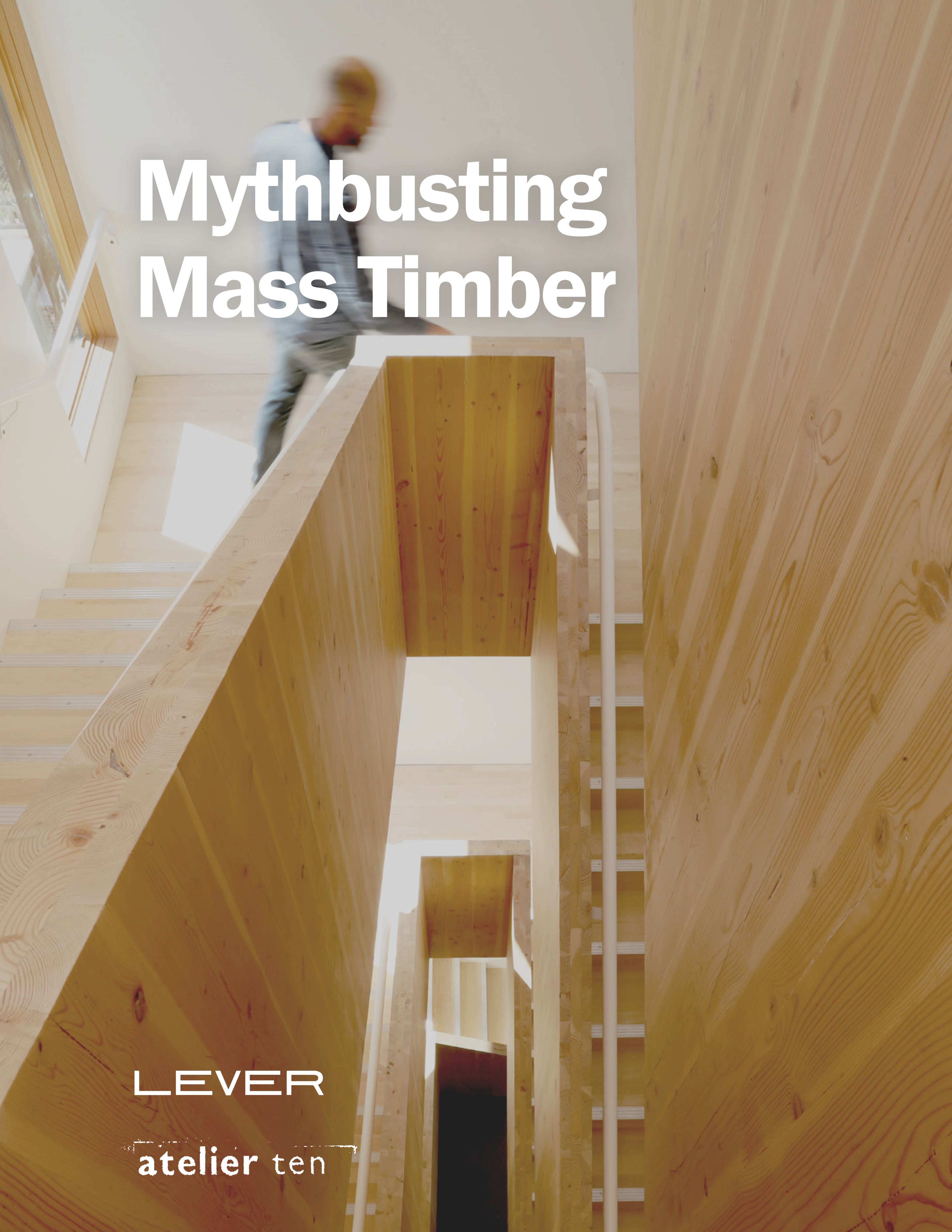
Mythbusting Mass Timber



LEVER

atelier ten

Introduction

Mass timber experts and carbon impact specialists debunk common myths about mass timber construction.

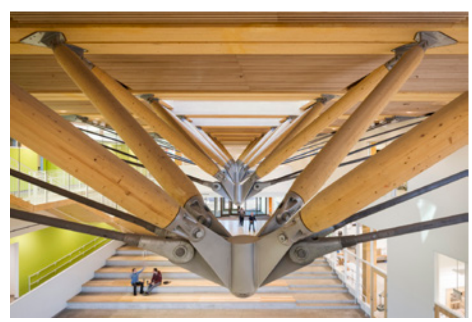
Buildings made of mass timber - layers of wood bonded together - are gaining popularity in the US. Through working together on several projects, Atelier Ten and LEVER Architecture realized misconceptions of the building material were also growing. To promote the responsible use of mass timber, Atelier Ten and LEVER Architecture wrote the following collection of essays discussing the common myths about mass timber construction. These essays hope to promote a more nuanced discussion in the industry to truly capture the potential wood has to offer.

The essays debunk the following common myths and provide guidance for design teams to make the best sourcing choices:

Myth: Mass timber buildings are carbon neutral
Fact: Mass Timber construction can be an important pathway toward carbon neutrality, but there are other critical factors that need to be considered.

Myth: Wood is always more sustainable than concrete
Fact: Solely utilizing wood products does not automatically make buildings more sustainable. It is important to take into account material sourcing and transportation carbon impacts.

Myth: Mass timber buildings absorb carbon emissions
Fact: Trees sequester carbon from the atmosphere. Timber buildings hold carbon absorbed by trees, but timber buildings do not actively absorb carbon.



Myth: All wood is good wood
Fact: Wood products are only as "good" as the forestry practices associated with those products.

As sustainable design and mass timber construction increase in popularity, design teams have unprecedented power to improve forest health, biodiversity, carbon emissions and reduce the impact of climate change.

PHOTOGRAPH BY ALBERT VECERKA/ESTO, UMASS AMHERST JOHN W. OLVER DESIGN BUILDING

Myth: Mass timber buildings are carbon neutral

FACT: Mass timber construction can be an important pathway toward carbon neutrality, but there are other critical factors that need to be considered.

~Amy Leedham, AIA, LEED AP ND, WELL AP

A common misconception about mass timber buildings is that they are carbon neutral, meaning the biogenic carbon stored in the wood offsets the emissions associated with the materials in the building. This is a problematic perception for several reasons. For one thing, there is no universal definition of carbon neutrality when it comes to buildings: The terms ‘carbon neutral’, ‘carbon positive’, and ‘carbon negative’ are often used interchangeably to mean the same thing. On top of this, even when we account for embodied carbon emissions using life cycle assessment, many aspects of the building project are not captured, giving an incomplete picture of the carbon footprint of our building. Finally, even when we have what appears to be robust data for embedded emissions in a building product via a product specific EPD (Environmental Product Declaration), there is still a wide range of uncertainty in that data because of the challenges inherent to this kind of data collection.

