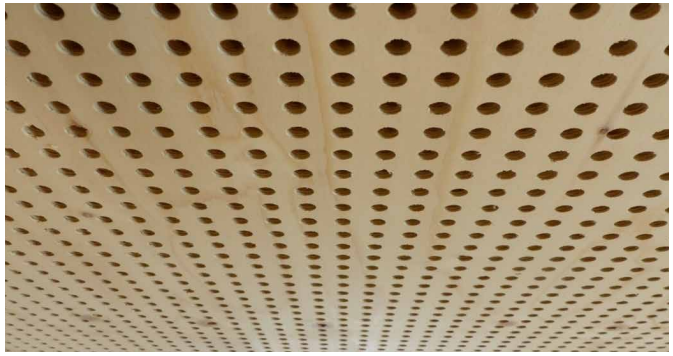
Surrounding noise can significantly impact your living comfort. When designing wooden buildings, especially terraced houses and apartments, acoustic quality plays a crucial role. Fortunately, this challenge has a solution. Achieving the right level of comfort for end users requires precise and integrated designing as well as an experienced prefabrication partner and contractor on site.

Acoustic performance

The degree of acoustic insulation of a Kerto-Ripa floor or roof depends on the overall construction. Kerto-Ripa elements offer excellent acoustic performance, making them ideal for both residential and commercial buildings. They effectively address both impact and airborne sound, ensuring a quiet and comfortable indoor environment. By integrating Kerto-Ripa elements into the construction projects, and by correct material choises, superior acoustic performance is ensured, reducing both impact and airborne sound and creating a modern building.

Airborne sound insulation

Kerto-Ripa elements also excel in reducing airborne sound transmission. The dense, laminated veneer structure acts as a barrier to airborne noise, such as voices or music. For enhanced performance, Kerto-Ripa walls and floors can be combined with additional acoustic layers, such as sound-absorbing panels and insulation materials, to further improve soundproofing.



Impact sound insulation

Kerto-Ripa floors are designed to minimize the transmission of impact sounds, such as footsteps or moving furniture. The robust structure of the elements, combined with additional layers of sound insulation materials, effectively dampens impact sound. Therefore, Kerto-Ripa floors are particularly suitable for multi-storey buildings where sound control between floors is critical.

Acoustic absorption

To improve acoustics in a space, especially in a large space, it may be desirable to equip Kerto-Ripa elements with acoustic panelling at the bottom. Adding these perforated panels, with fabric backing and insulation, helps to absorb reverberation and/or (flutter) echoes. The degree of acoustic insulation of a Kerto-Ripa element depends on the overall construction, used materials and perfo-ration degree of acoustic panels. It is possible to achieve high acoustic insulation values, which are well above the required level of a residential building, office or sports centre.

An acoustic consultant can provide targeted advice to find the right balance for a comfortable living or working environment.

Service classes

Kerto-Ripa elements may be used in service classes 1 and 2, as specified in Eurocode 5. This relates to structures in indoor or covered outdoor conditions where they are not exposed to weather. The elements shall be protected at all times from the influence of weather, for example, by protective cover during storage. Temporary exposure to moisture is not a problem as long as the element is allowed to dry afterwards. Long-term moisture accumulation on the elements should be avoided. It is advisable to check the moisture content of the top plate after moisture exposure: it shall remain below 15%.

Thermal insulation

Kerto-Ripa elements can easily achieve a high Rc value due to the low thermal conductivity of Kerto LVL (0.13 W/(m/K)) and the possibility to insulate the large cavities of the element.

Any type of thermal insulation may be used: glass wool, rock wool, wood fibre insulation, rigid or flexible. It should be taken into account that insulation contributes to the expected fire performance of the element.

Air tightness

Kerto LVL Q-panels are airtight beyond what can be measured. A structure with Kerto-Ripa elements, including the connections between the elements, provides sufficient air tightness in relation to the intended use. This includes limiting heat flows and the risk of condensation.

Water vapour resistance

Kerto LVL has a certain degree of water vapour resistance, declared for the purposes of building physics calculation. Additional measures such as a separate vapour barrier or ventilation of the cavities may be necessary in specific cases to prevent condensation within roof elements.

The corresponding water vapour resistance factors μ are shown in the table below. Check our Kerto LVL manual for more detailed information.

	KERTO LVL S-BEAM	KERTO LVL Q-PANEL
In the direction of thickness	80	62
In the direction of width	82	9.5
In the direction of length	3.9	4.7

Measured in 20 °C - 50/75 RH% conditions

Design tools

Finnwood

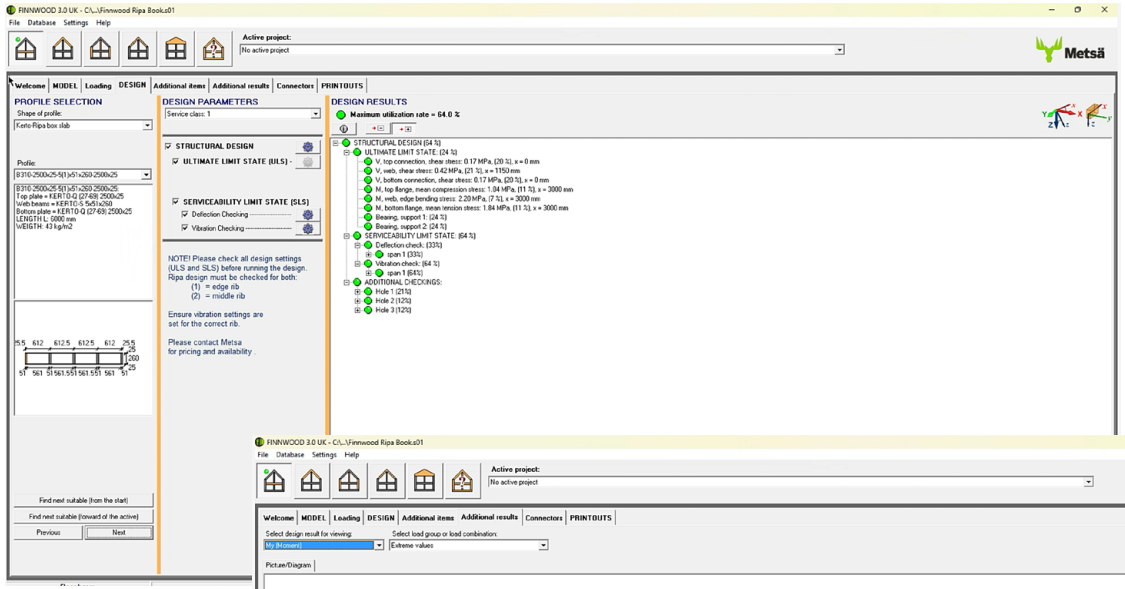
Finnwood design tool is an advanced, free software solution based on EC5, tailored for designers and structural engineers. This user-friendly tool facilitates the precise calculation and design of timber elements, primarily made of Kerto LVL and other Metsä Wood products. With Finnwood, users can seamlessly ensure both efficiency and reliability in structural design.

