MERCER
mass timber

Version 1.3

March 2025

# DESIGN GUIDE

TECHNICAL
SPECIFICATIONS

# MASS TIMBER IS TRANSFORMING CONSTRUCTION

## AND MERCER MASS TIMBER IS AT THE FOREFRONT

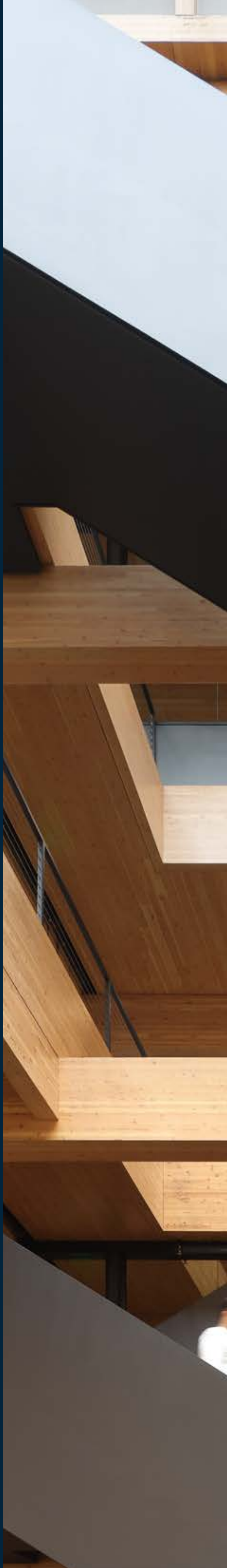
**Mercer Mass Timber is leading the charge in innovation, paving the way for mass timber to become the foundation for future generations of high-performance, low-carbon buildings.**

Mass timber construction is gaining momentum across North America, driven by growing demand and expanded building code acceptance. As access to high-quality mass timber increases, it is becoming a viable choice across diverse markets, building types, and regions.

Mass timber enables developers, designers, and builders to move beyond traditional trade-offs - delivering buildings that balance efficiency and sophistication, speed and structural integrity, affordability and aesthetics. With its ability to sequester carbon over a building's lifespan, it also provides a sustainable alternative to steel and concrete.

As mass timber continues to prove its value in cost-effectiveness, performance, and renewability, it is becoming a preferred choice for owners, architects, engineers, and builders.

Mercer Mass Timber supports this transition by providing expertise, high-quality materials, and industry-leading solutions to help clients realize the full potential of mass timber in their projects - whether prioritizing design, technical performance, functionality, or sustainability.



Google 1265 Borregas | Sunnyvale, California

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**MERCER MASS TIMBER (MMT) IS A WHOLLY-OWNED SUBSIDIARY OF MERCER INTERNATIONAL.**

High Line Timber Bridge | New York, New York

BC Passive House | Mount Currie, British Columbia


# BENEFITS OF MASS TIMBER CONSTRUCTION

1. Economically Competitive
2. Code-Approved
3. Quality Assured
4. Adhesives
5. Biophilic Properties
6. An Engineered Solution
7. Environmentally Superior

# 1. Economically Competitive

**Compared to traditional steel and concrete, mass timber construction shortens project schedules by transferring much of the on-site labor to the factory. Once on-site, it becomes more about assembly than construction.**

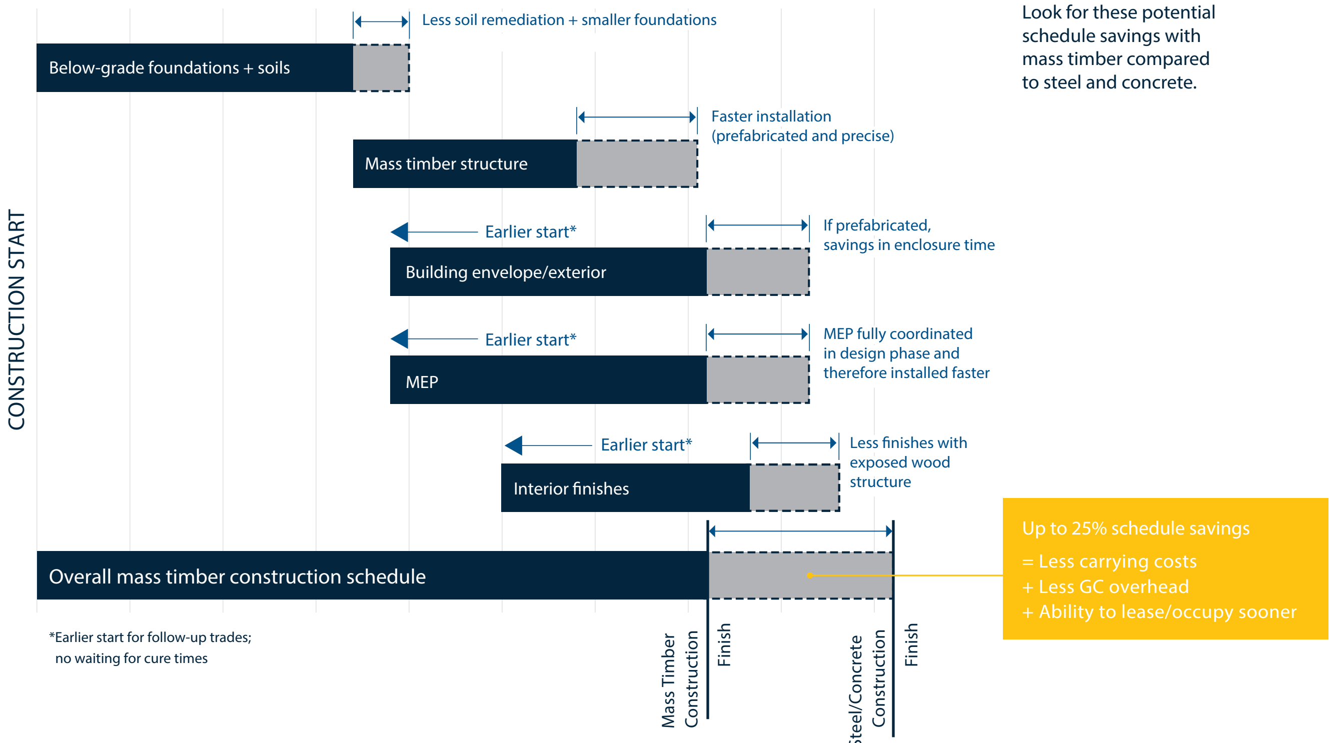
Since a portion of the labor costs is included in the mass timber materials cost, it's crucial to compare the costs of the two systems at the 'installed-complete/structure' stage of the project. The cost benefits of mass timber construction can be summarized as follows:

## REDUCED CONSTRUCTION CYCLE TIME

- As a fully integrated system supplier, Mercer Mass Timber delivers ready-to-assemble mass timber building systems, complete with all connecting hardware and accessories.
- When specified by the contractor, Mercer components arrive on-site with all pick points clearly identified, supporting safe and efficient lifting.
- Compared to traditional practices, where steel bar reinforcing is manually tied on-site, forms and false work are constructed, and concrete is poured and left to set and strengthen, mass timber solutions can accelerate production schedules by as much as 25% (see Figure 1).
- As part of The Mercer Mass Timber Advantage (see pages 19-23), further optimization of the construction schedule is achievable by coordinating the delivery and installation schedules.
- A compressed construction cycle not only accelerates completion but also minimizes the risk of delays inherent in extended cycles, potentially reducing the likelihood of claims and back charges.

For a comprehensive overview of our service options, refer to page 27.

# COMPRESSING THE TYPICAL CONSTRUCTION SCHEDULE




Look for these potential schedule savings with mass timber compared to steel and concrete.

FIGURE 1:
Mass timber vs. steel/concrete construction schedule. Mass timber cost and design optimization checklists.

*WoodWorks – Wood Products Council*

Catalyst | Spokane, Washington

## DECREASED DEMAND FOR SKILLED LABOR

- The availability of skilled labor is one of the industry's biggest challenges today, with more skilled laborers retiring from construction trades than entering.
- Mass timber construction shifts a significant portion of the on-site skilled labor to permanent manufacturing positions, significantly reducing labor costs for projects.

## IMPROVED JOBSITE SAFETY PERFORMANCE

Fewer jobsite laborers and a shorter cycle time contribute to enhanced jobsite safety performance, often leading to lower insurance rates and reduced costs associated with claims and recordable incident investigations.

## REDUCED FOUNDATION COSTS

- Mass timber components are up to 75% lighter than traditional reinforced concrete components used in similar projects. This reduction in total building weight allows for smaller and lighter foundations, leading to the following benefits:
    - Cost savings from reduced materials and labor for footings and foundations.
    - A viable solution for development in areas with poor soil quality.
    - More cost-effective seismic solutions.

## IMPROVED PROJECT ROI

- Accelerated build schedules materially reduce the cost of capital.

# 2. Code-Approved to North American Standards

The International Building Code (IBC) recognizes the following, provided they meet specific manufacturing standards, for use in mass timber construction building systems across various building typologies:

- Cross-laminated timber (CLT), when manufactured in accordance with the ANSI/APA PRG 320-2019 Standard for Performance Rated Cross-laminated Timber.
- Structural glue-laminated timber (GLT/glulam), when manufactured in accordance with the ANSI/APA A190.1-2017 Standard for Structural Glue-laminated Timber and Wood Construction Products.

These materials are approved for use in (see Figure 2):

- Multi-family residential buildings up to eighteen stories.
- Conventional non-residential buildings up to eighteen stories, including offices, banks, hotels, motels, dormitories, and other health facilities (excluding hospitals).
- Large non-residential buildings up to twelve stories, such as warehouses, stores, public and recreational facilities, schools, and government buildings.

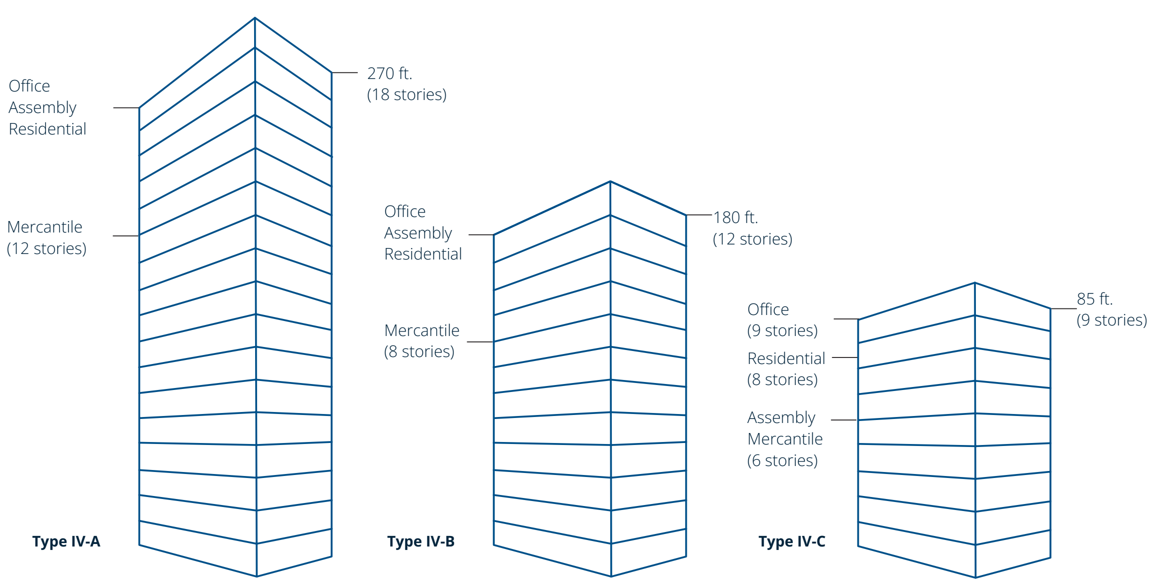



FIGURE 2:
Height Limits for Building Types IV-A, IV-B, and IV-C in the 2021 International Building Code (IBC), Woodworks - Wood Products Council

oN5 | Vancouver, British Columbia

## DESIGN PROPERTY COMPATIBILITY

The design capacities published in ANSI/APA PRG 320-2019 and ANSI A190.1 were derived analytically using the lumber properties published in the National Design Specification (NDS) for Wood Construction. Lumber from outside of North America has different characteristics, may not be recognized in the NDS and has published design values that are incompatible with those of North American lumber. As a result, the design properties for mass timber products manufactured with foreign species lumber should be carefully examined for compatibility with the North American design standards.

## MERCER MASS TIMBER PRODUCTS ARE CERTIFIED TO BE USED AS SLABS AND WALLS

The MMT evaluation report provides CLT reference design values for allowable stress design (ASD) for bending and in-plane shear in accordance with the IBC.

The CLT panels produced in our factories are produced for use as a diaphragm or shear walls, as per the IBC without the requirement of an Alternate Means and Methods Request (AMMR) within jurisdictions governed by the IBC, specifically. The in-plane shear design values include major and minor stress and strength capacities based on standard in-plane shear testing per Section 8.5.6.1 of ANSI/APA PRG 320 and Annex A3 of ASTM D5456.

# 3. Product Quality Assured

We are proud of our ongoing certification and adherence to the North American standards for cross-laminated timber and glue-laminated timber, as referenced throughout this guide. Mercer CLT and glulam are certified to meet the requirements of the Standard for Wood Products – structural glue-laminated timber and cross-laminated timber, as described in ANSI A190.1-2017 and ANSI/APA PRG 320-2019.

These standards outline the quality control measures required by ANSI, and compliance is verified by *APA – The Engineered Wood Association (www.apawood.org) through ongoing and monthly independent third-party inspection visits to Mercer's manufacturing operations. For more information on destructive performance testing, refer to Table 3 on page 39.

Further design considerations and local code approvals may be required when considering a foreign supply source, which can increase project timelines and cost. By adhering to these standards, MMT can assure a standard of quality to the professionals who specify our products.

80M | Washington, DC

# 4. Adhesives

## MERCER MASS TIMBER ADHESIVE SYSTEMS

The manufacturing of all code-approved mass timber products requires adhesives approved for face bond lamination and end-to-end finger jointing. MMT uses adhesives specific to our manufacturing processes that are certified to North American testing and manufacturing standards.

All adhesives must conform to ASTM testing methods for fire, heat and moisture and must support ANSI manufacturing standards (see Table 1 below). These test methods and manufacturing standards are approved in the U.S. by the International Building Code (IBC). The IBC is a model building code developed by the International Code Council (ICC).

The adhesive component is product thickness and depth dependent and comprises approximately 1% by weight of Mercer's mass timber building products.

## GLUE-BOND DURABILITY

The structural integrity of mass timber components depends upon the integrity of the glue-bond between the component lumber elements. This is true for the entire service life of these mass timber components.

Conditions that can impact the glue-bond integrity are exposure to elevated heat (such as a fire event) and exposure to high moisture conditions for extended periods.

## FIRE PERFORMANCE

The fire resistance of CLT and structural glulam is based on the certification requirements of the North American testing and manufacturing mass timber standards. These standards require rigorous adhesive heat durability testing to ensure mass timber product structural integrity under the most severe fire conditions.

## EMISSIONS

Both Henkel and Hexion adhesives used by MMT for manufacturing our mass timber products are certified to UL GREENGUARD Gold. GREENGUARD Gold certified products are qualified to meet UL GREENGUARD standards for low chemical emissions into indoor air during product usage. These adhesives are formulated to meet or exceed all global emissions standards.