It is important not to let perfection get in the way of progress, and we need language to be able to talk about the potential benefits of strategies like mass timber, but it is also important to have a shared understanding of key concepts and be transparent about the limitations of systems we use.

Defining Carbon Neutral

The definition of carbon neutrality is continuously evolving with the rise in green building awareness, practices and standards. Many design teams have turned to mass timber as a strategy to reduce their project’s carbon footprint. In order to understand a project’s carbon impact, we must first look at the evolution of the definition of carbon neutral.

Historically, carbon neutrality has focused only on operational carbon and meant a building was carbon neutral if it could meet its annual operational energy demands with 100% carbon-free energy (operational energy produced without fossil fuels). This could look like an all-electric building with an on-site photovoltaic system which offsets its annual energy demand, a natural gas building that purchases enough offsets to outweigh its gas use, or a portfolio that combines onsite renewable with offsite renewable energy procurement to target 100% carbon free energy.

When focusing on operational carbon only, we fail to account for the energy and carbon expended during the extraction, manufacture, transportation and installation of all the building’s components. According to Architecture 2030, in the next 10 years, 70-90% of carbon emissions from buildings are embodied and locked in by the time the building is occupied. We need to understand and capture all the carbon associated with the project in order to move toward individual buildings and a building industry that are truly carbon neutral.

As the industry has progressed more methods to measure carbon, the definition of carbon neutrality has evolved to capture the rest of the carbon associated with buildings. The International Living Future Institute Zero Carbon certification is one of the few sources that provides a clear path for how to achieve embodied carbon neutrality. First, reduce embodied emissions by at least 10% through design and procurement decisions, and then offset the rest. This is as clear a pathway as can be expected and yet only poses more questions. How can we optimize the design? What counts as an offset? How do I measure the embodied carbon footprint to know how much to offset?

Whichever definition of carbon neutrality is used, mass timber construction using sustainably harvested wood can offer the single most effective strategy to reduce embodied carbon in today’s market.

The Missing Pieces

To evaluate the original question of whether a mass timber building is carbon neutral, we need to consider how embodied carbon is measured. Life Cycle Assessment, or LCA, is the primary mechanism for estimating the embodied carbon emissions in our buildings. Because there is no way to measure actual emissions once the building is built (at least for now), LCA uses assumptions, which are ideally as project-specific as possible, to predict the estimated emissions.

While LCA has provided a useful method of estimating embodied carbon in buildings there are still some missing pieces in achieving true carbon neutrality. LCA standards primarily focus on building foundation, structure, and enclosure, which overlooks some critical elements of a project's carbon footprint. For example, embodied emissions associated with interior materials and finishes are often equivalent to those of the enclosure, and yet they are typically excluded from LCA. HVAC systems and site materials often contribute a further 15-25% and are even less likely to be included in LCA. In fact, when we expand the system boundary from foundation, structure and enclosure, to include interiors, HVAC and site materials, we see a 65-75% increase in the embodied carbon footprint of a project. If we are truly going to achieve carbon neutral - or better yet carbon negative - buildings, we need to address the missing pieces. This more holistic picture will give us better insight into just how effective mass timber construction is at reducing total embodied carbon.

To help illustrate this, we can look at the following two project examples (see Figure 1). Building 1 is a five-story mass timber office building and building 2 is a mass timber high rise. When limiting the scope of the LCA to just core and shell elements, building 1 has a GWP intensity of 49 kgco2e/m2 which is extremely low, but not carbon neutral. Building 2 shows a GWP intensity of -53, indicating that the wood structure is able to offset the emissions of the other structure and enclosure materials. However, when we account for interior materials and estimated HVAC systems, both projects have GWP intensities above 100 kgco2e/m2. While it is certainly possible for some specialty buildings to use primarily bio-based materials and have a negative embodied carbon footprint, even when accounting for full project, for the majority of mass timber buildings, especially at the larger scale, this will not be possible given current material technologies.

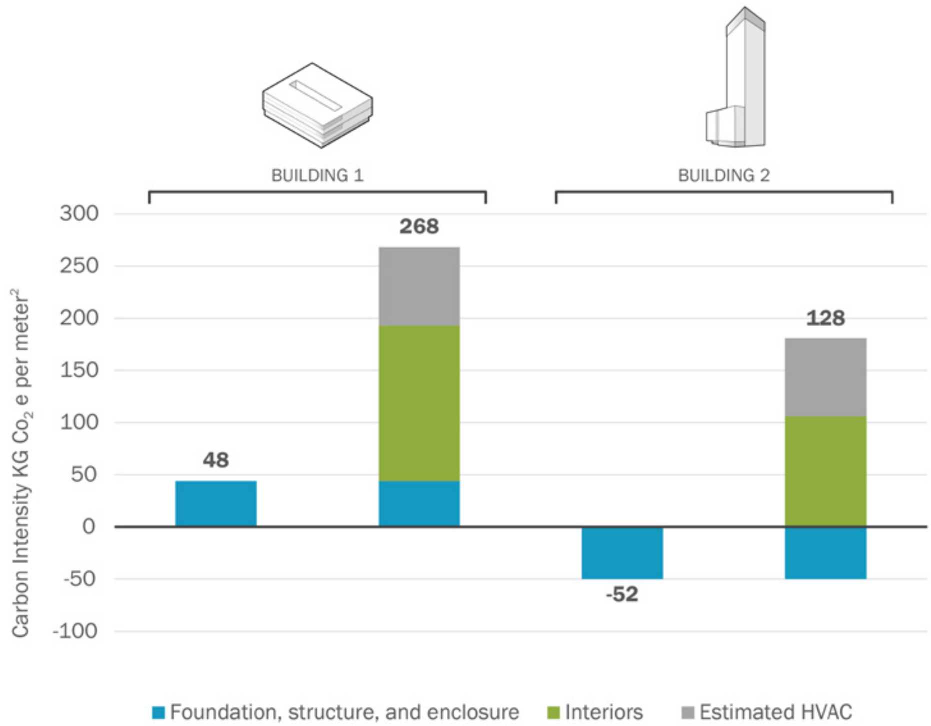


FIGURE 1 – Carbon intensity

Conclusion

Embodied carbon is still a relatively new focus for building projects, and the industry is rapidly evolving. For all projects, but especially mass timber projects with ambitious carbon goals, it is essential to establish agreed upon and clear definitions for carbon neutrality. Current best practice suggests measuring actual energy use and including as much building scope as possible in a life cycle assessment to establish the embodied carbon footprint before offsetting. As indicated in the example above, if we limit the scope of what we measure, we are not able to actually offset the emissions associated with the building, and thus we are not actually carbon neutral. Design teams can also continue to push for more transparency from manufacturers by requesting product specific EPDs for interior products and mechanical equipment. The more we are able to measure, the more information we have to drive innovation and achieve carbon neutrality.

