Woodrise Paper

Designed under the sponsorship of the Global Alliance for Buildings and Construction (GABC), an alliance launched during the "Building Day" of the COP21 with a secretariat provided by UN Environment, the Woodrise Paper compares the opinions of experts of all disciplines from 6 voluntary countries of the alliance: Canada, France, Finland, Brazil, Switzerland, and Japan. It is mainly intended for decision-makers – and wood enthusiasts – all over the world, and spread the word about good practices.

This Paper presents an unseen report on these different practices, through thematic focuses that show pertinent initiatives, often commented by those who have observed or carried them out. Interviews with experts and actors from the 6 countries have supplemented the paper with the sectors' major innovations, latest trends and hindrances, as well as the environmental aspects and the sustainable management of forests.

This Paper is a manifesto for wood construction. It is based upon reliable and documented figures. It forms the first international benchmark on situations and policies concerning wood construction. As such, it will fuel decision-makers and key stakeholders with fresh ideas, providing new tools to guide their actions.

This Paper initiates a tighter collaboration between the countries, stemming from the technological institutes supporting the project: BRI in Japan, CEDOTEC in Switzerland, FPInnovations in Canada, IPT in Brazil, VTT in Finland, FCBA in France. It is, and will remain, a work in progress, constantly, updated with worldwide inputs. Its starting point: the Woodrise Congress, first international congress on wood construction, held in Bordeaux, 12-14 September 2017.

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Boasting sturdy eco-friendly arguments, wood appears – once again – as a construction material ready to unfurl and build the cities of tomorrow. A worldwide phenomenon tangible over the last twenty years.

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Wood construction does not solely mean changing materials and construction processes. It also generates a newer, more virtuous relationship between man, his environment, and the forest. A mean of stabilising the great climatic balances.

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To establish itself as a baseline, scalable, construction material, the wood sector, endowed with ecological, technical, and aesthetic qualities, must now show its economic performance. Review of the materials' competitiveness throughout the world.

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While researchers, engineers and architects strive to knock down technological barriers impeding wood construction from soaring, it is really more habits and mentalities that stop the material from becoming fully democratic. Overview of the public policies aiming at promoting wood.

Experts, Stakeholders

Brazil

Carolina Bueno, ***Triptyque***
(french-brazilian architecture office)
two-way comparative analyses,
bio-sourced construction in Brazil

Dario Guarita Neto, ***Amata***
expertise on sustainable management of forests
and on Brazilian wood potential for construction

Finland

Anne-Christine Ritschkoff, ***VTT Institute***
technical approach on smart city and innovation

Petri Heino, ***Ministry of Environment***

Kimmo Lylykangas, architecte
expertise in wood conception, CLT, and renovation

Marco Casagrande, architect
Three-way perspective on wood architecture,
art, and philosophy

Olavi Koponen, architect
expertise on environmentally-friendly
domestic environment

Japan

Riichi Miyake, architect

Kengo Kuma Agency, architect
expertise in innovative wood architecture

Canada

Etienne Lalonde, ***Canadian Wood Council***

Robert Beauregard, ***Laval University***
expertise on wood products, wood construction,
cycle analysis and carbon management

Glenn Mason, Natural Resources Canada

Michael Green, ***MG-A architecte***
great-height wood construction pioneer

France

Jean-François Dhôte, ***Research Director at the INRA***
expertise on the role of forests in fighting climatic
change, in ways of managing and harvesting forests

Stanislas Pottier, ***BBCA (Bâtiment Bas Carbone)***
association President

Raphaël Ménard, ***Elioth***
expertise low-carbon innovation engineering

Paul Jarquin, ***REI Habitat, AdivBois***
the choice of wood for collective accommodation

Switzerland

Yves Weinand, architect-engineer IBois laboratory
director at the ***Ecole Polytechnique Fédérale***
de Lausanne

Thomas Büchi, Master-carpenter
and founder of ***Charpente-Concept***
technical expertise in wood conception
and entrepreneurial development

Daniel Ingold, ***Cedotec director***
technical and economical expertise
on the Swiss wood sector

Associated Countries

Forest Data:
FAO Global Resources Assessment

Brazil

Home of one of the planet's green lungs, incredibly biodiverse Brazil has a long history with wood. Its formal wood construction industry is just taking off and offers many promising prospects: **the future has yet to be invented.**

Referent technical centre
Instituto de Pesquisas Tecnológocas (IPT)

Forest area
493 million ha

Share of forest area in total area
59%

Finland

About three quarters of its territory is covered by forest. Finland is a historic country of the wood-forest sector and is home to industrial world leaders of wood transformation.

Referent technical centre
VTT Technical Research Centre of Finland

Forest area
22 millions d'ha

Share of forest area in total area
73%

Hardwood / Softwood distribution
20%

Japan

Traditional Japanese architecture, a thousand-year-old legacy, still makes up most of Japan's housing. It is, however, **future-oriented, with powerful industries and innovators constantly developing cutting-edge technology.**

Referent technical centre
Building Research Institute

Forest area
25 millions d'ha

Share of forest area in total area
69%

Canada

Wood has long been the widespread material **for individual Canadian houses - over 90%.** The country has one of the largest forests on Earth, with strong potential for improvement in its industry, and the surfacing of over four-storey high wood buildings.

Referent technical centre
FPInnovations

Forest area
347 millions d'ha

Share of forest area in total area
38%

Hardwood / Softwood distribution
20%

France

Land of the third European forest, **France has a wonderful potential for the wood sector.** With the recent experience of Adivbois, the country is aiming at becoming a world champion of wood through great height and well-being.

Referent technical centre
Institut Technologique FCBA

Forest area
17 millions d'ha

Share of forest area in total area
31%

Hardwood / Softwood distribution
64%

Switzerland

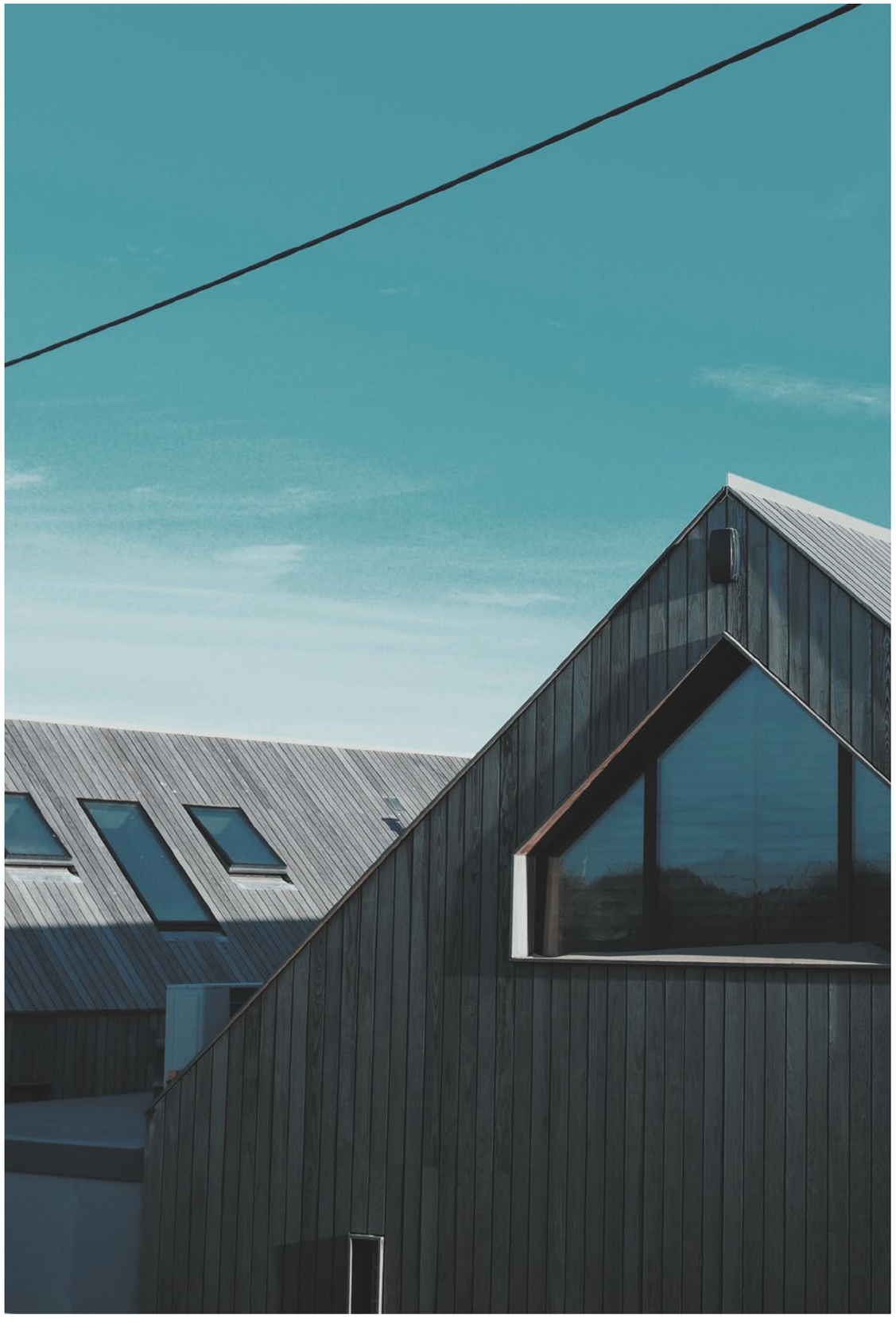
The Swiss forest holds 130 different essences and generates 80 000 jobs. **Its surface is increasing at a yearly rate of 5400 hectares.** Although it remains little harvested due to biodiversity protection, the country is home to state of the art know-how and engineering.