At the time of this publishing, this only refers to MMT Okanagan and MMT Conway factories. This is true for the entire service life of these mass timber components. Conditions that can impact the glue-bond integrity are exposure to elevated heat (such as a fire event) and exposure to high moisture conditions for extended periods.

TABLE 1: Adhesives for CLT and glulam products

| ADHESIVE APPLICATION | ADHESIVE BRAND | ADHESIVE TYPE | EMISSIONS CERTIFICATION | ADHESIVE PERFORMANCE TESTING | | |
|---|---|---|---|---|---|---|
| | | | | FULL SCALE FIRE TEST | HEAT DELAMINATION | MOISTURE DURABILITY |
| Finger Joints CLT/ Glulam | Hexion Cascomel™ | Melamine Formaldehyde (MF) | UL GREENGUARD Gold | ✓ | ✓ | ✓ |
| Face Bond Glulam | Hexion EcoBind™ | Melamine Formaldehyde (MF) | UL GREENGUARD Gold | ✓ | ✓ | ✓ |
| Face Bond CLT | Henkel Loctite HB X PURBOND | Polyurethane (PUR) | UL GREENGUARD Gold | ✓ | ✓ | ✓ |

# 5. Biophilic Properties

As humans, we have an inherent desire to connect with nature and our environment. Increasingly, we're seeing projects that embrace this connection to the natural world, especially in corporate offices where creating an appealing workspace serves as both a benefit and a competitive advantage. Mass timber is the ideal structural material for this biophilic approach to design, delivering the warmth and beauty of wood while facilitating inviting designs featuring soaring ceilings, organic shapes, and open spaces. Whether the mass timber components are encapsulated or you choose to highlight the natural allure of the wood, you create environments that people are drawn to and want to return to time and again.

# 6. An Engineered Solution

CLT components, when manufactured in accordance with ANSI/APA PRG 320-2019 Standard for Performance Rated Cross-laminated timber and Glulam components complying with ANSI A190.1 Standard for Wood Products for Structural Glue-laminated timber, are recognized in the National Design Specification (NDS) as structurally rated components.

Design professionals employing mass timber construction can use the same engineering principles and standards with the same safety and code compliance recognition as are applied to materials such as steel and concrete. Mass timber embodies strength, resiliency and design ability expanse with the potential to reduce design time compared to other building material selections.

# 7. Environmentally Responsible

**The United Nations states that two of the most compelling issues in the world today are shelter and climate change. Mass timber construction speaks to both.**

- Wood as a building material is a renewable resource that can be regenerated through sustainable forestry practices. Mercer uses only wood that is sustainably harvested, including Forest Stewardship Council® (FSC®) (FSC-C005872), Sustainable Forestry Initiative® (SFI®), and the Programme for the Endorsement of Forest Certification (PEFC) chain-of-custody certified.
- Harvested timber retains its carbon through the life of the building, while reforestation through replanting increases the carbon capture rate by as much as a factor of two times over the same acreage.
- Located within the timberlands it draws upon, MMT minimizes the transportation footprint required to produce mass timber components. This is most compelling when compared to importing competitive mass timber products or steel from offshore producers.
- Less energy is consumed in the production of mass timber components. By some estimates, wood conversion is as much as five times more efficient than cement for concrete and up to 20 times more energy efficient than the production of steel (see Figure 3).
- As a choice, mass timber construction enables a virtuous cycle of capturing carbon from the atmosphere while supporting the forestry practices of responsible harvesting techniques and reforestation practices.
- Both CLT and glulam beams and columns are ASTM certified with Environmental Product Declarations (EPD) to provide complete transparency of the materials used. EPDs are imperative for calculating building lifecycle costs.

## ENVIRONMENTAL IMPACT OF WOOD, STEEL AND CONCRETE

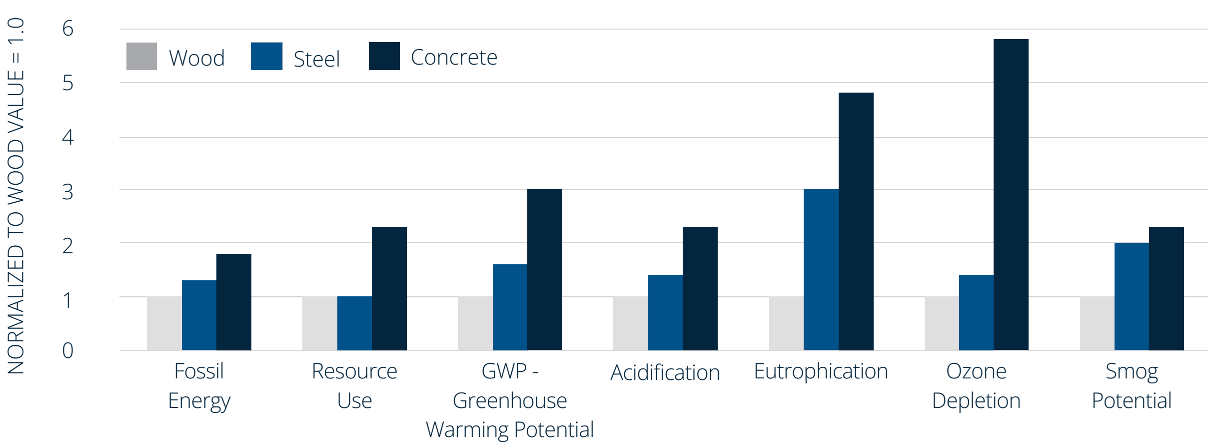
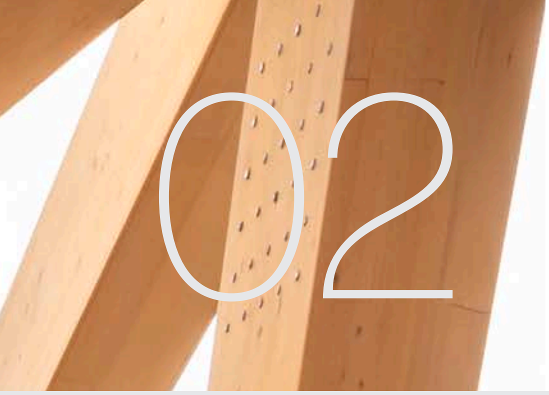



FIGURE 3: Normalized comparison of environmental impacts of wood, steel and concrete buildings

Three hypothetical buildings (wood, steel and concrete) of identical size and configuration are compared. In all cases, impacts are lower for the wood design.
SOURCE: Dovetail Partners using the Athena Eco-Calculator

UW Foster School of Business, Founders Hall | Seattle, Washington

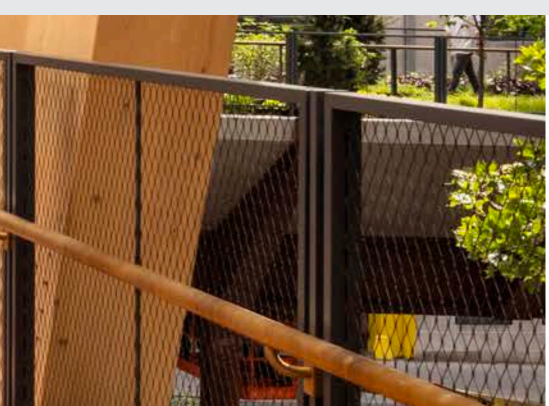
High Line Timber Bridge | New York, New York



02

# THE MERCER MASS TIMBER ADVANTAGE

1. A Vertically Integrated Team
2. Delivering New Levels of Value
3. Service Options



# 1. A Vertically Integrated Team

## When you choose Mercer Mass Timber, you have the assurance you'll be working with:

**THE NORTH AMERICAN INDUSTRY LEADER IN MASS TIMBER CONSTRUCTION.** MMT proudly supports and is certified by all North American (US and Canada) building codes and manufacturing standards, boasting the largest production capacity in North America.

**A DESIGN PARTNER.** MMT employs a team of specialist engineers, BIM coordinators, fabrication designers, project managers, DfMA specialists, logistic experts, and mass timber installers at your disposal to execute a comprehensive value proposition. Our services can be precisely tailored to your needs, from early design and specification to the finest details of steel connections and hardware. We meticulously bring your vision to life, down to the last screw, nut, and bolt.

**A PROJECT PARTNER.** MMT is fully 4D BIM capable, planning the delivery of every component to optimize your construction schedule, including the loading sequence of each truck. We can collaborate with specialized logistics companies to utilize staging yards near your job site, ensuring materials are readily available for a reliable installation schedule.

**A FULLY INTEGRATED SUPPLIER.** MMT supplies CLT and glulam beams and columns from our factories, as well as source and install off-site proprietary products, project-custom steel connections, and all related hardware.

**A STEWARD OF THE ENVIRONMENT.** MMT uses sustainably harvested wood, including SFI®, FSC®, and PEFC chain-of-custody certified materials. Certificates are available upon request.

# 2. Delivering New Levels of Value

For decades, our experience as a world-renowned fabricator of complex mass timber components has endowed us with deep knowledge and expertise to create beautifully designed systems of the highest quality. Our work process is meticulously designed to ensure 100% accountability through every step of your project, including:

## MASS TIMBER DESIGN-ASSIST

Our world-class team of specialists in design, supply and installation of mass timber structures have amassed the experience of every project we have supplied.

As a resource to your project design team, MMT can engage in design-assist services tailored for your project needs: engineering, BIM coordination, project management, fabricability and constructibility input. We will share our best practices and value propositions with you to deliver the most cost-effective and creative solutions that meet or exceed the requirements of the US building codes, as well as your own high expectations.

## BUDGETING

Our estimators and senior designers possess deep knowledge of mass timber design and engineering, including hardware and connections to provide you with accurate and timely SD-, DD- and CD-level budgets and quotations for your project.

## PROJECT EXECUTION MANAGEMENT

A dedicated project execution team composed of project managers, BIM coordinators, mass timber engineers and detailers are allocated to your job for an efficient design, fabrication, delivery and installation. The project manager is the single point of contact and the utmost in customer service.

## LUMBER PROCUREMENT

Through our strategic supply relationships, MMT has dedicated personnel to procure a wide range of commodity lumber and raw materials, as well as the related steel and system accessories, to protect against raw material price volatility. This mitigates the risk of price escalation for projects that have deferred production windows or prolonged production cycles.

## SUSTAINABILITY

MMT is a fully sustainability-certified manufacturer of mass timber building products and is committed to achieving the highest standards of sustainable construction requirements. Our mass timber building products can be supplied with SFI®, FSC®, and PEFC certification.

## FABRICATION APPROVAL AND 3D MODELING

Following the building design freeze, our fabrication approval team will create and coordinate an exact 3D model of your project including all mass timber components with all steel and hardware connectors, right down to every screw, nut, and bolt, including vital details such as holes, daps, slots, counterbores and chamfers, for fabrication. This process allows us to envision potential construction issues long before arriving on the jobsite.

This approach is streamlined for an efficient fabrication approval process, where the focus shifts from a design development perspective to a fabrication sign-off for production mindset, namely, finalizing exact component geometry, slab edges, member connections, panel connections and delivery sequence.

## FABRICATION

From an approved-to-produce 3D model, the data is transferred electronically, directly to our state-of-the-art CNC fabrication machinery where components are produced to extreme precision (less than 1/8”). Individual component shop drawings are produced with exacting specifications as part of our quality control best practices.

## QUALITY AND APPLICATION ASSURANCE

Throughout our process. MMT maintains a rigorous Quality and Application Assurance program that meets or exceeds the standards set forth in the North American model building codes. Third-party inspected and verified by APA and PFS-Teco.

MMT proudly delivers best-in-class product quality.

## CODES AND STANDARDS COMPLIANT

Mercer CLT and glulam beams and columns comply with the International Building Code (IBC) and National Design Specification (NDS) for their respective materials, and are manufactured to ANSI/APA PRG 320-2019 (CLT) and ANSI A190.1 (glulam) standards.

## OPTIONS – ADHESIVES, FINISHES AND COATINGS

We offer a variety of options to enhance the aesthetic appeal of glulam beams and columns, including two adhesives, three smooth finishes, three rustic finishes and a wide array of factory-applied coatings.

## PACKAGING AND DELIVERY

Secure arrival to the jobsite is the cornerstone of our delivery system. Depending on the job requirements, we factory install connectors and test-fit pieces to ensure smooth on-site assembly.

Glulam beams and columns are individually wrapped and sealed, corners are protected and additional packaging such as plywood sheathing is added when necessary. Please refer to page 70 for additional care and handling recommendations.

## COORDINATED INSTALLATION

The MMT team can self-perform the installation of mass timber projects or, together with the project manager, coordinate with the project installation team to ensure safe and efficient on-site deliveries and installation. The result is a building with optimized structural performance, rapid assembly and superior aesthetic appeal.

Our team takes pride in every project, from preliminary consultation and design through manufacturing, shipment and installation. We navigate the complexities of design and construction with a steadfast commitment to seamless execution.

# Superior Engineering for Superior Performance

## Staggered Multiple Piece Lamination vs. Block Glued Layup Methodology

**When manufacturing wide-section members, MMT utilizes a staggered multiple piece lamination technique as described in ANSI A190.1, section 9.3.**

In contrast, the block glued methodology, commonly used by foreign manufacturers, allows for narrower single-lamination components to be edge-glued along the face of the two beams to produce built-up wide-section components. These edge-laminated blocks create a continuous, vertical shear plane between the two edge-glued narrow beams.

The multiple piece layup where edge laminations are both staggered and face glued is a preferred methodology because it creates more diffused shear planes, better dimensional stability and increased homogenization of the lamstock in the glulam structural member.

**DIFFUSED SHEAR PLANES:**
Foreign manufacturers commonly use a block glued methodology where narrower single-lam components are edge-glued to produce built-up wide components. This creates a continuous vertical shear plane between the two edge-glued components. In contrast, the multiple piece lamination technique creates noncontiguous vertical glue-line shear planes through the components.

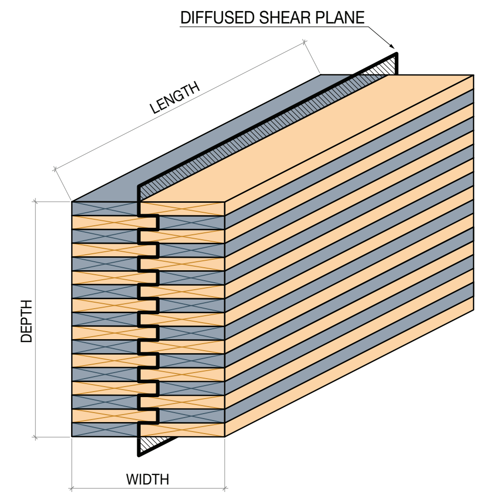
**DIMENSIONAL STABILITY:**
Based upon the same principle of an increased number of elements within the component, a staggered multiple piece lamination layup reduces the dimensional tendencies of any one element and can potentially increase the overall stability of the component. This can be most prominently realized in wider and deeper sections.

**INCREASED HOMOGENIZATION:**
Glulam beams and columns constructed through the staggered multiple piece lamination technique are composed of more individual elements than through a single lamination layup practice. This increased number of elements acts to further diffuse the impact of any one element on the resulting component and creates a more homogeneous construction.

FIGURE 4:
Staggered multi-piece lamination method

## STAGGERED MULTIPLE PIECE LAMINATION

- The staggered multiple piece lamination method creates a noncontiguous shear plane in the glulam member.
- This staggered layup does not rely on the glue line integrity to the same degree as the forces can be resisted by the overlapping laminations in shear.
- This staggered glulam composition method is implicitly safer, more robust and does not demand the same degree of quality control over the glue line integrity as the block glued lamination method.