PHOTOGRAPH BY GARRETT ROWLAND, ADIDAS EVE

Myth: Wood is always more sustainable than concrete

FACT: Solely utilizing wood products does not automatically make buildings more sustainable. It is important to take into account material sourcing and transportation carbon impacts.

~Jonathan Heppner, AIA, NCARB

Within the field of architecture, it is often cited that buildings account for 39% of global emissions (11% transportation and construction activity, and 28% building energy use). Global building floor area is projected to double in the next 30 years to accommodate an additional three billion people. According to industry projections, global cement demand, a concrete ingredient, will increase 43-72% by 2050. The urgency to build and utilize available strategies to reduce the built environment's impact on global warming has never been higher. Shifting away from the use of fossil fuels in production, and substituting a share of lower emitting ingredients, present viable improvements. However, as recent reports present, there is no silver bullet, and every viable alternative needs to be on the table, including concrete.

FIGURE 1 – Framework building advanced the acceptance of mass timber in current building codes. Image: LEVER Architecture

In evaluating wood alternatives, concrete is often framed in unflattering terms, however solely utilizing wood alone cannot solve this issue. Project-specific life cycle assessments have confirmed that the details of how wood is sourced and how it is delivered to the jobsite can result in final life cycle emissions and associated embodied carbon (carbon emitted prior to the building's operation) values comparative to an all-concrete structure. Ignoring these factors can undo the positive impacts wood has to offer and create a structure where concrete performs comparably from an emissions standpoint.

An Emissions Reduction Framework

In the case of the Framework 12-story mass timber high-rise project, one of the project's stated objectives was to reduce the building's overall global warming potential through utilization of a domestically sourced timber structure. (Figure 1).

Upon closer analysis, within a comparative life cycle assessment, these relevant benefits were discovered to be potentially undone if wood was procured without carefully managing its environmental performance and associated emissions. Sourcing wood from forests that were not sustainably managed, or delivering wood products from long distances to the site, significantly diminished the positive benefits of wood's carbon sequestration potential when compared to the other potential material options, such as concrete available closer to the project site. In considering transportation, the distance of the mass timber products from a local source became a critical component to determine whether or not the project was going to be climate positive, as greater transportation distances translated to higher emission values for its delivery. And relative to sourcing, linking the materials to a sustainably managed forest increased the potential impact and offset. To address these issues the design and engineering team identified three strategies that could be adapted to apply more broadly to other mass timber projects:

Strategy 1: Ensure wood is harvested from forests that are replenished at a rate that sustains the carbon pool in the forest region, noting that well-managed healthy forests provide a wealth of beneficial attributes that are not measured by carbon emissions.

Strategy 2: Combine various measures that reduce emissions by keeping wood products out of landfills. Design the building to accommodate deconstruction and reuse of mass timber elements, extending their sequestration capability.

Strategy 3: Focus on lowering transportation emissions and prioritize suppliers that use cleaner fuel and more efficient equipment and vehicles, as well as source from suppliers within the region of the project, supporting development of a supply chain closer to the project site.

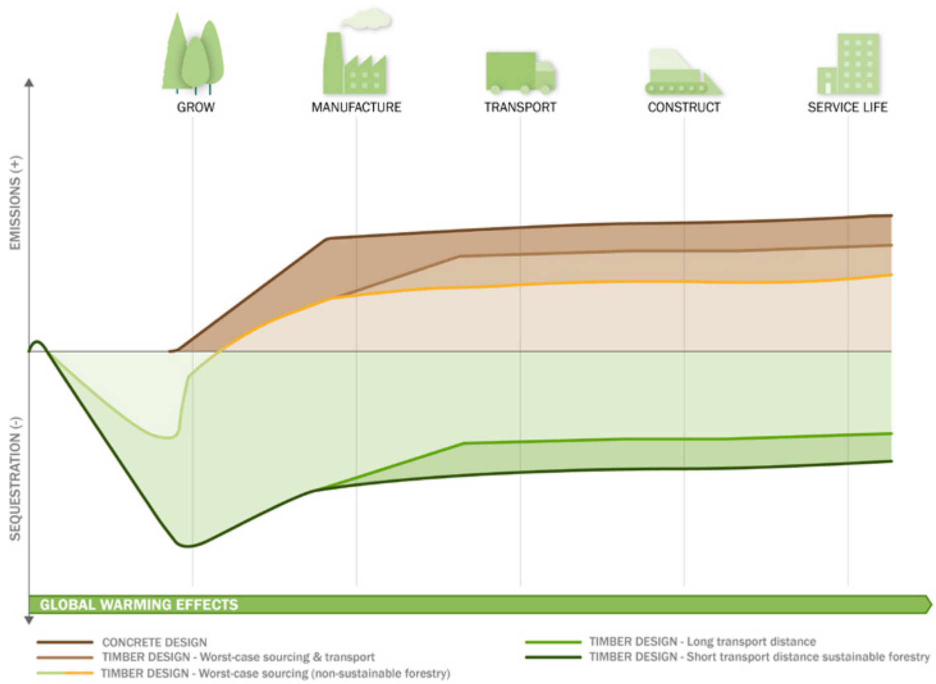


FIGURE 2 – Comparison of carbon emissions between timber design and concrete design over the life cycle of structural materials in a 12-story tower, when wood is not sourced from sustainably managed forests Adapted from: Arup/Bruce King