Referent technical centre
CEDOTEC

Forest area
1,3 million d'ha

Share of forest area in total area
31%

Hardwood / Softwood distribution
47%



This is a revolution

This is the story of the new generation of wood construction: project after project, country after country, all over the world, it comes back as an obvious solution. It comes back, and its story is indeed that of a comeback: the oldest wooden building, the Horyuji temple in Japan, dates back to the VIIth century. At the time of global ecological awareness, wood comes back to centre stage. In wood, promoters see a critical element in the millenary's environmental goals, and want to make it one of the main construction materials for the cities of tomorrow. A revolution.

Architects, engineers, and decision-makers rediscover with passion and enthusiasm this material, and strive at dispelling the doubts relating to its implementation and aptitude for construction. Since innovation even stems from thousand-year-old materials, they are constantly pushing the boundaries of the impossible. And there in lies a deep dramatic change in the manner in which humans inhabit the Earth. What if, after two centuries of building with finite resources and polluting materials, we decided to build with wood – an entirely renewable material? And what if we equipped ourselves with a true, tangible way, more efficient than any other faced with our century's greatest challenge: global warming? The issue digs far deeper and concerns our existential relation to the planet. Cities will not stop growing and we must find a lasting and virtuous model. Using wood is one of the answers. Indeed, behind each wooden building hides a forest, with its sustainable and lasting management and its key role in great climatic balances. Inventing a new model of wooden cities means inserting human life in a virtuous circle that benefits societies without withdrawing anything from nature.

Major international conferences are the opportunity to strongly reassert the intention of fighting global warming and defending a planet-wide process of sustainable development. The emergence of wood as a responsible construction material meets the demands of the Sustainable Development Goals (SDGs) decided by the Member States of the United Nations in 2015. Goals 11, 12 and 13 stress the need of "diminishing the negative environmental impact of towns per capita, including by paying a particular attention to the quality of air and to waste management, especially by local authorities", and of "reaching a sustainable management and a rational use of natural resources" and fighting global warming by 2030.

As one of the only materials able to stock carbon, stored all along the tree's growth thanks to photosynthesis during its entire life cycle, timber, as a construction material has many environmental upsides. The stakes are high, since construction is the third source of greenhouse gas emission (GES), after fossil fuel consumption and deforestation. Life cycle assessment studies (studies of the crude material's environmental impact until the end of its life) show the advantages of wood in construction, compared to steel and concrete, which emit respectively 34% and 81% more GES, and dump 400% and 350% pollutants in water, and generate 11% and 81% more solid waste.

Carbon neutrality thus becomes a key objective. What if tomorrow's post-carbon city was a carbon-storing city? "All cities should be built in wood", even devises Marco Casagrande, a Finnish architect and artist. "Wood has the same potential as concrete, but without the fracture with nature. We could build our buildings in organic fashion, turn our forests into cities".
In order to promote the cities of tomorrow, expertise still has to be strengthened, experiences to be shared. And so must the barriers related to wood construction be lifted.

This publication makes up an unprecedented assembly of experiences, viewpoints and feedbacks.

The solid tradition of the wood construction in Canada :

The Landing (1905) and the ***Wood Innovation and Design Centre*** *(Michael Green Architecture, 2014),*

both in Vancouver

From trees to cities

One potential major breakthrough of wood construction consists in the new relationship that could appear between human environments – cities, mostly – and natural environments – especially the forest. The idea is both simple and compelling: the more we will use wood for building, the more we will need the forest, thus spurring its "lung" function.

Wood: an instrument to defeat global warming

To curb global warming, it is usually believed that we must reduce greenhouse gases. Yet, only net carbon balance matters. Namely, the quantity of carbon the biosphere cannot absorb. The CO_2 constantly drawn by forests and oceans must therefore be included: this carbon cycle did not wait for humanity to find its balance. As explains prof. Robert Beauregard from Laval University in Québec, Earth can be compared to a tub constantly filling up with CO_2 – especially under human influence. When the tub is full, an obvious reflex is to close the tap. But in this image, we must not neglect the question of drainage. Thus the importance of forests, stocking up to 30% or 40% of Earth's biomass, and even up to 53% if we consider only land biomass. "Calling upon forests", that is to say producing wood and replanting trees, is one of the most efficient ways to remove CO_2 from the atmosphere. This involves wood construction, be it by storage and substitution, or by mixing with other materials, primarily concrete and steel.

A long-term greenhouse gas reduction could lie on the expansion of carbon sinks (trees, and therefore forests), and on carbon storage facilities (such as long life forest products – especially buildings – and replacement of other materials with a higher carbon impact). Two levers can be activated simultaneously. First, the carbon storage capacity in forest ecosystem (forest biomass, forest soils, deadwood) and in wood products; second, the substitution effects that avoid carbon emissions thanks to the replacement of fossil fuels (gas, fuel, coal) and competing industrial materials (concrete, steel, plaster, etc.) by wood. At any rate, fighting global warming cannot only mean reducing greenhouse gas emissions, but must also favour the use of materials able to capture and stock carbon.

Wood: an instrument for humanity to defeat global warming

This question has already been taken into account in the debates around eco-friendly certifications, core tools to guiding real estate construction. These labels are moving towards a general accounting of the buildings' carbon balance: in this balance are included emissions during construction and use of the building. Eventually, the use – or not – of bio-based materials, establishing the buildings capacity to store CO_2, will have to be systematically added to this calculation. In this regard, new labels are emerging, such as, in France, E+C (for "Positive Energy & Carbon Reduction") and BBCA (for "Low Carbon Building").

France, destination low-carbon: the case of the BBCA label

by Stanislas Pottier

Wood is one of the best solutions to answer the rising requirements of labels and certifications granted to high-performance projects, both in terms of energy and greenhouse gas reductions. In France, both public authorities and players in the sector are getting organised to further these projects, through pioneer regulatory State labels (such as E+C) or private certificates (BBCA, Effinergie, BEPOS).

Introduced alongside a new law dealing with all aspects of energy transition and green growth, the E+C label aims at settling the upcoming French environmental regulations for buildings through experimentation as well as the promotion of the first positive-energy buildings, or at least buildings with a low carbon footprint. This is a working basis for other labels, such as BBCA (Bâtiment Bas Carbone, or Low Carbon Building).

In the wake of the E+C label, BBCA, created in 2015 by players of the wood sector, adds to the former's requirements: it raises the expectations concerning carbon emission reduction over the entire building cycle. This label rests on the 4 pillars of the low-carbon building: sensible construction, controlled operation, carbon storage and circular economy. This way, emissions are avoided during the entire cycle, carbon is stored in constructive materials, efforts are made regarding circular economy (recycling, energy recovery), and there still remains the possibility to change the habits, BBCA President Stanislas Pottier stresses.

BBCA's frame of reference, at first only centred on tertiary buildings and collective buildings, is constantly developing. "A frame of reference has been developed for the hotel industry", Stanislas Pottier explains. "For example, the association's currently works on a frame of reference for low-carbon renovation. But the next step in developing low-carbon drastically changes the scale of reasoning: take the Quartier Bas Carbone (Low-Carbon Neighbourhood) project. It should allow us to ponder the insertion of buildings into a smart network of transports, energy, heating, cooling, and waste recycling. To solve its inclusion in a density, in an organisation of multiple uses: accommodation, offices, and recreational activities." An opinion shared by Raphaël Ménard, President of Elioth (a branch of Egis, a national firm) of engineering consultants: "we must also consider the carbon connected to the infrastructure, or to the operation carbon linked to, say, transportation, or even to nutrition. But also how the neighbourhood, as a whole, captures carbon, and how we can implement reuse and circular economy at this scale, or even how the district can adapt to climatic change, by alleviating the urban "heat island" effect, by improving comfort in extreme seasons, by preventing flooding, by protecting biodiversity…"

The association now groups over 120 members: real estate developers, investors, builders, architects, technical consultants. Suppliers cannot be members of the association, so as to guarantee the label's independence. The label has already certified about 15 successful candidates in 2017, and about 10 in 2017.

The association plays a key role in lobbying before local authorities in order to hasten the unfolding of good practices construction-wise.

But beyond the sole environmental interest, low-carbon building projects with high environmental value and good energy performances are now seen as top-notch risk-free investments. Labels, in their warrantying high levels of quality and safety, participate in the emerging green capitalism.

The only efficient technology against global warming is photosynthesis

Raphaël Ménard
Elioth's President (Egis)

You have worked on the City of Paris' carbon-neutral plan: how does wood construction fit into it?

A well operated forest pumps, in permanent regime, between 3.5 and 5 tons of CO_2 per year. From there, the math is simple. When Paris asked us to elaborate the no-carbon strategy for 2050, we shed light on the fact that the city was currently releasing about 20 million tons of CO_2 – 10 tons per capita per year. This means that it takes 3 hectares of forest to make up for each Parisian's emission – this is the person's "carbon indulgence". This is equivalent to 50 000 sq.km of wooded area – meaning that the Bois de Vincennes and Bois de Boulogne will not be enough.

Even in the most optimistic scenarios, with an in-depth behavioural shift concerning waste, food, or transports, tomorrow's ideal Parisian would still emit at least 2 or 3 tons of CO_2 a year. A surplus we will have to balance or capture. And for this, there is only one reliable technology: photosynthesis. We must therefore imagine a system which allots a hectare of forest to each inhabitant – which would mean that Paris would directly participate in the harvesting of about 10 000 sq.km of forestry spaces altogether.

