STEFEE KNUDSEN, AIA, LEED AP | AUGUST 28, 2026

Mass Timber in the Learning Environment

A White Paper Series: Part 1 of 3

Since the introduction of modern mass timber technology in North America in 2011, materials like Cross Laminated Timber (CLT) have changed how architects, engineers, and builders approach their work. It has also captured the public imagination, inspiring a wide range of organizations and industries to explore mass timber construction and materials for offices and residential buildings, airports, libraries, academic buildings, medical facilities, concert halls, and more.

As CLT and other engineered wood products have gained traction and a greater variety of buildings have been completed using this technology, the conversation around mass timber has evolved. How do these products handle wear-and-tear over years, especially in public environments that must endure abundant foot traffic and heavy use? How does one maintain and repair mass timber? How do mass timber ceilings perform acoustically, and how do users safely access ceiling-mounted devices? What benefits does mass timber offer public schools in particular as opposed to other more conventional strategies and materials?

In this white paper series, Bora takes on some of the most frequently asked, next-level questions we receive about mass timber school buildings, while addressing perceived implementation challenges specific to school district clients and facilities teams.

ABOVE Lincoln High School Teen Parent Center (Photo credit: Jeremy Bittermann)

ABOUT THE AUTHOR

Stefee Knudsen, AIA, LEED AP, is a Principal at Bora Architecture & Interiors and leader of the firm's K-12 education sector. Stefee's work in Portland's public high schools is leveraging mass timber to cut the carbon impacts of construction while championing healthy, enduring facilities.

New to your mass timber building? Recent occupants of mass timber buildings may want to check out our white paper "Getting Acquainted with Mass Timber" by Bora Associate Principal Scott Barton-Smith, which provides an overview of modern mass timber products while exploring the material's evolving history and unique qualities.

WHY MASS TIMBER?

With so many proven, conventional materials and structural systems to choose from for public school construction, why choose mass timber? Bora's advocacy around mass timber for public schools is motivated by its benefits to student health and wellness, to climate health, and to local economies—particularly in regions like the Pacific Northwest, where forestry plays an important role into our identity, culture and economy.

Children spend up to 90% of their days indoors, making learning environments impactful to physical, emotional, and cognitive health.

BENEFITS FOR STUDENT HEALTH

According to the American Academy of Pediatrics, children spend 80% to 90% of their time indoors[1]. By the time they graduate high school, they will have spent about 15,600 hours in school buildings[2]. With this much indoor time, designing healthy, indoor learning environments is an imperative in modern school design. It requires us to comprehensively consider the materials we select for these spaces, along with their impacts on the physical and emotional health of young learners, educators, and school support staff.

One reason Bora advocates for mass timber in schools is for its biophilic benefits as an exposed finish. Biophilia, a concept popularized by naturalist Edward O. Wilson in his 1984 book of the same name, describes the innate human tendency to seek connections with nature. Research consistently links these connections to positive health outcomes, while their absence correlates with negative ones[3].

Even indoors, natural materials like wood and stone, access to daylight, outside views, fresh air, and the presence of plants have been shown to reduce stress and improve student performance[4]. Studies focused specifically on wood environments find that people in such spaces are more comfortable[5], better able to concentrate[6], and more creative and innovative[7] than those in spaces dominated by manufactured materials. For students in particular, wood in learning environments is associated with lower heart rates, reduced stress[8], and stronger test scores[4].

A further efficient benefit of mass timber is that it can double as both structure and a finish. Unlike steel or concrete structures, a mass timber structure can be left exposed in many spaces, not requiring additional layers of drywall, paint, or other finishes. This contributes in part to the improved air quality generally found in mass timber buildings. As a natural material it is toxin-free, reducing students' passive exposure to VOCs and formaldehyde found in the off-gassing of common finish materials.