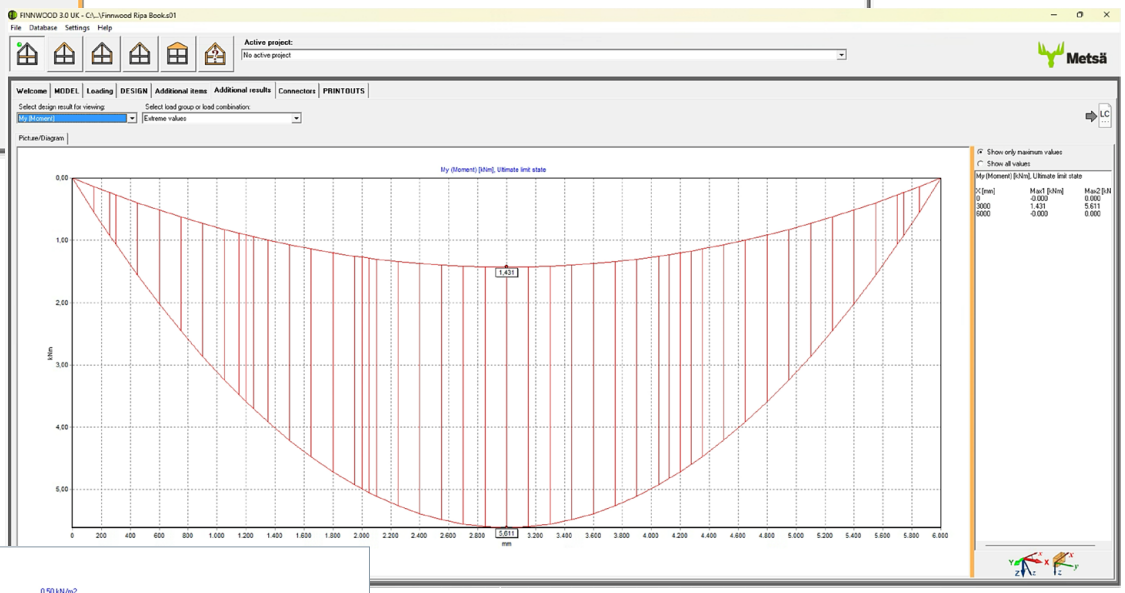
By combining the advanced capabilities of the Finnwood design tool with the innovative properties of Kerto-Ripa elements, Metsä Wood offers a comprehensive design solution. The capabilities include preset templates for floors, roofs, columns, and free structures, as well as customizable features such as holes and notches, compression at supports, and user-friendly comprehensive printouts.

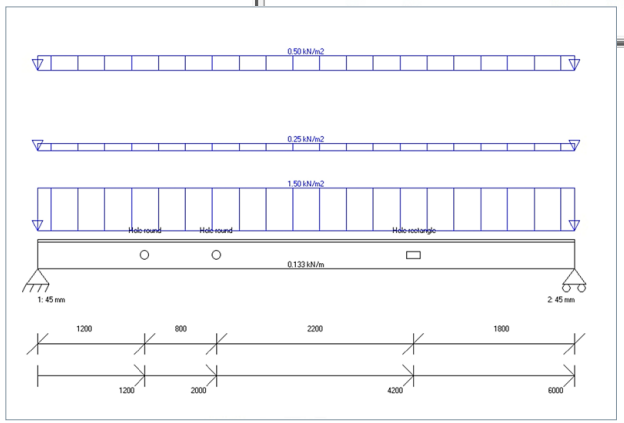
BIM library

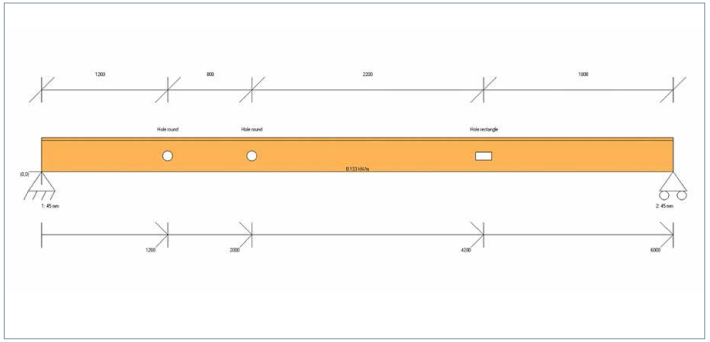
Kerto-Ripa elements are now readily available through our comprehensive BIM library. Organized into BIM families, our key engineered wood product systems and solutions can be easily downloaded for seamless integration into your digital projects.

Explore our BIM library to find and download digital models of Kerto-Ripa and other engineered wood products. This resource is designed to streamline your workflow and enhance the quality of your construction projects.



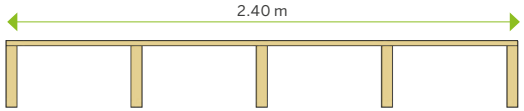




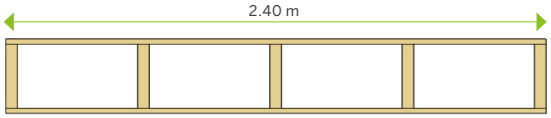


Span tables

These span tables indicate maximal span length for 5-rib Kerto-Ripa T or Box elements for roofs and different floor categories according to Eurocode 1 and National Annexes of NL and BE. Typical width is 2.40 m.



HEIGHT mm	WEIGHT kg/m²	ROOF m	FLOOR m			
			RESI-DENTIAL	OFFICE	SCHOOL	VENUE
225 (45 x 200 + 25)*	53.6	7.00	5.25	4.85		
231 (45 x 200 + 31)	60.9	7.20	5.40	5.05	4.05	3.15
250 (45 x 225 + 25)	56.4	7.80	5.80	5.45		
256 (45 x 225 + 31)	63.8	8.00	6.00	5.60	4.55	3.55
265 (45 x 240 + 25)	58.1	8.30	6.15	5.75		
271 (45 x 240 + 31)	65.5	8.50	6.30	5.90	4.80	3.80
285 (45 x 260 + 25)	60.4	8.90	6.55	6.15		
291 (45 x 260 + 31)	67.8	9.10	6.75	6.30	5.20	4.10
325 (45 x 300 + 25)	65.0	10.10	7.40	6.95		
331 (45 x 300 + 31)	72.4	10.25	7.60	7.15	6.00	4.70
385 (45 x 360 + 25)	71.9	11.35	8.65	8.10		
391 (45 x 360 + 31)	79.3	11.55	8.85	8.30	7.00	5.65
397 (45 x 360 + 37)	86.6	11.70	9.00	8.50	7.15	5.50
425 (51 x 400 + 25)	82.6	12.35	9.45	9.10		
431 (51 x 400 + 31)	90.0	12.50	9.65	9.35	7.90	7.05
437 (51 x 400 + 37)	97.3	12.70	9.85	9.55	8.10	6.80
475 (57 x 450 + 25)	96.0	13.40	10.35	10.25		
481 (57 x 450 + 31)	103.4	13.65	10.60	10.45	9.00	8.40
487 (57 x 450 + 37)	110.7	13.80	10.80	10.60	9.20	8.55
525 (63 x 500 + 25)	110.9	14.45	11.30	11.10		
531 (63 x 500 + 31)	118.3	14.70	11.55	10.30	10.10	9.40
537 (63 x 500 + 37)	125.6	14.85	11.75	11.50	10.30	9.65
543 (63 x 500 + 43)	133.0	15.00	11.95	11.65	10.55	9.85



HEIGHT mm	WEIGHT kg/m²	ROOF m	FLOOR m			
			RESI-DENTIAL	OFFICE	SCHOOL	VENUE
250 (25 + 45 x 200 + 25)**	84.2	10.25	7.65	7.15		
256 (31 + 45 x 200 + 25)	91.5	10.50	7.90	7.40	5.65	4.35
275 (25 + 45 x 225 + 25)	87.0	10.90	8.25	7.70		
281 (31 + 45 x 225 + 25)	94.4	11.15	8.50	7.95	6.30	4.85
290 (25 + 45 x 240 + 25)	88.7	11.25	8.60	8.05		
296 (31 + 45 x 240 + 25)	96.1	11.50	8.85	8.30	6.70	5.15
310 (25 + 45 x 260 + 25)	91.0	11.65	9.05	8.45		
316 (31 + 45 x 260 + 25)	98.4	11.90	9.35	8.75	7.25	5.50
350 (25 + 45 x 300 + 25)	95.6	12.50	9.80	9.35		
356 (31 + 45 x 300 + 25)	103.0	12.75	10.05	9.60	8.10	6.40
410 (25 + 45 x 360 + 25)	102.5	13.65	10.75	10.40		
416 (31 + 45 x 360 + 25)	109.9	13.90	11.00	10.60	9.20	7.75
434 (37 + 45 x 360 + 37)	131.9	14.60	11.80	11.00	10.00	7.90
450 (25 + 51 x 400 + 25)	113.2	14.40	11.40	11.05		
456 (31 + 51 x 400 + 25)	120.6	14.65	11.70	11.30	10.05	9.35
474 (37 + 51 x 400 + 37)	142.6	15.35	12.50	11.85	10.80	9.55
500 (25 + 57 x 450 + 25)	126.6	15.35	12.25	11.85		
506 (31 + 57 x 450 + 25)	134.0	15.60	12.50	12.10	10.95	10.30
524 (37 + 57 x 450 + 37)	156.0	16.30	13.35	12.65	11.55	11.05
550 (25 + 63 x 500 + 25)	141.5	16.25	13.05	12.65		
556 (31 + 63 x 500 + 25)	148.9	16.45	13.35	12.85	11.65	11.20
574 (37 + 63 x 500 + 37)	170.9	17.15	14.15	13.45	12.25	11.75
586 (43 + 63 x 500 + 43)	185.6	17.55	14.50	13.90	12.65	12.10

