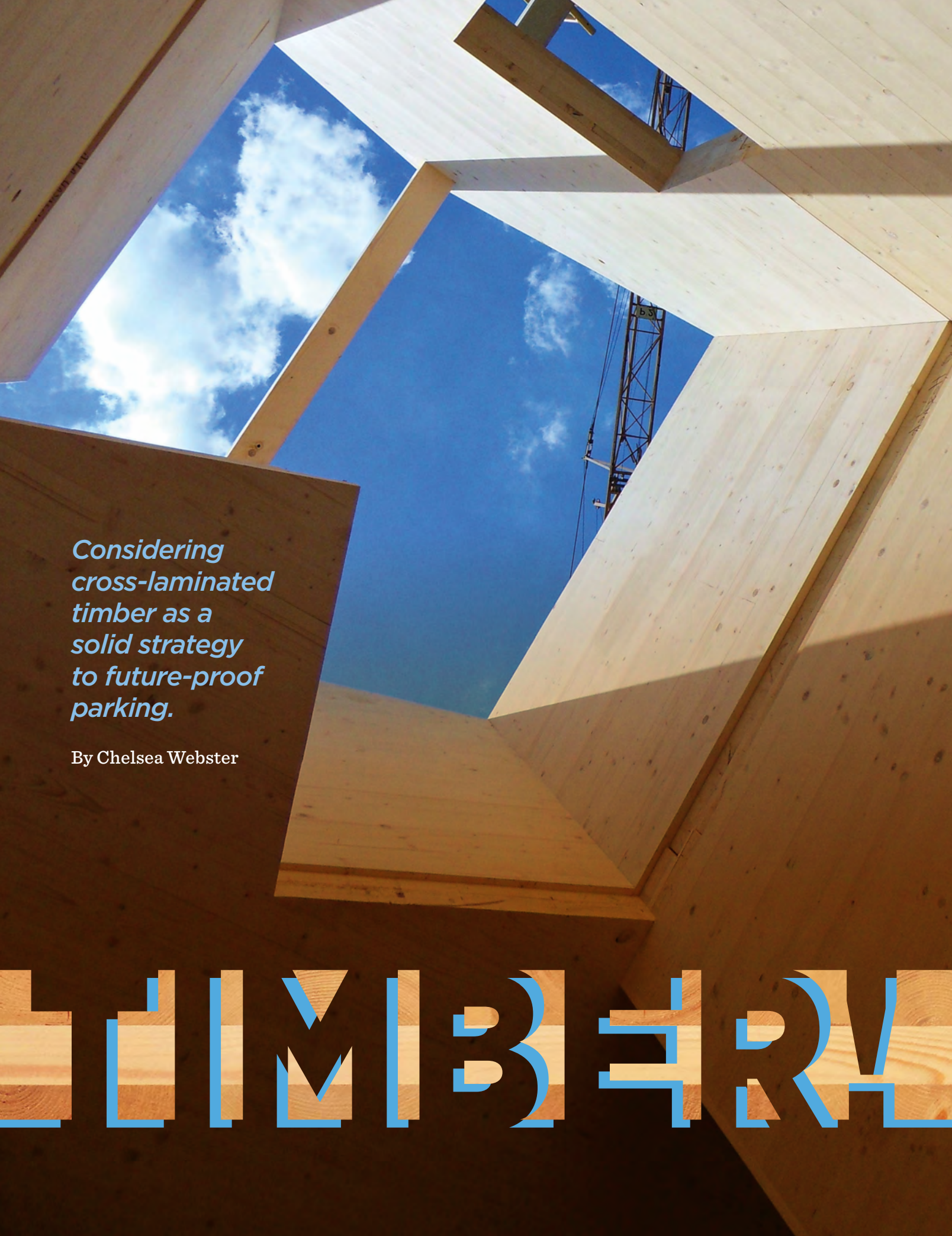

TIMBER

Considering cross-laminated timber as a solid strategy to future-proof parking.

