WOOD IN SPORT EQUIPMENT

HERITAGE, PRESENT, PERSPECTIVE

Edited by
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The icons represent some of the sports considered in the book (including all sports would have resulted in too small images for proper visualization). The wooden equipment is outlined by the colors of the wood species from which it is made, and by lines representing the grain of wood and the characteristics of the relative wood-based products.

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Design for sports facilities with structural components in wood as evidence of a new technological challenge

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The theme of architectures designed to host sports activities is at least as broad as the number of sports disciplines that take place in indoor spaces, however, taking the specific theme of architecture for sport made with wooden structures as an analysis filter offers the opportunity to represent, albeit in a concise and non-exhaustive way, one of the most fascinating and stimulating aspects of the history of wooden constructions since the end of the twentieth century (Figure 5.1).

In fact, over the last two decades, the conditions for starting a new, completely unprecedented trajectory for wooden constructions has been determined in Europe, through a process of technological innovation in this sector.

Figure 5.1 For the Olympic Games Helsinki 1952, Alvar Aalto (Reed 2009) designed a sports center in Otaniemi (Espoo, Helsinki) - today still perfectly operational - which impresses with the simplicity and elegance of its wooden structures, representing an extraordinary example of technological innovation in wooden construction of that time. Made of thin prefabricated timber trusses (Isohauta 2013), the structural "skeleton" can be considered a demonstration of architects and engineers' ability to experiment innovative constructive systems starting from new wood-processing industry construction products. Photograph copyright: Museum of Finnish Architecture, Heikki Havas.

Over the last twenty years, human capital in Europe, represented by the research and business system, by the world of professions and through its scientific and technological skills, has developed the functional conditions for the creation of a support network for the dissemination of completely new experimental construction and structural systems.

The experience and knowledge acquired in this sector in Europe were subsequently transferred to the international arena, resulting in a further boost in terms of innovation, particularly in North America. Architectures with wooden structural components have thus become the representation of possible new design approaches in a still completely experimental context.

Architecture, seen as the challenge of using new materials of natural origin, has thus returned to the tradition of constructing buildings and cities with wooden structural elements, but at the same time has evolved from a technological standpoint. In fact, not only do the engineered wooden components lack any apparent link with the traditional rules of good construction, but also the procedural organization into which the design and construction of a wooden building is inserted today passes through increasingly complex management tools. The transition from the mainly artisanal processing of the past to the modern-day industrialization of processes has required a capacity for organizing the flow of information, bringing elements and information from different disciplines, skills, professional figures and software tools together in a single centralized project.

In the first ten years of this century, this challenge involved the construction of new alpine shelters and the expansion of hotels in mountain settings, during a historical phase in which the primary objective at European level was the pursuit of energy efficiency of buildings.

In the following ten years this chain of skills became more specialized and dealt with new categories of architectural works such as multi-story buildings, redevelopment of the built heritage, the construction of public building structures such as schools and sports buildings in a new season no longer oriented towards the energy efficiency of the building heritage but towards environmental sustainability.

Today the timber construction sector can benefit from twenty years of European experience with very different approaches and experiences, pursuing some epochal challenges for the construction sector with respect to which engineered wood is and will certainly be the absolute protagonist, facing challenges such as decarbonization strategies, the need for innovation in the AEC sector and the industrialization of construction.

Obviously, this qualitative leap in the construction sector has been possible thanks not only to the production of new engineered components, the result of research and development, but also to the reference operational ecosystem in which the profession skills of designers, intent on developing and organizing increasingly complex processes is incorporated today.

In this framework, the buildings for sports facilities are the expression of an innovation that is appropriately expressed through very different design approaches. The case studies selected for this document contribution have different logics and approaches, all consistent within their cultural system of reference, from the prevalence of those using engineered wooden components with a view to industrializing the production processes related to construction, to those that intend to develop territorial supply chains by using solid wood components.

Architecture for sport has always had to cope with large spans but can now incorporate - also thanks to these new technological wooden components - structural and architectural concepts that are an expression of the potential of designing and building large wooden structures.