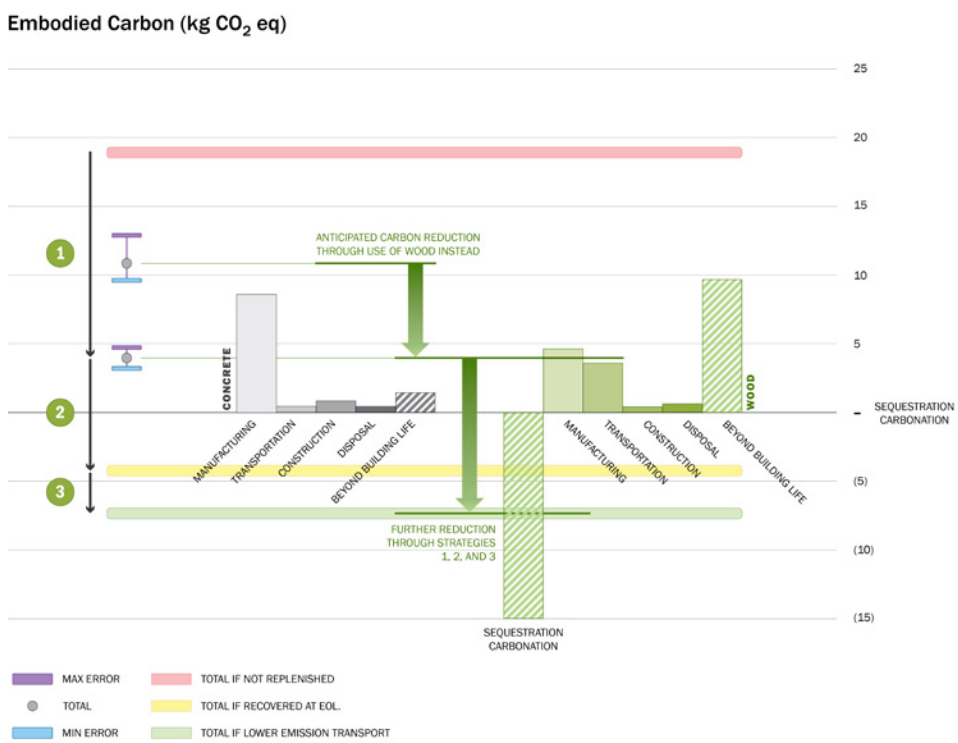


FIGURE 3 – Figure conceptually showing approximate embodied carbon of proposed wood structure compared to conventional concrete structure. Results indicate that some of the key strategies for reducing embodied carbon, shown in numbered circles, are: (1) Source from replenished harvest areas (2) Design for optimal End of Life (3) Arrange for lower emission transport. Adapted from: Arup

The basis of these strategies and related carbon comparisons focused the team on evaluating options, with the goal of improving the mass timber supply chain infrastructure to make all the wood options they were considering more feasible rather than using the carbon data of the project to disparage other material industries. The life-cycle embodied carbon of the wood structure could end up higher or lower than that of the concrete and steel structure. The strategies influenced how the project team evaluated the sourcing for the wood products, and presented considerations for how the design and engineering team might provide opportunities to allow reuse of the wood components after they fully serve the building to optimize other life-cycle stages.

A Concrete Opportunity

From a pragmatic standpoint, there is a major flaw in the assumption that wood is always more sustainable than concrete and steel. All wood buildings literally rely heavily on their concrete (and steel) components for foundations, cores, or as toppings on mass timber floor systems. These materials work as a collaborative team in the vast majority of mass timber buildings. Hybrid systems (Figures 3 and 4) fundamentally exist to take advantage of each material's unique structural or architectural qualities and provide alternatives to satisfy the unique conditions each project may present. Consideration of potential strategies for optimizing both wood and concrete technologies when evaluating the embodied carbon of a project is imperative, to take advantage of the unique properties of each.

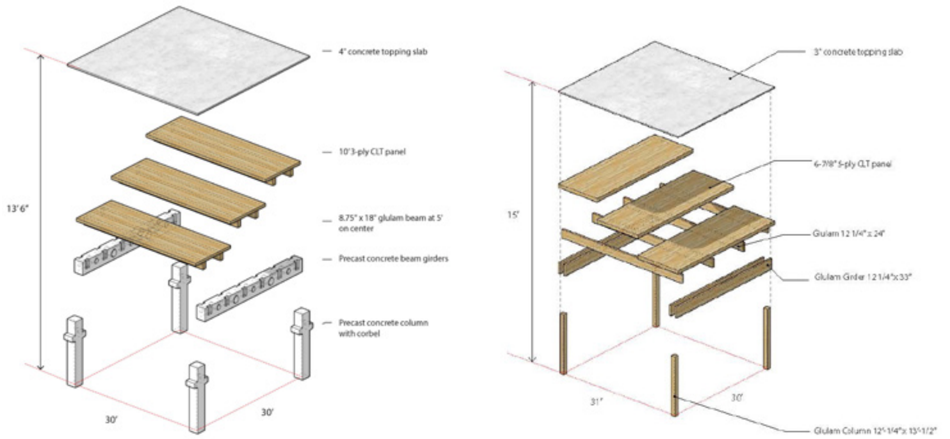


FIGURE 4 – Example of two hybrid systems utilized in Adidas North American HQ. Image: LEVER Architecture

FIGURE 5 – Adidas North American HQ utilized a pre-cast concrete frame with prefabricated mass timber floor decks to reduce construction costs and schedule for a financially viable project. Image: LEVER Architecture

It's an unavoidable fact that concrete is an extraction based technology with significant implications in a structure's embodied carbon emissions. After water, concrete is the most widely utilized substance on the planet and current projections suggest that between now and 2050, over 1.5 trillion square feet of new construction and major renovations will take place worldwide utilizing this resource. Concrete represents 8% of global emissions[1] as limestone is burned to create the elements of the concrete mix. However, innovation in concrete production is fundamental to address issues of global warming. America's cement manufacturers have committed to the goal of reaching carbon neutrality throughout the cement-concrete-construction value chain by 2050.

Due to its prevalence and the proportional scale of impact, it is imperative design teams consider concrete manufacturers with lower emitting options and work to develop specifications focused on the reduction of carbon in all categories of materials, including wood. Promising developments are occurring within the concrete industry and results of material research underway indicate advancement in the development of carbon negative concrete. Much like mass timber, there is movement within the concrete industry to address the factors affecting its global warming potential. The issues the industry is facing may sound familiar to mass timber advocates: overcoming economic barriers, determining how to produce at scale, reducing emissions in the supply chain, and determination of ways to incentivize products with lower global warming potential that may be currently economically infeasible. The development of concrete as a carbon negative material can reduce Co2 emissions by 70% using carbon instead of water to cure a special cement. Manufacturers[2] are exploring the reuse of Co2 waste captured from ammonia and gas plants. Waste Co2 is converted into oxalic or citric acid, then injected into the mix as a curing agent, resulting in a concrete that captures four times more carbon. Another company[3] is developing a type of concrete that foregoes the need for cement and has been confirmed carbon negative following lab tests. While not yet widely available or produced at scale, such steps make it clear that the race is on, and the era of carbon negative concrete is rapidly approaching.

A wide range of factors defining a building's measure of sustainability are within the control of the design team. Use of recycled materials within the mix, distance materials are procured from the project site, optimization of the structural system, and cure times specified and associated concrete admixtures, can all be modulated to reduce the carbon emissions of a project. For a holistic approach to reducing a building's carbon footprint, all options should be on the table.

PHOTOGRAPH BY JEREMY BITTERMAN, ALBINA YARD

Myth: Mass timber buildings absorb carbon emissions

FACT: Trees sequester carbon from the atmosphere. Timber buildings hold carbon absorbed by trees, but timber buildings do not actively absorb carbon.

