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THE MATERIALITY OF WOOD IN CONTEMPORARY ARCHITECTURE: A REINTERPRETATION OF THE VITRUVIAN TRIAD OF DURABILITY, FUNCTIONALITY AND BEAUTY

MATERIALNOŚĆ DREWNA WE WSPÓŁCZESNEJ ARCHITEKTURZE W ŚWIETLE WITRUWIAŃSKIEJ TRIADY TRWAŁOŚCI, FUNKCJONALNOŚCI I PIĘKNA

Abstract

Contemporary architecture is rediscovering wood as a material whose significance extends beyond structural performance. This paper reinterprets Vitruvius's triad of *firmitas*, *utilitas*, and *venustas* through the lens of contemporary timber architecture. Drawing on a review of the literature and recent research on mass timber, sustainability, well-being, and biophilic design, it demonstrates that the classical concepts of durability, functionality, and beauty have acquired broader meanings.

Keywords: *biophilic design, sustainability, timber architecture, Vitruvian triad*

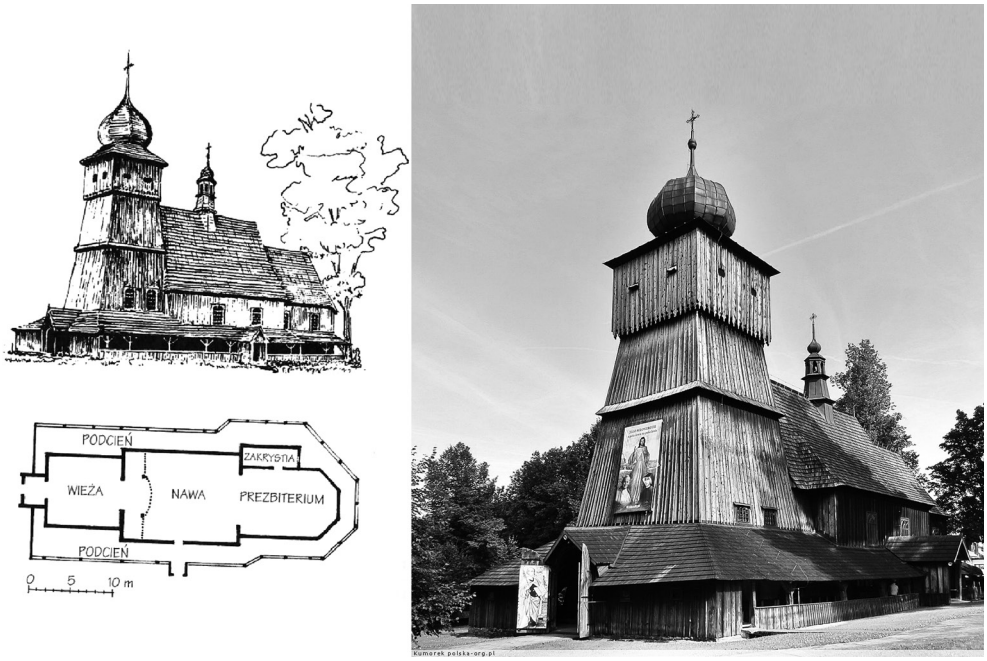
Streszczenie

Współczesna architektura ponownie odkrywa drewno jako materiał, którego znaczenie wykracza poza funkcję konstrukcyjną. Artykuł przedstawia reinterpretację witruwiańskiej triady *firmitas*, *utilitas* i *venustas* z perspektywy współczesnej architektury drewnianej. Na podstawie analizy literatury oraz współczesnych badań dotyczących drewna masywnego, zrównoważonego rozwoju, dobrostanu użytkowników i projektowania biofilicznego wykazano, że klasyczne pojęcia trwałości, funkcjonalności i piękna zyskują nowe znaczenie.

Słowa kluczowe: *architektura drewniana, biofilia, triada witruwiańska, zrównoważony rozwój*

1. INTRODUCTION

Wood is one of the oldest building materials used by humankind. For centuries, it was the primary building material, particularly in highly wooded regions, where its use was determined by local availability. Wooden architecture developed in close connection with climatic conditions, culture and craft traditions, and timber was used both structurally and decoratively, becoming a carrier of local material culture and place-based identity.