Assumptions:

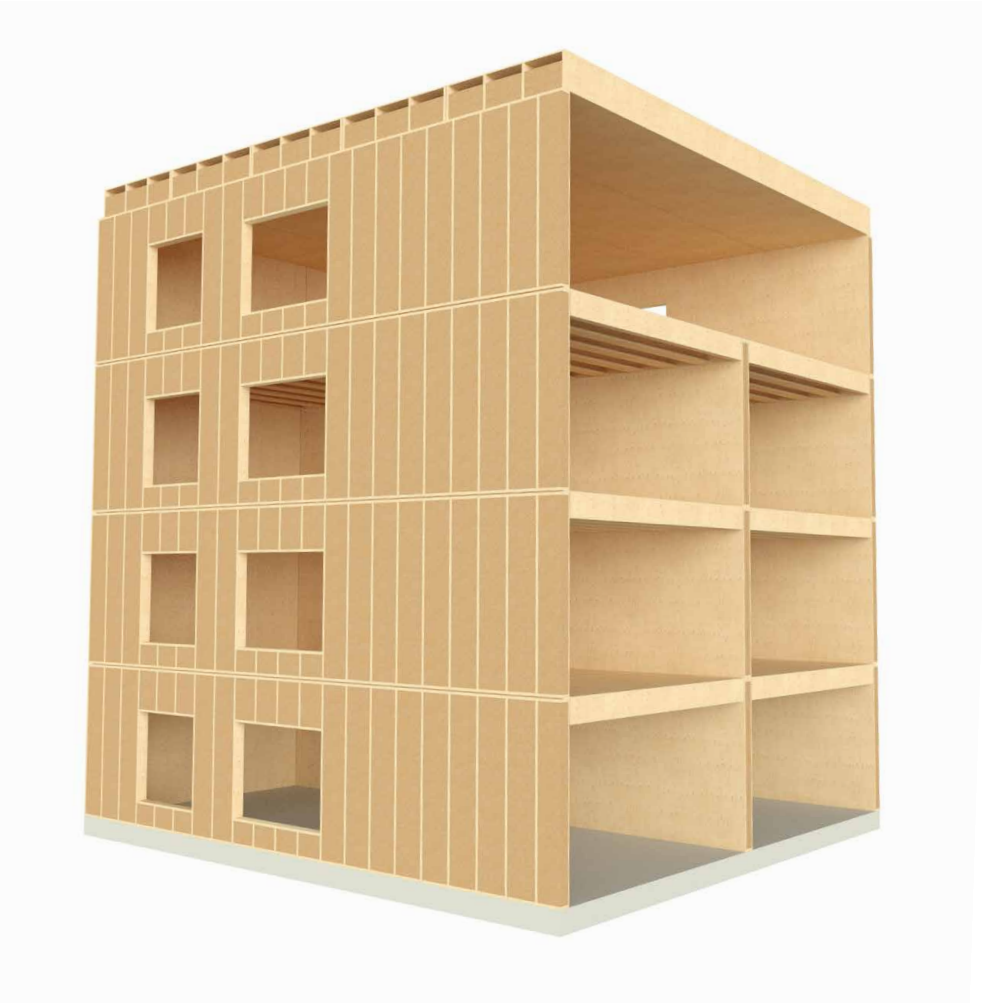
- **Roof weight 30 kg/m²**
- **Ceiling under floor or roof 15 kg/m²**
- **Floor floating screed 45 kg/m²**
- **Partition walls 50 kg/m²**

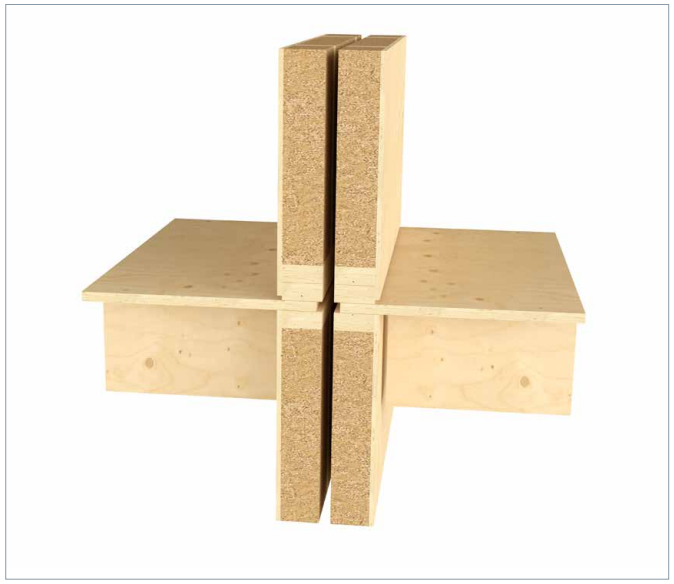
- **Vibration verified according to Eurocode 5, chap. 7.3.**
- **Fire resistance is not included**
- **For better acoustic performance, a 31 mm-thick top plate is recommended for T as well as Box elements**

* 5 ribs of 45 x 200 and a top plate of 25 mm. Total height of element is 225 mm
** 5 ribs of 45 x 200 and a top and bottom plate of 25 mm. Total height of element is 250 mm.

Connection details

Smart and innovative connection details allow the design of the most efficient structure.

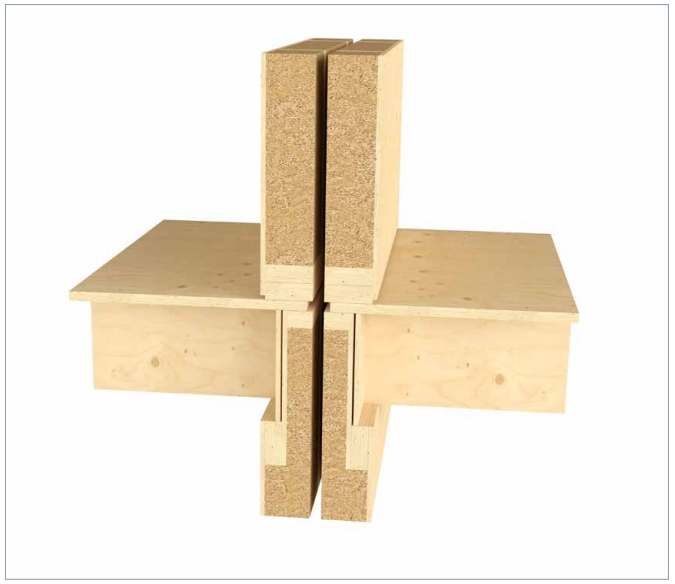




Load-bearing separation wall, top-plate support

Load-bearing wall, lintel support

Load-bearing wall, top-plate support over wall opening



Load-bearing separation wall, lintel support

Load-bearing separation wall, lintel support over wall opening

Design of a five-storey buiding

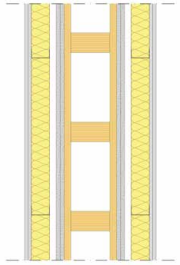
Metsä Wood has assessed floor and wall layouts, designed to meet both NL and BE market requirements for a fictive five-storey building. This includes structural, fire, acoustical (airborne and impact sound), thermal and also CO_2 (GWP) evaluations.