By Chelsea Webster

BUILDING A PARKING FACILITY IS EXPENSIVE— not only because of the land, permits and red tape, and technology you have to incorporate into the facility, but also because of the material and construction costs. To make matters worse, after sinking piles of money into the project, some parking structures end up being pretty ugly—think the common six-story, 25-year-old cracking concrete monstrosities. They're not really what you'd want to showcase your newest parking technology and investments in.

There is also a huge push from many directions to be more environmentally conscious in our endeavors—things such as LEED certification, Parksmart certification, sustainability, and new tech, including solar panels that shade parking lots and putting lights on a sensor system.

We recognize that we need to make changes in parking. But what?

A term we've heard a lot lately is "future-proofing." A couple key trends the parking industry has seen for new parking facilities are:

1. Mixed use developments: parking, commercial, residential, or some combination of these all under one roof.
2. Convertibility: meaning that at the end of their parking lifespan, with some modifications, garages can have another purpose, such as retail, public gathering places, or special event space (stadium, concert hall, etc.).

I am not discounting the value and purpose of our existing parking structures. But as new ones are built, we need to plan for their futures better than we did for those of their predecessors.

So how can we plan for the future of parking infrastructure while making it cost less, be more environmentally friendly, and look nice enough that people want to use it for more than just temporary vehicle storage?

Enter Cross-laminated Timber

Cross-laminated timber (CLT, also known as mass timber) is an engineered wood product made by gluing planks together to form layers and gluing layers together (perpendicularly) to form panels. Think of the board game Jenga. The panels are used in construction for walls, floors, and framing, either exclusively using CLT or in conjunction with other building materials (steel, concrete, etc.).[1] CLT performs similarly to traditional concrete elements and was meant to replace all sorts of materials, especially stone and masonry components.[2]

More facts:

- More layers means greater strength, with the typical panel consisting of three to seven layers.
- Panels range anywhere from 2 to 18 feet in width and 40 to 98 feet in length, depending on the production facility and purpose of the panel.[3]
- Load-bearing for large panels is around 82,000 pounds.
- It's great for buildings in the 40-story or 500-foot-tall range.
- It has comparable structural performance as traditional concrete elements.

APA—THE ENGINEERED WOOD ASSOCIATION

Why Use CLT?

The most common benefits of CLT are its light weight, faster construction time, environmental impact, and cost savings during construction and installation. Let me explain:

- **Weight:** Significantly less weight is held by the CLT structure than one with traditional building materials such as concrete. Less weight means fewer demands on the foundation, and the ability to build tall structures as the base can support a higher volume of materials. It's also less dense, which means it does not transmit as much noise.
- **Speed:** CLT is a prefabricated material, so panels that meet exact sizes and specifications (such as locations of door or window openings) can be made in advance. This reduces construction time, especially because there are many production facilities across North America.
- **Environment:** Mass timber is a renewable resource, in that trees used to make the panels come from sustainably managed forests that are planted and regrown (tree harvesting is currently outpaced by tree replanting in the U.S.). Trees are also CO^2 negative, meaning wood absorbs the gas rather than contributing to our pollution problem (900kg of CO^2 absorbed per ton[4]). Each cubic meter of wood saves two tons of emissions, resulting in a savings of 50,000 tons for a 40-story building.[5] And best of all, it's made primarily from trees infected with mountain pine beetle that would have had to be removed and destroyed regardless.[6]
- **Cost:** Foundation requirements are reduced significantly when CLT is used for building thanks to decreased weight. Labor requirements are also reduced as specialists aren't required,[7] and construction can be completed sooner, meaning the building can open and start generating revenue faster. Finally, CLT has excellent thermal insulation and air tightness and can help save on related costs in colder climates.[8]

Why Not Use Mass Timber?

CLT is a relatively new development in building materials. Although it has been used successfully across Europe for more than a decade, North America has been slow to adopt the technology. That's partly due to a previous lack of production facilities and partly due to a lack of examples and case studies proving the success of CLT.

Although mass timber is certainly catching on, there's still a great deal of research to be done on the longevity, durability, and conditions under which CLT would be a good choice of building material.