## BLOCK GLUED GLULAM

- The block glued glulam lamination method creates a contiguous vertical shear plane that relies on the glue-bond line integrity to transfer loads through the glulam member.
- In an asymmetric loading application, the load component must transfer across the glue line in shear to allow the glulam member to act as a compound unit.

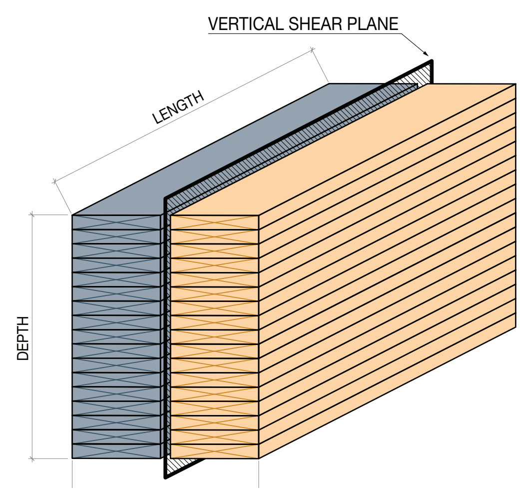


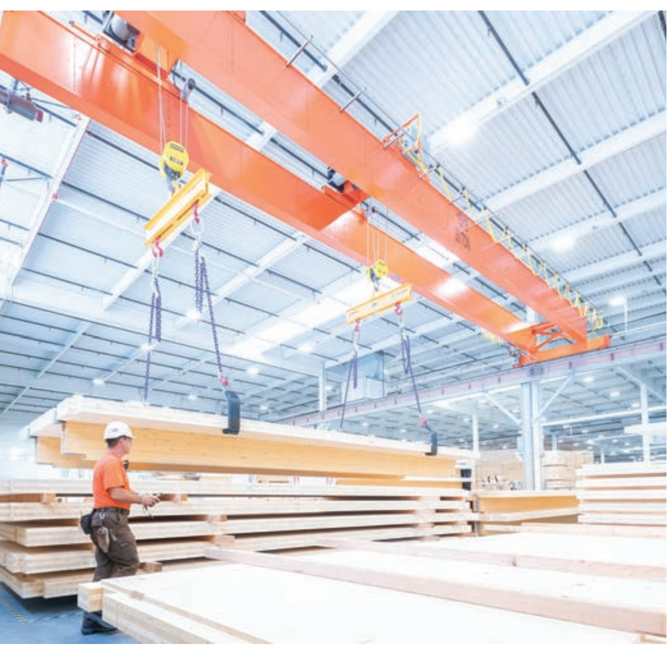

FIGURE 5:
Block glued multi-piece lamination method

## OVER 60 YEARS OF NORTH AMERICAN COMBINED MASS TIMBER EXPERTISE

When you choose MMT, you'll be working with the North American industry leader in mass timber manufacturing and project delivery, a company at the forefront of the mass timber revolution. Compared with the costs and logistics of working with overseas manufacturers, Mercer is the right choice for simplified construction and sustainability.

We are also your partner in the process. We use 3D Building Information Modeling (BIM) to detail your vision down to the last screw, nut and bolt. Our sophisticated CNC machinery ensures extreme precision (less than 1/8") in all our fabrication. No other manufacturer in North America can match our quality and precision on CLT and glulam building products. We plan the delivery of every component to maximize your construction schedule, right down to how each member is loaded on every truck.

We work closely with you every step of the way. That's an advantage that overseas companies simply cannot achieve.



Mercer Spokane Factory | Spokane, Washington

## AS A MANUFACTURER, MERCER MASS TIMBER DELIVERS

Defect-free quality, the first time, every time. MMT utilizes state-of-the-art CNC robotics, along with a rigorous Quality and Application Assurance program throughout our process, from 3D modeling and inline lumber testing to test-fitting all component connections, ensuring what is delivered to the jobsite matches precisely with the 3D model created in our design center.

Our advanced scheduling system ensures your project is delivered complete, on schedule, and to spec. This will take place when milestone-based scheduling is adhered to, allowing for production to meet your expected deliveries.

# 3. Service Options

Our customers are at the heart of our business. MMT offers a range of design and fabrication service levels, each incorporating various elements of The Mercer Mass Timber Advantage. The service options range from fabrication only of your approved shop drawings, to traditional supply with our technical services, to consulting on cost efficiency through an engagement of design for manufacturing and assembly (DfMA). We will work with you to understand your needs, preferences and budget to select the right service level for your project.

**OUR SERVICE OPTIONS INCLUDE:**

### FABRICATION ONLY

- Supply of mass timber components per your approved single-piece shop drawings and fully detailed 3D model

### TRADITIONAL SUPPLY

- Complete detailing and supply of mass timber kit-of-parts (including steel connectors and hardware) per MMT single-piece shop drawings, as approved by the project's Architect, Engineer and Contractor (AEC) team
- Project management and scheduling services, ensuring your mass timber kit-of-parts arrives on-site, on-time, in-full and on-spec to meet your construction schedule

### DESIGN ASSIST AND SUPPLY

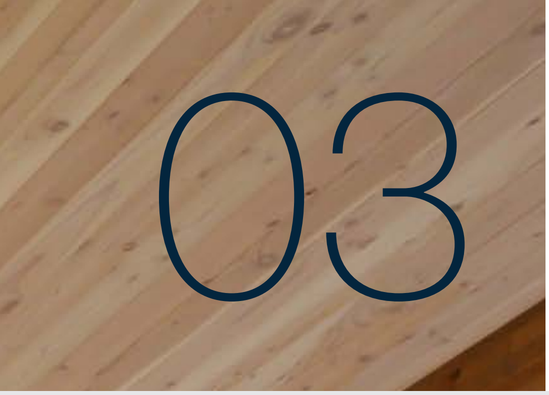
- Collaborate with the AEC team to achieve design cost optimization through efficiencies in manufacture and on-site assembly of the mass timber kit-of-parts
- Complete detailing and supply of mass timber kit-of-parts (including steel connectors and hardware) per Mercer single-piece shop drawings, as approved by the AEC team
- Project management and scheduling services, ensuring your mass timber kit-of-parts arrives on-site, on-time, in-full and on-spec to meet your construction schedule

### DELEGATED DESIGN AND SUPPLY

- Provide mass timber specialty engineering design services with consent and collaboration with the EOR and with respect to the architect's design intent
- Complete detailing and supply of mass timber kit-of-parts (including steel connectors and hardware) per MMT single-piece shop drawings, as approved by the AEC team
- Project management and scheduling services, ensuring your mass timber kit-of-parts arrives on-site, on-time, in-full and on-spec to meet your construction schedule

**We believe Mercer Mass Timber is uniquely positioned to meet even the most challenging project requirements. We are confident that you will find our decades of North American experience and expertise worthy of further discussion.**

Wood Innovation and Design Centre | Prince George, British Columbia



03

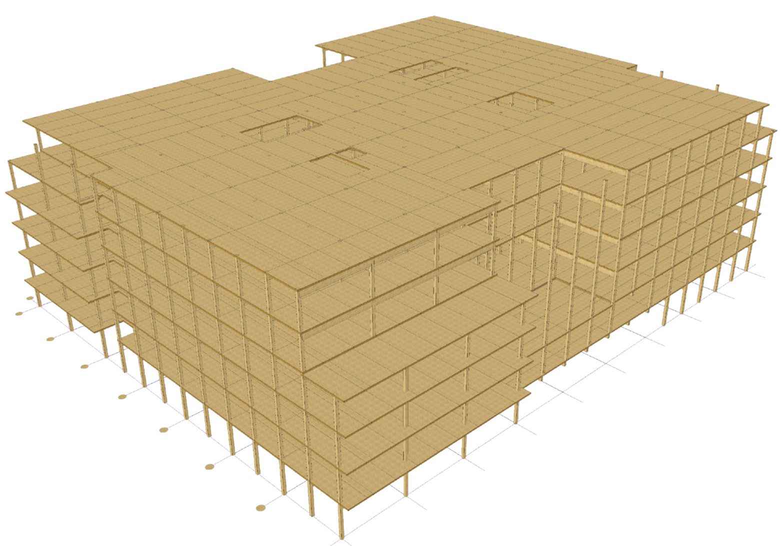
# MASS TIMBER DESIGN PROCESS

# 1. Mass Timber Design-Assist Process

**Once you've determined mass timber construction is your preferred building approach and chosen Mercer Mass Timber as your supply partner, we recommend the following series of steps and decisions to help guide your progression forward.**

We're ready to support your project.

Whether you engage us for design, supply, fabrication, or any stage in between, involving our mass timber specialists early ensures the best outcomes.



01

Determine standard grid pattern(s) for your design.

02

Select a mass timber building system for your project.

03

Consider each design aspect (fire performance, acoustics and sound transmission, vibration control, etc.) through the Design Considerations section in the guide (pages 33-75) and the effect each consideration may have on member sizing.

04

Using the engineering design properties provided in the guide for Mercer CLT (see pages 33-55) and glulam beams and columns (see pages 57-75), determine preliminary member sizing for individual grid assemblies for the load and applicable code requirements of your project

05

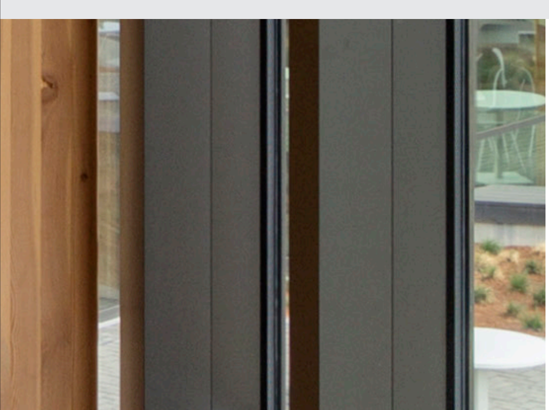
As you develop a working design solution, your MMT regional manager will work with you to complete your design, including validation of grid layout and member sizing and positioning, as well as to develop a preliminary budget for your project. To optimize your project, consult your MMT regional manager early in the design process.

Fort McMurray International Airport | Fort McMurray, Alberta

First Tech Federal Credit Union | Hillsboro, Oregon


# MERCER CLT PRODUCTS





# Mercer Mass Timber Cross-laminated Timber (CLT)

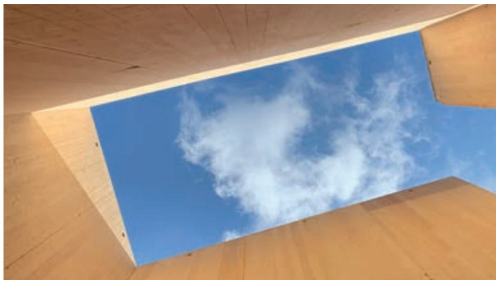
As a North American manufacturer with deep roots in wood construction, we understand building codes and the construction process. Our history is also what makes us uniquely suited to deliver solutions that serve the construction industry.

CLT is a sustainable, carbon-negative alternative to concrete, ideal for floors, walls, roofs, cores, and shafts. Its two-way spanning capability enhances design flexibility, making it a game-changer in modern construction.

The technical information in this guide is compiled to support you in developing designs that specify Mercer CLT panels. If you have questions and need help, let our qualified team of mass timber specialists and technical support representatives help you specify the right solution for your project.

## MERCER MASS TIMBER CLT ADVANTAGES:

- North American (US and Canada) code-approved
- Superior wood fiber and appearance
- Engineering, BIM coordination, fabrication approval services available
- CNC fabricated to exacting tolerances
- Delivered in coordinated sequence to installation schedule
- Steel and connecting hardware included
- All required holes, daps, slots, counterbores and chamfers included
- Rigorous quality control process



# 1. CLT Product Applications

## FLOORS

Mercer CLT panels are ideally suited for modern floor systems because they are two-way span capable and ship to site as ready-to-install components, greatly simplifying building construction and increasing jobsite productivity. Mercer CLT products help ensure an optimized structural solution that allows you to install up to 700-square-feet per lift, or over 15,000-square-feet per day.

## ROOFS

Mercer CLT panels provide overhanging eaves and span a variety of roof layouts. Their inherent thermal insulation contributes to a more efficient envelope assembly. Panels can be as thin as 3.43" (87mm) and as thick as 12.42" (315mm), resulting in a maximum roof span of 40' with appropriate loading. CLT roofs are installed quickly, allowing projects to approach lockup and a watertight state in a short amount of time.

## WALLS

Mercer CLT wall panels are a lighter, cost-competitive alternative to traditional load bearing wall systems like precast concrete and tilt-ups, but with much better thermal performance. When used as a system with wall and roof panels, there is an inherent gain in energy efficiency in the building design.

CLT walls can be used as non-load bearing or load bearing. Additionally, the latest revision of ASCE (American Society of Civil Engineers) and SDPWS (Special Design Provisions for Wind & Sesimic) has formally recognized CLT walls as lateral load resisting systems.

As vertical and horizontal load-bearing elements, Mercer CLT panels extend the design envelope for industrial projects and allow the use of one structural system for an entire project.

## SHEAR WALLS AND DIAPHRAGMS

Mercer CLT panels are certified to use as lateral force-resisting systems (LFRS) for both wind and seismic loads per ASCE7-22 and SDPWS-2021.

MMT pioneered the use of CLT as shear walls in the Catalyst project (Spokane, WA) and CLT diaphragms in the UW-FSB project (Seattle, WA). Our APA and PFS-Teco certifications provide in-plane shear capacities that can be used for LFRS design, in accordance to US design standards.

## CORES AND SHAFTS

Mercer CLT panels are well suited for use in cores and shafts. These can be erected quicker and easier than comparable steel and concrete designs while still providing lateral bracing. Elevator and stair shafts can achieve two-hour fire resistance ratings.

# 2. Mass Timber Building Code Considerations

The International Building Code (IBC) recognizes cross-laminated timber (when manufactured per ANSI/APA PRG 320-2019 Standard [for Performance Rated Cross-laminated Timber]), and Glue-laminated Timber (when manufactured per ANSI/APA A190.1). MMT, as a manufacturer of these components certified in North America, adheres to these standards.

*The values in this table are generalized. The validity of this information is the responsibility of the Architect and Engineer.*

*Assumes Occupancy Classification (B) - Office Space U.N.O. For other occupancy classes, see IBC 2024. Building height corresponds to a sprinklered building.

**Fire ratings for interior Primary Structural Frame and floors. See IBC 2024 for other building elements and other special considerations related to the protection of wood.