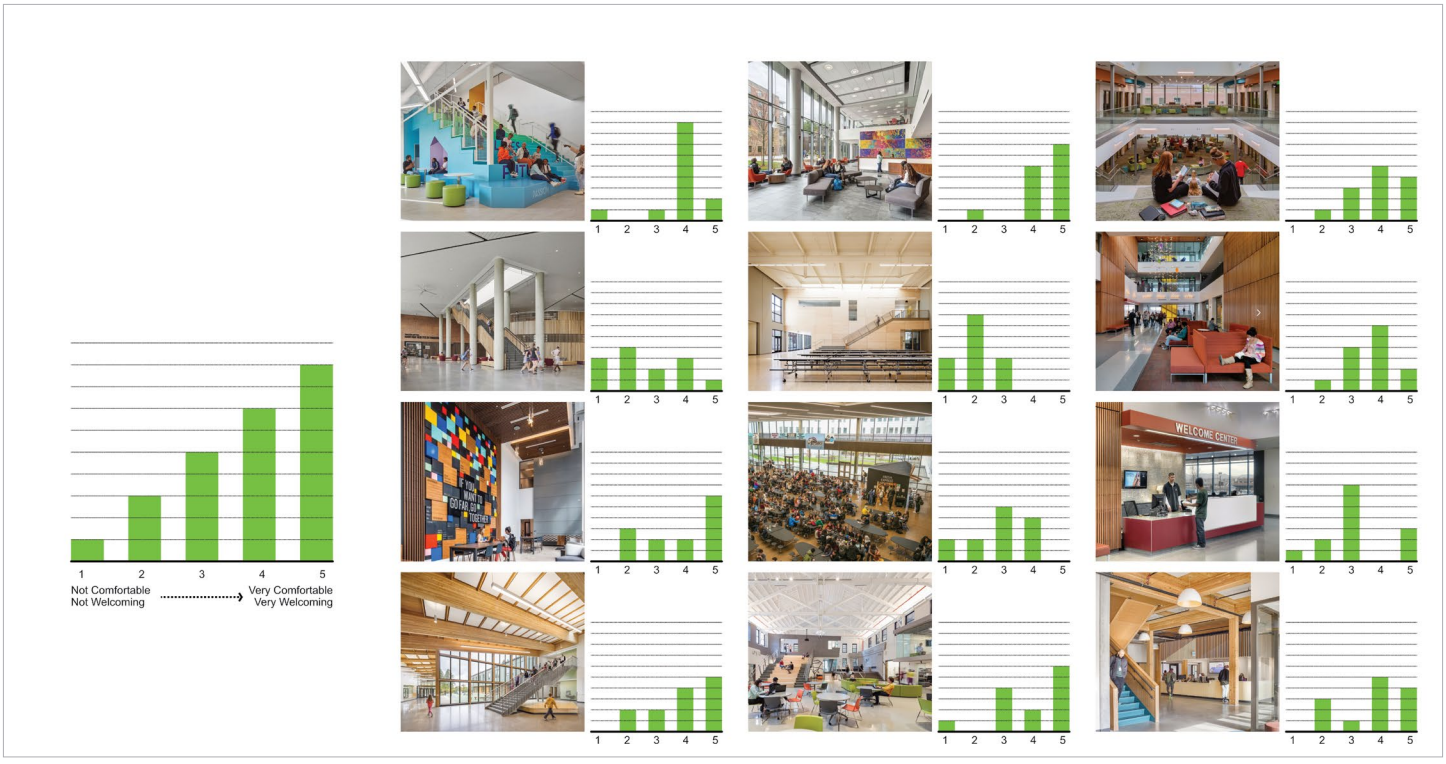
CASE STUDY: IDA B. WELLS HIGH SCHOOL

In Bora's work with Portland Public Schools on the new Ida B. Wells-Barnett High School, the design team surveyed students and community members to learn more about the qualities of spaces that would feel the most welcoming and comfortable. Respondents were asked to rate a collection of images showing a variety of classrooms, auditoriums, cafeterias, gyms, circulation spaces, and outdoor spaces to indicate their preferred environments.

The engagement group responded best to images with clean wood structures, simple materials, daylight, bold colors, and art, feedback that helped establish a student-guided design direction and demonstrated an incredible value-add that mass timber could provide to the client.