The key assumptions are listed below, and the results as well as background information can be made available by taking contact via metsawood/nl.

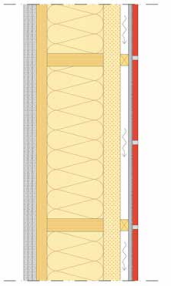
Assumptions / key figures

- **Building code** ..... **BE and NL**
- **Storeys** **5**
- **Applications** ..... **Floors, outer walls and separation walls**
- **Floor finish** ..... **Wet and dry screed system evaluated**
- **Wall finish** ..... **Plasterboard**
- **Floor span / wall height** ..... **6.50 m / 3 m**
- **Permanent load** ..... **depending on layout (dry or wet screed, etc.)**
- **Live load** ..... **Residential use (Cat. A as per EN 1991-1-1)**
- **Vibration** ..... **According to EN 1995-1-1 with cross-checking for Performance Level III from prEN 1995-1-1**
- **REI** ..... **Up to 120 min**
- **Acoustic performance** ..... **According to NL or BE, whichever is the most demanding, with consideration of low frequencies as of 50 Hz**

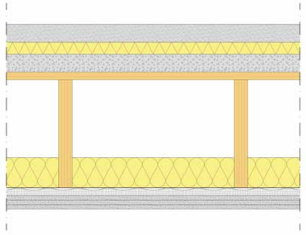
Example structures



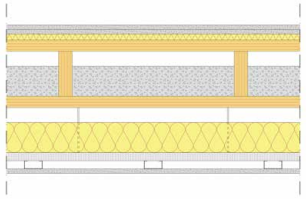
Internal separating wall
- Kerto-Ripa Box element
- Depth 310 mm
- REI 90 with 2 x 15 mm Gypsum fiberboard
- REI 120 with 3 x 15 mm Gypsum fiberboard
- Rw+C ≥ 65 dB (with additional partition walls on both sides)



Outer wall
- Load bearing wall
- Kerto-Ripa T-element, with Kerto LVL Q-panel inside
- Brick slips outside, upon ventilated air gap
- Total depth 390 mm
- U = 0,2 W/m²K
- REI 60-90-120 possible
- Rw+C ≥ 58 dB



Kerto-Ripa T-element floor
- Dry or wet screed possible, upon resilient layer and mass (gravel) layer
- Total depth around 600 mm
- REI 60-90-120 possible
- Rw+C ≥ 64 dB (including low frequencies)



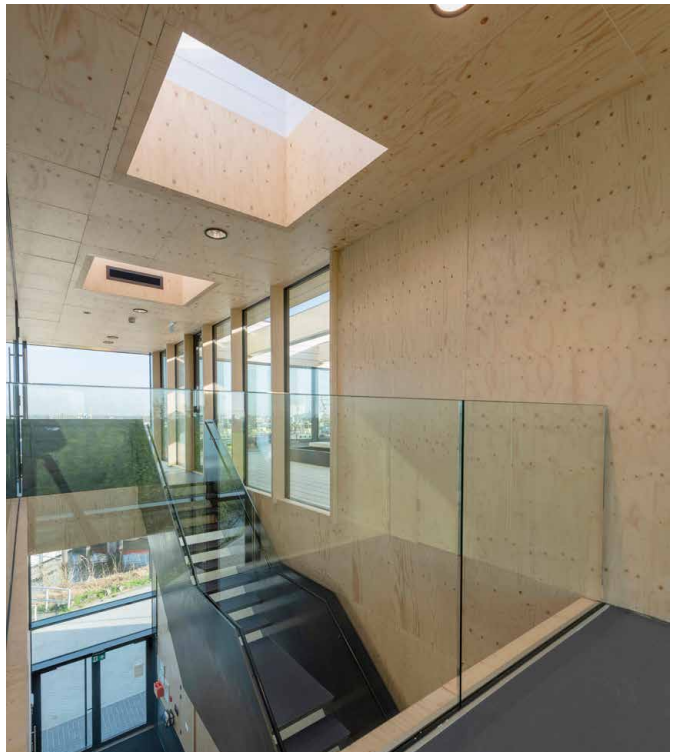
Kerto-Ripa Box element floor
- Dry or wet screed possible, upon resilient layer
- Mass (gravel) layer inside the cavities
- Total depth around 450 mm
- REI 60-90-120 possible
- Rw+C ≥ 62 dB (including low frequencies)

References

Nautical Coordination Center

OFFICE

LOCATION	Amsterdam, Netherlands
DESIGN	WRK Architects
APPLICATION	Wall, floor, roof | Floor 8 m span

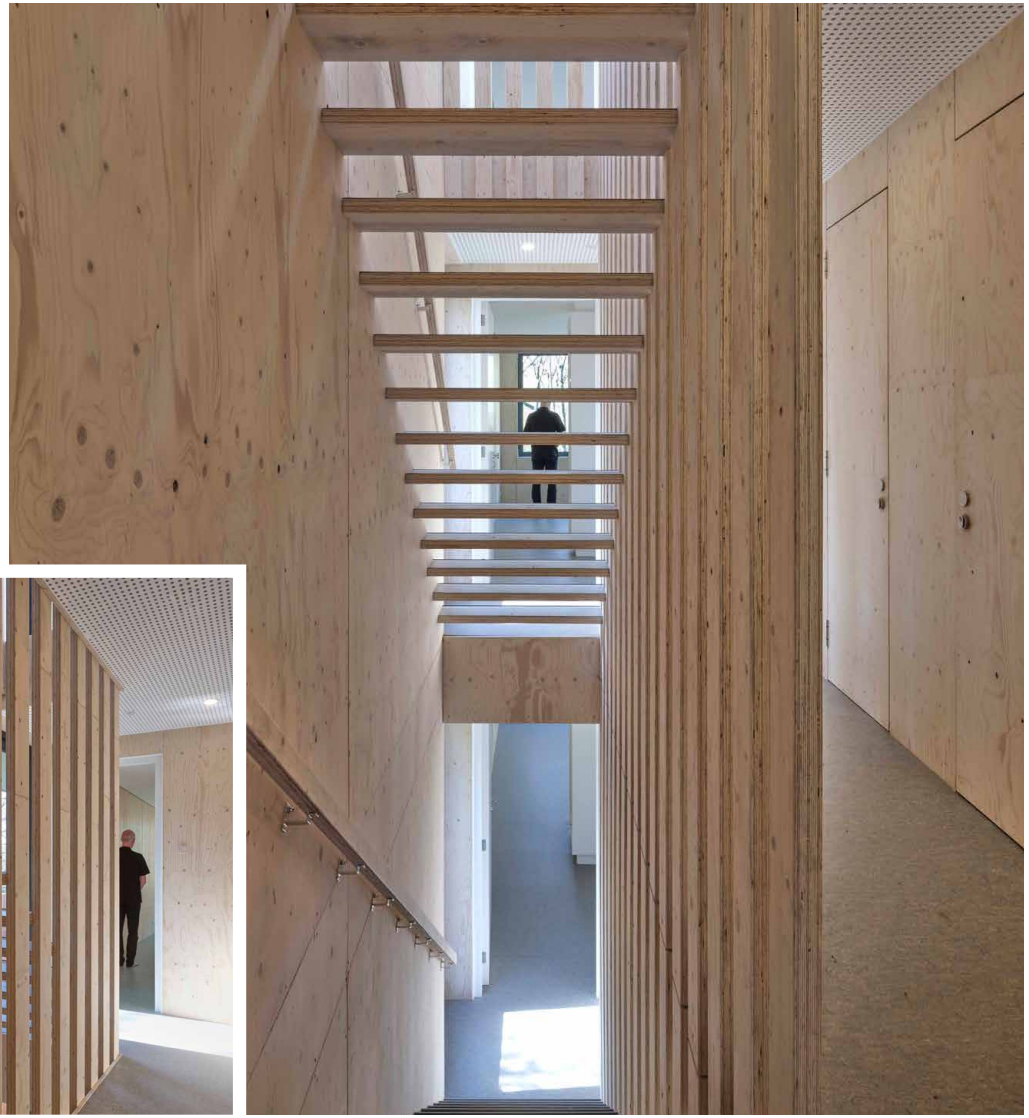


Images: Leonard Fäustle

Monicahof

RESIDENTIAL

LOCATION	Utrecht, Netherlands
DESIGN	Ramin Visch
APPLICATION	Wall, floor, roof | Floor 7 m span, REI 90 min.