Ill. 1. The Church of Sts. Peter and Paul the Apostles in Lachowice – one of the most valuable examples of wooden religious architecture in Poland. The preserved log-frame structure and the high level of craftsmanship highlight the exceptional durability, craftsmanship, and timeless value of wooden architecture, making the church an enduring symbol of Poland's cultural heritage and architectural identity. Source: bit.ly/00v3vz (access: 11.07.2026)

In the 20th century, wood gradually gave way to reinforced concrete and steel, as well as to the widespread use of masonry techniques, which were a more cost-effective solution to the needs of the growing construction industry. Wood was regarded as a material that requires maintenance and is susceptible to fire, damp and biological factors; consequently, its use was largely confined to regional architecture.[1]

Interest in modern wooden architecture has surged globally and in Poland, thanks to advances in engineered timber like glulam and CLT. These technologies allow for buildings with larger spans, heights, and complexity, broadening structural and aesthetic options.[2]

However, the renaissance of timber architecture is not solely a consequence of technological progress. In the face of the challenges posed by climate change, wood has once again come to the fore as a renewable material with the potential to reduce the construction industry's negative environmental impact.

[1] T.E. Malec, *Cultural Identity in the Recreational Architecture of the Beskid Mountains*, "Architecture" 2026, no. 6(1).

[2] M.K. Kuzman, D. Sandberg, *Engineered Wood Products in Contemporary Architectural Use – A Concise Overview*, "Wood Material Science & Engineering" 2023, no. 18(6), pp. 2112–2115.

Recent research shows wood's role goes beyond structure and environment, influencing architectural perception, space quality, and user experience. It is now seen as a medium that creates meaning, atmosphere, and human-place connections.[3]

Given the wide range of properties, modern timber architecture requires an analysis that goes beyond assessing technical or environmental parameters. It serves as a starting point for re-examining the fundamental values of architecture, asking how technological developments and changing expectations regarding space influence our contemporary understanding of architecture, and how timber can play a significant role in this context.

2. REINTERPRETATION OF THE VITRUVIAN TRIAD IN CONTEMPORARY WOODEN ARCHITECTURE

The triad of *firmitas*, *utilitas* and *venustas*, formulated by Vitruvius in *De architectura*, remains a key reference in architecture discussions. Written towards the end of the first century BC, it presents a design system that balances durability, functionality, and beauty, which are interconnected rather than separate values. Vitruvius not only described a building's appearance but also outlined principles like *ordinatio, dispositio, eurythmia, symmetria, decor* or *distributio.* Today, despite modern shifts toward asymmetry and irregularity, this timeless triad continues to offer a relevant model for understanding architecture across changing contexts.

Durability (*firmitas*), utility (*utilitas*), and beauty (*venustas*) should be in balance with one another, and it is only through their coexistence that truly complete architecture is created. Although contemporary design practice often departs from classical principles of composition, consciously employing asymmetry, freedom of form, or irregularity as means of expression, the very idea of the interplay between durability, functionality, and beauty remains relevant. Understood in this way, the triad is not so much a closed set of historical principles as a timeless model for interpreting architecture, subject to contemporary reinterpretations resulting from changing technological, environmental, and social conditions.[4]

In modern timber architecture, the historical triad gains new meaning. Wood fulfils structural, practical, and aesthetic functions simultaneously, enabling analysis of durability, functionality, and beauty as interconnected aspects. Advances in solid-wood technology and shifting expectations are expanding these traditional concepts.

Modern construction now operates under different conditions than Vitruvius's time, with sustainability – covering environmental, economic, and social aspects –becoming a key criterion for architecture. Wood, due to its natural origins, fits well within this framework. However, sustainability should not be seen as the fourth element of the Vitruvian triad but as the modern context for understanding durability, utility, and beauty.

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[3] A. Starzyk, J. Marchwiński, V. Milošević, *Wood as an Architectural Medium: Aesthetics, Function and Social Perception from a Historical and Contemporary Perspective*, "Acta Scientiarum Polonorum. Architectura" 2025 no. 24(1), pp. 380–389.