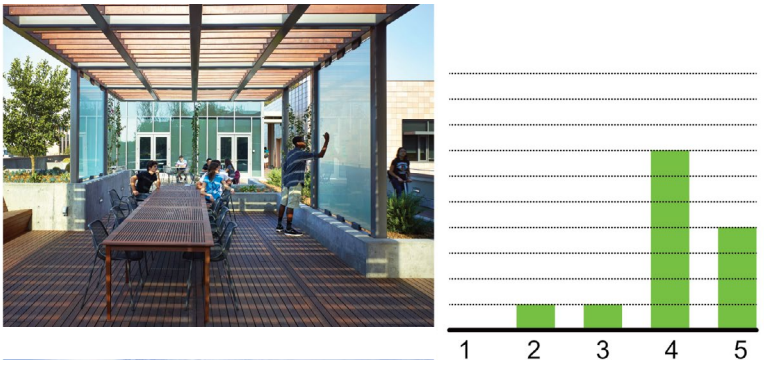
ABOVE Ida B. Wells-Barnett High School's west facade reveals its mass timber structure.

BELOW Results of surveys with the Ida B. Wells community reveal which spaces felt most comfortable and welcoming to them.



OPPOSITE PAGE FAR LEFT + BOTTOM
Students at Creekside Community High School enjoy wood environments both inside and outdoors. (Photo credit: Jeff Amram)

OPPOSITE PAGE ABOVE Upright cedar logs and maple ash feature prominently in the lobby at Vernonia K-12 School. (Photo credit: Lincoln Barbour)



BENEFITS FOR CLIMATE HEALTH

In mass timber design and construction, the conversation around carbon is two-pronged.

"Operational carbon" refers to the carbon emitted through the day-to-day operation of a building, the energy and water it consumes, and the emissions those resources generate.

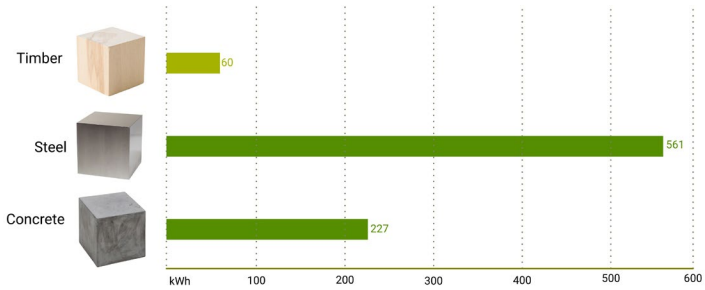
"Embodied carbon" refers to the carbon emitted to produce the materials used to construct the building.

Mass timber offers a significant advantage over steel and concrete in reducing embodied carbon. The Oregon Forest Resources Institute published a study comparing the energy required to produce columns of equal load-bearing capacity made from each of the three materials. As the diagram to the right illustrates, mass timber requires a fraction of the energy that steel or concrete demands, a difference rooted in each material's full life cycle. Wood is a renewable resource that requires less energy to manufacture, and sequesters carbon rather than releasing it. Many mass timber products are also designed for straightforward recycling at end of life. Steel and, to a lesser extent, concrete, can also be recycled, but those processes carry their own significant energy and carbon costs.

CASE STUDY: JEFFERSON HIGH SCHOOL

Early in the design process for Jefferson High School, another Portland Public Schools project, Bora's team analyzed multiple options for renovations and expansion at the existing high school campus comparing mass timber and steel options. In studying embodied carbon for each proposed option, we found that, compared to a steel structure solution, a new mass timber structure could save 1,940 tons of carbon, or $368,000 in social cost, the annual carbon footprint equivalent of 412 people.

In November 2022, the EPA calculated that each ton of carbon released into the atmosphere from any source costs society approximately $190 in increased medical expenses, extreme weather events, crop failures, loss of ecosystems, higher insurance premiums, and more. While no single project can resolve our broader carbon challenges, reducing emissions in the built environment remains an important goal for publicly funded projects, especially for owners with large building portfolios.