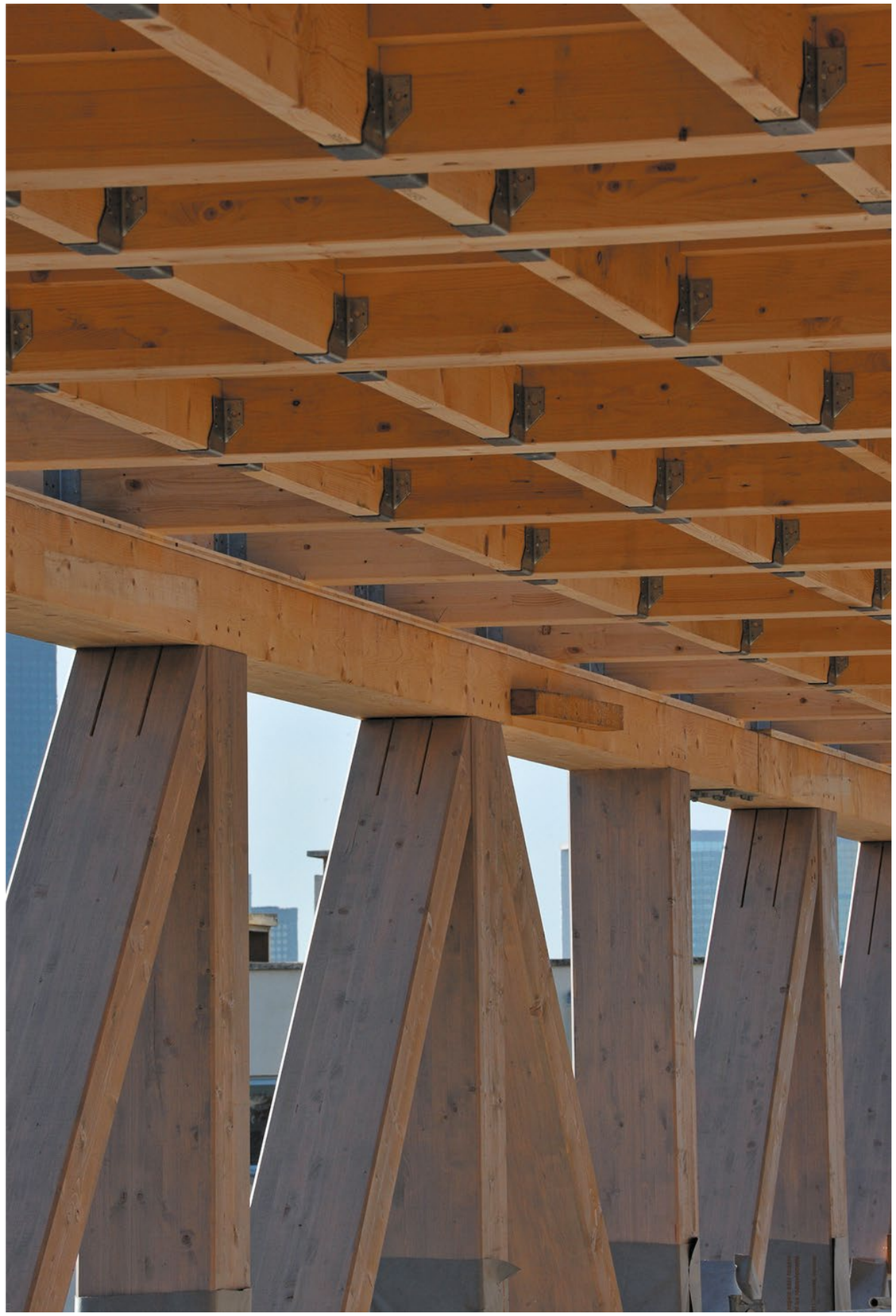
This is a far more systematic vision than what we usually hear…

This is a core issue, because it commands we reflect upon each architecture's catchment: when you see a five-storey building, what is its ecological mirror? For wood construction, things are actually pretty simple: every square metre that is built needs 10 square metres of forest – forest that has been constantly pumping carbon for years. As for the other materials, the mirror is obviously not quite the same.

Following that thought, we may draw different analyses about the way in which life is organised on Earth, through the prism of the great climatic machine. In order to analyse Paris, or any one of the global metropolises, we call upon a real extra-territorial dimension. Even in utopian scenarios, we cannot imagine fully neutral high-density territories. We must therefore think each large city together with its green corolla, and find scalable relations between places that are emission peaks and places that are carbon sinks and areas of photosynthesis – rural spaces, forests, oceans…

Altogether, will creating additional forestry spaces be enough?

By definition, a forest generates biomass that captures carbon. Of course, to be neutral, this biomass should not be burnt. This means that we will have to take wood out of the forest, and transform it into buildings and furniture. But with a rhythm of 3 cubic meters of wood per hectare of forest, renewing the building stock will not be enough. We could build all of Paris with wood, we would still need to harvest wood. So, should we dream of wooden infrastructures?



Cutting, planting, managing

From Brazil to France, the mere idea of a harvested forest seems daunting, opposed to the – widely fantasized – idea, of a rainforest haven. One of the main concerns with wood construction is of course the issue of deforestation. And indeed, on a global scale, forests have diminished by 130 million hectares in 25 years (-3%). And while the rate of deforestation is decreasing, it is still high, especially concerning natural tropical forest. It plays a crucial part in global warming, for according to the IPCC, deforestation is responsible for around 12% of greenhouse gas emissions – ranking third in the worldwide emission sources, behind agriculture and use of fossil resources.

"There are three cases" French-Brazilian architect Carolina Bueno sums up: "illegally logged wood, legally logged wood, and certified wood from sustainable forests". Based in Sao Paulo, she is in a good position to understand that the problem cannot simply be shunned "forests represent more than half of Brazil's total surface. How can the law be enforced in these conditions? At this time, it is extremely easy to obtain informal wood supplies from Brazil. This is in fact an eminently social matter: illicit harvesting of forests represents a significant revenue stream for numerous poor communities. Restriction can therefore not suffice. All in all, less than 1% of the wood on the Brazilian market guarantees a certified origin".

As Carolina Bueno highlights, licit wood does not mean certified, or even virtuous, wood. However, harvesting a forest does not necessarily involve deforestation, and there are many environmental-friendly ways of managing it. The claim according to which wood construction would damage forestry heritage, or that it would aggravate the evil it is purportedly fighting, is baseless. All the experts recall that harvesting does not mean deforesting – quite the contrary. Provided that the issues of sustainable management are emphasized, solicitation by constructors of the forest-wood sector allows ecosystems to enter reinforced growth and diversity cycles.

According to the United Nations, sustainable management of forests implies "a sustained and strengthened economic, social, and environmental value of all kinds of forests for the well-being of both present and future generations". This approach aims not at turning forests into shrines, but at their sustainable management by looking after their biodiversity and by harvesting them without their long term destruction entailing, for instance with methods for fallowing, selective cutting, and diversification of essences and uses.

Several management approaches coexist, as they do for the issue of cutting – clearcut or selective. The stake surpasses the mere question of carbon footprints: a forest also means a sentimental heritage, a great landscape, a certain variety of uses – hunting, leisure… The definition of sustainable management of forests is vast enough for each country, tradition, and culture, to be satisfied with it.

Sustainable management of forests: current state of the debate

Since 1993, after the Rio Summit, there is a consensual definition of the sustainable management of forests: it is grounded on the key criterion of the continuation over time of the forest's ecological carrying capacity, of biodiversity, of the renewal of ecosystems, and of the ability to withstand crises. However, definitions and methods associated with sustainable management of forests greatly vary. State of play of the ongoing debate.

A cutting-edge school of thought matches the "ecosystem-based" management of forests. Provinces of countries such as Canada already endorse that kind of initiative, as they look to root their forest in long-term sustainable economics.

"In Canada, we harvest but a small portion of forest growth" explains prof. Robert Beauregard from Laval University. "The forest's ecosystem-based management ensures its natural protection and regeneration, and attempts to bridge the gaps between managed and "natural" forests." The cornerstones of this ecosystem-based management are the incorporation of extremely accurate knowledge about ecology and human replication of nature's spontaneous functioning. In other words, this imitation of primary forests prohibits monoculture – though several forests are naturally single-species – as it exists with softwood in the Nordic countries, or with the notorious Landes pine in southern France. Examples that may be of interest from an industrial standpoint, but also face certain risks.

VARIOUS SCHOOLS OF THOUGHT CONCERNING WOOD CUTTING TECHNIQUES

According to Jean-François Dhôte, a French researcher at the National Institute of Agronomic Research (INRA) and forest specialist, clear cutting, potentially opening the way to monoculture, does not jeopardise the forests' sustainable management. He points to the example of state-owned forests, managed as regular timber forests, which are a very good example of sustainable management of forests: timber forests allow for a good regeneration of soils and vegetation cover, for a good distribution of age groups, and for outstanding scenic values and rich biodiversity.

According to him, the debate about wood cutting techniques mostly revolves around the issue of landscape protection. Acceptability by local communities and by defenders of the integrity of landscapes is the main hindrance to this type of cutting. Some prefer selective logging. Designed as more respectful, this type of cutting also happens to be logistically heavier – and thus (slightly) more expensive. Additionally, in the case of forests, game management represents an issue within the issue: game excess jeopardises vegetation regeneration.

Another discussion topic is the fight against soil acidification. According to some, clear cutting oils its wheels. To others, such as Jean-François Dhôte, it is mainly explained by other – geographical – factors, linked to the presence of certain essences (some resinous trees, or beech trees). At any rate, lessening acidification may be implemented through several known solutions: we can provide a temperature in the soil humus to foster their decaying. Active forestry is a favourable environment since it heats up the soils. Soil amendment is an other method: increasing limestone and magnesium heightens the soil pH value and spurs biological activity and plant litter decaying. This has been a widespread technique in Germany for the last 30 years.