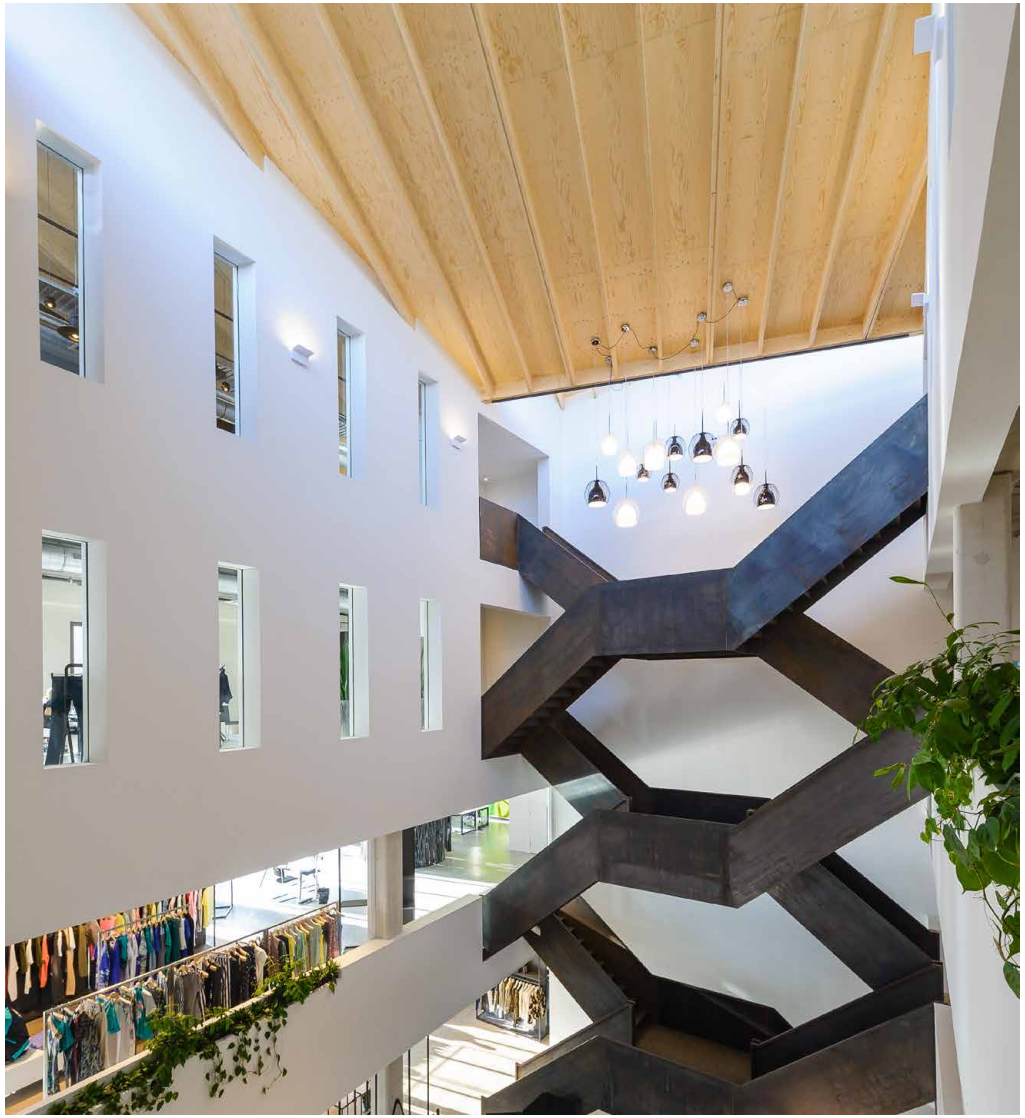


Images: Jeroen Musch C Photography

Diesel Benelux HQ

OFFICE

LOCATION	Amsterdam, Netherlands
DESIGN	Dedato ontwerpers en architecten
APPLICATION	Roof | 8 & 16 m span



Images: Diesel

Le Pavillion de Terre-Bonne

SCHOOL

LOCATION	Nyon/Eysins, Swiss
DESIGN	Dedato architecten en ontwerpers
APPLICATION	Floor, roof | 7.20 m span

Images: STUDIO DE NOOYER

103 Apartments Viikki

RESIDENTIAL

LOCATION	Viikki, Finland
DESIGN	HMV Architects
APPLICATION	Floor, roof | 6.30 and 7.50 m span

Images: Hans Koistinen

Office Verstoep

LOCATION	Schoonhoven, Netherlands
DESIGN	Verstoep
APPLICATION	Floor, roof | 7 to 10 m span

OFFICE

Images: Verstoep projects

Police station

LOCATION	Diksmuide, Belgium
DESIGN	Goedefroo architects
APPLICATION	Floor | 4.5 m span, Box filled with 70 mm sand

OFFICE

Images: G2 Architectural Graphics

Velve-Lindenhof, 211 dwellings

RESIDENTIAL

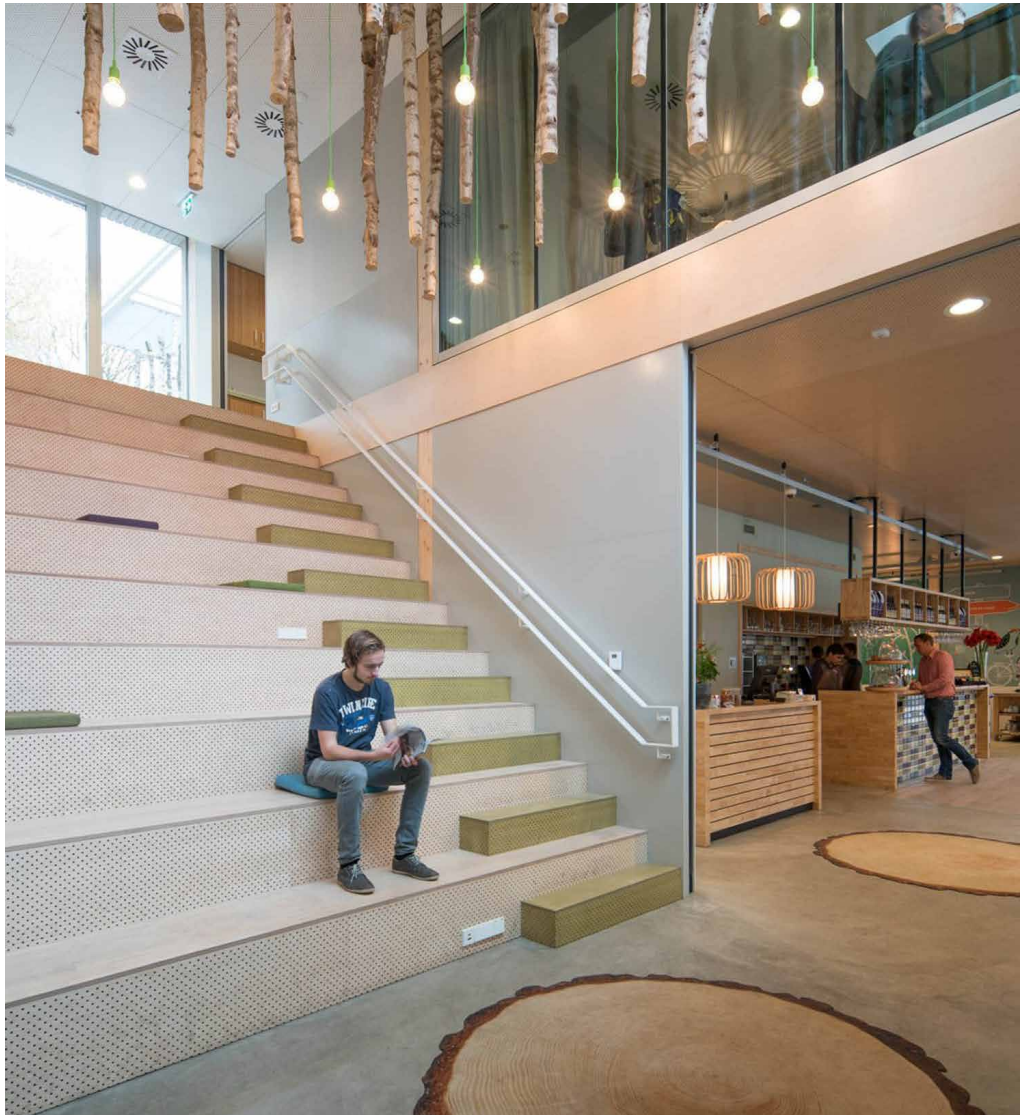
LOCATION	Enschede, Netherlands
DESIGN	Beltman Architects
APPLICATION	Floor | 5.80 m span