~Maggie Smith, LEED AP BD+C, LFA

Wood is about 50% carbon and timber building products do store carbon for the service life of the building because of a phenomenon called biogenic carbon sequestration. In the context of mass timber construction, sequestration refers to the storage of biogenic carbon in wood. Trees remove carbon dioxide (CO2) from the atmosphere during the photosynthesis process and store it in the biomass of the tree. The longer a tree lives, the more carbon dioxide it can remove from the atmosphere. When trees either die of natural causes or are harvested for lumber, dead trees are no longer able to absorb carbon dioxide. However, the carbon dioxide absorbed over the lifetime of the tree is stored in the wood until it is released through burning or decomposition.

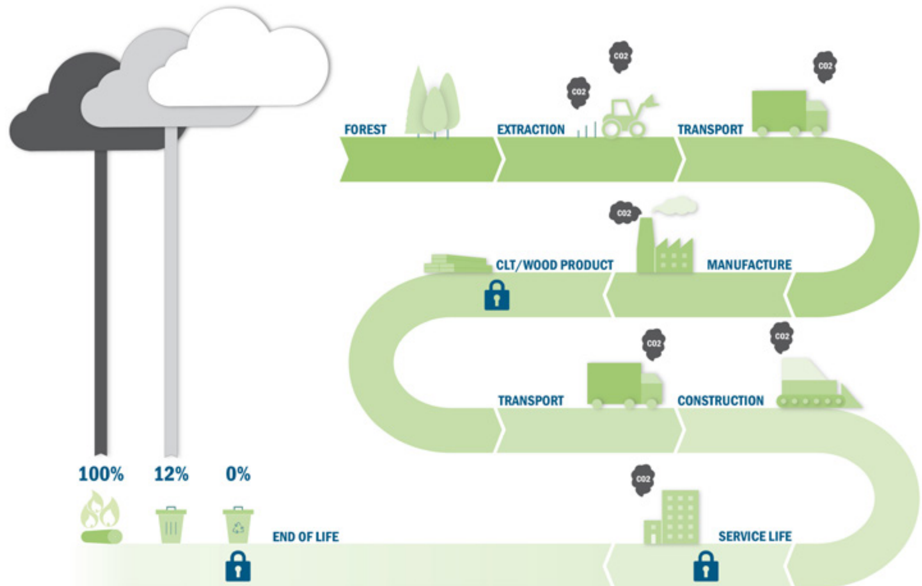


FIGURE 1 – Mass Timber Life Cycle Stages. The graphic above shows the carbon intake, sequestration, and emissions associated with mass timber from forest to end of life.

This simplified description of biogenic carbon sequestration touches on a few of the key factors that affect the environmental impact of building with wood: forest management and end-of-life treatment; two critical components in the carbon storage benefit of mass timber construction.

In short, trees store carbon in their wood. Typically, mass timber stores more carbon than it takes to harvest, transport and manufacture them. That is to say, even after accounting for emissions from harvesting, transporting, and manufacturing, mass timber is often still a carbon negative building material by the time it arrives to a project site. This is dependent on sustainable forest management and end of life treatment. At the most basic level, timber construction is only truly sustainable if it results in a net increase in regional carbon stores and forest health. Current carbon accounting protocols don't account for the impact of logging on forest carbon. Forest carbon, which is all the carbon stored in a forest including soils, is typically left out of carbon accounting of wood products.

The amount of carbon stored in timber products is a function of many factors and accurately accounting for the carbon footprint of any timber product is a very complex process. The building industry relies on established guidelines and technical guidance in the form of product category rules (PCRs), life cycle assessments (LCAs), and environmental product declarations (EPDs) to determine the carbon footprint of a building. The Mass Timber Life Cycle Stages diagram illustrates the life cycle stages and key carbon flows of wood construction elements.

Sustainable Forestry Accounting

Timber sequesters carbon prior to conversion into a building product, and that carbon is then stored within the structure of mass timber buildings. Current LCA guidelines rely on national data to represent forest management and harvest, which does not represent the wide range of practices in use today.

The core rules for environmental product declarations of construction products and services under the International Organization of Specifications state that biogenic carbon sequestration may only be counted for wood that comes from forests with stable or increasing forest carbon stocks (ISO 21930:2017 clause 7.2.11). Forest carbon stock refers to the amount of carbon sequestered within a forest ecosystem, including in wood biomass and soil. The guidance states that "national reporting under the United Nations Framework Convention on Climate Change (UNFCCC) can be used to identify forests with stable or increasing forest carbon stocks." The current UNFCCC for the United States and Canada show that forest carbon stocks have increased over the past few years, qualifying any wood products from North American to claim sequestration credit.[4]

However, there are a wide range of forestry practices in use today in North America. To ensure a continued increase in forest carbon stocks in the coming years, architects should aim to source wood from sustainable forests, ask for transparency during procurement and specify materials with sustainable forestry certifications such as the Forest Stewardship Council (FSC).

One example, the San Mateo County Civic Center in Redwood City, CA, is a 5-story mass timber building using sustainably sourced glulam and cross laminated timber. The project, initially designed as a concrete building, demonstrates a 70% reduction in embodied carbon compared to the original concrete design. The structure sequesters over 2,500 metric tons of carbon – equivalent to taking 540 gas-powered vehicles off the road for a year.