SUSTAINABLE MANAGEMENT AND CLIMATE CHANGE

Finally, a study conducted by the INRA and the IGN (National Institute of Geographical and Forest Information) with support from the FCBA Institute (Forest Cellulose Lumber Furnishing Institute) modelled the evolution of the French forests' ability to fight climate change from now to 2050, according to several management scenarios. The different scenarios were based upon opposite choices in terms of the forest harvesting (intensification or status quo). They resulted in equivalent total carbon footprints, but different as to the manner in which the carbon was stored (storage in the forestry biomass or storage in forest products and substitution of more polluting energies and materials).

In a scenario stimulating crop (and therefore, among other things, wood construction), intensive harvesting still remains sustainable, and the forest system becomes more resilient to hazards and to major health crises stemming from climate change. Without taking sides on which of the rival scenarios to choose, the study recalls that sustainable forest management offers a substantial climatic benefit.

At the end of the day, should the main criterion of sustainable forest management be boiled down to this crucial question: is the tree layer renewed at a proper rate?

Far from dogmas, the sustainable management of forests must above all be based on a well-informed knowledge of the ecosystems' functioning, of ecosystem services provided by forest areas and by the essences that make it up.

Amata : <u>investing</u> in sustainable forest

In Brazil, Amata, a company that markets and promotes FSC (Forest Stewardship Council) certified wood, was the first Brazilian company to obtain a forestry concession from the State. According to CEO Dario Guarita Neto, the company's primary ambition is to overturn a deeply rooted concrete tradition in Brazil, by demonstrating the capabilities of wood as a competitive industrial material, while being beyond reproach on the wood production and exploitation procedures. It meets the sustainable forest management standards all along its project cycle.

As a matter of fact, before exploitation, the Brazilian company encourages the knowledge of the exploited forests: conducting studies on landscapes, on faunal and floristic diversity, on hydrography, on the forests' social and economic issues. Before and after exploitation, it monitors essence diversity and tree growth rate, diligently referencing their coordinates. After exploitation, it provides maintenance for the forest: fostering sprouting, destroying lianas that compete with trees, and planting new trees. Cutting projects only last a year and each launch is audited individually. With this approach, cutting cycles enable to never destroy more trees than there grows back.
Furthermore, it involves local communities (incomes, employments) and supervises localised reforestation.

Amata is part of the worldwide company network B Corp. This community brings together companies whose goal is not only to generate revenue, but also to promote social and environmental progress. Amata is a corporation owned by large investors, institutional investors, banks, and private individuals. It is a good example of the economic forces' potential regarding their ability to foster green economy and, in this case, to invest in sustainable forest. The next step in Amata's development, beyond the mere marketing of certified timber, will be to develop internally the production of wood construction materials inside the group: Glulam, CLT. Fair evidence that the economic players of the timber industry spontaneously turn to construction, as an obvious choice.

<u>Maniwa,</u> world capital of wood circular economy

In Japan, the municipality of Maniwa in the province of Okayama submitted the concept of "Biomass Town" as soon as 2006 and organised a local wood economy ingrained in ecological principles. The town of Maniwa possesses approximately 70 000 hectares of cypress wood.

This wood is harvested locally as biomass to produce energy by combustion (so-called fuelwood), but the released CO_2 does not participate in the global warming of the atmosphere, as it is consumed by massive planting and local production of the forest. And given that wood is not a finite resource, fuelwood is in fact a renewable energy.

The Maniwa Biomass Collect was built in 2009 in completes biomass plants. This collection and wood transformation centre falls within a thoroughly-structured wood economy in this town. The result of this policy is striking: the town as reached a high level of energy independence, spurred the development of the forest and the wood sector, the creation of non-transferable jobs and the revival of neighbouring towns and villages. The concept of Biomass Town has even become a tourist attraction.

Maniwa has also shown that it could rapidly adapt to technological evolutions, to external demand of wood material and to climatic issues. The town produces Cross Laminated Timber (CLT), the latest, ultra-performing, wood construction material. A Forest and Forestry Master Plan for a sustainable development of the forest is currently under study, so as to find a balance between promotion, maintenance and conservation of the forest. In this context, a test area in Maniwa's planted forest is monitored by Airborne Laser Scanning, enabling a close supervision of the vegetation cover's evolution.

Long-established in Maniwa, Meiken Lamwood Corporation is a timber industry company comprising several activities. It produces CLT since 2010 and also possesses biomass plants and a fabric that transforms wood into pellets sold to private individuals (for heating). While the production of CLT requires an advanced level of industrial technology; craftsmanship remains soundly rooted in Japanese culture and still find its place.

The company, alongside the Japan Agency for Forestry and the Ministry of Land, Infrastructure, Transport and Tourism, strongly supports the insertion of CLT as construction material in the wood-building code. In Maniwa, a test project for a two-storey house from local cypresses has sprung up.

Maniwa as reached a high level of <u>energy independence,</u> spurred the development of the forest and the wood sector, the creation of non–transferable jobs and the revival of neighbouring towns and villages

The example of the town of Maniwa thus appears as a specifically virtuous economy model and shows that the local development of the wood and forest sector can have an extremely positive impact on a set of contemporary issues: employment, sustainable development, circular economy, renewable energies. Since the beginning, Maniwa's project has been the subject of a significant structuring on behalf of all the actors, a key factor in its success: be they institutional (town, prefecture), suppliers and companies of the wood and forest sector, academics, or local businesses and farmers.
It shows that the implementation of a local and circular timber economy, in the fuelwood, forest management and wood construction sectors, both environmentally friendly and creating non transferable jobs, lies within our reach.

We need to open a global conversation on our built environment, its quality and its impact

Michael Green
canadian architect

The industry

Not only is wood construction an environmental issue, it also is an economical issue. If it is to be more wishful thinking however, and in order to be competitive compared to other construction materials, the wood sector must find ways to structure itself on a large scale. Some countries claim that they already are at a stage in which wood is seen as the "normal" material to build different kinds of buildings: housing, offices, equipments… Such is the case of Japan, for instance, or even Canada, where nearly all detached houses and small apartment blocks already have a wooden framework. In Canada, again, even mid and great-height buildings are becoming more accessible – the sole British Columbia, has reached the threshold of 500 six-or-more storey-high buildings. We have since stopped counting. The same goes for Finland: "prevalent in the detached-house market, wood now expands to great-height buildings" notes Anne-Christine Ritschkoff, VTT Technical Research Centre of Finland Executive VP.

For other countries, this turn towards normalisation is currently happening.

Becoming competitive

Comparisons with organic production are sometimes drawn since there was a time when it was supported by responsible and informed consumers, not with standing extra costs. Nowadays, thanks to scaling-up, it is within range of most anyone. Massification of the wood construction sector should result in a similar economy of scale.

The stake is quite simple: so that wood-building may really take off and become a mass-market product, it must not cost more than other construction materials. To this end, it boasts sound assets: for instance, the perks of the dry process framework, such as substantial in-factory prefabrication, faster on-site assembly operations, cutting labour and financial costs.

But for this to happen, one must know how to handle wood and design projects in accordance to the material's requirements. The division between the architect, who comes up with a design, and the engineer, who provides the calculations, is often pinpointed as a reason for extra costs on some wood projects. But, as the Franco-finnish architect Olavi Koponen remarks: "architecture depends upon structure". In other words, "architects and engineers must cooperate as soon as possible, and find together practical solutions. If you know how to work with wood, then things become far easier…". And less expensive.

Incidentally, an array of questions about the sector and supplier chain, from the forest to the city, still remain unanswered. To whom do the forest lands belong? How do sawyers, carpenters, builders, promoters and architects structure themselves as a system? Do the companies have the critical masses to perform economy of scale and thus become competitive? Each one of these factors, both upstream and downstream, impacts the entire chain, and therefore determines the final building costs – and the democratisation of wood construction.

Structuring a promising sector

With a powerful argument, liable to even the less receptive to environmental issues: just like renewable energies, the forest-wood sectors often represent a great source of non transferable jobs for the countries that develop it.

In Switzerland, forest-based economy and the wood sector generate 80 000 direct and indirect jobs, as estimates Thomas Buchi, founding chairman of Charpente Concept. In France, the Ministry of Agriculture puts the figure at 425 000 jobs. In Canada, the sole forest sector represents about 200 000 jobs. As Glenn Mason, Assistant Deputy Minister, Department of Natural Resources and Energy deservedly phrases it "The remarkable aspect of this employment booster is that it chiefly concerns rural areas, small communities,

Architects and engineers must cooperate as soon as possible, and find together practical solutions

villages in which the sawmill is sometimes the only employer. This is a strong incentive to develop new uses for wood, at a time when the paper industry is failing, and to explore new markets, be it in construction, in bioeconomy or biofuel."

Besides, territories can bet on bioeconomy to promote local resources and jobs: the example of Maniwa in Japan indeed goes to show wood's capacity of being the driving force of succeeding local economies, based on the judicious and virtuous exploitation of the biomass.

Industrialisation, standardisation: the keys to mass construction

To take off successfully, wood construction will need an intrinsic competitive model. Often compared to the concrete industry, well-structured on a large scale across the world, the forest-wood construction sectors often face similar problems: company youth, competition from other materials and international sectors, growth and development management, structuring.

One of the challenges for sectors generally made up of medium-sized or even family companies, is to reach a critical size that will enable them to fully answer the new demand. One such example is that of Finland, that has witnessed the emergence of great industrial groups, both rational and efficient, just like MetsäWood, which now place the country as a world champion of wood construction… And of high added-value wood products exportation.

The Austrian forest is also perceived as a pioneer regarding rational organisation. It has been reformed and rethought according to tenets drawn from "industrial machinery", according to Jean-François Dhôte, a researcher at the National Institute of Agronomic Research (INRA): a road network three times as dense as that of French forests, cable techniques to saw in steep mountain slopes, and 4-meter-long standardised forest products, ready to be transported in trucks. From this strategic choice, significant competitive edges entail – even though the Austrian resource is in fact pretty scarce.