[4] P. Lefas, *On the Fundamental Terms of Vitruvius's Architectural Theory*, "Bulletin of the Institute of Classical Studies" 2000, no. 44(1), pp. 179–197.

2.1. *FIRMITAS* – DURABILITY OF MATERIAL AND STRUCTURE

In Vitruvius's classical conception, *firmitas* denoted the durability and reliability of a structure. At present, this concept retains its basic meaning, but advances in materials technology allow it to be interpreted much more broadly.

In timber architecture, durability encompasses safety and environmental responsibility. Buildings constructed from solid timber can be durable and stable. Engineered timber, with a laminated, cross-layered design, offers high stability, mitigates the effects of humidity and temperature, and overcomes traditional timber limitations. It remains a natural, energy-efficient alternative to concrete. Cross-laminated timber (CLT) combines strength with low weight, making it ideal for multi-storey buildings. Its lightness reduces foundation loads, and prefabrication speeds construction and improves quality.

Solid timber today is no longer just an alternative in construction. Its strength-to-stiffness-to-weight ratio calls for a different structural approach. Timber architecture should be viewed as a unique system that leverages the material's properties to develop new architectural forms, rather than merely replicating concrete or steel designs.[5]

Structural safety is also a key aspect of the modern understanding of *firmitas*. For solid timber, fire resistance stems from a predictable charring process, during which the outer layer limits the flow of heat into the member's interior, while the uncharred core retains its load-bearing capacity for a long time. Modern CLT structural design is based on calculating the load-bearing capacity of the cross-section remaining after charring, thereby enabling reliable fire-resistance design in accordance with European standards.[6]

The modern understanding of *firmitas* goes beyond a structure's durability. In the case of timber, this involves the responsible management of natural resources and minimising the building's environmental impact as assessed in its life cycle assessment (LCA).

Life-cycle analysis considers raw material extraction, production, transport, use, re-use, and recycling. Wood is a renewable material whose production requires relatively little energy. As trees grow, they absorb carbon dioxide from the atmosphere, which remains bound in structural elements throughout the building's entire service life. Structural timber not only meets strength and safety needs but also supports energy efficiency, emissions reduction, and the circular economy. Its environmental benefits depend on the building's entire life cycle, including production location, transport, energy sources, and supply chain organisation. Timber can be a sensible alternative to concrete and steel when the entire construction project is responsibly planned.[7]

Modern sustainability recognises responsibility for materials that continues after a structure's use ends. Design for disassembly is key, allowing recovery and reuse of components. Wood can be reused, processed into new products, or used for energy recovery,

[5] V. De Araujo et al., *Is Cross-Laminated Timber (CLT) a Wood Panel, a Building, or a Construction System? A Systematic Review on Its Functions, Characteristics, Performances, and Applications*, "Forests" 2023, no. 14(2), art. 264.

[6] B. Östman et al., *Fire Design of CLT in Europe*, "Wood and Fiber Science" 2018, no. 50 (Special Issue), pp. 68–82.

[7] C. Jin, S. Zhu, H. Feng, *Life Cycle Assessment of Engineered Wood Products in the Building Sector: A Review*, "Buildings" 2025, no. 15(22), art. 4193.

aligning with the circular economy. Wood is a renewable material that requires little energy to produce. As trees grow, they absorb atmospheric carbon dioxide, which remains stored in a building's structure throughout its lifespan. Using timber reduces a building's carbon footprint, especially when replacing high-emission materials like concrete or steel. Therefore, a material's durability should also be viewed as its environmental sustainability.[8]

In this context, *firmitas* refers to responsibility for the entire life cycle of a material and is one of the cornerstones of responsible design. It is also increasingly often understood to encompass 'emotional durability', according to which the durability of architecture is determined not only by its structural and environmental reliability, but also by its ability to forge a lasting bond between the user and the place. In this context, the natural materiality of wood is one of the factors that reinforce the emotional durability of architecture.