In sports facilities where the architectural concept cannot ignore the structural dimension of the project, there is no space for the rhetoric of wood as a ‘natural material’, on the contrary, it is assumed to be a ‘structural body’ which, thanks to an increasingly high performance from a mechanical point of view, meets the architectural need for lightness and tests the material to the ultimate limit of resistance. This is perhaps the condition that brings together the rigorous dialectic of structural engineers and the freer vision of architects in sports architecture, giving life to a synthesis of design ideas and cultural visions that are clearly expressed by the case studies analyzed above.

Compared to the large spans with structural components in glulam, which from the 1970s onwards were widely used in the design of swimming pool roofs and sports halls, a two-dimensional logic of the portal has been overcome and a spatial approach of more complex architectural and structural projects has been adopted.

With the case studies analyzed as part of this contribution, we intend to outline a possible geography of architecture for sport, of the underlying structural and architectural concepts that can now be documented in Europe. The analysis is not intended to be exhaustive, but representative, and is conducted by briefly setting out the specific nature of some case studies while proposing a comparative succinct reading of the different case studies characterized by using different engineered components.

The case studies are the expression of ambitious technological challenges characterized by different visions, logics and strategies which, compared to the past, enrich the specific theme of architecture and structures for sport, projecting it into a new dimension, a direct consequence of a technological innovation in the wood construction sector, the leitmotif of this publication.

SELECTED CASE STUDIES

Thirteen case studies are analyzed below, in chronological order from 1995 to 2020, using a taxonomic chart for a comparative reading of the works according to the structures and the engineered components used (FIGURE 5.2).

The chart is qualitative, and the intent is to synthetically represent the different structural and constructive conceptions of structures, using engineered components whose utilization, in some cases, is very recent. With the aim of contextualizing some of the works in more depth, seven case studies are described, which are a limited number for a matter of space, compared to those investigated.