LIFE CYCLE ANALYSIS: GLOBAL WARMING POTENTIAL

8975 COB3 - 60% CD

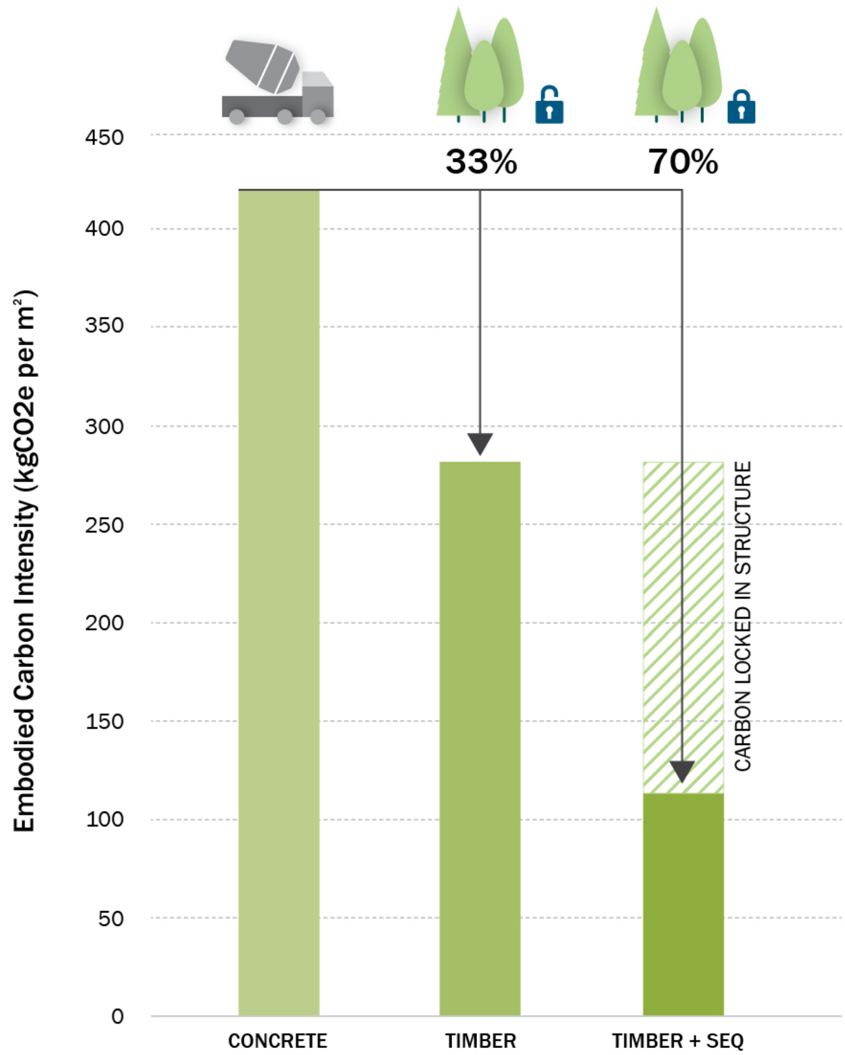


FIGURE 2 – The image above shows the progressive improvement to embodied carbon over the course of the project. Starting from the original concrete structure baseline, the project achieved a 33% reduction by switching to mass timber, an additional 7% (40% total) reduction from optimizations to concrete, insulation, and gypsum board, and an additional 30% (70% total) offset after accounting for the carbon sequestered in the mass timber.

Biogenic Carbon Emissions

In order to fully calculate biogenic carbon sequestration, it is critical to capture the full cradle-to-grave carbon emissions of wood. While carbon is stored in mass timber for the life of the project, the end-of-life treatment of the wood can have a significant impact on the life cycle biogenic carbon emissions.

If the wood is ultimately incinerated, all carbon that was previously sequestered in the wood is immediately released, negating all carbon benefits. More commonly in North America, wood will be sent to a landfill where it slowly decomposes over time, releasing previously stored CO2 – similar to a tree decomposing in a forest. However, in landfills, the decomposition process happens extremely slowly. Many landfills include gas capture which prevents some of the greenhouse gas emissions from reaching the atmosphere. According to the EPA Waste Reduction Model (WARM), only 12% of sequestered carbon is ultimately emitted when wood ends up in a North American landfill.[5] One way teams can extend the length of time the full biogenic carbon content is stored in wood, is by salvaging and recycling wood, pushing off the end-of-life carbon release.

While there is uncertainty in the end-of-life treatment of wood in new buildings, teams have the ability to influence end-of-life treatment of materials in existing buildings on project sites. To the greatest extent possible, teams should avoid combustion, as 100% of carbon held in timber products is released back into the atmosphere when wood is burned. In new buildings, teams can design for deconstructability to enable future reuse of building materials, including wood products. When wood products are salvaged, reclaimed, or recycled, the sequestered carbon is held and we can push off the end-of-life release of carbon, reducing global CO2 emissions.

Conclusion

Mass timber is growing in popularity thanks to its ability to hold onto carbon sequestered by the trees up until the point of harvest. The sequestered carbon gives mass timber the ability to be a carbon-negative building product. While there is a lot of uncertainty around biogenic sequestration accounting, two critical components are sustainable forestry and end-of-life treatment. Sourcing timber that is FSC certified helps ensure that forest carbon stocks continue to grow, and thoughtful end-of-life treatment ensures that the majority of carbon remains sequestered, even after the building reaches the end of life.

PHOTOGRAPH BY JEREMY BITTERMAN, L ANGOLO ESTATE

Myth: All wood is good wood

FACT: Wood products are only as "good" as the forestry practices associated with those products. Unless we ask how forests are being managed, we have no way of knowing if a wood product is helping or hindering progress.[6]

~Timothy Cooke, AIA, LEED AP

There is a common misconception that all wood sourced from the US is essentially "good". In part, this idea stems from the assumption that bio-based materials are inherently better for the environment and the climate than their inorganic counterparts such as steel and concrete.

The wood products industry has the tremendous potential to help solve our climate crisis and support healthy and resilient ecosystems that provide the clean air and water that we all depend on—all while lifting up rural communities whose economies have disproportionately suffered over the last few decades. These potential benefits can only be realized, though, if we ask tough questions and educate ourselves as consumers so that we can make the best choices when selecting the wood that we use in our buildings.

To illustrate why we need to better understand the forests that our wood is being sourced from, we will use the example of log size to show how starkly different ecological outcomes can be elided by oversimplified conceptions of forest ecosystems and sustainable forestry. Over the past few years LEVER has regularly encountered the common assertion, usually made by those in the mass timber industry and in the wood products industry in general, that using young, small diameter logs is a good thing for the environment, forest health and resilience, and climate change mitigation, and a positive development within the industry over the last three decades. But if we look more closely at what it means to utilize small diameter logs, we begin to see that knowing the diameter of a log is only the beginning of the story and by itself does not provide enough information to make an informed decision.

The Timber Wars and a Shift in Forestry Approach

In the Pacific Northwest, the sense that small diameter logs are good seems to originate, in part, from the history of logging in the region. The Pacific Northwest is the second largest timber producing region in the US, and during the region's "timber wars"[7] of the 1980s and 90s, when the environmental movement galvanized popular support for the protection of old growth forests on public lands, the stakes of the fight were clear. The story of old growth and why it might need to be preserved was easy to tell and brought advocacy groups together to push back against the timber industry's unchecked harvesting in the region. This struggle to protect ancient forests was compelling and brought attention to the plight of the vanishingly small percentage of old growth forests that remained after a century of rapacious timber harvest.

In the decades since the logging of old growth was largely restricted on federal forest land in the Pacific Northwest, the industry has developed a powerful new message: we are no longer cutting down precious ancient forests, but instead only harvesting young, small diameter trees. As a result, the general public does not need to be concerned about current forestry practices in the region. The logic is simple: if the large diameter logs coming from old growth forests are bad, then it must follow that small diameter logs are good.