2.2. *UTILITAS* – FUNCTIONALITY AND USER WELL-BEING

According to Vitruvius, *utilitas* referred to the usefulness of a building and the appropriate adaptation of its functions to the user's needs. Today, this encompasses not only functionality, but also comfort, health and the quality of the indoor environment, taking into account the psychophysical impact of architecture on people.

The practical benefits of solid wood technology are clear in its spatial and functional efficiency. The thinness of CLT walls allows for larger usable floor areas while keeping external dimensions the same, as shown by comparisons with timber, reinforced concrete, and masonry structures. Its high load capacity and low dead weight enable larger spans and flexible spaces. The lightweight structure also simplifies adding storeys and adapting existing buildings, expanding timber's use in modernisation.[9]

The role of contemporary timber architecture extends beyond structural solutions. An expanded understanding of the classical concept of *utilitas* recognises well-being as a fundamental indicator of architectural quality. Research shows that the indoor environment affects not only comfort but also health, well-being and the perception of space. From this perspective, wood should be seen not only as a structural and aesthetic material but also as an element that contributes to users' well-being. The importance of these issues is reflected in building assessment schemes, where, alongside environmental certifications such as BREEAM and LEED, the WELL standard – which focuses on the quality of the indoor environment and the health of occupants – is playing an increasingly significant role. [10]

Wood improves the quality of the indoor environment by regulating air humidity, stabilising temperature conditions and enhancing comfort. In this context, *utilitas* refers not only to the efficiency of a space, but also to the quality of its users' experience. Research suggests that the presence of wood in interiors helps to reduce stress and improve well-being,

[8] M.H. Ramage et al., *The Wood from the Trees: The Use of Timber in Construction*, "Renewable and Sustainable Energy Reviews" 2017, no. 68(1), pp. 333–359.

[9] M. Gierbienis, Ł. Łukaszewski, *Environmental Life Cycle Assessment (LCA) of Model Massive Timber and Concrete Buildings. Implementation of Cross-Laminated Timber (CLT) in an Educational Facility at the Forest Botanical Garden Marszewo in Gdynia*, "Archives of Civil Engineering" 2026, no. 72(2), pp. 587–605.

[10] G.B. Öztürk, *Wood for Well-Being: Interior Architecture Perspectives and International Comparative Analysis*, "Celal Bayar University Journal of Science" 2026, no. 22(2), pp. 257–268.

concentration and productivity. Wood thus becomes not only a finishing material but also a factor contributing to well-being and the quality of the indoor environment.[11]

One explanation for this phenomenon is people's biophilic connection with nature. In architecture, biophilia involves the conscious shaping of the built environment through the use of natural materials, light, and structures and patterns inspired by the natural world.

Contemporary concepts in biophilic design suggest that these solutions can help to reduce stress, improve mood, concentration and overall well-being; for this reason, they are increasingly incorporated into design strategies focused on human health. Wood fits naturally with these principles. As a renewable material, it exerts an influence through its physical and perceptual properties, engaging the senses of sight, touch and, at times, smell. Unlike many other biophilic elements, its positive effects do not depend on access to daylight or direct contact with the landscape, and its hygroscopic properties help to stabilise the indoor microclimate and improve thermal comfort.[12]

In this context, *utilitas* refers not only to the functionality of a space, but also to its ability to promote the health, comfort and well-being of its users. Thanks to its structural, environmental and biophilic properties, timber combines technical efficiency with a high-quality architectural experience. Contemporary functionality, therefore, ceases to mean merely the correct fulfilment of a functional programme, becoming instead a category that encompasses the relationship among people, materials and the environment, in line with the humanistic dimension of the reinterpreted Vitruvian triad.

2.3. *VENUSTAS* – FROM BEAUTY TO THE EXPERIENCE

In Vitruvius's view, *venustas* meant beauty arising from harmony, proportion, and proper composition. He valued mathematical relationships, believing they created eurythmy. However, he noted that these principles were not absolute and may need adjustments based on perception and site. Thus, ancient beauty linked geometry to human experience and perception.[13]

Today, *venustas* goes beyond the aesthetics of form. The assessment of architecture is also shaped by light, atmosphere, materiality, acoustics and the context of the place, which together create a multisensory experience of space. The beauty of architecture is increasingly understood not as a property of the form itself, but as the result of how it is experienced by people. Light not only reveals architectural form, but also brings out the texture of materials, shapes the atmosphere of an interior and influences the emotional perception of a space.[14]

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[11] M.D. Burnard, A. Kutnar, *Wood and Human Stress in the Built Indoor Environment: A Review*, "Wood Science and Technology" 2015, no. 49(5), pp. 969–986.