For a full list of jurisdictions implementing IBC 2024 code provisions, visit WoodWorks (www.woodworks.org).

| CONSTRUCTION TYPE (OCCUPATION CLASS*) | BUILDING HEIGHT* | ALLOWABLE FOR EXPOSED TIMBER** | FIRE RESISTANCE RATING (FLOORS AND MAIN FRAME**) |
|---|---|---|---|
| II-A/B, I-A/B (B) | Roof only (max 2 story) or Fire-retardant-treated wood or Alternate Fire Testing per 2303.2, as well as non-bearing elements. | | |
| III-B (B) | 4 stories / 75’ | 100% | 0h |
| III-A (B) | 6 stories / 85’ | 100% | 1h |
| IV-HT (B) | 6 stories / 85’ | 100% | HT |
| IV-C (B) | 9 stories / 85’ | 100% | 2h |
| IV-B (B) | 12 stories / 180’ | Partial (IBC 2024) | 2h |
| IV-A (B) | 18 stories / 270’ | 0% | 2h (3h primary frame) |
| V-B (GENERAL) | 1-3 stories / 40-60’ | 100% | 0h |
| V-A (GENERAL) | 1-3 stories / 40-60’ | 0% to 100% | 0h to 1h |

**Manufacturers of mass timber cross-laminated timber components, certified in North America, adhere to the standards set forth as described above.**

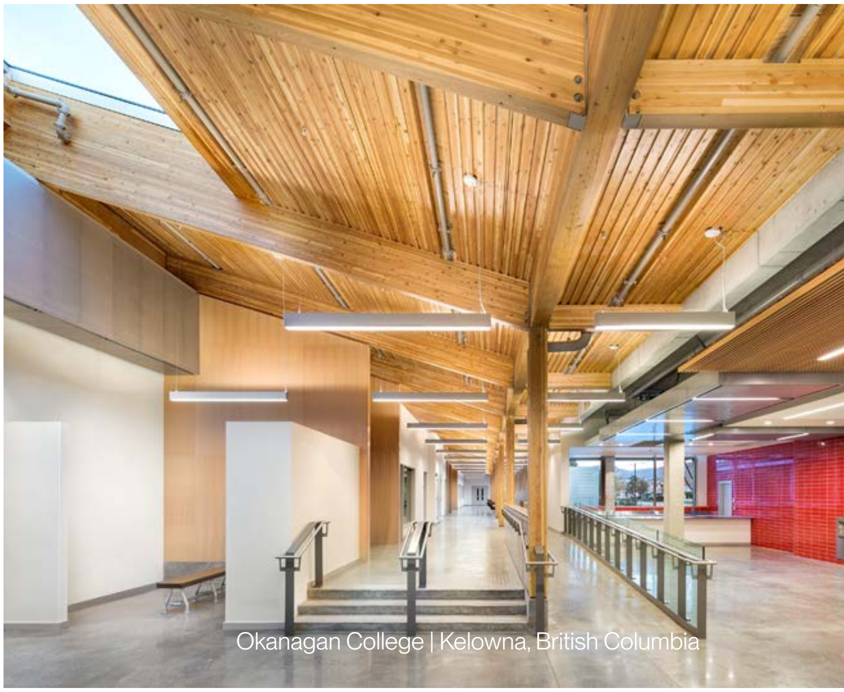
## MERCER MASS TIMBER APA AND PFS-TECO REPORTS

Mercer Mass Timber APA PR-L314 (Mercer Okanagan), APA PR-L347 (Mercer Conway) and PFS-Teco BPER 0141 (Mercer Spokane) evaluation reports provide Mercer CLT reference design values for allowable stress design (ASD) for bending and in-plane shear in accordance with the IBC.

This additional recognition allows Mercer CLT to be considered for use as a diaphragm per IBC without the requirement of an Alternate Means and Methods Request (AMMR) within jurisdictions governed by the IBC, specifically. The in-plane shear design values include major and minor stress and strength capacities based on standard in-plane shear testing per Section 8.5.6.1. of ANSI/APA PRG 320 and Annex A3 of ASTM D5456. Using Mercer CLT for diaphragm use is advantageous since additional layers of plywood are not required to satisfy code requirements.

## PRODUCT QUALITY ASSURED

We are proud of our ongoing certification and adherence to the North American cross-laminated timber and glue-laminated timber standards referenced throughout this guide. Mercer CLT is certified to meet the requirements of Standard for Wood Products – Structural Glue-laminated Timber and Cross-laminated Timber (GLT/CLT) as described in ANSI A190.1-2017 and ANSI/APA PRG 320-2019.


Okanagan College | Kelowna, British Columbia

These standards outline the quality control requirements required by ANSI and are verified by APA – The Engineered Wood Association (www.apawood.org) through ongoing and monthly independent third-party inspection visits to Mercer's manufacturing operations. For more information on destructive performance testing, see Table 3 on page 39.

Further design considerations and local code approvals may be required when considering a foreign supply source, which can increase project timelines and cost. By adhering to these standards, MMT can assure a standard of quality to the professionals who specify our products.

Environmental Product Declarations (EPDs) are available upon request.

# 3. Adhesives

## MERCER MASS TIMBER ADHESIVE SYSTEMS

The manufacturing of all code-approved mass timber products to produce long length lamellas requires adhesives approved for face bond lamination and end-to-end finger jointing. MMT uses adhesives specific to our manufacturing processes that are certified to North American testing and manufacturing standards.

All adhesives must conform to ASTM testing methods for fire, heat and moisture and must support ANSI manufacturing standards (see Table 2 below). These test methods and manufacturing standards are approved in the US by the International Building Code (IBC). The IBC is a model building code developed by the International Code Council (ICC).

The adhesive component is product thickness and depth dependent and comprises approximately 0.5% by weight of Mercer's mass timber building products.

## GLUE-BOND DURABILITY

The structural integrity of mass timber components depends upon the integrity of the glue-bond between the component lumber elements. This is true for the entire service life of these mass timber components. Conditions that can impact the glue-bond integrity are exposure to elevated heat (such as a fire event) and exposure to high moisture conditions for extended periods.

## FIRE PERFORMANCE

The fire resistance of cross-laminated timber and structural glue-laminated timber is based on the certification requirements of the North American testing and manufacturing mass timber standards. MMT uses heat-resistant glues in its production of CLT, as required per PRG-320:2019 Annex B which requires rigorous adhesive heat durability testing to ensure mass timber product structural integrity under the most severe fire conditions.

MMT has successfully passed 2-hr Fire Resistance Rating (FRR) tests to ASTM E119 on 5-ply CLT panels produced in several facilities. We can provide test evidence to design teams and the authority having jurisdiction (AHJ) that Mercer CLT products perform better than the numerical model proposed in NDS Chapter 12. This allows the use of 5-ply CLT panels on 2-hr FRR scenarios, like in Building Types IV-A, IV-B and IV-C per the IBC.

## EMISSIONS

Both Henkel and Hexion adhesives used by MMT for manufacturing our mass timber products are certified to UL GREENGUARD Gold. GREENGUARD Gold certified products are qualified to meet UL GREENGUARD standards for low chemical emissions into indoor air during product usage. These adhesives are formulated to meet or exceed all global emissions standards.

| ADHESIVE APPLICATION | ADHESIVE BRAND | ADHESIVE TYPE | EMISSIONS CERTIFICATION | ADHESIVE PERFORMANCE TESTING | | |
|---|---|---|---|---|---|---|
| | | | | FULL SCALE FIRE TEST | HEAT DELAMINATION | MOISTURE DURABILITY |
| FINGER JOINTS CLT | Hexion Cascomel™ | Melamine Formaldehyde (MF) | UL GREENGUARD Gold | ✓ | ✓ | ✓ |
| FACE BOND CLT | Henkel Loctite HB X PURBOND | Polyurethane (PUR) | UL GREENGUARD Gold | ✓ | ✓ | ✓ |

TABLE 2:
Adhesives for CLT products

| TYPE | METHODOLOGY |
|---|---|
| SHEAR TESTING | Test blocks are sampled where the glue-bond lines are mechanically loaded to withstand failure |
| CYCLIC – DELAMINATION TEST | Advanced wood aging process designed to simulate environmental trauma across 50 years of exterior service |
| END JOINT TENSION TESTING | Destructive lot-testing of manufactured finger joints to ensure that final products meet the prescribed strength ratings |

TABLE 3:
Destructive performance testing

Note: As a standard procedure, each test result is documented and used to certify Mercer Mass Timber products prior to shipment.

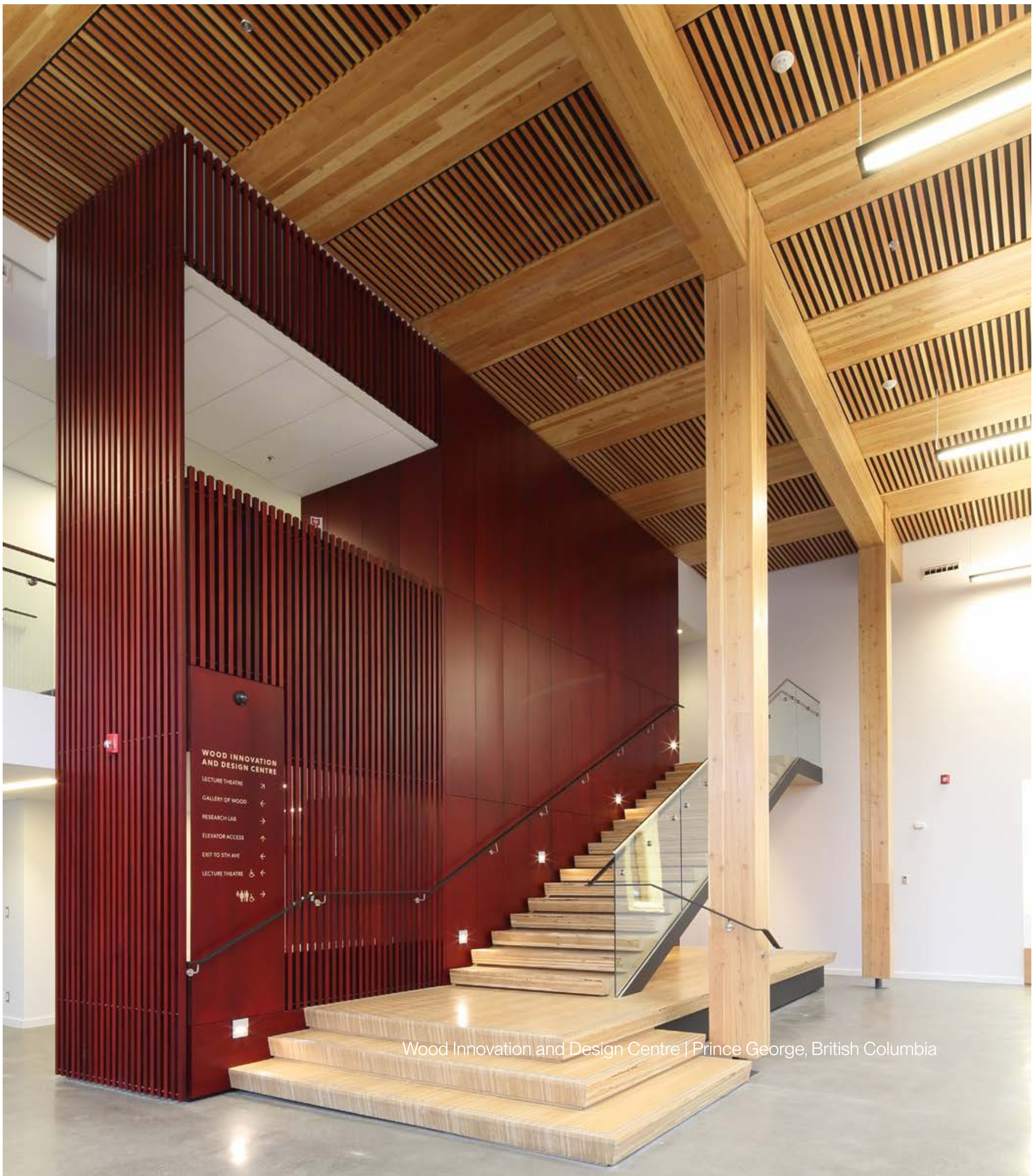
FIGURE 6:
Glue-bond sample test blocks

# 4. Mercer CLT Product Characteristics

TABLE 4: Product characteristics

| | MMT OKANAGAN | MMT CONWAY | MMT SPOKANE |
|---|---|---|---|
| MAXIMUM PANEL SIZE | 10' x 40' (3,048 mm x 12,192 mm) | 12' x 60' (3,660 mm x 18,288 mm) | 12' x 60' (3,660 mm x 18,288 mm) |
| MAXIMUM THICKNESS | 12.42" (315 mm) | | |
| MINIMUM THICKNESS | 3.43" (87 mm) | | 3.24" (82mm) |
| PRODUCTION WIDTHS | 8', 10' (2,438 mm to 3,048 mm) | 7'-10½" to 11'-6" (2,400 mm to 3,505 mm) | 9'-9" to 11'-9" (2,972 mm to 3,581 mm) |
| MOISTURE CONTENT | 12% (+/-3%) at time of manufacturing | | |
| FACE BOND GLUE TYPE | Henkel Loctite HB X PURBOND | | |
| FINGER JOINT GLUE TYPE | Hexion Cascomel® | Henkel Loctite HB X PURBOND | |
| SPECIES | SPF, DF-L, SYP | SYP | SPF, DF-L, SYP |
| LUMBER GRADES | SPF #2, SPF MSR 2100, SPF #3, DF-L #2, SYP #2, SYP #3 | SYP #2, SYP MSR 2100 | SPF #2, SPF #3, SPF MSR 2100, DF-L #2, DF-L #3, DF-L MSR 2100, SYP #2, SYP MSR 2100 |
| STRESS GRADES | V2M1.1, V2.1, E1M4, E1M5 | V3M1, V3.1, E4M2, E4M3 | 1.4V, 1.8M |
| MANUFACTURING CERTIFICATION | APA-PR L314 | APA-PR L347 | PFS-TECO BPER 0141 |
| DENSITY | SPF: 30pcf DF-L: 35pcf SYP: 40pcf | | |
| MOISTURE DIMENSIONAL STABILITY | Longitudinal and Transverse 0.01% per % change in MC. Thickness 0.20% per % change in MC | | |
| THERMAL CONDUCTIVITY | R value: 1.2 per inch (h·ft$^2$·°F /Btu) | | |
| $CO_2$ SEQUESTRATION | 37.4 lbs/ft$^3$ (subject to local manufacturing and distances) | IN PROGRESS | |
| **DIMENSIONAL TOLERANCES** | | | |
| THICKNESS | +/- 1/16" (2 mm) or 2% of CLT thickness, whichever is greater | | |
| WIDTH | +/- 1/8" (3 mm) of the CLT width | | |
| LENGTH | +/- 1/4" (6 mm) of the CLT length | | |
| SQUARENESS | Panel face diagonals shall not differ by more than 1/8" (3 mm) | | |
| STRAIGHTNESS | Deviation of edges from a straight line between adjacent panel corners shall not exceed 1/16" (2 mm) | | |
| MACHINED SURFACES | +/- 1/8" (3 mm) with all tooling units except the chainsaw, which is +/- 1/4" (6 mm) | | |

# 5. Mercer CLT Panel Layups

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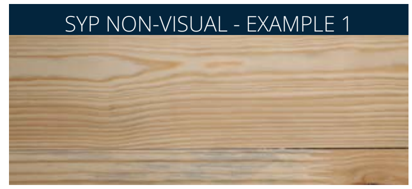
# 6. Mercer CLT Finishes and Appearance Classification

| | VISUAL | NON-VISUAL |
|---|---|---|
| INTENDED USE | Where one or both faces are left exposed | Where both faces are covered by another material |
| FACE LAYER - V SERIES | SPF #2&Btr Appearance Grade, Douglas-fir, Appearance Grade,<br>SP #2&Btr Appearance Grade | SPF #2&Btr, SP #2&Btr |
| FACE LAYER - E SERIES | SPF MSR 2100 Square Edge | SPF MSR 2100, SP MSR 2100 |
| SANDED FACE | 80 grit<br>Note: Final finishing prep work must be completed on-site, including cleaning and touch-up of panels | N/A |

| | ALLOWABLE FIBER CHARACTERISTICS | |
|---|---|---|
| SHAKE AND CHECKS | Several up to 24" long, none through | As per NLGA #2, SPF #2&Btr |
| STAIN | Up to a max of 5% blue stain, heart stain allowed<br>Note: E Series panels have no blue stain restrictions | Allowed, not limited |
| KNOTS | Firm & Tight (NLGA #2) | NLGA #2 |
| PITCH STREAKS | Not limited | Not limited |
| WANE ON FACE | None | Allowed |
| SIDE PRESSURE | Yes | None |
| SURFACE QUALITY | SPF APPEARANCE GRADE<br><br>DOUGLAS-FIR APPEARANCE GRADE<br><br>SYP APPEARANCE GRADE<br> | SPF NON-VISUAL - EXAMPLE 1<br><br>DOUGLAS-FIR NON-VISUAL - EXAMPLE 1<br><br>SYP NON-VISUAL - EXAMPLE 1<br> |