ABOVE TOP Embodied carbon comparison

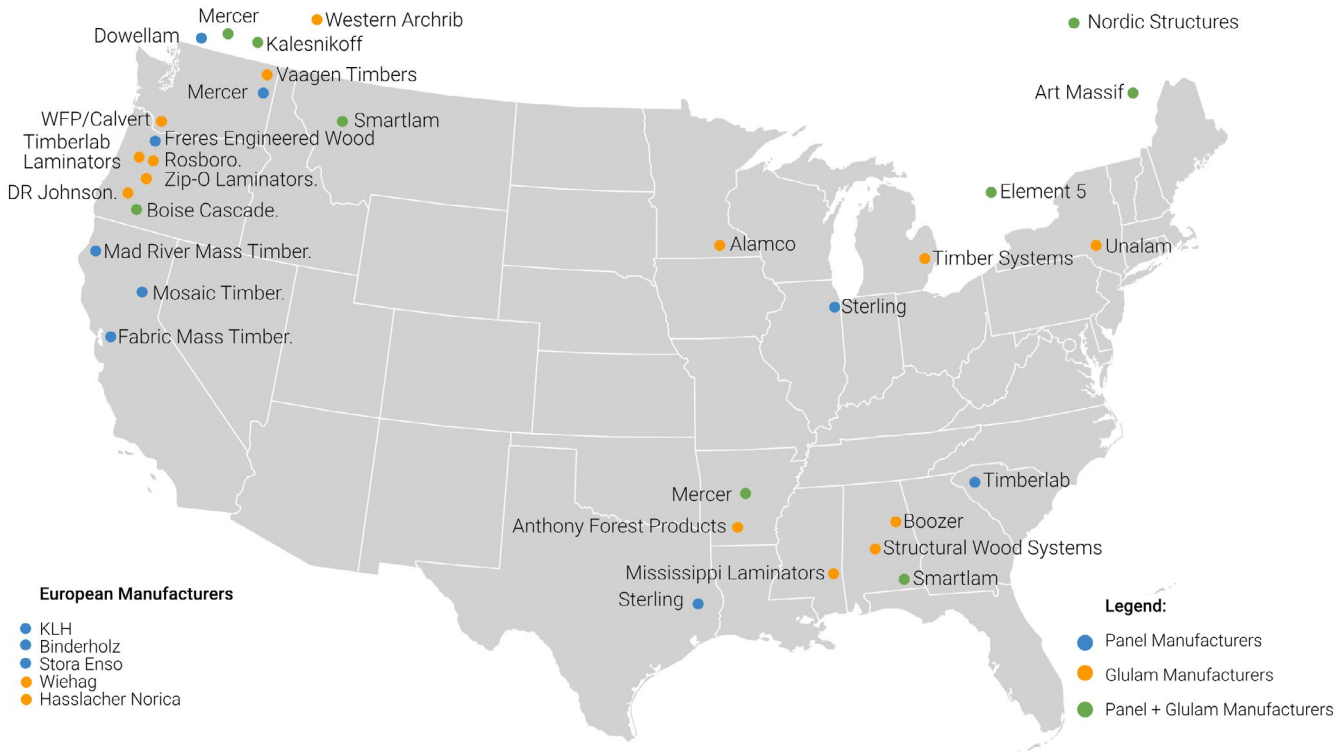
ABOVE BOTTOM Jefferson High School commons featuring a mass timber stucture

LEFT Jefferson High School exterior

OPPOSITE PAGE Mass timber manufacturers as of Q2, 2026

SUPPORTING HEALTHY LOCAL ECONOMIES

The forests of the Pacific Northwest are an incredibly important resource in our region, contributing significantly to the economic backbone and the shared social and cultural identities of local communities. Recent advances in mass timber technology have helped to promote economic growth across the Pacific Northwest, and especially in smaller rural towns with economies that rely on forestry and forest products. One of the reasons Bora advocates for mass timber in schools—urban, suburban, and rural areas alike—is the opportunity that this product presents to strengthen the economic and social connections across communities large and small.