Images: M. den Besten

Hostel Stayokay

HOTEL

LOCATION	Bergen op Zoom, Netherlands
DESIGN	Personal Architecture
APPLICATION	Floor | 5 m span



Images: Ossip van Duivenbode

Nij Smellinghe Drachten

SCHOOL

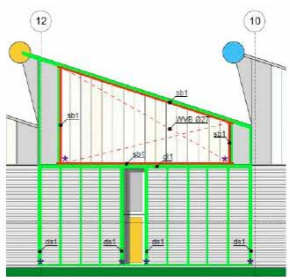
LOCATION	Drachten, Netherlands
DESIGN	VMEZ Architects
APPLICATION	Floor, roof | 6.50 m span

Image: Martijn Heemstra Fotografie

6 Carnivall halls

PRODUCTION

LOCATION	Oldenzaal, Netherlands
DESIGN	Max 3D! Tekenstudio
APPLICATION	Wall, floor, roof | Shed roof 6.50 m span, wall height 10 m

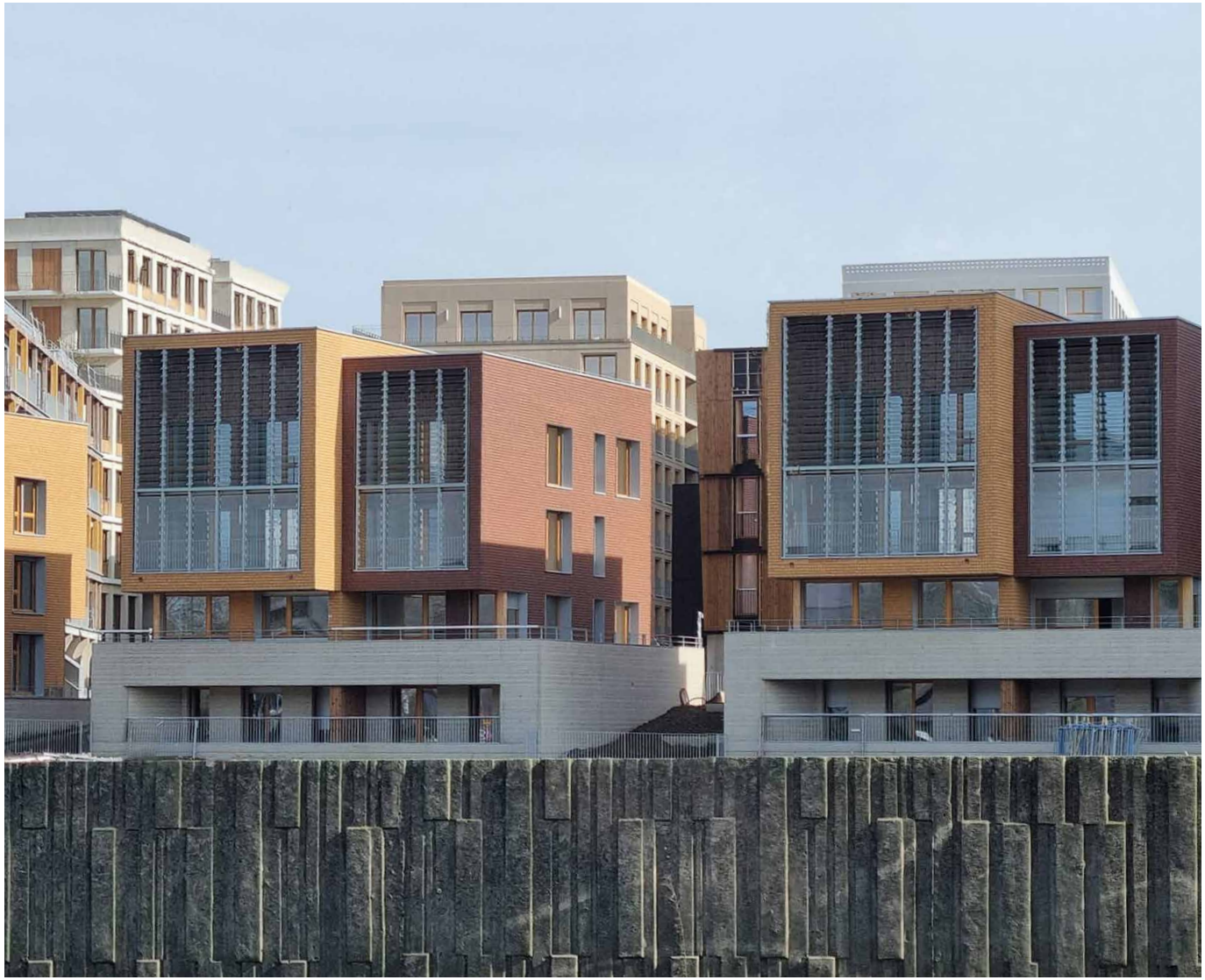


Images: Vreeswijk / Oude Roelink

2024 Olympic Games, Villages des Athletes

RESIDENTIAL

LOCATION	Paris, France
DESIGN	Gustave
APPLICATION	Floor | 5.80 m span



Images: Alexandre Wallon

The Hurlingham Club Racquet Centre

LOCATION	London, United Kingdom
DESIGN	David Morley Architects
APPLICATION	Roof | 13.5 m span

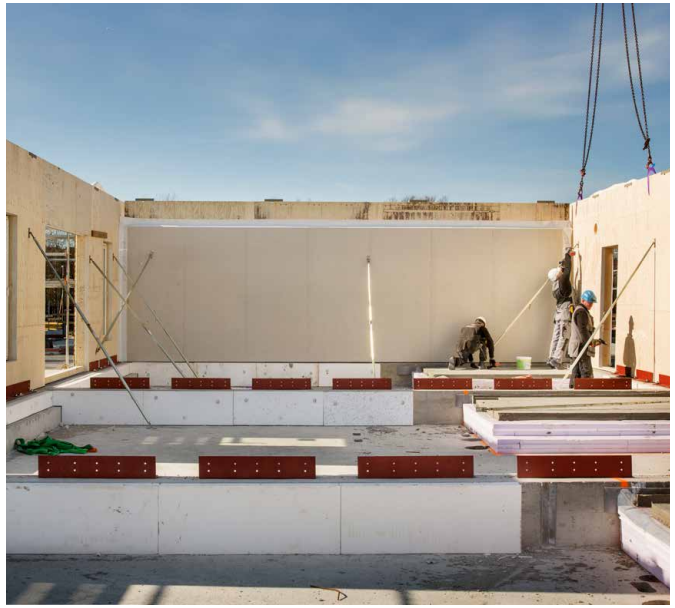
SPORTS CENTER

Images: The Hurlingham Club

Sustainable neighbourhood Verksbyen

RESIDENTIAL

LOCATION	Fredrikstad, Norway
DESIGN	Frogner Arkitektkontor
APPLICATION	Wall, floor, roof