[12] C. Thomas, Y. Xing, *To What Extent Is Biophilia Implemented in the Built Environment to Improve Health and Wellbeing? – State-of-the-Art Review and a Holistic Biophilic Design Framework*, [in:] R.J. Howlett, J.R. Littlewood, L.C. Jain (eds.), *Emerging Research in Sustainable Energy and Buildings for a Low-Carbon Future*, *Advances in Sustainability Science and Technology*, Springer, Singapore, 2021, pp. 227–247.

[13] P. Lefas, *op.cit.*

[14] J. Pallasmaa, *Dwelling in Light: Tactile, Emotive and Life-Enhancing Light*, "Daylight & Architecture" 2016, no. 26, pp. 6–12, https://issuu.com/da-magazine/docs/da26/4?e=13&o=1 (access: 7.07.2026).

From this perspective, wood holds a special place as a timeless material, used in both traditional and contemporary architecture. It is not merely a structural element but a fully-fledged architectural medium, combining aesthetic, technological and social values. Through its physicality, it influences the atmosphere of a space, the way it is perceived, and the user's relationship with the place, becoming a vehicle for meanings and narratives rooted in the local context.[15]

Timber's flexibility distinguishes it from modern materials, making architecture both functional and artistic. Its natural structure and precise machining give wood a sculptural quality, emphasising craftsmanship and individuality. The aesthetic appeal lies in its form and detail, enhancing appreciation of its texture and grain. Precise workmanship and clear joints deepen the architectural experience, showcasing wood's blend of structural and artistic qualities.

This potential was significantly expanded with the advent of solid-wood technology. CLT elements enable the design of spaces with large spans and a clear composition, highlighting timber's natural materiality as a deliberate element of architectural expression. The freedom to shape forms allows contemporary timber architecture to transcend traditional conventions, combining minimalist solutions with more expressive compositions without losing the material's distinctive characteristics.

It is the natural variability of wood that makes it unique. The grain, colour, texture and ageing process ensure that the material retains its character, which cannot be fully replicated by synthetic materials. Its aesthetic value stems not from perfect repeatability, but from its authenticity, natural diversity and ability to age gracefully. The beauty of wood stems from both the material's properties and the way it is finished and displayed within an architectural space.

The appeal of wood goes beyond its visual qualities. Contemporary architectural theory emphasises that the perception of space is multisensory and cannot be reduced to a purely visual experience. The material reveals its properties through light, touch, surface temperature, scent and the way it ages, helping to shape the atmosphere of a place and the emotional character of the architecture. In the case of wood, the nature of these experiences depends on the species, the method of processing and the surface finish, ensuring that each project retains its own unique character.[16]

Contemporary research indicates that wood in interiors reduces stress, enhances well-being, concentration, and attention span. Studies in two identical rooms – differing only in materials – found that wood environments promote cognitive restoration and are seen as more comfortable, natural, and user-friendly. Thus, wood is not just a finish but also enhances indoor well-being and environmental quality.[17]

Wood, thanks to the combination of its natural beauty with the possibilities offered by modern technology, is becoming a material that forges an emotional bond between people and places, lending a contemporary dimension to the classical concept *of venustas*.

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[15] A. Starzyk, J. Marchwiński, V. Milošević, *op.cit.*

[16] J. Pallasmaa, *op. cit.*

[17] M.L. Demattè et al., *Wooden Indoor Environments' Restorativeness*, "Forests" 2022, no. 13(12), art. 2073.