Traceability: paving the way for short circuits

The effort for sustainable development parallel to the emergence of wood construction requires to take the sector's carbon footprint into account, aswell as a proper appreciation of the circular economy of wood, which functions in short circuits, in order to avoid long-distance transportation. Hence, traceability is one of the major challenges incumbent to wood construction's upmarket move. It is one of the subjects about which local and national governments can play a key role.

In France or elsewhere, it is often difficult for a constructor to establish a chain of custody over the full wood value chain, from logging to finished buildings. Knowing the timber's origin is key to ensuring that it comes from sustainably managed forests, to assessing and curtailing the carbon impact due (in particular) to transportation, to transparency with customers, populations and collectivities, to reassuring about the sector's functioning, to being able to estimate the impact employment -wise, and finally to promoting the scaling back of economic cycles towards shorter – and therefore more virtuous – circles.

How is it possible that in Japan, importing wood from abroad is less expensive than carrying nationally-produced wood? Architect Riichi Miyake judges that the main factor is weakness of the Japanese domestic market.

According to Thomas Büchi, chairman of Charpente Concept (Switzerland), succeeding in tracing wood above all requires a political will shown on different scales. Firstly, from the States themselves, with the implementation of labels warranting origin. Some countries have already launched certifications aiming at showcasing national productions. France is an example, with the label Origine France Garantie, published by the FCBA since 2011, or at a local level the Bois des Alpes certificate which certifies 28 companies. In Switzerland, the Certificate Origine Bois Suisse, published since 2010 by Lignum, ensures that the marketed product is composed of at least 80% Swiss wood. It currently certifies 400 companies from all sectors of the Swiss wood industry: forest-based economy, logging and transportation companies, sawmills, fuelwood, framework and construction, carpentry and woodworking, lumber trade.

Municipalities also embody a relevant level of decision-making for matters of traceability – for to really be a part of an eco-responsible, traceability requires the implementation of short circuits. More than merely knowing from where the wood comes, the development of short and sustainable chains must be encouraged. Thomas Büchi even calls local economy the "antithesis of globalisation".

Local government (municipalities, inter-municipal authorities, departments and regions in France, and other forms of local and regional organisations) can warrant the implementation of short circuits, bolster structure and dialogue for local and regional actors of the wood and forest sector, and bring information about the origin and processing method at each step of the value chain, from cutting to the finished product.

These public bodies can also be the project owner. Therefore, it is also up to them, not only to foster wood construction if they wish to, but also to require from all the other actors of the chain that they watch upon the resource's traceability. "It is necessary and sufficient to include traceability criteria in the specifications the companies receive during tender bids", sums up Thomas Büchi. For his part, French promoter Paul Jarquin (REI Habitat – France) insists:" We ask our builders and suppliers to take a stand on this criterion".

Petri Heino consultant

The effort for sustainable development parallel to the emergence of wood construction requires to take the sector's carbon footprint into account

What is the state of wood construction in Finland?

Wood is a traditional construction material in Finland. It is deeply rooted in our society and continues to be massively praised nowadays: it represents a third of building market shares. This figure rises to 85% of market shares for detached houses, and 30% for public infrastructures, schools in particular.

The multi-storey wooden buildings construction sector is currently thriving, and now represents 6% of market shares in Finland.

How can wood construction be encouraged?

We have carried out a significant work to knock down the regulatory barriers that had no scientific basis. As such, rules must not be based on opinion. In any case, all possible progress in this direction must be conducted with civil society. There has been a work on regulation: it has been carried out together with the public and relevant parties, firefighters for instance.

I believe that regulation in construction has been suitable since 2011. Efforts must now be made concerning information sharing, education, the architects' and engineers' organisation.
As for the improvement of wood competitiveness, the answer is simple: the more general contractors and customers will use wood to build, the more the wood construction sector will be economically competitive compared to other construction sectors.

Brock Commons
FPInnovations

Réalimenter Massena, Paris
Hertel / Lina Ghotmeh

Pushing boundaries

To this day, promoters and designers already have a large array of wood technologies already successfully tested in building detached houses, public amenities, and, more recently, mid-height buildings. Besides solid wood, reference material of traditional constructions, other industrial products have appeared in the last decades, such as glue-laminated timber, or, lately, structural composite wood. Glued or nailed products, plastic-wood composites and treated woods are all evolving at fast pace. Rich and related to new building systems, they bring adapted solutions for each kind of use and each kind of work: “nowadays, we can build most anything with wood” confirms Canadian architect Michael Green.

Sometimes, ancient technologies reinvent themselves. For instance, the NLT (Nail Laminated Timber) – nailed wooden slats used as flooring or as panels – is back in fashion in North America, owing to simplicity of manufacture and aesthetic and economic advantages.

Century-old glue-laminated timber (or “glulam”) is among the products that continue to evolve and adapt to the needs of the time. It was developed in 20th century Germany, Switzerland and France based a patent submitted by German carpenter Otto Hetzel. The concept: replacing metal pieces by gluing to assemble the wooden slats and hereby make beams of unprecedented lengths. New lengths that pave the way for a newfound architectural freedom. Bridges, gateways, stations and airports thus enter the prism of potential wooden constructions.

As ancient as they may be, the know-hows linked with wood can nonetheless be high-tech and open to evolutions – or even revolutions. The subject of great height is a blatant example: by itself, it requires a high amount of innovations. This topic is what allows wood, already popular among detached houses and widely associated with the chalet imagery, to come back in the centre of great cities.

Beyond the blossoming (at least in the minds) symbolic projects consisting in 15, 20 or 30 storey-high buildings, 4, 5, 6 or 7-level wood buildings are normalizing. Massive development of high wood constructions is already under way with nine-or-more storey-high buildings already erected in the UK, in Switzerland, Germany and Canada – the latter even having built the highest wood building to this day: an 18-storey student residence in Vancouver, in British Columbia. In France, two 8-storey buildings, developed by Le Toit Vosgien, opened the way for new collective housing projects, including in Paris.

Beyond wood products, the nascent constructive systems open a brand new array of possibilities. After centuries of half-timbering and stacking solid wood, the time has come for industrial facilities, and, in particular, for the premanufacturing of frames and supports. These solutions are quick, cut on-site assembly times, and therefore construction costs and nuisances. Many projects now mesh several techniques – and in particular the wooden skeleton, chosen for its simplicity and flexibility, and the pole and beams system, already used in Asian religious architecture, enabling freer plans and facades with large openings.
Wood treatment is also changing: the new thermal and fireproof treatments allow wood to rise, to enter facades and buildings, granting them stability and durability.
Finally, other “glued” technologies are appearing, such as Laminated Veneer Lumber (LVL), a material made up of thin wood veneer glued with parallel grain, or more significantly Cross Laminated Timber (CLT). The material is on everyone’s lips, given its tremendous potential in matter of great heights.

Wood is the first bio–sourced material to be used in construction. These materials are the biggest winners of the low–carbon goal

Structure, materials : finding the right mix

Finally, the key is finding the right "mix", on a project by-project basis, between materials and construction techniques. "We are currently reflecting on this matter", confesses Raphaël Ménard from Elioth engineering consultants. "Our goal is to combine the materials' ecological impact and their structural capacities – traction, compression, flexion, stiffness, resistance – in order to assess when exactly wood becomes the most interesting material for a given project. Let's take the example of a footbridge on a 50-meter mesh: is it best to go for an all-steel frame or to include wood in the structure?"
Besides, this reflexion stretches beyond the concrete/steel/wood tryptic, and concern all materials: especially the whole range of bio-sourced materials, from bamboo to earth all the way through stone, reed and typha. All the more concerning territories that do not have important forestry resources, but want to develop use of local, renewable materials.

The same applies to construction methods: "in Canada, the market for resorting to CLT doesn't really exist yet" admits Glenn Mason. Sure, the product is expensive – and yet very useful, and perhaps compulsory, to reach new heights in the great heights area. Hence the importance of competitiveness, and also of the good use of every product, or material, and of the good balance between techniques.

Wood at the time of R&D

Wood has been used and handled for several millennia. But research is accelerating just now.

Belgian architect and civil engineer Yves Weinand directs the Chair of Wood Building IBOIS at the Ecole Polytechnique Fédérale de Lausanne. This Swiss research cell aims at realising wood technologies, promoting technology transfers and changing mentalities. "Wood-methods are embryonic and still have to be invented" declares Yves Weinand. He particularly strives at improving "digital manufacturing" methods and tools, essential to innovation in construction: software enabling the creation of complex forms, control and dimensioning of finished elements, digital machine control…

The issue of building durability, which must comprise their demolition and recycling modalities, led him to work on the concept of modular or even dismountable buildings. "Their feasibility relies on the development of systems of connexion stemming from woodworking and scaled up to large construction".

The Pavillon of the theatre of Vidy-Lausanne, delivered in the fall of 2017, will be a full-scale demonstration of the potential of construction by wood-wood interlocking. And indeed the structure uses neither screws nor nails. It was assembled in a record-breaking time: six days were enough. In this structure, each piece coming from domestic wood is both premanufactured, and unique, with a direction: all are numbered. This feat was made possible by new calculus models allowing to determine very precisely the mechanical resistance of this kind of assembly and to incorporate their manufacturing constraints.

When we ask him about great-height wood construction, Yves Weinand replies that the main problem of going high with wood (over ten stories) concerns the conception of the junction of knots to give a vertical support to the floorboard. The current methods use mixed systems such as metal or concrete knots or cores.

According to him, wood's most interesting potential in constructive innovation concerns raising existing buildings. He summons the example of Cologne where many two-storey high buildings have been raised up to five levels thanks to wood.