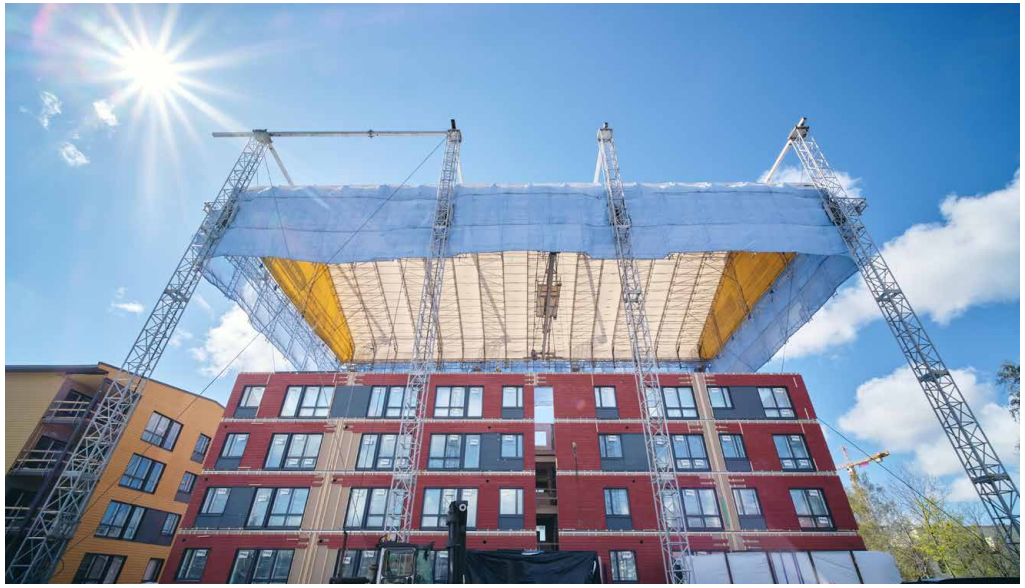


Images: Arca Nova AS & Tom-Egil Jensen

Linnanfältti wooden district

RESIDENTIAL

LOCATION	Turku, Finland
DESIGN	Schauman Architects
APPLICATION	Wall, floor, roof

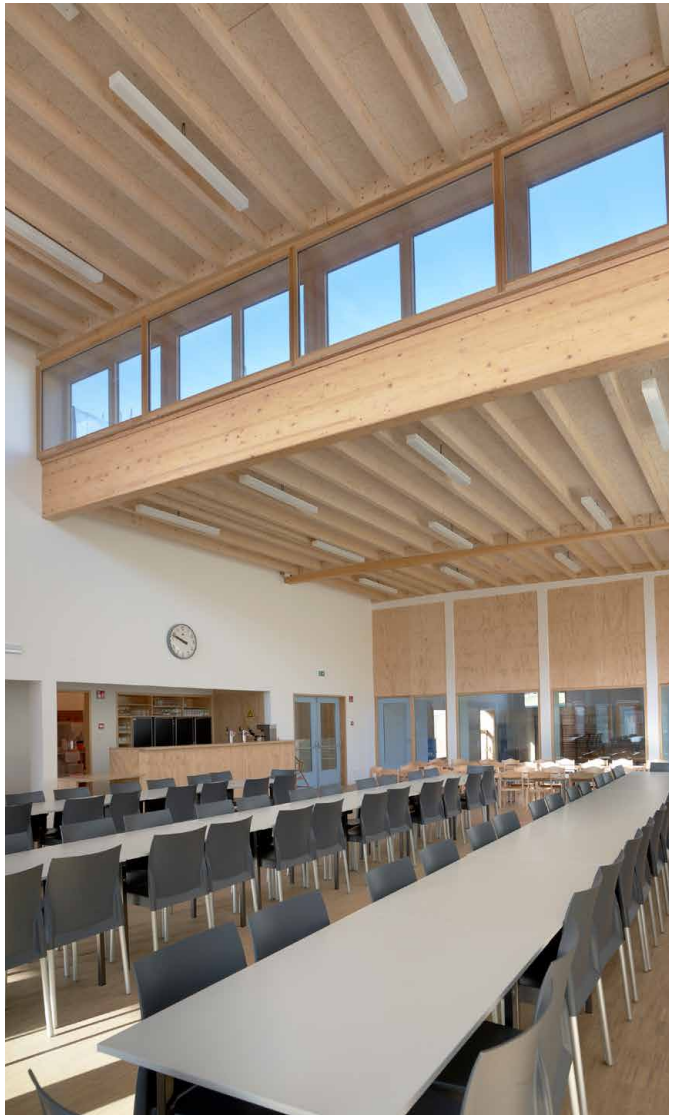


Images: Hannu Aaltonen

School Sint-Agatha-Rode

SCHOOL

LOCATION	Huldenberg, Belgium
DESIGN	Lava Architects
APPLICATION	Roof | 2.70 to 12 m span, REI 30 & 60 min

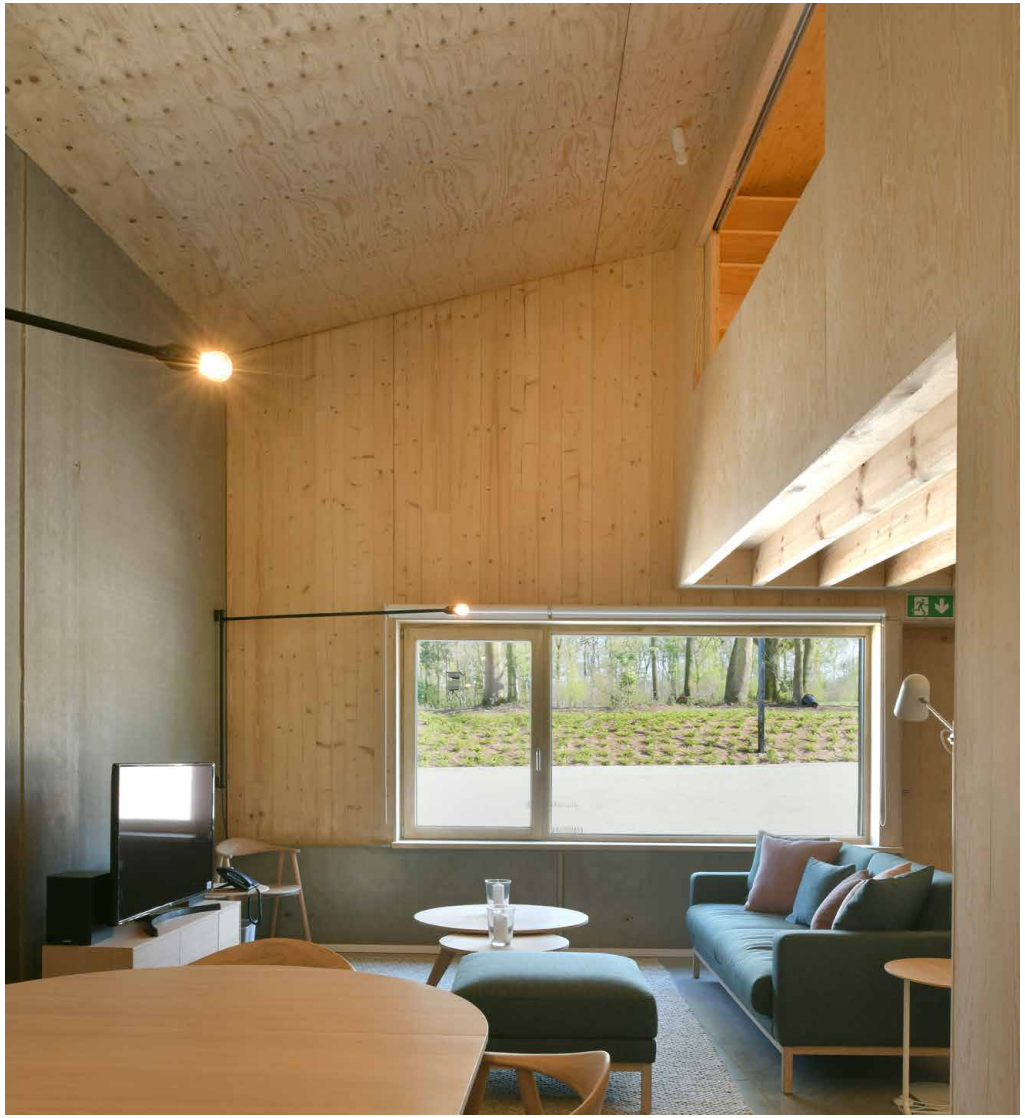


Images: Toon Grobet/ Lumecore i.o.v. Lava architecten

Château de Bousval, winery

LOCATION	Genappe, Belgium
DESIGN	AWAA architects
APPLICATION	Floor, roof | 10 m span