3. CONCLUSIONS

Contemporary timber architecture reinterprets the Vitruvian triad, in which durability, utility, and beauty complement one another. Advances in engineered timber have shifted it from a traditional material to a modern medium. *Firmitas* now also includes environmental responsibility and life-cycle analysis; *utilitas* extends beyond functionality to user comfort, health, and well-being; *venustas* encompasses form, materiality, atmosphere, and multisensory experience. Wood's properties show how these elements intertwine, forming a holistic view of architectural quality.

Contemporary timber architecture demonstrates that durability, functionality and beauty are not competing values, but rather complement one another, confirming the timelessness of the Vitruvian triad as one of the most important models for interpreting architecture.



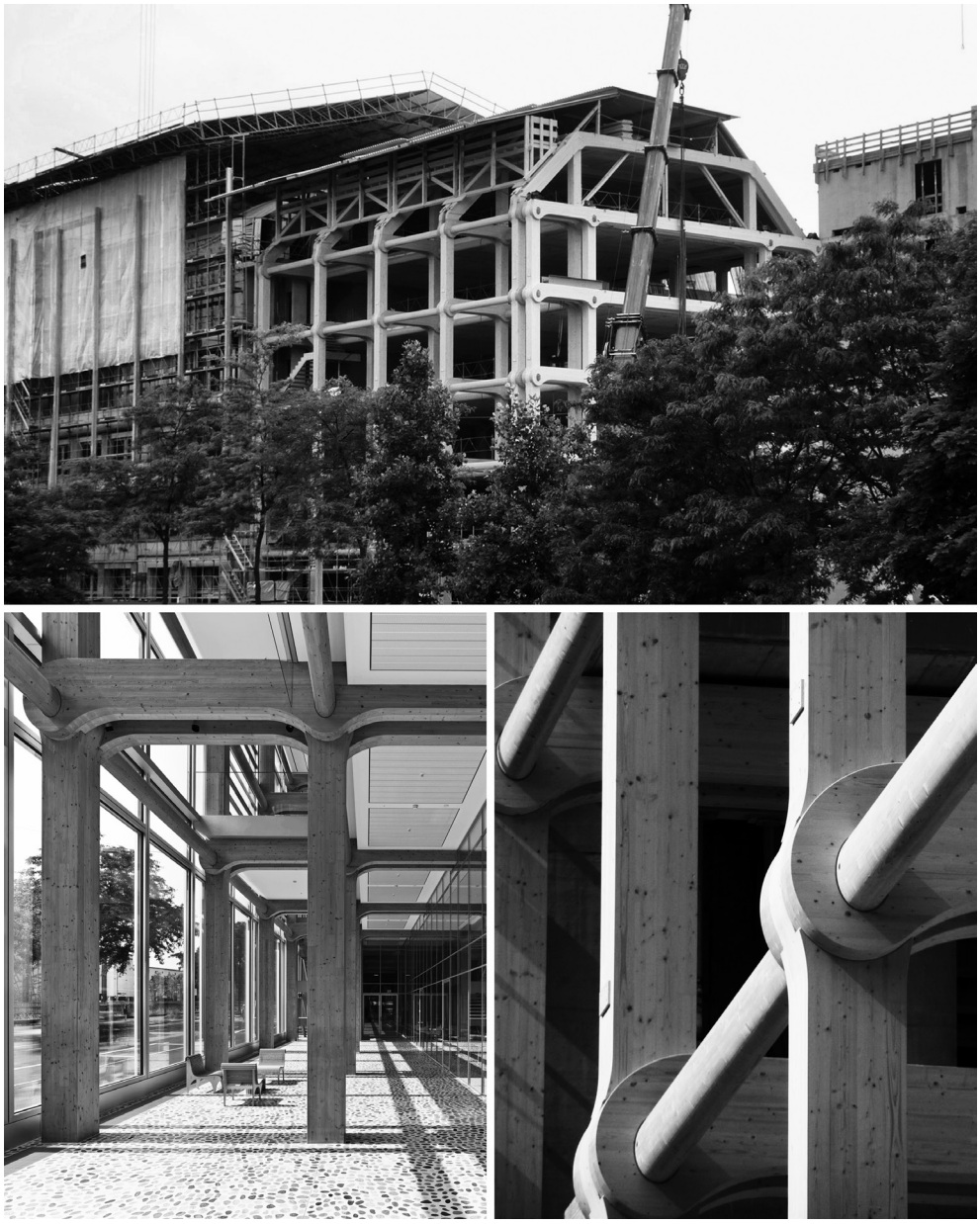
Ill. 2. The Våler Church in Norway, designed by Espen Surnevik, reinterprets the tradition of wooden religious architecture through a contemporary architectural language. Symbolically, it assumes a new architectural form while preserving its timber lineage. Source: https://espensurnevik.no/Valer-kirke (access: 11.07.2026)