Timber construction's strength consists in the fact that it meshes structural work and completion, and therefore cuts construction time in half. This asset is capable of convincing not only construction players, but also investors and banking organizations. According to Yves Weinand, future developments of wood construction models must notably concern the betterment of planning, especially through fine-tuning the model in BIM (Building Information Modelling), which allows to incorporate in a sole file all of the information (structure, liquids) concerning a building project.

Bio–sourced materials

Wood is part of an array of solutions to build tomorrow's city. The sustainable and low-carbon development approach aiming at reducing the environmental toll of building construction has spurred the emergence of a new set of construction materials directly deriving from plant, animal, and soil biomass. These materials are said to be bio-sourced.

Use of such materials creates a new relationship between Man and his built environment on the one hand, and nature on the other, thus bringing new environmental performances in construction. This can consist in insulating materials (straw, wood, hemp, wool, etc.), and also in treatment products (pasting, completion) and constructive components (wood panels, plant fibres, hemp or linen concrete).
Bio-sourced materials are therefore used in a variety of applications in construction.

Wood is the first bio-sourced material to be used in construction. These materials are the biggest winners of the low-carbon goal. The collectivities' demands regarding the use of local bio-sourced products in constructions have recently become greater, especially because they promote local forestry products, thus avoiding long distance transportation and creating a circular economy and local jobs.

However, the sole use of bio-sourced materials does not automatically guarantee an eco-friendly material: analysis of the cycle of life and calculation of grey energy used in particular by modes of transportation and transformation must of course be taken into account. These materials thus participate in a broader framework, associating competitive constructive methods, material types, and organisation of sectors in short circuits.

Building a wooden building in Brazil: where everything remains to be done

The real estate and construction sector in Brazil is deeply marked by the tradition of concrete and "solid" building, related to the influence firstly, of colonialism, and secondly, of modernism during the second half of the 20th century. This tradition is obvious in typical Brazilian urban landscapes, such as the capital Brasilia, or the mineral skyline of Sao Paulo or Curitiba.
However, Brazil has a strong relationship with wood, its very name referring to an essence, the Pau Brazil or Pernambuco.

Brazilian architect from the French-Brazilian agency Triptyque Carolina Bueno highlights this paradox and explains that efforts must be made in terms of educating the populations to heighten awareness about the issues of sustainable development, about the benefits of wood materials and about the fundamental difference between processes of deforestation and sustainable management of forests.

In Brazil, flexibility in procedures enables the new players to be source of proposals. Norms have to be invented, and players of the architectural and forestry spheres are organising in workgroups to suggest norms and regulations to the public authorities.

Though subjective, there are tangible, positive effects of wood on housing health and well–being

The agency Triptyque, in partnership with the new wood giant Amata, is launching a pilot program to demonstrate the constructive possibilities of wood in Brazil. It will consist in an R+13 building in the heart of São Paulo, with a mixed program (private housing, commercial activity, co-working spaces) that shows wood material's capacity to adapt.
Being an unprecedented constructive system in Brazil, its realisation will require importing some products, which will introduce the Brazilian sector to new construction techniques. In any case the products used will originate from sustainably managed forests, related to Amata's activities.

The agency, based in Paris and Sao Paulo, promotes exchanges of expertise between countries. Through this overall approach of experiment, educating populations, exchanging expertise, the wood-construction sector will be able to grow in the optimal way.

Olavi Koponen

Has the opinion on wood changed?

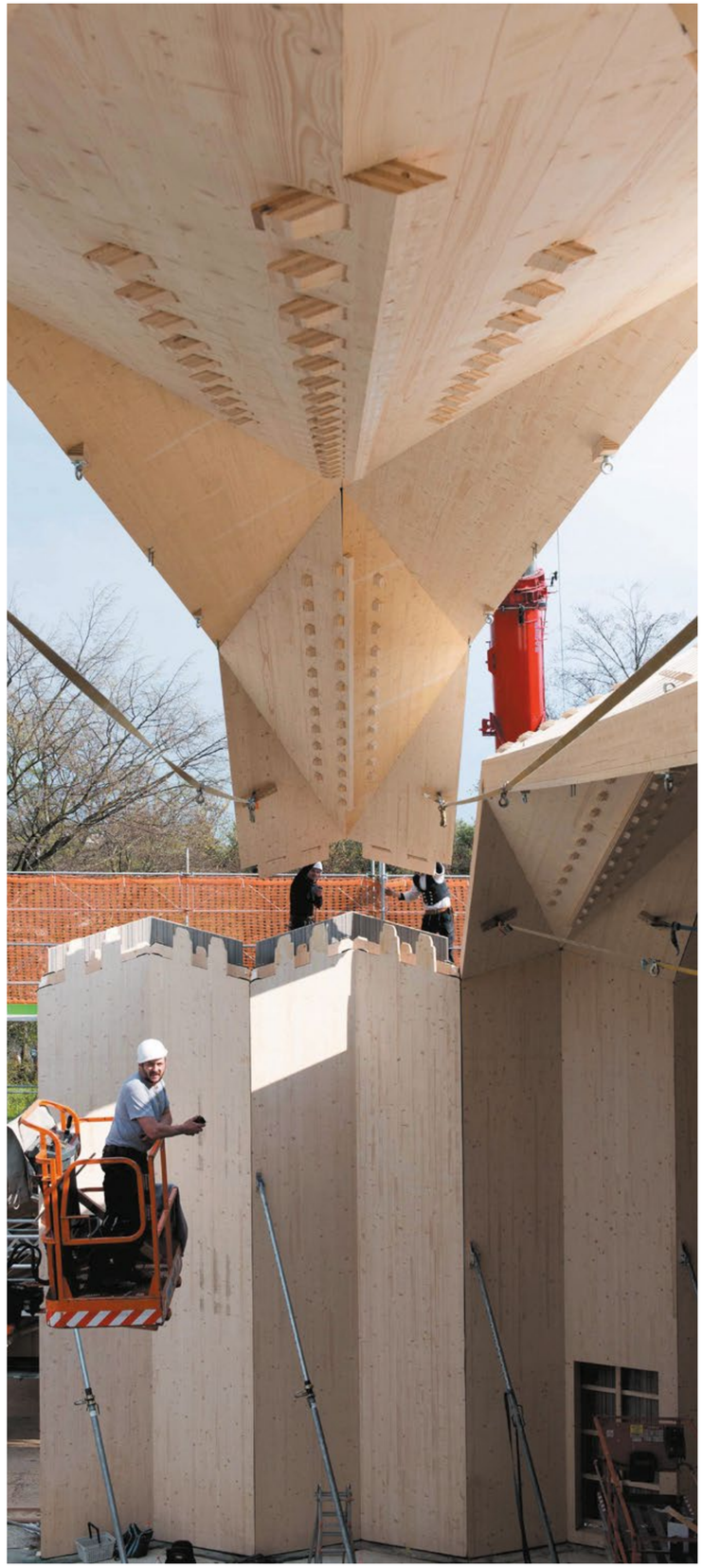
Wood has a head start, at least in Finland. But lastly, one can sense the emergence of a genuine collective awareness about the environmental benefits of wood.

Though subjective, there are tangible, positive effects of wood on housing health and well-being . Quantifying such effects is a challenge, but that does not lessen their empirical observation.

As an architect, how does one handle wood?

All construction materials have features we must acknowledge. Just like concrete has a nature, wood has to be mastered, and requires a real know-how. Material guides the architect, and for instance, we cannot replicate a concrete structure with wood. Wood is an exceptionally light material; thus the building must look light.
However, sufficient wood engineering knowledge is lacking, as the material is substantially different from other construction materials. We must also foster close cooperation between engineers and architects.

The best concrete structures from the 60s and 70s stemmed from good partnerships between architects and engineers. Nowadays, twenty-storey high wood buildings are emerging. Their success will depend upon increased cooperation. A wood product treated with drying agents, pasting, wood stain, or painting with polluting chemicals cannot be called environmental-friendly.



Pavillon de Vidy-Lausanne
Yves Weinand

Kimmo Lylykangas

Is wood a perfect material ?

I have been working with wood since my first project. Wood is a particularly effective material, especially from an environmental standpoint. But even the most recent technological developments must be improved. I am referring to CLT's problems with water seepage and acoustic issues for instance. We must also consider transformation and treatment processes: they are what makes wood an environmental-friendly material – or not.

According to you, what are the setbacks for wood's competitiveness in construction?

The substantial cost of wood construction techniques. Sometimes, the norm must be circumvented: for a restoration project in Riihimaki, the inversion of the direction of wood in CLT pannels (while the direction must be vertical according to the Finnish norm) drastically cut costs: from 170€ to 55€ per square meter. But let it not be said that the limits to wood competitiveness lie in regulations and competition from concrete: they mainly lie in its intrinsic technical limitations.

Pavillon Jardin des Tuileries, Paris
Kengo Kuma & Associates

Sébastien Yéou, Kengo Kuma Agency

Why is wood at the very heart of Kengo Kuma's architecture ?

Kengo Kuma is predominantly interested in the direct connection with nature. He favours locally sourced materials, and the choice of wood thus is quite obvious. But it is not the only one: in China, for instance, we work with local bricks. Wood is not an inert material, it evolves over time, it is a living material. In architecture, it creates a distinctive and warm atmosphere, fitting Kengo Kuma's belief: an architecture that shelters men.