We have heard a version of this argument many times, especially when discussing mass timber products. In simple terms the argument goes something like this: we used to cut down old growth trees and mill them into heavy timbers that were used as large beams and columns in grand, mostly industrial buildings of the 20th century. But today, because we have already cut down most of the old growth forests, we now focus on cutting down younger trees, turning them into smaller pieces of lumber that are then glued together to create massive timber panels, beams, and columns (mass timber). Along the way, we've managed to engineer these newer massive timber products to be more dimensionally stable and structurally predictable. We have "innovated" our way out of needing old growth trees to build large commercial wood buildings, and in the process, we have also expanded the market for small trees. Based on this telling of the story, it appears that all is well and good in our Pacific Northwest forests today.

Redefining Sustainable Forestry

As designers and champions of mass timber buildings, we need to be asking, what kinds of trees are we sourcing for our mass timber projects and what kinds of forests do they come from? As old growth logging has diminished over the last half century, the industry has transitioned to producing products that utilize much smaller trees. The industry has gotten so good at utilizing young trees that stands are now typically cut after only 35 to 40 years. So, is this a good thing or a bad thing? The answer, as is often the case, is not so simple.

If we are talking about utilizing small diameter logs that are coming off single-aged, industrial tree plantations that are clearcut on ever shorter rotation cycles, then small diameter logs are categorically not good. If we are talking about taking small diameter logs off a landscape as part of a comprehensive approach to ecological forest management, then small diameter logs are wonderfully positive. To help better understand the differences between a tree plantation and a healthy ecological forest, it is instructive to see examples of these two starkly different approaches to forest management.

Figures 1 and 2 highlight some of the key differences between industrial tree plantations and healthy and thriving forest ecosystems that, in addition to timber production, can also provide multiple climate, ecological, and social benefits. Both photos were taken in the Oregon Coast Range on the same day and within approximately 100 yards of each

FIGURE 1 – A healthy forest ecosystem | Photograph by Timothy Cooke, LEVER Architecture

FIGURE 2 – Tree Plantation | Photograph by Timothy Cooke, LEVER Architecture

other. The first forest is an example of a healthy ecosystem with multiple tree species, ages, and a thriving understory. The second forest is an example of a tree plantation that shows how a single aged stand of just one tree species creates an otherwise lifeless environment, devoid of the plants and animals that one might expect to find in a healthy forest ecosystem (these trees are in fact alive, but because they have been planted so close together and have never been thinned, all of their lower branches have died).

These two images start to illustrate that different forest management practices can lead to strikingly different outcomes. But these differences are not just confined to the structure and relative complexity of a forest ecosystem. It has been shown that forests that are treated as valuable ecosystems—that are managed for multiple benefits in addition to fiber production—have the capacity to improve ecological diversity, foster climate change resilience, reduce catastrophic wildfire risk, while at the same time sustaining the economies of rural communities that have depended on these forests for generations.[8]

In contrast to this wholistic approach to forest management, which is called “ecological forest management”, industrial tree plantations like the one shown above are typically managed more like an industrial agriculture monocrop such as corn or soybeans. At 35 to 40 years old, the trees shown in Image 2 are typically clearcut and the land is replanted with Douglas fir seedlings that must be sprayed with herbicides to eliminate competition from other plant species. This cycle of clearcutting and replanting is technically sustainable in that it provides a sustained yield of timber over the long term, but when we consider the other benefits that forests can provide beyond fiber, these plantations don’t have much to offer, and can in fact have harmful impacts. For example, the large scale clearcuts and herbicide spraying typically used on these Douglas fir monocrops have deleterious effects on water quality and fish habitat. This type of clearcutting also increases soil erosion, landslide risk, and chemical contamination in the waterways that rural communities rely on for drinking water.

Are Sustainable Forestry Certifications Important?

Because the state regulations that govern forest practices on private forest land in the US can sometimes be weak and overly permissive—for example allowing clearcuts up to 120 acres in Oregon—consumers have turned to sustainable forestry certification programs to help ensure that better forestry practices are being used when sourcing wood products.

Certification programs can be an essential tool for consumers that desire a higher level of forest stewardship than the bare minimum that state regulations might require. As is usually the case though, it is important to understand the differences between the various certification programs so that one can make an informed decision. The two most well-known certification programs are run by the Forest Stewardship Council (FSC) and the Sustainable Forestry Initiative (SFI). FSC certification is widely considered to have the most stringent requirements within the US, including comprehensive third-party auditing, and generally stricter limits on clearcut size and higher tree retention requirements. On the other hand, while SFI certified wood products can provide consumers with some additional assurances beyond what might be required by law, the program standards can be vague and contain major loopholes. SFI also relies heavily on plans rather than actions and tends to leave it to companies to interpret and implement those plans. In contrast, FSC is more squarely rooted in ecological forest management principles and has detailed requirements for forest protection, harvesting, and restoration practices. It is also important to note that SFI was originally founded by an industry trade group, the American Forest & Paper Association, in response to the perceived threat that the industry felt FSC posed.[9]

At LEVER, we view FSC as the only program that provides a somewhat imperfect proxy for ecological forestry. If a client is willing to commit to FSC certified wood that is sourced locally, then we know we are not supporting industrial plantation operations that conduct large-scale clearcutting. Sometimes, though, there can be limited FSC availability or cost premiums can be prohibitive for FSC certified wood. In these cases, there are other options available to consumers that can be just as—or more—meaningful and impactful, but they do require more time and effort on the part of the building design and construction team.

Restoration Wood and Tribal Wood Products

In recent years, we have become increasingly interested in the great potential of restoration forestry initiatives to help solve our climate crisis and correct a century of misguided fire exclusion policies on forest lands[10]. If a project team can partner with wood suppliers and fabricators to source wood from these types of restoration projects, these wood sources have the potential to have a profound positive impact on the environment and our society. For example, for both the Oregon Conservation Center[11] and Meyer Memorial Trust[12] projects, LEVER was able to work with Sustainable Northwest, a nonprofit organization based in Portland, Oregon, to identify sources of restoration wood products within the Pacific Northwest and integrate them into the projects.

To illustrate what forest restoration looks like, below are two images (Figure 5 and 6) that show ongoing commercial thinning within a different part of the same industrial single-aged tree plantation shown in Figure 2. These images show how restoration projects that carefully remove trees from overcrowded plantations can be used to convert an industrial tree plantation into an ecological forest that contains healthy biodiversity, while at the same time providing a wonderful source of wood fiber. The Bureau of Land Management (BLM) project shown below is intended to restore this plantation into a Late Successional Reserve (LSR) forest. LSR forests are managed so that they will eventually become an ecologically diverse and healthy old growth ecosystem.[13]

Restoration projects like the one shown above are occurring in many parts of the region, especially on public lands where these types of projects are mandated by federal regulations. If possible, we encourage project teams to ask their wood suppliers if they can source restoration wood and provide chain of custody documentation showing that their wood came from restoration projects.