# 7. Panel Applications

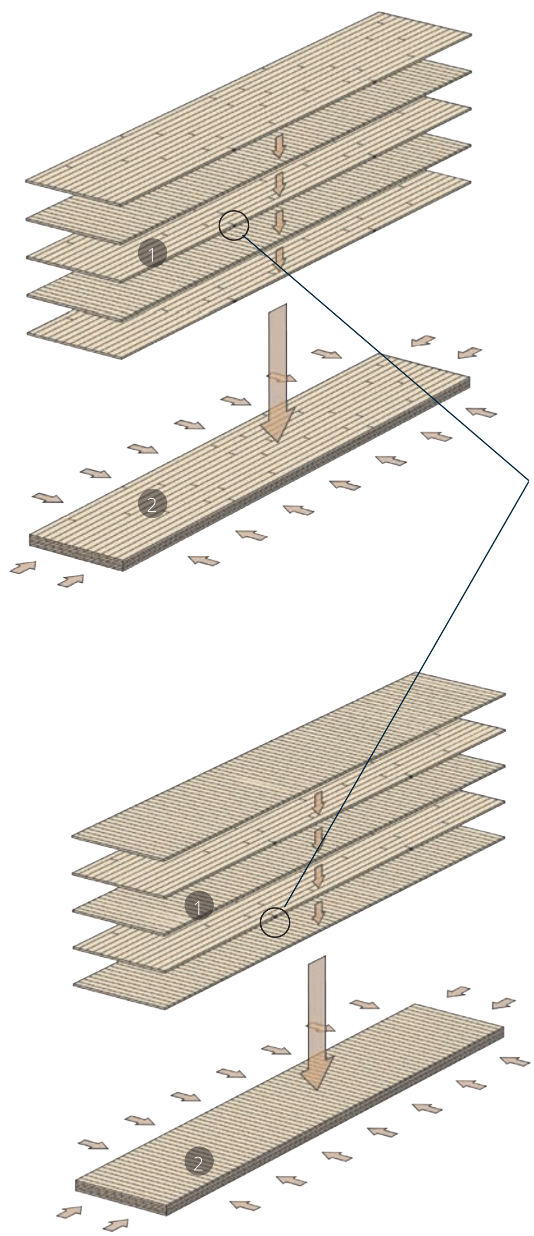
Mercer CLT panels are primarily intended for one-way slab, single or multi-span behavior in the panel strong direction for out-of-plane loads and acts as the floor/roof diaphragm without the addition of plywood sheathing or structural concrete topping for in-plane loading. The bottom face of appropriately-sized floor panels may be visually exposed and achieve a 1- or 2-hour fire resistance rating through charring of the wood.

The width of laminations (boards) in outer visible layers and inner layers of panels are nominally 6 inches. Architectural and Industrial Appearance surface classifications are available, where an Architectural Appearance surface classification may be specified on one, both, or neither of the faces of the panel. Our CLT is compatible with a number of different surface treatments (i.e., painted, stained, sealed, etc.), which should be evaluated on a project-by-project basis.

Boards are end jointed (finger-jointed) at random lengths to create continuous boards from which the billet is laid up. End joints are cut parallel to the wide face of laminations, thus the fingers will be visible on the narrow face of boards. Transverse boards may not contain finger joints.

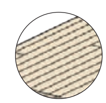
Finished panels are accurately fabricated from full billets to the user-specified size, shape, and level of detail by state-of-the-art CNC machines installed at production at each facility to provide precise field fit. Consult with MMT on a project basis to review the manufacturability of the proposed CLT panelization, holes, and edge cut fabrication at early design stages.

## LAYUP OF A 5-PLY MERCER CLT BILLET




MAJOR STRENGTH DIRECTION

Transverse laminations

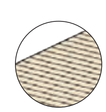


END JOINTS IN LONGITUDINAL LAMINATIONS

1. Face bond adhesive between each layer
2. Top, end, and side pressure applied during curing

MINOR STRENGTH DIRECTION

Longitudinal laminations



# 8. Structural Panel Properties and Allowable Design

TABLE 6: Allowable design properties for laminations - **Western Species (SPF, DF-L)***

| CLT GRADE | MAJOR STRENGTH DIRECTION | | | | | | MINOR STRENGTH DIRECTION | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $F_B$ (psi) | E ($10^6$ psi) | $F_T$ (psi) | $F_C$ (psi) | $F_V$ (psi) | $F_S$ (psi) | $F_B$ (psi) | E ($10^6$psi) | $F_T$ (psi) | $F_C$ (psi) | $F_V$ (psi) | $F_S$ (psi) |
| V2.1<br>1.4V 875 SPF<br>1.4V 875 DF-L | 875 | 1.4 | 450 | 1,150 | 135 | 45 | 500 | 1.2 | 250 | 650 | 135 | 45 |
| V2M1.1 | 875 | 1.4 | 450 | 1,150 | 135 | 45 | 875 | 1.4 | 450 | 1,150 | 135 | 45 |
| E1M4<br>1.8M 2100 SPF<br>1.8M 2100 DF-L | 2,100 | 1.8 | 1,575 | 1,875 | 160 | 50 | 500 | 1.2 | 250 | 650 | 135 | 45 |
| E1M5 | 2,100 | 1.8 | 1,575 | 1,875 | 160 | 50 | 875 | 1.4 | 450 | 1,150 | 135 | 45 |

NOTES:
1. Tabulated values are allowable design values and not permitted to be increased for the lumber size adjustment factor in accordance with the NDS.
2. The CLT grades are developed based on APA and PFS-Teco Certifications. Please refer to specific grade layups for complete panel information.
3. The design values shall be used in conjunction with the section properties provided by the CLT manufacturer based on the actual layup used in manufacturing the CLT panel (see table above).

TABLE 7: Allowable design properties for laminations - **Southern Species (SYP)***

| CLT GRADE | MAJOR STRENGTH DIRECTION | | | | | | MINOR STRENGTH DIRECTION | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $F_B$ (psi) | E ($10^6$ psi) | $F_T$ (psi) | $F_C$ (psi) | $F_V$ (psi) | $F_S$ (psi) | $F_B$ (psi) | E ($10^6$psi) | $F_T$ (psi) | $F_C$ (psi) | $F_V$ (psi) | $F_S$ (psi) |
| V3.1 | 750 | 1.4 | 450 | 1,250 | 175 | 55 | 450 | 1.3 | 250 | 725 | 175 | 55 |
| V3M1<br>1.4V 750 SYP | 750 | 1.4 | 450 | 1,250 | 175 | 55 | 750 | 1.4 | 450 | 1,250 | 175 | 55 |
| E4M3 | 2,100 | 1.8 | 1,575 | 1,875 | 175 | 55 | 450 | 1.3 | 250 | 725 | 175 | 55 |
| E4M2<br>1.8M 2100 SYP | 2,100 | 1.8 | 1,575 | 1,875 | 175 | 55 | 750 | 1.4 | 450 | 1,250 | 175 | 55 |

NOTES:
1. Tabulated values are allowable design values and not permitted to be increased for the lumber size adjustment factor in accordance with the NDS.
2. The CLT grades are developed based on APA Product Report PR-L314, APA Product Report PR-L347 and PFS-Teco Building Product Evaluation Report BPER-0141. Please refer to specific grade layups for complete panel information.
3. The design values shall be used in conjunction with the section properties provided by Mercer Mass Timber based on the actual layup used.
4. Values are calculated per one-foot-wide section of panel.

*This list is non exhaustive. Contact Mercer Mass Timber for additional grades.

TABLE 8: Allowable stress design capacities for **Western Species (SPF, DF-L)***

| CLT GRADE | PANEL | WEIGHT LBS/FT² | MAJOR STRENGTH DIRECTION | | | | MINOR STRENGTH DIRECTION | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_BS_{EFF,0}$ (lbs-ft/ft) | $EI_{EFF,0}$ ($10^6$lbs-in²/ft) | $GA_{EFF,0}$ ($10^6$lbs/ft) | $V_{S,0}$ (lbf/ft) | $F_BS_{EFF,0}$ (lbs-ft/ft) | $EI_{EFF,90}$ ($10^6$lbs-in²/ft) | $GA_{EFF,90}$ ($10^6$lbs/ft) | $V_{S,90}$ (lbf/ft) |
| V2.1 1.4V 875 SPF 1.4V 875 DF-L | 87 V | 8.5 | 1,440 | 56 | 0.48 | 1,230 | 35 | 0.36 | 0.30 | 240 |
| | 90 V | 8.8 | 1,500 | 60 | 0.39 | 1,270 | 115 | 2.0 | 0.44 | 425 |
| | 150 V | 14.8 | 3,450 | 229 | 0.78 | 2,120 | 1,010 | 51 | 0.89 | 1,270 |
| | 139V | 13.7 | 3,325 | 206 | 0.96 | 1,970 | 540 | 21 | 0.60 | 980 |
| | 191V | 18.8 | 5,925 | 503 | 1.40 | 2,700 | 1,220 | 83 | 0.91 | 1,710 |
| | 243V | 23.9 | 9,200 | 995 | 1.90 | 3,450 | 2,140 | 209 | 1.20 | 2,450 |
| V2M1.1 | 105 V | 10.3 | 2,050 | 96 | 0.53 | 1,490 | 280 | 3.7 | 0.53 | 495 |
| | 175 V | 17.2 | 4,725 | 366 | 1.10 | 2,480 | 2,410 | 96 | 1.10 | 1,490 |
| | 245 V | 24.1 | 8,350 | 906 | 1.60 | 3,475 | 5,550 | 366 | 1.60 | 2,480 |
| | 315 V | 30.9 | 12,925 | 1,806 | 2.10 | 4,475 | 9,800 | 906 | 2.10 | 3,475 |
| E1M4 1.8M 2100 SPF 1.8M 2100 DF-L | 87 E | 8.5 | 3,475 | 72 | 0.50 | 1,230 | 35 | 0.40 | 0.38 | 270 |
| | 139 E | 13.7 | 7,975 | 264 | 0.99 | 1,970 | 540 | 21 | 0.77 | 1,090 |
| | 191 E | 18.8 | 14,175 | 645 | 1.50 | 2,700 | 1,230 | 83 | 1.10 | 1,910 |
| | 243 E | 23.9 | 22,075 | 1,278 | 2.00 | 3,450 | 2,160 | 209 | 1.50 | 2,725 |
| E1M5 | 105 E | 10.3 | 4,900 | 123 | 0.54 | 1,490 | 275 | 3.70 | 0.66 | 550 |
| | 175 E | 17.2 | 11,250 | 469 | 1.10 | 2,480 | 2,400 | 96 | 1.30 | 1,650 |
| | 245 E | 24.1 | 19,900 | 1,161 | 1.60 | 3,475 | 5,550 | 366 | 2.00 | 2,750 |
| | 315 E | 30.9 | 30,850 | 2,314 | 2.10 | 4,475 | 9,825 | 906 | 2.60 | 3,850 |

TABLE 9: Allowable stress design capacities **Southern Species (SYP)***

| CLT GRADE | PANEL | WEIGHT lb/ft² | MAJOR STRENGTH DIRECTION | | | | | MINOR STRENGTH DIRECTION | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $F_BS_{EFF,0}$ (lbf-ft/ft) | $EI_{EFF,0}$ ($10^6$ lbf-in²/ft) | $GA_{EFF,0}$ ($10^6$ lbf/ft) | $F_BS_{EFF,90}$ (lbf-ft/ft) | $V_{S,0}$ (lbf/ft) | $EI_{EFF,90}$ ($10^6$ lbf-in²/ft) | $GA_{EFF,90}$ ($10^6$ lbf-in²/ft) | $V_{S,90}$ (lbf/ft) |
| V3.1 | 87 V SP | 11.4 | 1,240 | 56 | 0.51 | 35 | 1,510 | 0.39 | 0.30 | 295 |
| | 139 V SP | 18.2 | 2,850 | 206 | 1.00 | 485 | 2,410 | 23 | 0.61 | 1,200 |
| | 191 V SP | 25 | 5,075 | 503 | 1.50 | 1,100 | 3,300 | 91 | 0.91 | 2,100 |
| | 243 V SP | 31.9 | 7,900 | 996 | 2.10 | 1,920 | 4,200 | 227 | 1.20 | 3,000 |
| V3M1 1.4V 750 SYP | 105 V SP | 13.8 | 1,750 | 95 | 0.53 | 235 | 1,820 | 37 | 0.53 | 605 |
| | 150 V SP | 19.7 | 2,950 | 230 | 0.90 | 1,510 | 2,600 | 60 | 0.90 | 1,560 |
| | 175 V SP | 22.9 | 4,025 | 366 | 1.10 | 2,060 | 3,025 | 95 | 1.10 | 1,820 |
| | 245 V SP | 32.1 | 7,125 | 906 | 1.60 | 4,750 | 4,250 | 366 | 1.60 | 3,025 |
| | 315 V SP | 41.3 | 11,050 | 1,806 | 2.10 | 8,375 | 5,450 | 906 | 2.10 | 4,250 |
| E4M3 | 87 E SP | 11.4 | 3,475 | 72 | 0.53 | 35 | 1,510 | 0.39 | 0.38 | 295 |
| | 139 E SP | 18.2 | 7,975 | 264 | 1.10 | 485 | 2,410 | 23 | 0.77 | 1,200 |
| | 191 E SP | 25 | 14,200 | 646 | 1.60 | 1,100 | 3,300 | 91 | 1.20 | 2,100 |
| | 243 E SP | 31.9 | 22,075 | 1,278 | 2.10 | 1,940 | 4,200 | 229 | 1.50 | 3,000 |
| E4M2 1.8M 2100 SYP | 105 E SP | 13.8 | 4,900 | 123 | 0.50 | 140 | 1,820 | 3.4 | 0.65 | 605 |
| | 175 E SP | 22.9 | 11,250 | 469 | 1.10 | 1,240 | 3,025 | 89 | 1.30 | 1,820 |
| | 245 E SP | 32.1.3 | 19,875 | 1,160 | 1.50 | 2,850 | 4,250 | 341 | 2.00 | 3,025 |
| | 315 E SP | 41.3 | 30,800 | 2,312 | 2.00 | 5,050 | 5,450 | 845 | 2.60 | 4,250 |

*Not all layups shown. Some layups might be specific to a factory. Contact Mercer Mass Timber for more details.