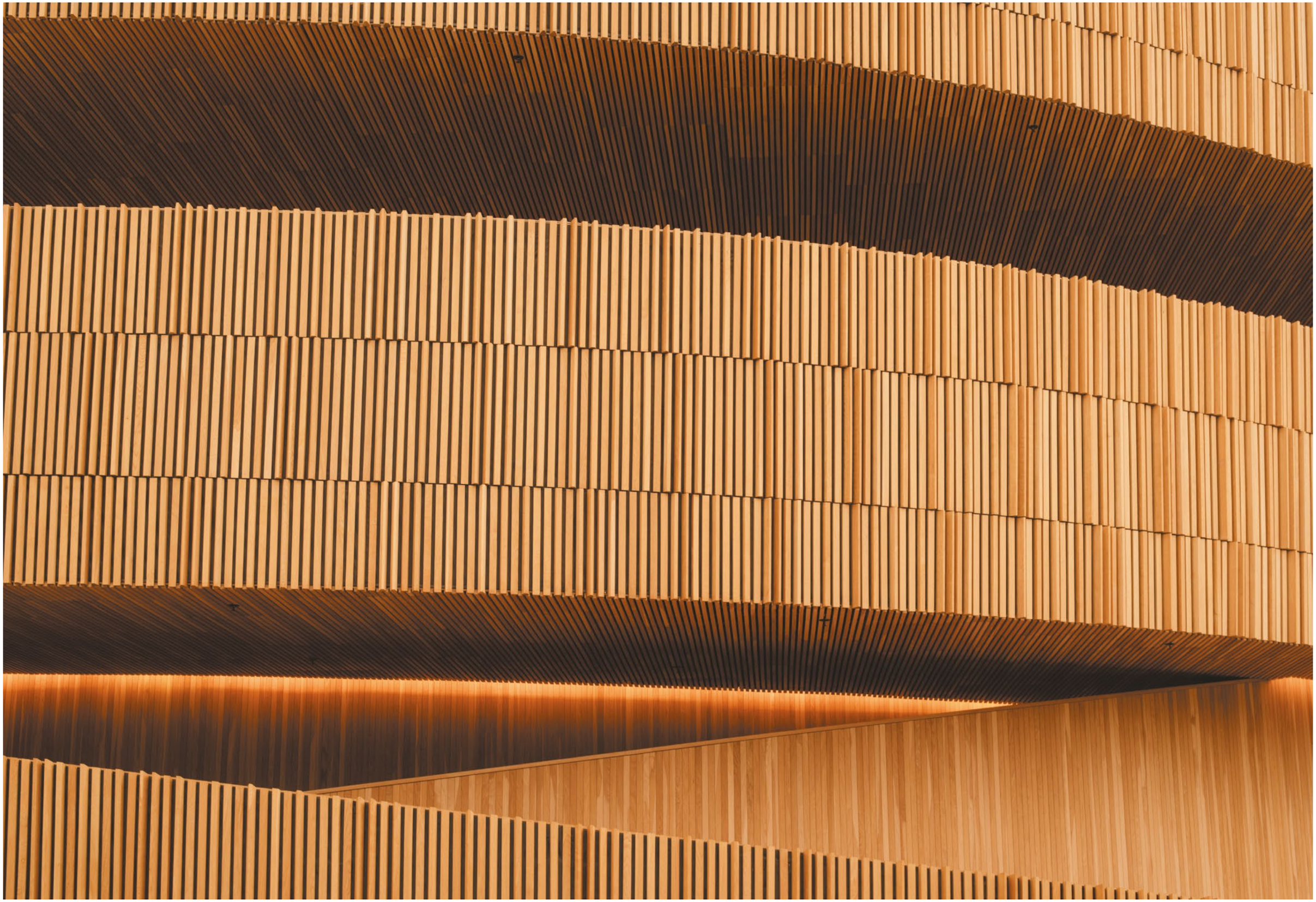
Beyond Kengo Kuma's architecture, how is wood construction perceived in Japan?

Each country's history and geography has led to distinctive building traditions: concrete quickly spread in France, its home. But Japan is a predominantly wooded country, and there is a genuine wood building tradition, as wood is a light and local material. 20th century modernist architecture spread to Japan and established concrete as the new baseline material. But Kengo Kuma grew during this period, always refusing to break the bond with wood. His goal was to combine tradition and technology: even though we elaborate cutting-edge building concepts, manual know-how remains essential. As such, cooperation with engineers is equally essential.
Finally, tradition sometimes gives better answers to today's issues: during the Fukushima disaster, we realized that lighter constructions, in traditional Japanese fashion, absorbed shocks better.

And great heights? Is that an opportunity for you?

Height for height, no. However, instigating great-height projects could be a wonderful accelerator for the timber industry. Experimenting the material and testing its limits will trigger regulation changes, in France especially.

Experimenting the material and testing its limits will trigger regulation changes, in France especially



Tools

The will for wood: the political factor

Sole technical progress cannot be enough, and the organisation of economic sectors also calls for a strong political will: in the end, public actors will decide – or not – if wood becomes a baseline material, through regulations, norms, contests, calls for projects, and impetus favouring the wood construction sector.

The many benefits of wood in construction, be they environmental, technical, economic, should convince all of the public actors aware of the issue, from national government to elected local officials. The latter must above all be persuaded of the unique opportunity wood represents concerning the implementation of short circuits, of a more local – and therefore more virtuous – economy.

Hence the importance of a "green lobby" constantly promoting the assets of wood among decision-makers, used alone or mixed with other materials. Hence, also, the importance of technical institutes and research cells continuing their work to be infallible source of proposals to the public authorities, and to influence evolution of rules around wood – the goal being to reach regulations "based in scientific parameters, and not on opinion" as Glenn Mason puts it. In other words, to reach this "regulatory neutrality" that will allow wood and bio-sourced materials to improve without hindrance compared to other building solutions. This compulsory task of modernising concerns almost all countries, since wood suffers from such a stigma, especially due to fire hazards. This includes developing countries, such as Brazil, for which, Carolina Bueno admits, "regulation on the matter starts from scratch".

Regulation is but one obstacle among others in the development of construction wood. Other paths should be explored – country by country – to understand the lacks of competitiveness. Sectors and technical centres must identify which switches they must activate. At the very start, for instance, the problem of land plays a key role: Finnish and Canadian forests, for example, are in one piece and belong to large owners/operators. On the contrary, the French forest is dispersed and fragmented and belongs to thousands of small land owners, who do not have true incentives to make the shift to active forestry. Hence the significant under-exploitation of a forest that nonetheless stands third among European forests surface-wise, and, down the line, the additional costs builders have to face. But here, solutions also are within the reach of decision-makers: creating a network of landowners, prompting regrouping.

Mainstream Wood

The general public will undoubtedly be one of timber's greatest allies – many accounts vouch for the revival of wood's popularity. Popularity and, therefore, a new demand to be met. To consolidate it, boasting wood's performances (low carbon, energy performance, bio-sourced material) partly requires the implementation of high-level labels and certifications, quality guarantee for the general public… and for the financial world, regrouping small and large real estate investors, usually interested in "stone", and who also become convinced of the value (and sustainability!) of wood.

In order to empirically demonstrate all of wood's capabilities, countries such as Switzerland, Canada (WoodWorks!) or France (Adivbois), wood construction sectors and public authorities have launched flagship projects demonstrating timber's possibilities concerning mid and great heights, to boost wood construction's notoriety and thus hasten its development. Less is more: necessarily exemplary, groundbreaking and unprecedented height, architecture and on-site-wise, they also serve to reassure regarding small "daily" projects, small-scale equipment, office and family buildings as many are built every year in every town.

Finally, in order to make wood succeed, international technology transfers will have to be fostered, assisted by open source and open data initiatives, based on the example of existing initiatives such as Rethink Wood, backed by the North American sector through Softwood Lumber Board. New open, collaborative and experimental teaching programs can be one of the pillars of timber's ascent through the next generation of architects and engineers.

Regulatory neutrality: the case of Switzerland

Transforming regulation so that it does not discriminate materials: it is one of the barriers that must be lifted so that wood may play its part in tomorrow's construction… Without giving away an inch on health, quality, and security issues, in particular faced with a sensitive issue such as fire hazards Director of the Swis-French office of Lignum, Genève, Daniel Ingold looks at Switzerland's path.

How have Swiss regulations evolved in favour of wood?

Daniel Ingold: When speaking of regulations, the key issue consists in successive changes of fire safety standards. In Switzerland, fire regulations are revised every 10 years. In 1995, there were such limitations that the only wooden buildings were detached houses. In 2000, pilot projects are now allowed with special authorization, and collective housing becomes possible in the limit of R+6. These pilot projects were hotel or hospital projects. The special authorization was generalized in 2005. In any case, an equivalence with non-combustible materials had to be established. But 2015 is a turning point: regulations removed the combustible material's specificity: henceforth, only the material's resistance matters, we do not say "it burns" or "it doesn't burn" anymore.

Broadly speaking, what are the prospects for wood construction, especially concerning height?

Daniel Ingold: Development of wood construction height-wise is more limited than it once was: a large number of companies were willing to go from R+2 to R+6. But going from 6 to 10 storeys is far more complicated, and less companies are willing to do so. But more and more are interested in that prowess, and the scale has changed: before, it was a challenge among carpenters only.

But there is a fundamental cost problem, particularly linked to the under-exploitation of Swiss forests. We have one of the strictest forestry laws in the world, which is fine for Swiss forest biodiversity. But the first transformation of Swiss wood is depressed and our sawmills are not competitive, notwithstanding the increase of the need for timber since 2005.
Unfortunately, public authorities cannot do a great deal, with public markets and the fact that a canton cannot enforce the use of wood in construction. However, we could strengten the discourse on short circuits and reassure investors.
We are today in a phase of inception.

New open, collaborative and experimental teaching programs can be one of the pillars of timber's ascent through the next generation of architects and engineers

The City Above The City: the enhanced city

Contests and calls for projects probably are a great way to meet the technical and conceptual challenges of wood in architecture and city design. At a time when growing urbanisation implies considerable construction endeavours, wood appears as the most sustainable solution.