BUILDER'S RISK INSURANCE: LESSONS LEARNED

When school districts initially compare costs for a mass timber structure against more conventional systems, they are often surprised by the high cost of Builder's Risk (BR) insurance. Following are a few reasons why premiums can run high, and why they don't have to:

- Insurers base risk assessments on past project data, and mass timber projects are still relatively few in the U.S. Less experienced insurers tend to take a more conservative approach.
- Insurers unfamiliar with mass timber often group it with conventional "stick-built" framing; but from a fire and risk perspective, mass timber is far less susceptible to water and fire damage.
- The mass timber structure typically represents only a small portion of overall project cost and risk.
- The initial Builder's Risk insurance estimate is a starting point for negotiation, not the final answer.

A general contractor with mass timber experience can help navigate this. In one recent project, contractor-broker collaboration dropped BR insurance costs from nearly $2 million to under $300,000. They accomplished this by clarifying that mass timber was only 7% of project cost, compartmentalizing the timber to one side of the building, and leveraging broker and contractor experience with the material.

Resources

- BR insurance providers with mass timber experience, such as Zurich, are starting to promote the benefits of mass timber on their website and can be a resource for questions.
- Questionnaires, such as this example provided by Woodworks, provide insights into important considerations for the brokers.
- Woodworks' Insurance Playbook addresses specific concerns and risk mitigation strategies.

FREQUENTLY ASKED QUESTIONS

Is mass timber more expensive than steel or concrete construction?

Mass timber is typically cost-competitive with steel when you account for the fact that the exposed structure doubles as finished ceiling, eliminating suspended ceilings, drywall, and associated labor. For publicly funded projects, embodied carbon savings also represent real avoided social cost. Bora's analysis of Jefferson High School found that a mass timber option saved an estimated $368,000 in social cost compared to steel.

Does mass timber require specialized contractors, and is there enough local supply?

Because mass timber takes significant advantage of prefabrication, on-site crews need less specialized experience than one might expect. Components are precision-cut by CNC machinery in a factory and arrive on site as a ready-to-assemble kit of parts. Complex joinery and quality control happen during fabrication, and erection can typically be accomplished with small crews, faster schedules, and less waste than site-built alternatives.

Specialized industry expertise still matters, however. A growing number of regions, like the Pacific Northwest, have developed mature mass timber supply chains. Engaging a design team and general contractor with documented mass timber experience early in preconstruction makes a meaningful difference in efficient design, cost management, and construction coordination.

How does mass timber perform in an earthquake?

Wood's light weight relative to steel and concrete reduces the seismic forces acting on the building, and engineered wood products like CLT and glulam have excellent strength-to-weight ratios well-suited to high-seismic regions. A growing body of completed mass timber projects across the Pacific Northwest, which has the same seismic zone as much of California, demonstrates that these structures can be designed to meet or exceed code requirements for seismic performance.

ABOVE Glulams at Art Rutkin Elementary School
(Photo credit: Josh Partee)

Is mass timber appropriate for all climates?

Mass timber has been successfully built in climates ranging from the rainy Pacific Northwest to humid Southeast to the cold Midwest, with proper detailing, end-grain sealing, envelope testing, and careful construction sequencing being the key to performance in any region. Engineered wood products like CLT and glulam are dimensionally stable even with exposure to the elements during construction. Moisture management protocols are well-established in standard practice. However, products with cross-lamination may be most appropriate in highly humid climates.

What happens to mass timber at the end of a building's life?

Unlike steel or concrete, mass timber members can often be demounted and reused directly in future construction, thanks to the precision fabrication of engineered wood products. When reuse is not possible, wood can be composted or used as biomass fuel, a favorable end-of-life profile that reinforces the material's sustainability case from day one.

ADDITIONAL WHITE PAPERS + RESOURCES

We are always eager to share our research and lessons learned with others to advocate for mass timber as a viable, sustainable design solution.

- Subsequent white papers in this series:
  Paper 2: *Caring for Mass Timber (It's Not That Fragile)*
  Paper 3: *Mass Timber Ceilings: Functional Beauty*
- *Getting Acquainted with Mass Timber*, an introduction for new mass timber building occupants by Bora Associate Principal Scott Barton-Smith.
- *Mass Timber 101: A Podcast*, a user-friendly dialogue around key mass timber topics (available on Spotify and Apple Podcasts)

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