PRODUCTION



Images: Serge Brison

Demountable Building

OFFICE

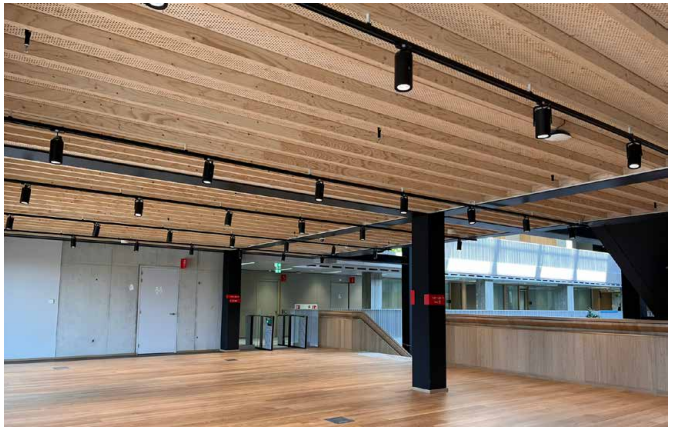
LOCATION	Delft, Netherlands
DESIGN	Cepezed architects
APPLICATION	Floor, roof | 10 m span

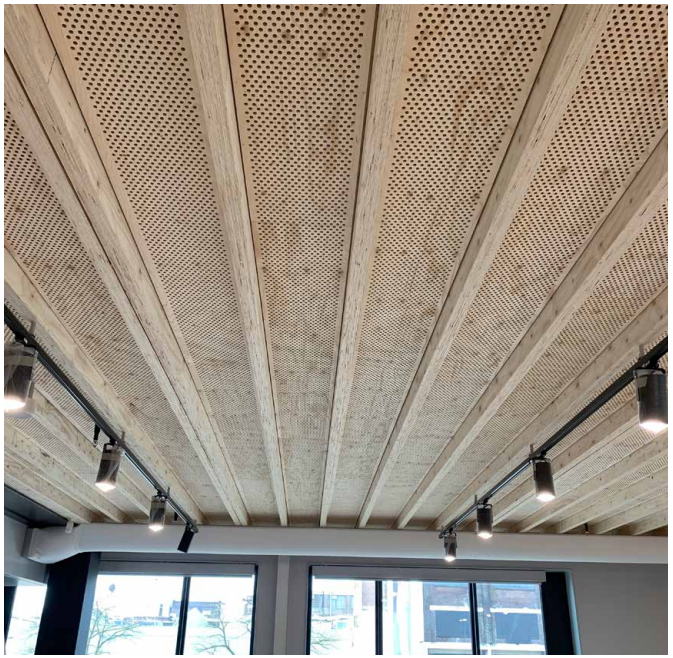
Images: Lucas van der Wee

Huis voor de Stad, town hall

PUBLIC BUILDING

LOCATION	Helmond, Netherlands
DESIGN	Kraaijvanger Architects
APPLICATION	Floor | 7 m span



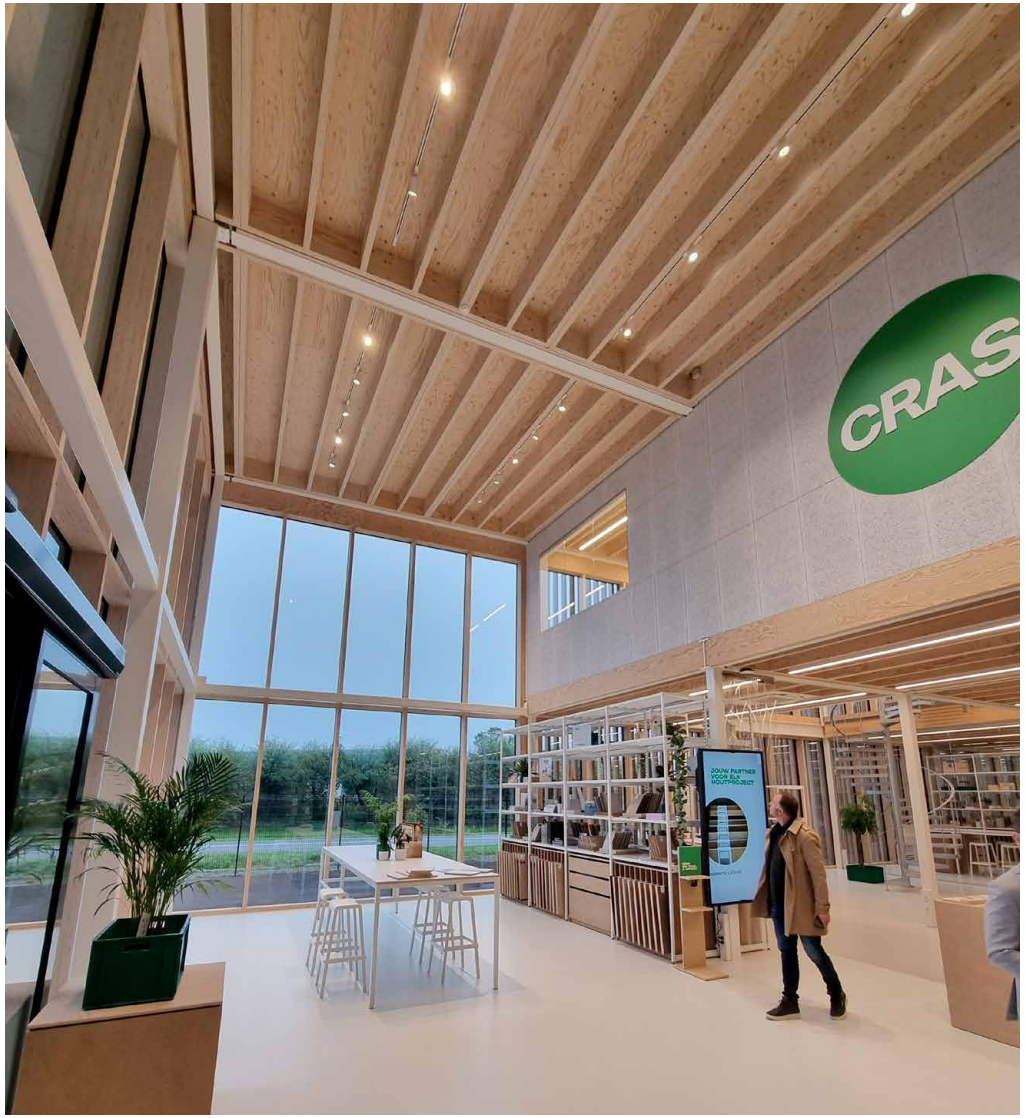


Images: Mertens Bouwbedrijf B.V.

Cras Woodshop

OFFICE

LOCATION	Oostende, Belgium
DESIGN	ArQ Architectuurstudio
APPLICATION	Floor, roof | 6 m span



Images: Cras

Nature visitor center

LOCATION	Almere, Netherlands
DESIGN	Drost + Van Veen Architectuur
APPLICATION	Floor | 7.50 m span

PUBLIC BUILDING

Image: Roos Aldershoff

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