Launched in 2016 by one of the Finnish wood industry leaders, MetsäWood, the contest The City Above The City invited young architects from all over the world to reflect on the wood raising of existing buildings. In fact, research estimates that about a quarter of the existing buildings are strong enough to be raised, and wood is the most appropriate material for this kind of intervention, given it is lighter than any other construction material. The latest technological innovations with regard to wood, such as the LVL (Laminated Veneer Lumber) or the CLT (Cross-Laminated Timber), are a springboard to innovate in this direction. Their substantial in-factory prefabrication means very short on-site building periods and minimal inconveniences.

Besides, the fight against urban sprawl in a global context of massive urbanisation calls for a sustainable densification of the urban fabric and the choice of sustainable urbanism over disposable construction. Michael Green, jury chairman of the contest, is thoroughly convinced of this: we need to build higher buildings, and stop the systematic destruction of structures that have become obsolete.

The organisation of such a contest has spurred emulation around an architectural and urban challenge by calling upon young talents engaged in green construction. The objective was nothing more and nothing less than to reflect upon the ecological enlargement – from the top – of our urban centres. The contest beckons us to rethink high-rise construction in an innovative and sustainable way, in urban landscapes that must see their heritage preserved. Here lies one of the core issues of tomorrow's urban revolution: how is it possible to incorporate innovative and environmentally-friendly 21st century construction technique in urban landscapes built over several centuries?

New York, Berlin, Shanghai, Istanbul, the prize-winning architects, selected amongst over 170 projects, have not lacked ambition: they gave wooden responses to the challenge of the sustainable densification of world-class large metropolises.
Far from being a wishful thinking event, the contest converts inventiveness into real-life projects, as show clear examples of ongoing or already carried out building raising projects in Paris and Geneva.

The contest takes part in the Plan B project, launched in 2015, and which aims in particular at providing public access to Metsä technologies by offering "Open Source Wood". The coalescence of architectural emulation and sharing information about material design emerge as a relevant lever for the development of the wood construction sector.

We need to build higher buildings, and stop the systematic destruction of structures that have become obsolete

Michael Green: researching, investing, teaching, sharing

Global demographic growth will strongly impact the built environment. It is anticipated that the need for accommodation will keep increasing: according to pioneering architect in non-conventional wood construction Michael Green, 1 billion will have to be built by 2025.
When we know that construction and built environment represent about 20% of greenhouse emissions (IPCC, 3rd working group, 2014), new demographic risks, at this rate, to make this number soar by 2050. The percentage, Michael Green believes, could rise up to 50%. Bad omens.
"Right now, current research and development in the field of construction does not rise up to the challenge", claims the architect. "In the USA, investment in innovation for constructive sciences represents but a fraction of research investment. The situation is the same for a majority of countries".

As a consequence, Mr. Green advocates for an acceleration of research. In this regard, some development innovations: imagine buildings entirely printed in 3D: only the finished product would actually be produced. The door is open to a zero-waste architecture.
A "new world for architecture".

But more than anything, the development of constructive innovations requires that sensitivity to green architecture be drastically improved, and so too its teaching and the sharing of knowledge at the scale of the planet. To this end, Michael Green has launched the Design Building Research (DBR), an action and teaching cell for sharing feedback from all countries, and making students work via practical projects and constructive innovation contests. A global teaching platform about wood, including workshops for all ages, and encouraging familiarisation with materials and transformation and manual assembly techniques.

In order to facilitate an international exchange of knowledge and to expand this ambition worldwide, DBR will, in the next few months, incorporate an online teaching platform about new wood building concepts: the Timber Online Education (TOE). The classes, given by international experts, will be free, open to all, and translated in multiple languages. The contents will be adapted to voluntary students' area of residence so that they may acquire geographically identified information: local and regional organisation of timber construction sectors, forest biogeography, communal and national norms and regulations.

Elevation proposed as part of ***The City Above The City*** *contest*

Wooden Apartment Buildings: the French "demonstrators" of great–height wood

Or how France aims at becoming a world champion of timber construction.

In 2014, the State launches its "Nouvelle France Industrielle" (New Industrial France) policy, since become "Plan Industrie du Futur" (Industry Plan for the Future"). Recognizing the need for innovation in the field of wood construction, it launched AdivBois (Association pour le Développement des Immeubles à Vivre Bois, or Association for the Development of Wood Apartment Buildings), with public funding from BPIFrance as part of the "Investissements d'Avenir", and a strategic goal: multiplying expertise and feedback, developing symbolic projects with a high architectural value, including great-height buildings, and, in so doing, structuring from the top, from downstream up, from building to the forest, the French sector. In other words, a manner of activating the operation and management of French forest regions, that are especially large - but under-exploited, with less than 50% of the yearly net production being actually harvested.

A mid-term objective of the "wood-industries plan", is to build great-height buildings (30 or more storeys) by 2030. To trigger this process, an intermediary step will consist in building – in the very next years – mid or great-height family buildings (10 to 15 storeys), which will demonstrate the height capacities of wood construction, allow an evolution of the reglementation and legislation, with and intended architectural quality liable to turn the projects into European references. The bet is straightforward: the realisation of flagship projects will allow a swift democratisation of mid-height buildings (3 or 4 storeys) which will arguably become the majority on the residential market in cities of the developed countries over the next years.

A plea is voiced to collectivities and planners who wish to see timber buildings spring up on their territory. Answers exceed expectations, with 24 selected sites and 12 "associated" projects to Adivbois. Finally, a national contest is organised to assemble vast multidisciplinary teams, combining architects, engineers, builders, professional furniture designers and, if need be, promoters. At the same time, a Vade-Mecum explains to manufacturers and promoters, the concept of wood family-buildings from a technical and architectural standpoint. The first prize-winning teams are announced on September 12 during the Woodrise Congress in Bordeaux. To be continued.

Wood construction: the well–being asset?

Research has already abundantly shown the positive effects of exposition to a natural environment on health and well-being. Could the next step not be to bring back nature inside buildings, in order to bring a new quality of life in our housing? At any rate, the question of the effects of construction and interior design timber on health and welfare draws the industries' and the researchers' attention.

Wood constructions have hygrometric, absorption, and moisture rejection capacities. Provided that it is not covered by a film-forming coating, wood breathes and generates a healthy air by regulating moisture. When moisture is lacking or in excess, numerous problems entail.

An Austrian study has tried to assess the effect of the use of wood material indoors on students' stress level in a school in which some classrooms had been renovated with wooden ceilings, floors, and walls. The results have shown a decrease in children's stress in the renovated room by opposition to the conventional classroom. AdivBois also led polls that highlighted the various expectations of the public regarding construction – and a strong appeal towards wood and natural materials.

Canadian institute FPinnovations and The University of British Columbia have also carried out a study comparing biological parameters for students placed in four rooms equipped with more or less wooden elements and plants, without them knowing that this was the subject of the study. Researchers measured the testers' skin conductivity and heart rate. There too, the outcome was positive: the testers' stress, both in resting conditions and during mental exercises, was lower in a room equipped with natural materials.
Therefore, the study has shown that the indoor use of timber participates in reducing stress rates and improving the health of the building's occupants. Based on this study, FPInnovations has launched a communication to develop timber construction, mainly for hospitals, schools and medical centres. The institute has convinced several Canadian hospitals to try out wood construction on a part of their services, for assessment.

Warmth, well-being, comfort, aesthetics… Beyond the outcome of scientific observations, some of wood's inherent qualities in accommodation may perhaps be impossible to quantify, but are strongly seconded by the public. Wood construction – able to make its structure invisible – will probably have to rely on these aspects to get popular.

The input of technical research institutions: VTT in Finland

We know that wood plays an important part in Finland, and that the Finnish sector continues to grow.

Anne-Christine Ritschkoff: yes, and VTT supports this growth both through public and private research. As for timber, it mainly concerns the development of composite materials from wood. In a broader manner, we are heading towards the development of biomechanics and solutions in biochemistry. The goal over the next few years is to increase the added value of Finland-made wood products.

Besides, environmental requirements demand that we change our habits: use of the material during transformation must be brought back to a minimum, and so must waste: recycling is the condition for implementing a true circular economy.
Indeed, technical developments must be able to meet the ambitious goal of dramatically reducing Finland's carbon footprint by 2050. Change in our lifestyle is very well received in Finland, and while progress must be made information-wise, this direction is approved by a large number.

Therefore, VTT supports the development of innovative solutions to take up this immense challenge?

Anne-Christine Ritschkoff: exactly. We rely on a deeply rooted forest sector in Finland; and also on the surfacing of new digital and electronic tools. We try to blend both to reach new industrial performances and new design practices, more eco-friendly and more efficient.

Undoubtedly, the Smart City has tremendous potential for improvement over the next few years; we are also working on solutions in this direction: controlling the heating, regulating humidity and air-conditioning systems in buildings, etc.

Wood breathes and generates a healthy air by regulating moisture

Environmental requirements demand that we change our habits: use of the material during transfor–mation must be brought back to a minimum

Towards new horizons

The discussions that occurred for the purpose of the Woodrise Paper have led to the advent of common ideas, showing the wood-sector players' impetus to drive the industry's development. This Paper has emphasized a true shared interest around new generation timber construction worldwide, with a common vision that opens up a whole new realm of possibilities.

But this topic remains confined to experts and stake-holders in the sector. It must become a general public issue, and the latter must be convinced of the need to build cities in another fashion. Democratization of wood construction – which can be achieved through making "demonstrator" projects a success – and improving awareness of populations may make wood surface as a widespread construction material.

In the meantime, this Paper can be used by all as a platform and an invitation to discuss and act, building on feedback and the good practices it discloses.
This is, and will remain, a work in progress.

This is only a beginning.

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