# 9. Floor Span Tables, Western Species (SPF, DF-L)

TABLE 10: Single span CLT floor slabs, SDL=40 psf. Includes panel self-weight and live load as below. Maximum span in [ft].

| CLT PANEL | RESIDENTIAL SPACE LIVE LOAD=40 PSF | | | OFFICE SPACE LIVE LOAD=50 PSF | | | MECHANICAL ROOM LIVE LOAD=75 PSF | | | STORAGE AREA LIVE LOAD=100 PSF | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD |
| 87 V | 8.56 | 9.33 | 11.36 | 8.53 | 9.10 | 10.77 | 8.47 | 8.60 | 9.63 | 8.40 | 8.19 | 8.78 |
| 87 E | 9.22 | 10.15 | 17.69 | 9.19 | 9.90 | 16.77 | 9.12 | 9.36 | 14.99 | 9.05 | 8.91 | 13.67 |
| 90 V | 8.73 | 9.44 | 11.57 | 8.70 | 9.20 | 10.97 | 8.63 | 8.70 | 9.81 | 8.57 | 8.28 | 8.95 |
| 105 V | 9.98 | 10.95 | 13.40 | 9.95 | 10.69 | 12.72 | 9.87 | 10.11 | 11.40 | 9.80 | 9.63 | 10.41 |
| 105 E | 10.75 | 11.90 | 20.85 | 10.71 | 11.61 | 19.79 | 10.63 | 10.97 | 17.71 | 10.56 | 10.45 | 16.17 |
| 139 V | 12.39 | 14.12 | 16.74 | 12.35 | 13.80 | 15.92 | 12.27 | 13.11 | 14.31 | 12.18 | 12.53 | 13.10 |
| 139 E | 13.35 | 15.38 | 26.05 | 13.31 | 15.03 | 24.77 | 13.21 | 14.26 | 22.24 | 13.12 | 13.63 | 20.35 |
| 150 V | 12.75 | 14.43 | 16.95 | 12.71 | 14.11 | 16.13 | 12.62 | 13.40 | 14.51 | 12.54 | 12.80 | 13.30 |
| 175 V | 14.57 | 16.69 | 19.52 | 14.53 | 16.33 | 18.60 | 14.43 | 15.53 | 16.77 | 14.34 | 14.86 | 15.39 |
| 175 E | 15.70 | 18.18 | 30.40 | 15.66 | 17.78 | 28.95 | 15.55 | 16.89 | 26.08 | 15.45 | 16.15 | 23.92 |
| 191 V | 15.92 | 18.58 | 21.72 | 15.88 | 18.19 | 20.71 | 15.78 | 17.33 | 18.70 | 15.68 | 16.61 | 17.19 |
| 191 E | 17.16 | 20.28 | 33.79 | 17.12 | 19.85 | 32.21 | 17.00 | 18.90 | 29.06 | 16.90 | 18.11 | 26.68 |
| 243 V | 19.26 | 22.83 | 26.35 | 19.21 | 22.38 | 25.19 | 19.09 | 21.39 | 22.85 | 18.98 | 20.54 | 21.06 |
| 243 E | 20.78 | 24.95 | 41.11 | 20.72 | 24.45 | 39.27 | 20.60 | 23.35 | 35.58 | 20.47 | 22.41 | 32.77 |
| 245 V | 18.74 | 21.94 | 25.04 | 18.70 | 21.51 | 23.94 | 18.58 | 20.54 | 21.72 | 18.48 | 19.71 | 20.02 |
| 245 E | 20.19 | 24.01 | 38.99 | 20.14 | 23.52 | 37.26 | 20.02 | 22.45 | 33.76 | 19.90 | 21.54 | 31.09 |
| 315 V | 22.67 | 26.83 | 30.13 | 22.61 | 26.33 | 28.88 | 22.49 | 25.23 | 26.34 | 22.37 | 24.28 | 24.37 |
| 315 E | 24.36 | 29.19 | 46.59 | 24.30 | 28.65 | 44.67 | 24.17 | 27.46 | 40.74 | 24.04 | 26.43 | 37.69 |

NOTES:
1. See Table 11 for notes.

TABLE 11: Double span CLT floor slabs, SDL=40 psf. includes panel self-weight and live load as below. Maximum span in [ft].

| CLT PANEL | RESIDENTIAL SPACE LIVE LOAD=40 PSF | | | OFFICE SPACE LIVE LOAD=50 PSF | | | MECHANICAL ROOM LIVE LOAD=75 PSF | | | STORAGE AREA LIVE LOAD=100 PSF | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD |
| 87 V | 10.27 | 12.69 | 11.36 | 10.24 | 12.39 | 10.77 | 10.16 | 11.74 | 9.63 | 10.08 | 11.20 | 8.78 |
| 87 E | 11.07 | 13.82 | 17.69 | 11.03 | 13.49 | 16.77 | 10.95 | 12.78 | 14.99 | 10.87 | 12.19 | 13.23 |
| 90 V | 10.47 | 12.90 | 11.57 | 10.44 | 12.59 | 10.97 | 10.36 | 11.92 | 9.81 | 10.28 | 11.37 | 8.95 |
| 105 V | 11.98 | 14.97 | 13.40 | 11.94 | 14.62 | 12.72 | 11.85 | 13.86 | 11.40 | 11.77 | 13.23 | 10.41 |
| 105 E | 12.90 | 16.29 | 20.85 | 12.86 | 15.90 | 19.79 | 12.76 | 15.07 | 17.71 | 12.67 | 14.38 | 15.83 |
| 139 V | 14.87 | 19.16 | 16.74 | 14.82 | 18.74 | 15.92 | 14.72 | 17.82 | 14.31 | 14.62 | 17.06 | 13.10 |
| 139 E | 16.02 | 20.88 | 26.05 | 15.97 | 20.42 | 24.77 | 15.86 | 19.41 | 22.24 | 15.75 | 18.57 | 20.35 |
| 150 V | 15.30 | 19.66 | 16.95 | 15.26 | 19.23 | 16.13 | 15.15 | 18.29 | 14.51 | 15.05 | 17.51 | 13.30 |
| 175 V | 17.48 | 22.74 | 19.52 | 17.43 | 22.26 | 18.60 | 17.31 | 21.21 | 16.77 | 17.20 | 20.32 | 15.39 |
| 175 E | 18.85 | 24.79 | 30.40 | 18.79 | 24.26 | 28.95 | 18.66 | 23.10 | 26.08 | 18.54 | 22.12 | 23.92 |
| 191 V | 19.11 | 25.20 | 21.72 | 19.06 | 24.68 | 20.71 | 18.93 | 23.55 | 18.70 | 18.81 | 22.59 | 17.19 |
| 191 E | 20.60 | 27.51 | 33.79 | 20.54 | 26.94 | 32.21 | 20.40 | 25.69 | 29.06 | 20.28 | 24.63 | 26.68 |
| 243 V | 23.11 | 30.96 | 26.35 | 23.05 | 30.36 | 25.19 | 22.91 | 29.05 | 22.85 | 22.78 | 27.93 | 21.06 |
| 243 E | 24.93 | 33.84 | 41.11 | 24.87 | 33.18 | 39.27 | 24.71 | 31.72 | 35.58 | 24.57 | 30.48 | 32.77 |
| 245 V | 22.49 | 29.87 | 25.04 | 22.43 | 29.29 | 23.94 | 22.30 | 28.01 | 21.72 | 22.17 | 26.93 | 20.02 |
| 245 E | 24.23 | 32.65 | 38.99 | 24.17 | 32.01 | 37.26 | 24.02 | 30.59 | 33.76 | 23.88 | 29.39 | 31.09 |
| 315 V | 27.20 | 36.54 | 30.13 | 27.14 | 35.88 | 28.88 | 26.99 | 34.43 | 26.34 | 26.85 | 33.17 | 24.37 |
| 315 E | 29.23 | 39.71 | 46.59 | 29.16 | 30.00 | 44.67 | 29.00 | 37.42 | 40.74 | 28.85 | 36.06 | 37.69 |

NOTES:

1. For panel properties refer to Table 8. Span Tables are intended for Preliminary Sizing only.
2. Span Table includes self-weight plus a superimposed dead load of SDL=40psf. This SDL covers a typical 2" thick concrete topping + 15psf for miscellaneous imposed dead loads.
3. For double span situations, both spans are assumed to be equal. Live load pattern loading has not been considered. Live loads are assumed to be uniform over both spans.
4. Deflection checks were made assuming a maximum allowable deformation of L/240 (L = span) under total load, including creep behavior as defined on NDS clause 3.5.2 with Kcr=2.0
5. Vibration design is based on the approach outlined in the CLT Handbook as described on the latest US Mass Timber Floor Vibration Design Guide. Vibration span values are increased by 20% for double span situations based on the US CLT Handbook and the Mass Timber Floor Vibration Guide. The effect of flexible supports (e.g. glulam beams) is not considered on the vibration results presented. More sophisticated vibration analysis might be required.
6. ASD spans shown are established not to exceed the maximum Moment and Shear capacities of the panels, as per ASD design methodology defined on the NDS. All adjustment factors outlined in NDS Table 10.3.1 have assumed as 1.0
7. Span table values are only valid in the major strength direction of the CLT panels.
8. Some of the indicated spans exceed manufacturing capacities (60' single span panel, 2x30' for double span.) In some manufacturing plants or conditions, the maximum limit might be reduced. Contact Mercer Mass Timber for more details.

# 10. Floor Span Tables, Southern Species (SYP)

TABLE 12: Single span CLT floor slabs, SDL=40 psf. Includes panel self-weight and live load as below. Maximum span in [ft].

| CLT PANEL | RESIDENTIAL SPACE LIVE LOAD=40 PSF | | | OFFICE SPACE LIVE LOAD=50 PSF | | | MECHANICAL ROOM LIVE LOAD=75 PSF | | | STORAGE AREA LIVE LOAD=100 PSF | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD |
| 87 V SP | 8.54 | 9.29 | 10.48 | 8.51 | 9.07 | 9.94 | 8.45 | 8.58 | 8.89 | 8.39 | 8.18 | 8.12 |
| 87 E SP | 9.19 | 10.09 | 17.54 | 9.16 | 9.84 | 16.64 | 9.09 | 9.32 | 14.89 | 9.03 | 8.88 | 13.60 |
| 105 V SP | 9.96 | 10.95 | 12.34 | 9.92 | 10.69 | 11.72 | 9.85 | 10.13 | 10.51 | 9.78 | 9.66 | 9.61 |
| 105 E SP | 10.71 | 11.86 | 20.59 | 10.67 | 11.58 | 19.56 | 10.59 | 10.97 | 17.53 | 10.52 | 10.46 | 16.03 |
| 139 V SP | 12.35 | 14.02 | 15.36 | 12.31 | 13.71 | 14.62 | 12.23 | 13.04 | 13.16 | 12.15 | 12.48 | 12.07 |
| 139 E SP | 13.28 | 15.24 | 25.70 | 13.24 | 14.90 | 24.46 | 13.15 | 14.17 | 22.02 | 13.06 | 13.56 | 20.18 |
| 175 V SP | 14.51 | 16.64 | 17.93 | 14.47 | 16.28 | 17.10 | 14.38 | 15.52 | 15.45 | 14.29 | 14.86 | 14.19 |
| 175 E SP | 15.59 | 18.00 | 29.88 | 15.55 | 17.62 | 28.50 | 15.45 | 16.79 | 25.74 | 15.35 | 16.08 | 23.66 |
| 191 V SP | 15.86 | 18.43 | 19.87 | 15.82 | 18.05 | 18.97 | 15.72 | 17.23 | 17.16 | 15.62 | 16.52 | 15.79 |
| 191 E SP | 17.06 | 20.02 | 33.24 | 17.02 | 19.61 | 31.73 | 16.91 | 18.71 | 28.71 | 16.81 | 17.95 | 26.42 |
| 243 V SP | 19.17 | 22.62 | 24.08 | 19.12 | 22.19 | 23.05 | 19.01 | 21.24 | 20.95 | 18.90 | 20.43 | 19.34 |
| 243 E SP | 20.62 | 24.53 | 40.25 | 20.57 | 24.07 | 38.52 | 20.45 | 23.03 | 35.02 | 20.34 | 22.14 | 32.33 |
| 245 V SP | 18.66 | 21.79 | 22.89 | 18.62 | 21.37 | 21.91 | 18.51 | 20.45 | 19.92 | 18.41 | 19.65 | 18.39 |
| 245 E SP | 20.04 | 23.57 | 38.18 | 19.99 | 23.12 | 36.55 | 19.88 | 22.11 | 33.23 | 19.77 | 21.25 | 30.67 |
| 315 V SP | 22.52 | 26.56 | 27.42 | 22.47 | 16.09 | 26.32 | 22.35 | 25.05 | 24.07 | 22.24 | 24.14 | 22.31 |
| 315 E SP | 24.22 | 28.78 | 45.83 | 24.17 | 28.27 | 44.00 | 24.04 | 27.13 | 40.23 | 23.92 | 26.14 | 37.29 |

NOTES:
1. See Table 13 for notes.

TABLE 13: Double span CLT floor slabs, SDL=40 psf. Includes panel self-weight and live load as below. Maximum span in [ft].

| CLT PANEL | RESIDENTIAL SPACE LIVE LOAD=40 PSF | | | OFFICE SPACE LIVE LOAD=50 PSF | | | MECHANICAL ROOM LIVE LOAD=75 PSF | | | STORAGE AREA LIVE LOAD=100 PSF | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD | VIBRATION | L/240 | ASD |
| 87 V SP | 10.25 | 12.64 | 10.48 | 10.21 | 12.34 | 9.94 | 10.14 | 11.70 | 8.89 | 10.06 | 11.17 | 8.12 |
| 87 E SP | 11.03 | 13.73 | 17.54 | 10.99 | 13.41 | 16.64 | 10.91 | 12.71 | 14.89 | 10.83 | 12.14 | 13.60 |
| 105 V SP | 11.95 | 14.93 | 12.34 | 11.91 | 14.59 | 11.72 | 11.82 | 13.85 | 10.51 | 11.74 | 13.23 | 9.61 |
| 105 E SP | 12.85 | 16.19 | 20.59 | 12.81 | 15.82 | 19.56 | 12.71 | 15.01 | 17.53 | 12.62 | 14.34 | 16.03 |
| 139 V SP | 14.82 | 19.02 | 15.36 | 14.78 | 18.62 | 14.62 | 14.67 | 17.72 | 13.16 | 14.58 | 16.98 | 12.07 |
| 139 E SP | 15.94 | 20.67 | 25.70 | 15.89 | 20.22 | 24.46 | 15.78 | 19.26 | 22.02 | 15.68 | 18.44 | 20.18 |
| 175 V SP | 17.41 | 22.61 | 17.93 | 17.36 | 22.14 | 17.10 | 17.25 | 21.13 | 15.45 | 17.15 | 20.27 | 14.19 |
| 175 E SP | 18.71 | 24.50 | 29.88 | 18.66 | 23.99 | 28.50 | 18.54 | 22.89 | 25.74 | 18.42 | 21.95 | 23.66 |
| 191 V SP | 19.03 | 24.98 | 19.87 | 18.98 | 24.48 | 18.97 | 18.86 | 23.39 | 17.16 | 18.74 | 22.46 | 15.79 |
| 191 E SP | 20.48 | 27.15 | 33.24 | 20.42 | 26.61 | 31.73 | 20.29 | 25.42 | 28.71 | 20.17 | 24.41 | 26.42 |
| 243 V SP | 23.00 | 30.65 | 24.08 | 22.95 | 30.08 | 23.05 | 22.81 | 28.82 | 20.95 | 22.69 | 27.74 | 19.34 |
| 243 E SP | 24.74 | 33.27 | 40.25 | 24.68 | 32.65 | 38.52 | 24.54 | 31.28 | 35.02 | 24.40 | 30.10 | 32.33 |
| 245 V SP | 22.39 | 29.61 | 22.89 | 22.34 | 29.06 | 21.91 | 22.21 | 27.83 | 19.92 | 22.09 | 26.78 | 18.39 |
| 245 E SP | 24.05 | 32.07 | 38.18 | 23.99 | 31.47 | 36.55 | 23.85 | 30.14 | 33.23 | 23.72 | 29.00 | 30.67 |
| 315 V SP | 27.02 | 36.10 | 27.42 | 26.96 | 35.48 | 26.32 | 26.82 | 34.10 | 24.07 | 26.69 | 32.90 | 22.31 |
| 315 E SP | 29.06 | 39.17 | 45.83 | 29.00 | 38.49 | 44.00 | 28.85 | 36.99 | 40.23 | 28.70 | 35.68 | 37.29 |