Ill. 3. The Educational Building in the Marszewo Forest Botanical Garden, designed by Gierbienis +Poklewski studio, exemplifies the use of an exposed CLT structural system combined with a façade clad in Shou Sugi Ban charred larch boards. Photos by B. Barczyk. Source: personal archive



Ill. 4. The Vennesla Library, designed by Helen & Hard, demonstrates the potential of glue-laminated timber through an expressive rib structure that integrates construction, building services, and interior elements into a unified architectural system. Source: https://helenhard.no/work/vennesla-library/ (access: 11.07.2026)



Ill. 5. The Tamedia Office Building in Zurich, designed by Shigeru Ban, demonstrates how precisely crafted timber joints express both structural logic and architectural beauty. Source: https://hicarquitectura.com/2014/04/shigeru-ban-architects-tamedia-office-building/ (access: 11.07.2026)

References

[1] Burnard M.D., Kutnar A., *Wood and Human Stress in the Built Indoor Environment: A Review*, "Wood Science and Technology" 2015, no 49(5), pp. 969–986.

[2] De Araujo V. et al., *Is Cross-Laminated Timber (CLT) a Wood Panel, a Building, or a Construction System? A Systematic Review on Its Functions, Characteristics, Performances, and Applications*, "Forests" 2023, no. 14(2), art. 264.

[3] Demattè M.L. et al., *Wooden Indoor Environments' Restorativeness*, "Forests" 2022, no. 13(12), art. 2073.

[4] Gierbienis M., Łukaszewski Ł., *Environmental Life Cycle Assessment (LCA) of Model Massive Timber and Concrete Buildings. Implementation of Cross-Laminated Timber (CLT) in an Educational Facility at the Forest Botanical Garden Marszewo in Gdynia*, "Archives of Civil Engineering" 2026, no. 72(2), pp. 587–605.

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[6] Kuzman M.K., Sandberg D., *Engineered Wood Products in Contemporary Architectural Use – A Concise Overview*, "Wood Material Science & Engineering" 2023, no. 18(6), pp. 2112–2115.

[7] Lefas P., *On the Fundamental Terms of Vitruvius's Architectural Theory*, "Bulletin of the Institute of Classical Studies" 2000, no. 44(1), pp. 179–197.

[8] Malec T.E., *Cultural Identity in the Recreational Architecture of the Beskid Mountains*, "Architecture" 2026, no. 6(1), art. 8.

[9] Östman B. et al., *Fire Design of CLT in Europe*, "Wood and Fiber Science" 2018, no. 50 (Special Issue), pp. 68–82.

[10] Öztürk G.B., *Wood for Well-Being: Interior Architecture Perspectives and International Comparative Analysis*, "Celal Bayar University Journal of Science" 2026, no. 22(2), pp. 257–268.

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[13] Starzyk A., Marchwiński J., Milošević V., *Wood as an Architectural Medium: Aesthetics, Function and Social Perception from a Historical and Contemporary Perspective*, "Acta Scientiarum Polonorum. Architectura" 2025 no. 24(1), pp. 380–389.

[14] Thomas C., Xing Y., *To What Extent Is Biophilia Implemented in the Built Environment to Improve Health and Wellbeing? – State-of-the-Art Review and a Holistic Biophilic Design Framework* [in:] Howlett R.J., Littlewood J.R., Jain L.C. (eds.), *Emerging Research in Sustainable Energy and Buildings for a Low-Carbon Future*, *Advances in Sustainability Science and Technology*, Springer, Singapore 2021, pp. 227–247.

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