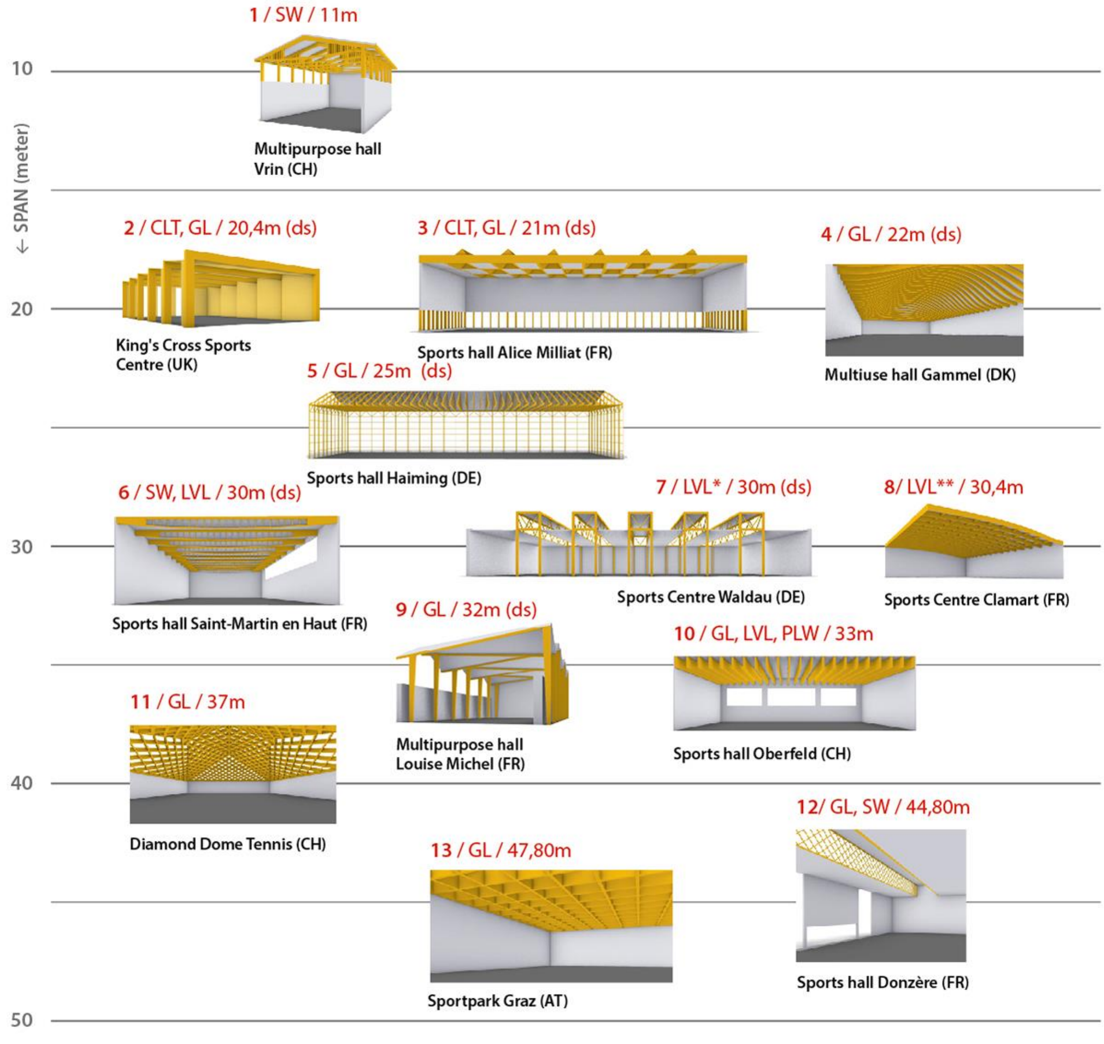

FIGURE 5.2 The comparison of thirteen case studies, including those analyzed in this article, shows the different typologies of roof structures related to the wood-based building materials and their maximum span. Original graphics: G. Callegari, P. Simeone, E. Merolla, Department of Architecture and Design, Politecnico di Torino. SW: solid wood / GL: glulam / CLT: cross laminated timber / LVL: laminated veneer lumber / LVL*: hardwood (Beech) laminated veneer lumber / LVL**: curved laminated veneer lumber / PLW: plywood / (ds): span deducted from architectural drawings available on the Internet (see also CASE STUDIES at the end).

A first case study from 1995 is the **Multipurpose Hall in Vrin (1995)**. The architect Gion Caminada together with the civil engineer Jürg Conzett designed a small work of art. both from the construction technique point of view and the wise use of non-engineered wooden structural elements. Starting from a knowledgeable understanding of traditional construction systems (Schlorhaufer 2005), the conception of the roof load-bearing structures covering the large span is a harmonious play of contrasting stresses using simple solid wooden elements - slats, struts and posts - in a binder construction designed as an understretched system (FIGURE 5.3).

Multipurpose hall
Vrin (CH) 1995
Architecture: Gion A. Caminada with civil engineer Jürg Conzett
Photography: Lucia Degonda

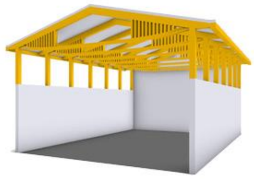

FIGURE 5.3 Multipurpose Hall Vrin; photograph copyright: Lucia Degonda; original graphics: G. Callegari, P. Simeone, E. Merolla, Department of Architecture and Design, Politecnico di Torino.

The **gymnasium and sports hall in Saint Martin en Haut (2012)** designed by the French company Tekhné architectes & urbanistes, impresses with its spatial roof design formed by an unconventional timber framework. The load-bearing structure consists of ten inverted "organic" wooden trusses - each of them divided into two parts - that support a planted 'green' roof covering a span of 30 meters: the crisscross girder trusses are made up of both engineered wood and solid timber: tensioned and compressed LVL (laminated veneer lumber) beams for the chord members and vertical and oblique solid timber bars for the latticework (FIGURE 5.4).

Sports hall gymnasium
Saint-Martin en Haut (FR), 2012
Architecture: Tekhnê Architectes
Wood structure: Arborescence
Photography: Renaud Araud

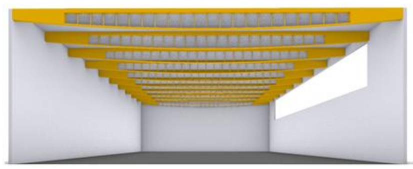

FIGURE 5.4 Sports hall gymnasium; photograph copyright: Renaud Araud; original graphics: G. Callegari, P. Simeone, E. Merolla, Department of Architecture and Design, Politecnico di Torino.