NOTES:

1. For panel properties refer to Table 9. Span Tables are intended for Preliminary Sizing only.
2. Span Table includes self-weight plus a superimposed dead load of SDL=40psf. This is SDL covers a typical 2” thick concrete topping + 15psf for miscellaneous imposed dead loads.
3. For double span situations, both spans are assumed to be equal. Live load pattern loading has not been considered. Live loads are assumed to be uniform over both spans.
4. Deflection checks were made assuming a maximum allowable deformation of L/240 (L = span) under total load, including creep behavior as defined on NDS clause 3.5.2 with Kcr=2.0
5. Vibration design is based on the approach outlined in the CLT Handbook as described on the latest US Mass Timber Floor Vibration Design Guide. Vibration span values are increased by 20% for double span situations based on the US CLT Handbook and the Mass Timber Floor Vibration Guide. The effect of flexible supports (e.g. glulam beams) is not considered on the vibration results presented. More sophisticated vibration analysis might be required.
6. ASD spans shown are established not to exceed the maximum Moment and Shear capacities of the panels, as per ASD design methodology defined on the NDS. All adjustment factors outlined in NDS Table 10.3.1 have assumed as 1.0
7. Span table values are only valid the major strength direction of the CLT panels.
8. Some of the indicated spans exceed manufacturing capacities (60’ single span panel, 2x30’ for double span.) In some manufacturing plants and conditions, the maximum limit might be reduced. Contact Mercer Mass Timber for more details.

# 11. Roof Span Tables, Western Species (SPF, DF-L)

TABLE 14: Single span CLT roof slabs, SDL=25 psf and LR=20psf. Includes panel self-weight and snow loads as below. Maximum span in [ft].

| CLT PANEL | SNOW ROOF LOAD S=20 PSF | | | SNOW ROOF LOAD S=30 PSF | | | SNOW ROOF LOAD S=50 PSF | | | SNOW ROOF LOAD S=100 PSF | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD |
| 87 V | 10.92 | 15.87 | 14.57 | 10.92 | 13.82 | 13.39 | 10.92 | 11.58 | 11.69 | 10.92 | 9.07 | 9.26 |
| 87 E | 11.91 | 17.25 | 22.73 | 11.91 | 15.01 | 20.87 | 11.91 | 12.58 | 18.21 | 11.91 | 9.84 | 14.41 |
| 90 V | 11.07 | 16.19 | 14.81 | 11.07 | 14.08 | 13.62 | 11.07 | 11.78 | 11.90 | 11.07 | 9.19 | 9.44 |
| 105 V | 12.79 | 18.94 | 17.07 | 12.79 | 16.47 | 15.73 | 12.79 | 13.78 | 13.79 | 12.79 | 10.75 | 10.97 |
| 105 E | 13.93 | 20.55 | 26.62 | 13.93 | 17.86 | 24.51 | 13.93 | 14.94 | 21.45 | 13.93 | 11.64 | 17.05 |
| 139 V | 16.27 | 24.57 | 21.07 | 16.27 | 21.40 | 19.51 | 16.27 | 17.96 | 17.20 | 16.27 | 14.11 | 13.79 |
| 139 E | 17.77 | 26.68 | 32.88 | 17.77 | 23.23 | 30.41 | 17.77 | 19.49 | 26.77 | 17.77 | 15.31 | 21.42 |
| 150 V | 16.62 | 25.39 | 21.25 | 16.62 | 22.10 | 19.70 | 16.62 | 18.52 | 17.41 | 16.62 | 14.51 | 13.99 |
| 175 V | 19.12 | 29.72 | 24.30 | 19.12 | 25.86 | 22.59 | 19.12 | 21.68 | 20.03 | 19.12 | 16.98 | 16.18 |
| 175 E | 20.88 | 32.26 | 37.96 | 20.88 | 28.07 | 35.25 | 20.88 | 23.52 | 31.21 | 20.88 | 18.40 | 25.15 |
| 191 V | 21.15 | 33.11 | 26.90 | 21.15 | 28.85 | 25.06 | 21.15 | 24.22 | 22.28 | 21.15 | 19.04 | 18.05 |
| 191 E | 23.15 | 35.97 | 42.00 | 23.15 | 31.34 | 39.07 | 23.15 | 26.31 | 34.68 | 23.15 | 20.68 | 28.03 |
| 243 V | 25.74 | 41.59 | 32.20 | 25.74 | 36.25 | 30.14 | 25.74 | 30.44 | 26.99 | 25.74 | 23.95 | 22.08 |
| 243 E | 28.20 | 45.20 | 50.41 | 28.20 | 39.39 | 47.13 | 28.20 | 33.07 | 42.13 | 28.20 | 26.01 | 34.37 |
| 245 V | 24.77 | 40.24 | 30.58 | 24.77 | 35.04 | 28.64 | 24.77 | 29.39 | 25.65 | 24.77 | 23.06 | 20.99 |
| 245 E | 27.16 | 43.70 | 47.79 | 27.16 | 38.06 | 44.69 | 27.16 | 31.93 | 39.96 | 27.16 | 25.07 | 32.61 |
| 315 V | 29.95 | 50.66 | 36.21 | 29.95 | 44.11 | 34.11 | 29.95 | 37.00 | 30.81 | 29.95 | 29.04 | 25.50 |
| 315 E | 32.57 | 55.02 | 56.00 | 32.57 | 47.92 | 52.75 | 32.57 | 40.21 | 47.65 | 32.57 | 31.58 | 39.44 |

NOTES:
1. See Table 15 for notes.

TABLE 15: Single span CLT roof slabs, SDL=25 psf and LR=20psf. Includes panel self-weight and snow loads as below. Maximum span in [ft].

| CLT PANEL | SNOW ROOF LOAD S=20 PSF | | | SNOW ROOF LOAD S=30 PSF | | | SNOW ROOF LOAD S=50 PSF | | | SNOW ROOF LOAD S=100 PSF | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD |
| 87 V | 14.81 | 21.39 | 14.57 | 14.81 | 18.65 | 13.39 | 14.81 | 15.67 | 11.69 | 14.81 | 12.35 | 9.26 |
| 87 E | 16.15 | 23.26 | 22.73 | 16.15 | 20.27 | 20.87 | 16.15 | 17.03 | 18.21 | 16.15 | 13.42 | 14.41 |
| 90 V | 15.05 | 21.85 | 14.81 | 15.05 | 19.04 | 13.62 | 15.05 | 15.99 | 11.90 | 15.05 | 12.57 | 9.44 |
| 105 V | 17.39 | 25.56 | 17.07 | 17.39 | 22.27 | 15.73 | 17.39 | 18.70 | 13.79 | 17.39 | 14.71 | 10.97 |
| 105 E | 18.97 | 27.75 | 26.62 | 18.97 | 24.17 | 24.51 | 18.97 | 20.29 | 21.45 | 18.97 | 15.95 | 17.05 |
| 139 V | 22.02 | 33.08 | 21.07 | 22.02 | 28.85 | 19.51 | 22.02 | 24.27 | 17.20 | 22.02 | 19.15 | 13.79 |
| 139 E | 24.05 | 35.92 | 32.88 | 24.05 | 31.32 | 30.41 | 24.05 | 26.34 | 26.77 | 24.05 | 20.78 | 21.42 |
| 150 V | 22.55 | 34.22 | 21.25 | 22.55 | 29.83 | 19.70 | 22.55 | 25.07 | 17.41 | 22.55 | 19.75 | 13.99 |
| 175 V | 25.95 | 40.04 | 24.30 | 25.95 | 34.91 | 22.59 | 25.95 | 29.34 | 20.03 | 25.95 | 23.12 | 16.18 |
| 175 E | 28.36 | 43.49 | 37.96 | 28.36 | 37.91 | 35.25 | 28.36 | 31.86 | 31.21 | 28.36 | 25.09 | 25.15 |
| 191 V | 28.62 | 44.56 | 26.90 | 28.62 | 38.87 | 25.06 | 28.62 | 32.70 | 22.28 | 28.62 | 25.82 | 18.05 |
| 191 E | 31.32 | 48.41 | 42.00 | 31.32 | 42.22 | 39.07 | 31.32 | 35.52 | 34.68 | 31.32 | 28.04 | 28.03 |
| 243 V | 34.82 | 55.96 | 32.20 | 34.82 | 48.81 | 30.14 | 34.82 | 41.07 | 26.99 | 34.82 | 32.44 | 22.08 |
| 243 E | 38.15 | 60.82 | 50.41 | 38.15 | 53.05 | 47.13 | 38.15 | 44.64 | 42.13 | 38.15 | 35.25 | 34.37 |
| 245 V | 33.61 | 54.20 | 30.58 | 33.61 | 47.26 | 28.64 | 33.61 | 39.74 | 25.65 | 33.61 | 31.34 | 20.99 |
| 245 E | 36.82 | 58.84 | 47.79 | 36.82 | 51.32 | 44.69 | 36.82 | 43.15 | 39.96 | 36.82 | 34.04 | 32.61 |
| 315 V | 40.67 | 68.22 | 36.21 | 40.67 | 59.49 | 34.11 | 40.67 | 50.02 | 30.81 | 40.67 | 39.46 | 25.50 |
| 315 E | 44.19 | 74.07 | 56.00 | 44.19 | 64.60 | 52.75 | 44.19 | 54.33 | 47.65 | 44.19 | 42.87 | 39.44 |

NOTES:

1. For panel properties refer to Table 8. Span Tables are intended for Preliminary Sizing only.
2. Span Table includes self weight plus a superimposed dead load of SDL=25psf. This SDL covers a typical roof finishes + 15psf for miscellaneous imposed dead loads. An ordinary roof live load or Lr=20psf is also considered for Total deflection and ASD calculations.
3. For double span situations, both spans are assumed to be equal. Snow load pattern loading or snow drifts have not been considered. Snow loads are assumed to be uniform over both spans. Deflection checks were made assuming a maximum allowable deformation of L/240 (L = span) under total load, including creep behavior as defined on NDS clause 3.5.2 with Kcr=2.0
4. Deflection checks were made assuming for total load composed of D+Lr for a deformation of limit of L/240, i.e., including creep behaviour as defined on NDS clause 3.5.2 with Kcr=2.0, as well as for the instantaneous deflection under the specified Snow Load for a deflection limit of L/360.ASD spans shown are established not to exceed the maximum Moment and Shear capacities of the panels, as per ASD design methodology defined on the NDS. All adjustment factors outlined in NDS Table 10.3.1 have assumed as 1.0
5. ASD spans shown are established not to exceed the maximum Moment and Shear capacities of the panels, as per ASD design methodology defined on the NDS. All adjustment factors outlined in NDS Table 10.3.1 have assumed as 1.0 except the load duration factor, that was taken as CD=1.15
6. Span table values are only valid the major strength direction of the CLT panels.
7. Some of the indicated spans exceed manufacturing capacities (60' single span panel, 2×30' for double span). In some manufacturing plants and conditions, the maximum limit might be reduced. Contact Mercer Mass Timber for more details.

# 12. Roof Span Tables, Southern Species (SYP)

TABLE 16: Single span CLT roof slabs, SDL=25 psf and LR=20psf. Includes panel self-weight and snow load as below. Maximum span in [ft].

| CLT PANEL | SNOW ROOF LOAD S=20 PSF | | | SNOW ROOF LOAD S=30 PSF | | | SNOW ROOF LOAD S=50 PSF | | | SNOW ROOF LOAD S=100 PSF | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD |
| 87 V SP | 11.70 | 15.89 | 13.38 | 11.70 | 13.83 | 12.32 | 11.70 | 11.59 | 10.78 | 11.70 | 9.09 | 8.56 |
| 87 E SP | 12.71 | 17.26 | 22.40 | 12.71 | 15.03 | 20.62 | 12.71 | 12.59 | 18.04 | 12.71 | 9.86 | 14.33 |
| 105 V SP | 13.75 | 18.98 | 15.65 | 13.75 | 16.51 | 14.44 | 13.75 | 13.83 | 12.69 | 13.75 | 10.82 | 10.12 |
| 105 E SP | 14.91 | 20.60 | 26.11 | 14.91 | 17.91 | 24.10 | 14.91 | 15.00 | 21.17 | 14.91 | 11.72 | 16.88 |
| 139 V SP | 17.40 | 24.58 | 19.24 | 17.40 | 21.41 | 17.84 | 17.40 | 17.98 | 15.78 | 17.40 | 14.13 | 12.69 |
| 139 E SP | 18.91 | 26.70 | 32.18 | 18.91 | 23.26 | 29.85 | 18.91 | 19.53 | 26.39 | 18.91 | 15.35 | 21.23 |
| 175 V SP | 20.53 | 29.77 | 22.19 | 20.53 | 25.93 | 20.67 | 20.53 | 21.75 | 18.39 | 20.53 | 17.08 | 14.91 |
| 175 E SP | 22.23 | 32.28 | 36.98 | 22.23 | 28.11 | 34.46 | 22.23 | 23.57 | 30.65 | 22.23 | 18.49 | 24.85 |
| 191 V SP | 22.63 | 33.13 | 24.47 | 22.63 | 28.87 | 22.84 | 22.63 | 24.25 | 20.37 | 22.63 | 19.08 | 16.57 |
| 191 E SP | 24.59 | 36.01 | 40.93 | 24.59 | 31.38 | 38.21 | 24.59 | 26.35 | 34.08 | 24.59 | 20.73 | 27.72 |
| 243 V SP | 27.53 | 41.64 | 29.22 | 27.53 | 36.29 | 27.43 | 27.53 | 30.49 | 24.65 | 27.53 | 24.01 | 20.26 |
| 243 E SP | 29.88 | 45.22 | 48.85 | 29.88 | 39.41 | 45.85 | 29.88 | 33.10 | 41.21 | 29.88 | 26.05 | 33.86 |
| 245 V SP | 26.57 | 40.33 | 27.76 | 26.57 | 35.13 | 26.06 | 26.57 | 29.48 | 23.43 | 26.57 | 23.16 | 19.26 |
| 245 E SP | 28.77 | 43.70 | 46.32 | 28.77 | 38.06 | 43.48 | 28.77 | 31.93 | 39.09 | 28.77 | 25.07 | 32.13 |
| 315 V SP | 32.09 | 50.70 | 32.71 | 32.09 | 44.17 | 30.90 | 32.09 | 37.08 | 28.02 | 32.09 | 29.14 | 23.32 |
| 315 E SP | 34.80 | 55.02 | 54.69 | 34.80 | 47.92 | 51.65 | 34.80 | 40.21 | 46.84 | 34.80 | 31.58 | 38.97 |

NOTES:
1. See Table 17 for notes.