I spoke with John Nairn, professor of mechanical engineering at Oregon State University and an avid researcher of CLT.[9] When it comes to mass timber, his biggest concern with the structural functionality of the material is cracking. If not dried properly, or exposed to changes in moisture content, the wood cracks and loses structural integrity.

I also asked John if cars constantly driving and parking in the structure cause vibrations, noise, or other mechanical stress issues. It turns out that vibrations and noise are actually dampened by wood constructions, so this is actually a benefit over other materials.

Addressing the Elephant(s) in the Room

It's made of wood. Will my parking structure catch fire?

It's understandable that many people would assume that because it's made of wood, it's easily combustible. In reality, CLT is actually difficult to set on fire, and one of the best properties is that it attempts to put itself out if it catches fire.[10]

When designing a CLT-based building, it's important to note that thicker panels (due to more layers, not thicker boards) are more fire-retardant than thinner ones. Also, vertical panels (such as walls) are more resistant to flames than horizontal panels (such as ceilings).[11]

I hope it goes without saying that you should consult a professional in the field and follow all building standards. For those interested, CLT is recognized in the international building code, and both the U.S. and Canada have handbooks on building with CLT.

Can CLT Be Used for Parking Structures?

My answer for you (after much research and interviewing Nairn) is a definite yes—with some considerations.

The first thing to think about is your climate. Wood components of CLT are ideally dried to within 1 to 3 percent moisture and then remain at the same moisture content. So, if you're in a humid location such as New Orleans, La; Atlanta, Ga.; or almost anywhere in Florida, you'll need to have the panels made nearby so they don't absorb the moisture in the air once shipped and used in construction.

Riverfront Square: 2 million square feet of offices, 2,000 residential units, a hotel, public space, and cultural facilities comprise the three-building project. This is slated to be the biggest CLT project in the U.S. to date.

That being said, rainy climates such as Vancouver, Canada, and Seattle, Wash., are some of the most prominent (North American) pioneers when it comes to building projects using CLT. Issues occur when there is a *change* in the environment—the resulting residual shrinkage and expansion causes problems, not any given climate itself.

Also of note are particularly snowy climates, but efficient snow removal (as in before it melts into the wood) should combat this issue. Another option is coating the panels to be waterproof, although this would add to the cost of the material. Salt and sand used to combat snow are unlikely to be an issue if panels are properly sealed.

The second thing to think about is maintaining a consistent temperature. CLT cracks the least when it's kept at a relatively consistent temperature. So, if you're in a climate that varies drastically between seasons, it would be necessary to manually control the temperature on an ongoing basis.

The third consideration is the quality of the CLT panels. A CLT panel with thinner but more layers is better resistant to fire and cracking, can handle more weight, and is generally better prepared to handle other issues. However, these quality concerns often come at a higher price, and it may also be more difficult to find a production facility willing to accommodate.

Mitigating Challenges

Considering the above challenges, there are several ways to address the potential issues and overcome them. Each of these items can also be monitored on an ongoing basis as a preventive maintenance plan, and any issues can be addressed before they develop further.

Let's start with cracking. If (or more likely when) cracking does occur, it isn't necessarily a problem. Panels can lose up to 50 percent of their strength and weight-bearing ability once cracked, but if you build to only ever use the panels up to 50 percent of their rated capacity, you won't have an issue with cracks. A durability analysis is a good step to figuring out the rate at which cracks are likely to occur, and planning occupancy and use around the results will mitigate any issues.

Next up is the consistency of the temperature. If you live in a moderate climate, you're set. If you don't, one option is to use mass timber on the inside of a structure—for walls, floors, and ceilings. CLT is a great candidate for an indoor application where temperature is regulated. For parking, a heated or temperature-controlled garage is an ideal use case. Even better, mass timber products work great in conjunction with other materials. So, you could build a concrete foundation and exterior walls and use CLT for the elevator shafts, stairwells, ceilings, and other indoor components.