For the roof supporting structure of the new sports hall of the **Louise Michel High School in Gisors (2015),** the French architecture studio Arch5 designed an original spatial configuration of eleven non-parallel wooden portal frames made out of vertical glulam paired pillars and inclined glulam (glued laminated timber) beams and characterized by the protrusion of the load-bearing elements that cross the external wall along one side of the hall. A spectacular architectural composition that shows the will of the architects to enhance both the aesthetic and structural qualities of the apparently simple constructive system (FIGURE 5.5).

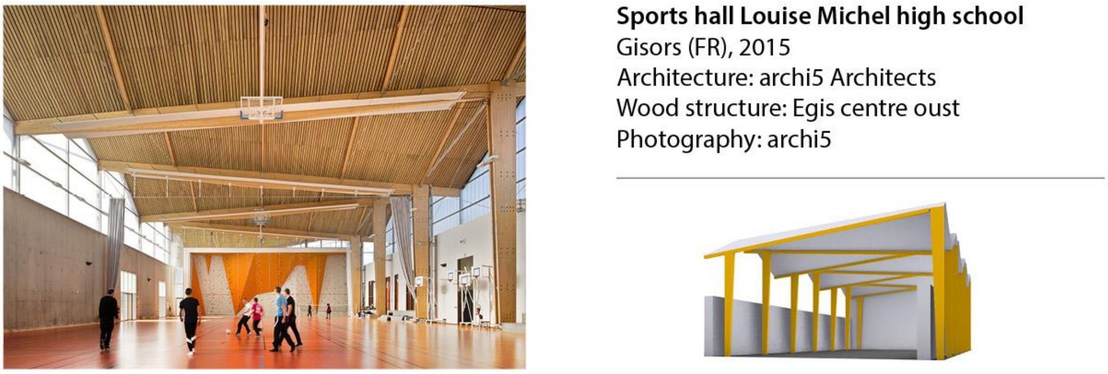

FIGURE 5.5 Sports hall Louise Michel high school; photograph copyright: archi5; original graphics: G. Callegari, P. Simeone, E. Merolla, Department of Architecture and Design, Politecnico di Torino.

In a former industrial estate of Lyon, Dietrich I Untertrifaller architectural studio designed the **Alice Milliat Sports Hall (2016)**. For the architects, the structure of the main sports hall roof had to speak the formal language of the former factories and their shed-roofs but with a new 100% bio-based grammar. Glulam (glued laminated timber) for the long beams and straw for the thermal-acoustic insulation. The ceiling of the sports hall is impressive, with skylights in the form of truncated wooden pyramids made of CLT (cross laminated timber) panels, as an interpretation of the original industrial sheds, arranged like a chessboard to form a structure that lightly covers the long span (FIGURE 5.6).

FIGURE 5.6 Sports hall Alice Milliat; photograph copyright: Julien Lanoo; original graphics: G. Callegari, P. Simeone, E. Merolla, Department of Architecture and Design, Politecnico di Torino.

The **Haiming Sports Hall (2016)** by Almannai Fischer, impresses with its simplicity and the slenderness of the structural components used for both the roof and the walls: posts, bars and diagonals with minimal resistance section create a large geometric pattern. The system of timber frame wall and narrow roof trusses includes galvanized gang nail plates: the cheapest general-purpose connector for the timber structures, demonstrating that the architects wanted to make the most of the mechanical property strength/lightness of the wooden load-bearing elements while creating a refined minimalist skeleton (FIGURE 5.7).

Sports hall Haiming
Haiming (DE), 2013-16
Architecture: Almannai Fischer Architects
+ Harald Fuchshuber Engineer
Photography: Sebastian Schels

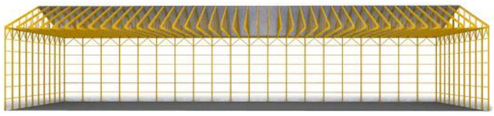

FIGURE 5.7 Sports hall Haiming; photograph copyright: Sebastian Schels; original graphics: G. Callegari, P. Simeone, E. Merolla, Department of Architecture and Design, Politecnico di Torino.