Another great source for ecologically sound forest products comes from tribal forest lands. Tribal forest stewards are especially skilled and experienced at managing forests with ecological principles in mind. For example, tribal wood products can be obtained from mills such as Yakama Forest Products[14] located on Yakama Nation land in Washington state. It is also important to note that small, private, and family-owned timber land is also less likely to be managed as plantation-style tree farms with short harvest rotations. And finally, Forest Collaboratives[15,16]—which bring together stakeholders within the wood industry, the government, and environmental and community groups to come up with forest management plans that all parties can agree to—are a wonderful model for forest restoration, and wood from Forest Collaboratives should also be sought out if possible.

FIGURE 3 – The Nature Conservancy's Oregon Conservation Center, Portland, Oregon

FIGURE 4 – The Meyer Memorial Trust Headquarters, Portland, Oregon

FIGURE 5 – Ongoing thinning project on Bureau of Land Management (BLM) forest land

FIGURE 6 – Ongoing thinning project on Bureau of Land Management (BLM) forest land

Conclusion

Ultimately, designers and builders can ensure that they are choosing “good” wood by first asking, where is my wood coming from? FSC may be a readily available option, but if you have more time and motivation, you can always ask for transparency from your wood supply chain so that you can begin to understand if the wood you are sourcing is truly supporting healthy forest ecosystems.

We should first ask, what types of forests do we want to support and see flourish? Then design our buildings so that they utilize the wood being sourced from those forests, thus incentivizing the timber industry to change their forestry practices to meet this demand. Through conscientious sourcing decisions, design teams have the powerful opportunity to choose the type of forest land their wood comes from and ultimately impact the way forests are managed. We should support forests that are managed for longer harvest rotations, with multi-age class stands that are proven to be more ecologically valuable, wildfire resilient, and better able to store carbon in the long term. We need to get away from the black and white understanding of forests as either “old growth” that needs to be protected, or productive plantations that must be clear cut. Imagine a healthy forest ecosystem that has a long-term management plan that includes the protection of high value older trees, along with the removal of a small percentage of older trees and a larger percentage of lower value young trees to help promote wildfire resilience, ecological diversity, and carbon sequestration. One great example of this model of forestry is the Winston Creek Carbon Forest[17] located near Mount St. Helens in Washington state and owned by Port Blakely. We need wood products markets that include a healthy demand for all log sizes, but more importantly, these logs should be coming from ecologically managed forests. Wood coming from industrial forest plantations that are clearcut every 35 years is not promoting a sound climate solution that enhances and protects resilient, climate-adapted ecological systems. On the other hand, we can confidently say that wood is indeed good if it comes from ecologically managed forests and forest restoration projects that are correcting a century of fire exclusion and introducing a diversity of age classes and species into former tree plantations.

FIGURE 7 – Port Blakely’s Winston Creek Carbon Forest

PHOTOGRAPH BY LARA SWIMMER, OREGON CONSERVATION CENTER

References

1. Ellis, L. D., Badel, A. F., Chiang, M. L., Park, R. J.-Y. & Chiang, Y.-M. Proc. Natl Acad. Sci. USA 117, 12584–12591 (2020).

2. Solida. Accessed November 18, 2022. https://www.solidiatech.com/impact.html

3. "'Breakthrough' cementless concrete passes carbon-negative tests." Gas World. Access November 18, 2022 https://www.gasworld.com/story/breakthrough-cementless-concrete-passes-carbon-negative-tests/

4. "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017." American Center for Life Cycle Assessment. May 2019 https://35lda021311pzuv6h2568a88-wpengine.netdna-ssl.com/wp-content/uploads/ISO-21930-Final.pdf

5. Product Category Rule (PCR) Guidance for Building-Related Products and Services Part B: Structural and Architectural Wood Products EPD Requirements (Version 1.1). UL Environment Standard. Standard 10010-9, Edition 1. October 21, 2019.

6. Diaz, David, and Brent Davies. Exploring the Landscape of Embodied Carbon. Portland, OR: Ecotrust, 2021. https://ecotrust.org/publication/exploring-the-landscape-of-embodied-carbon/

7. Scott, Aaron. Timber Wars. Podcast audio. January 19, 2021. https://www.opb.org/specialreports/timberwars/

8. Franklin, Jerry F., Debora L. Johnson, and K. Norman Johnson. Ecological Forest Management. Long Grove, IL: Waveland Press, Inc., 2018. https://www.waveland.com/browse.php?t=730

9. Law, Steve. "Pulp Fiction? Some Eco-Labels for Wood Less Green than They Appear." Sustainable Life. August 15, 2013. https://pamplinmedia.com/sl/158971-pulp-fiction

10. Hessburg, Paul. "Why Wildfires Have Gotten Worse and What We Can Do about It." TEDx Talk. Lecture

presented at the TEDxBend, May 2017. https://www.ted.com/talks/paul_hessburg_why_wildfires_have_gotten_worse_and_what_we_can_do_about_it

11. Eastman, Janet. "Tour the Energy-Sucking Building Transformed into the Green Oregon Conservation Center." The Oregonian / OregonLive, August 28, 2019. https://www.oregonlive.com/life-and-culture/g66l-2019/08/e4edca090e7087/tour-the-energysucking-building-transformed-into-the-green-oregon-conservation-center.html

12. Vanderford, Paul. Meyer Memorial Trust Headquarters: Using Wood Procurement to Achieve Community, Equity and Conservation Goals. Portland, OR: Sustainable Northwest, 2021. https://static1.squarespace.com/static/5eab584a296dca09a66e85a6/t/60396f24f32fa44fadb4144a/1614376747226/+HQ_+Using+Wood+Procurement+to+Achieve+Community%2C+Equity+%26+Conservation+Goals+FINAL+2.26.pdf

13. "Northwest Forest Plan." Oregon Wild. Accessed May 12, 2022. https://oregonwild.org/forests/forest-protection-and-restoration/nwfp.

14. Yakama Forest Products. Accessed May 12, 2022. https://yakamaforestproducts.com/

15. Forest Collaboratives. Sustainable Northwest. Accessed May 12, 2022. https://www.youtube.com/watch?v=0QIkClXH1OM&t=8s

16. "Public Forest Lands." Sustainable Northwest. Accessed May 12, 2022. https://www.sustainablenorthwest.org/public-forestlands.

17. "Addressing Climate Change." Port Blakely Companies. Accessed May 12, 2022. https://portblakely.com/port-blakely/addressing-climate-change

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