Finally, let's tackle the quality and availability of CLT. The industry is growing quickly both abroad (Europe and Japan in particular) and domestically (production facilities are opening and expanding on a monthly, if not weekly basis[12]). With new facilities opening regularly, product technology will improve, competition will bring down costs, and new locations will broaden availability and reduce shipping challenges. The logical progression will be that CLT panels will increase in quality (thinner layers, and more of them, with new coatings to prevent delamination and other deterioration) and availability.

Example Structures

Still a bit unsure about mass timber as a building material? Here are some examples from Canada, the U.S., and the U.K. showing successful construction projects.

1. **Dalston Works:** Apartment complex in London, England, made of a cluster of buildings ranging from five to 10 stories high. 33.8 meters tall, 374 days to complete (pre-fabricated pieces made offsite), 121 apartments total plus restaurant and retail space.
2. **Wayne Gretzky Sports Centre:** Located in Brantford, Ontario, Canada, this project used CLT in expansion of the preexisting facility for ceilings, outdoor shelters, indoor panels, and design elements.
3. **Albina Yard:** A four-story office building in Portland, Ore., which was the first U.S. building to use a domestically made CLT structural system.
4. **Riverfront Square:** 2 million square feet of offices, 2,000 residential units, a hotel, public space, and cultural facilities comprise the three-building project. This is slated to be the biggest CLT project in the U.S. to date.

These are just a select few of the projects already planned or completed using mass timber.

What's Next?

More research is definitely on the agenda. Organizations such as the Softwood Lumber Board, Binational Softwood Lumber Council, United States Department of Agriculture, Natural Resources Canada, and Canadian NEWBuildS Network are supporting considerable research around the use of CLT and other mass timber systems.[13] Things such as lifespan, load bearing, and durability all need to be carefully researched, and conditions for proper use documented.

Expanded mass timber production is also on the horizon. Canadian company Structurlam is on the forefront of the mass timber revolution. It produces CLT for projects across North America (Microsoft, Vancouver Convention Centre, Raleigh Durham Airport, Ronald McDonald House, recreation centers, Art Gallery of Ontario, and more) and is supplying materials to all sorts of projects across Canada and the U.S. Structurlam is setting the stage for many successful companies to produce and supply this reinvigorated building essential.

Partnerships are developing among key players as well. Architects, engineers, wood producers, and builders are working together to design and produce sound structures with an environmentally conscious backbone. It's only a matter of time before government becomes involved and starts to regulate (maybe even mandate) eco-friendly building materials such as mass timber. We're at the precipice of a new wave of carbon emission regulations and other restrictions on traditional construction techniques. If all parties come to the table, safety, environmental protection, profits, urban living, and other priorities don't have to compete.

Overall, cross-laminated timber is a promising new application of wood as a safe and efficient building material for residential, commercial, recreational, and parking buildings. It lowers the cost of the project, speeds up construction time, and is environmentally friendly.

By incorporating mass timber in this way, we meet a lot of needs in parking: We stay relevant and innovative for our customers, we meet environmental regulations, and we implement new overhead cost-reduction options. When it comes down to it, who wouldn't like to be on the forefront of bringing these benefits to the parking industry? ◆

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Additional Resources

As always, I'm not a subject matter expert on CLT. I think it's a great technology we can implement in parking, and I'd love to talk more about it with anyone who's interested. Email me at chelsea.webster@getparkplus.com. If you want to research deeper into mass timber, below are some of the sources I recommend.

- **GreenSpec: Everything from the history, manufacturing process, use, and performance of CLT. www.greenspec.co.uk/building-design/cross-laminated-timber-design/**
- **The Future of Timber Construction: Report addressing wood as a building material, trends of the future, the market for wood products, impact of demographics, and changes in society that affect building materials, purposes, and technology. www.clt.info/wp-content/uploads/2017/06/Stora-Enso-The-future-of-timber-construction-EN.pdf**
- **Naturally Wood: Document reviewing wood in an industrial building use case, best practices, applications, and case studies. The main website also provides insights in emerging trends, design, sustainability, and connects you to suppliers in the industry. www.naturallywood.com/sites/default/files/documents/resources/bc_wood_industrial_buildings_0.pdf**