The new sports hall for the **Oberfeld school complex (2018)** - designed by Gäumann Lüdi Von Der Ropp Architekten - is characterized by a sophisticated approach to the use of wood as a building material by the Holztragwerke-Engineering & Innovations engineering company. A system of glulam beams with a 33-meter span forms the principal load-bearing element of the roof structure, which is braced by the combination of three different engineered wood components: smaller glulam beams orthogonally connected to the principal ones, external perimeter reinforcement made out of narrow LVL beams and plywood panels connected to the extrados of the beams (FIGURE 5.8).

New sports hall Oberfeld
Langnau im Emmental (CH), 2018
Architecture: Gäumann Lüdi Von Der Ropp
Wood structure: Holztragwerke Engineering
Photography: Alessandro Fabris

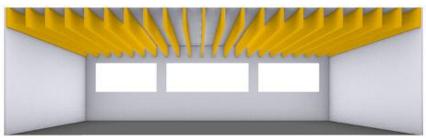

FIGURE 5.8 New sports hall Oberfeld; photograph copyright: Alessandro Fabris; original graphics: G. Callegari, P. Simeone, E. Merolla, Department of Architecture and Design, Politecnico di Torino.

The two long wooden truss beams parallel to each other positioned on the longer side of the roof are the exceptional architectural sign of the new **Donzère sports hall (2020),** designed by the French company Tekhné architectes & urbanistes. Composed of two sections for a total length of 45 meters, the wooden lattice girders have a reticular configuration that performs both static functions and lets natural light in from the roof. The elegant constructive system consists of two glulam upper and lower oriented flat beams and a wooden truss web made of compression members and tensioned diagonal members both in solid wood (FIGURE 5.9).

Sports hall Donzère
Donzère (FR), 2020
Architecture: Tekhnê Architectes
Wood structure: Arborescence
Photography: Renaud Araud

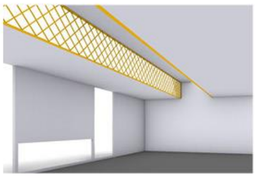

FIGURE 5.9 Sports hall Donzère; photograph copyright: Renaud Araud; original graphics: G. Callegari, P. Simeone, E. Merolla, Department of Architecture and Design, Politecnico di Torino.

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CASE STUDIES
1: Multipurpose hall, Vrin (CH) 1995, architect Gion Caminada + civil engineer Jürg Conzett / 2: King's Cross Sports Centre, London (UK), 2020, Bennetts Associates architect, Ove Arup & Partners Engineers) / 3: Sports hall Alice Milliat, Lyon (FR), 2014-16, Dietrich Untertrifaller + Tekhnê architectes, Arborescence ingénierie / 4: Multi-use hall Gammel Gymnasium, Hellerup (DK), 2013, BIG Architects / 5: Sports hall, Haiming (DE), 2016, Almannai Fischer Architects + Harald Fuchshuber Engineer / 6: Sports hall gymnasium, Saint-Martin en Haut (FR), 2012, Tekhnê architectes, Arborescence ingénierie / 7: Sports Centre Waldau, Stuttgart (DE), 2020, Glück + Partner architectes / 8: Sports Centre, Clamart (FR), 2016, Gaëtan Le Penhuel architectes / 9: Multipurpose hall Louise Michel high school, Gisors (FR), 2015, archi5 Architects, Egis centre oust /10: Sports hall Oberfeld, Langnau im Emmental (CH), 2018, Gäumann Lüdi Von Der Ropp architect, Holztragwerke Engineers / 11: Diamond Dome Tennis, Zurich (CH), 2011-17, Rüssli Architects / 12: Sports hall, Donzère (FR), 2020, Tekhnê architectes + Arch'Eco, Arborescence ingénierie / 13: Sportpark, Graz (AT), 2020, projektCC architects, Peter Lechner Engineers.

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