TABLE 17: Double span CLT roof slabs, SDL=25 psf and LR=20psf. Includes panel self-weight and snow load as below. Maximum span in [ft].

| CLT PANEL | SNOW ROOF LOAD S=20 PSF | | | SNOW ROOF LOAD S=30 PSF | | | SNOW ROOF LOAD S=50 PSF | | | SNOW ROOF LOAD S=100 PSF | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD | TOTAL L/240 | SNOW L/360 | ASD |
| 87 V SP | 15.82 | 21.40 | 13.38 | 15.82 | 18.66 | 12.32 | 15.82 | 15.69 | 10.78 | 15.82 | 12.36 | 8.56 |
| 87 E SP | 17.20 | 23.27 | 22.40 | 17.20 | 20.28 | 20.62 | 17.20 | 17.05 | 18.04 | 17.20 | 13.43 | 14.33 |
| 105 V SP | 18.63 | 25.59 | 15.65 | 18.63 | 22.31 | 14.44 | 18.63 | 18.74 | 12.69 | 18.63 | 14.76 | 10.12 |
| 105 E SP | 20.22 | 27.78 | 26.11 | 20.22 | 24.21 | 24.10 | 20.22 | 20.34 | 21.17 | 20.22 | 16.00 | 16.88 |
| 139 V SP | 23.51 | 33.08 | 19.24 | 23.51 | 28.86 | 17.84 | 23.51 | 24.27 | 15.78 | 23.51 | 19.16 | 12.69 |
| 139 E SP | 25.54 | 35.94 | 32.18 | 25.54 | 31.35 | 29.85 | 25.54 | 26.37 | 26.39 | 25.54 | 20.82 | 21.23 |
| 175 V SP | 27.77 | 40.09 | 22.19 | 27.77 | 34.96 | 20.67 | 27.77 | 29.40 | 18.39 | 27.77 | 23.19 | 14.91 |
| 175 E SP | 30.10 | 43.48 | 36.98 | 30.10 | 37.91 | 34.46 | 30.10 | 31.88 | 30.65 | 30.10 | 25.14 | 24.85 |
| 191 V SP | 30.56 | 44.57 | 24.47 | 30.56 | 38.88 | 22.84 | 30.56 | 32.72 | 20.37 | 30.56 | 25.84 | 16.57 |
| 191 E SP | 33.21 | 48.45 | 40.93 | 33.21 | 42.26 | 38.21 | 33.21 | 35.56 | 34.08 | 33.21 | 28.08 | 27.72 |
| 243 V SP | 37.18 | 56.00 | 29.22 | 37.18 | 48.86 | 27.43 | 37.18 | 41.12 | 24.65 | 37.18 | 32.50 | 20.26 |
| 243 E SP | 40.37 | 60.83 | 48.85 | 40.37 | 53.07 | 45.85 | 40.37 | 44.65 | 41.21 | 40.37 | 35.27 | 33.86 |
| 245 V SP | 35.95 | 54.28 | 27.76 | 35.95 | 47.34 | 26.06 | 35.95 | 39.82 | 23.43 | 35.95 | 31.43 | 19.26 |
| 245 E SP | 38.95 | 58.84 | 46.32 | 38.95 | 51.32 | 43.48 | 38.95 | 43.15 | 39.09 | 38.95 | 34.04 | 32.13 |
| 315 V SP | 43.43 | 68.23 | 32.71 | 43.43 | 59.51 | 30.90 | 43.43 | 50.06 | 28.02 | 43.43 | 39.52 | 23.32 |
| 315 E SP | 47.14 | 74.07 | 54.69 | 47.14 | 64.60 | 51.65 | 47.14 | 54.33 | 46.84 | 47.14 | 42.87 | 38.97 |

NOTES:

1. For panel properties refer to Table 9. Span Tables should be used under dry conditions and for Preliminary Sizing only.
2. Span Table includes self weight plus a superimposed dead load of SDL=25psf. This SDL covers a typical roof finishes + 15psf for miscellaneous imposed dead loads. An ordinary roof live load or Lr=20psf is also considered for Total deflection and ASD calculations.
3. For double span situations, both spans are assumed to be equal. Snow load pattern loading or snow drifts have not been considered. Snow loads are assumed to be uniform over both spans.
4. Deflection checks were made assuming for total load composed of D+Lr for a deformation of limit of L/240, i.e., including creep behaviour as defined on NDS clause 3.5.2 with Kcr=2.0, as well as for the instantaneous deflection under the specified Snow Load for a deflection limit of L/360.
5. ASD spans shown are established not to exceed the maximum Moment and Shear capacities of the panels, as per ASD design methodology defined on the NDS. All adjustment factors outlined in NDS Table 10.3.1 have assumed as 1.0 except the load duration factor, that was taken as CD=1.15
6. Span table values are only valid the major strength direction of the CLT panels.
7. Some of the indicated spans exceed manufacturing capacities (60’ single span panel, 2×30’ for double span). In some manufacturing plants and conditions, the maximum limit might be reduced. Contact Mercer Mass Timber for more details.

TABLE 18: Mercer CLT in-plane shear design properties

| | CLT LAYUP | LAYUP ID | THICKNESS, $t_P$ (in) | IN-PLANE SHEAR STRESS | | IN-PLANE SHEAR CAPACITY (b) | |
|---|---|---|---|---|---|---|---|
| | | | | $F_{V,E,O}$ (psi) | $F_{V,E,90}$ (psi) | $F_{V,E,0}\ T_P$ (lbs/ft of width) | $F_{V,E,90}\ T_P$ (lbs/ft of width) |
| SPF DF-L | V2.1 | 87 V | 3.43 | 175 | 235 | 7,200 | 9,700 |
| | | 139 V | 5.47 | 175 | 235 | 11,500 | 15,400 |
| | | 191 V | 7.52 | 175 | 235 | 15,800 | 21,200 |
| | | 243 V | 9.57 | 175 | 235 | 20,100 | 27,000 |
| | V2M1.1 1.4V 875 SPF 1.4V 875 DF-L | 90 V | 3.54 | 190 | 215 | 8,100 | 9,100 |
| | | 105 V | 4.14 | 195 | 290 | 9,700 | 14,400 |
| | | 150 V | 5.90 | 240 | 235 | 17,000 | 16,600 |
| | | 175 V | 6.9 | 270 | 290 | 22,400 | 24,000 |
| | | 245 V | 9.66 | 270 | 290 | 31,300 | 33,600 |
| | | 315 V | 12.42 | 270 | 290 | 40,200 | 43,200 |
| | E1M4 1.8M 2100 SPF | 87 E | 3.43 | 175 | 235 | 7,200 | 9,700 |
| | | 139 E | 5.47 | 175 | 235 | 11,500 | 15,400 |
| | | 191 E | 7.52 | 175 | 235 | 15,800 | 21,200 |
| | | 243 E | 9.57 | 175 | 235 | 20,100 | 27,000 |
| | E1M5 | 105 E | 4.14 | 195 | 290 | 9,700 | 14,400 |
| | | 175 E | 6.9 | 270 | 290 | 22,400 | 24,000 |
| | | 245 E | 9.66 | 270 | 290 | 31,300 | 33,600 |
| | | 315 E | 12.42 | 270 | 290 | 40,200 | 43,200 |
| SYP | V3.1 | 87 V SP | 3.43 | 193 | 259 | 7,900 | 10,700 |
| | | 139 V SP | 5.47 | 193 | 259 | 12,700 | 17,000 |
| | | 191 V SP | 7.52 | 193 | 259 | 17,400 | 23,400 |
| | | 243 V SP | 9.57 | 193 | 259 | 22,200 | 29,700 |
| | V3M1 1.4V 750 SYP | 105 V SP | 4.14 | 215 | 319 | 10,700 | 15,800 |
| | | 150 V SP | 5.900 | 240 | 235 | 17,000 | 16,600 |
| | | 175 V SP | 6.9 | 297 | 319 | 24,600 | 26,400 |
| | | 245 V SP | 9.66 | 297 | 319 | 34,400 | 37,000 |
| | | 315 V SP | 12.42 | 297 | 259 | 44,300 | 38,600 |
| | E4M3 | 87 E SP | 3.43 | 193 | 259 | 7,900 | 10,700 |
| | | 139 E SP | 5.47 | 193 | 259 | 12,700 | 17,000 |
| | | 191 E SP | 7.52 | 193 | 259 | 17,400 | 23,400 |
| | | 243 E SP | 9.57 | 193 | 259 | 22,200 | 29,700 |
| | E4M2 1.8M 2100 SYP | 105 E SP | 4.14 | 215 | 319 | 10,700 | 15,800 |
| | | 175 E SP | 6.9 | 297 | 319 | 24,600 | 26,400 |
| | | 245 E SP | 9.66 | 297 | 319 | 34,400 | 37,000 |
| | | 315 E SP | 12.42 | 297 | 319 | 44,300 | 47,500 |

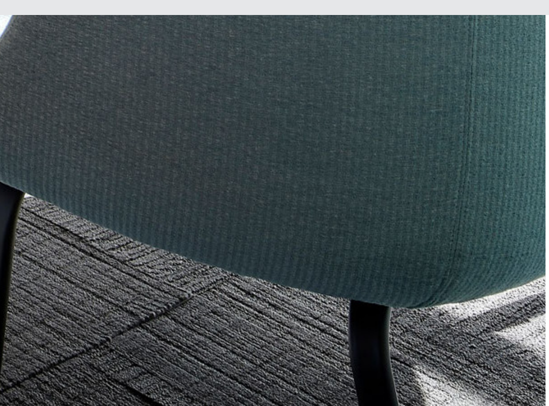
NOTES:
1. The tabulated values are allowable design values.
2. The tabulated values are for the full thickness (tP) of the CLT. The values shall be reduced when the CLT panel thickness is less than the full thickness.
3. Some values are based on test results from other layups. Refer to the relevant APA and PFS-TECO documents for more details.

*Not all layups shown. Some layups might be specific to a factory. Contact Mercer Mass Timber for more details.

Fastenal HQ | Winona, Minnesota


# MERCER GLULAM BEAMS AND COLUMNS





# Mercer Mass Timber Glulam Beams and Columns

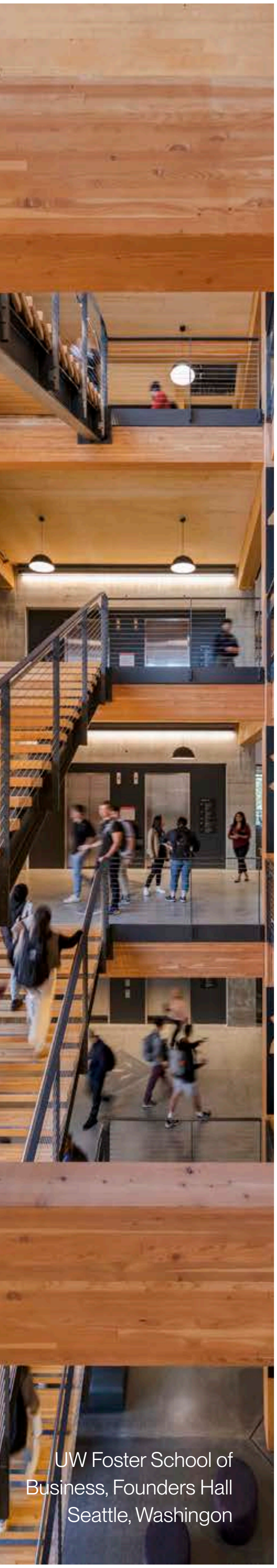
Mercer glulam is manufactured using the highest-quality, sustainably harvested lumber, produced to exacting standards and finished to create North America's most beautiful glulam beams and columns; this allows you to expose the structural elements of your building as a high-grade visual component.

Manufactured in a wide range of shapes, sizes and finish options to match the vision of your design, with options like factory-installed connections and factory-applied stain, Mercer glulam beams and columns stand above all others. When combined with Mercer CLT walls, floors and roof panels, Mercer glulam is a key component of beautiful, economically efficient structures.

The technical information in this guide is compiled to support you in developing designs that specify Mercer glulam beams and columns. If you have questions and need help, let our qualified team of mass timber specialists and technical support representatives help you specify the right solution for your project.

## MERCER GLULAM ADVANTAGES:

- North American (US and Canada) code-approved
- Range of shapes and sizes
- Superior wood fiber and appearance
- Engineering, BIM coordination, fabrication approval services available
- Available in sanded, high-quality finish
- Prefabricated kit-of-parts, CNC-fabricated to tight tolerances
- Top-notch project delivery experience
- BIM modeling options
- Shop-assembled steel connections, proprietary hangers and reinforcement screws
- Rigorous quality control process
- Delivered in coordinated sequence to installation schedule
- Installation services available




# 1. Code-approved to North American Standards

The International Building Code (IBC) recognize structural glue-laminated timber as a structural material for wood construction when manufactured in accordance with ANSI A190.1 Standard for Wood Products – Structural glue-laminated timber.

The IBC approves the use of structural glue-laminated timber as a structural member for Type IV Construction and Chapter 5 of the NDS references design values, design equations and overall engineering design specification for structural glue-laminated timber.

Manufacturers of glue-laminated timber, certified in North America, adhere to the standards set forth as described above.

## PRODUCT QUALITY ASSURED

We are proud of our ongoing certification and adherence to the North American cross-laminated timber and glue-laminated timber standards referenced throughout this guide. Mercer glulam is certified to meet the requirements of Standard for Wood Products – Structural Glue-laminated Timber and Cross-laminated Timber (CLT) as described in ANSI A190.1-2017.

These standards outline the quality control requirements required by ANSI and are verified by the APA – The Engineered Wood Association (www.apawood.org) through ongoing and monthly independent third-party inspection visits to Mercer's manufacturing operations. For more information on destructive performance testing, Table 18 on page 55.

By adhering to these standards, Mercer can assure a standard of quality to the professionals who specify our products.

# 2. Adhesives

## MERCER MASS TIMBER ADHESIVE SYSTEM

The manufacturing of all code-approved mass timber products to produce long length lamellas requires adhesives approved for face bond lamination and end-to-end finger jointing. MMT uses adhesives specific to our manufacturing processes that are certified to North American testing and manufacturing standards.

All adhesives must conform to ASTM testing methods for fire, heat and moisture and must support ANSI manufacturing standards (see Table 11 below). These test methods and manufacturing standards are approved in the US by the International Building Code (IBC). The IBC is a model building code developed by the International Code Council (ICC) .

The adhesive component is product thickness and depth dependent and comprises approximately 0.3% by weight of Mercer's mass timber building products.

## GLUE-BOND DURABILITY

The structural integrity of glulam components depends upon the integrity of the glue-bond between the component lumber elements. This is true for the entire service life of these mass timber components. Conditions that can impact the glue-bond integrity are exposure to elevated heat (such as a fire event) and exposure to high moisture conditions for extended periods.

## FIRE PERFORMANCE

The fire resistance of glue-laminated timber is based on the certification requirements of the North American testing and manufacturing mass timber standards. These standards require rigorous adhesive heat durability testing to ensure mass timber product structural integrity under the most severe fire conditions. Mercer glulam products complies with these standards.

## EMISSIONS

Both Henkel and Hexion adhesives used by MMT for manufacturing our mass timber products are certified to UL GREENGUARD Gold. GREENGUARD Gold certified products are qualified to meet UL GREENGUARD standards for low chemical emissions into indoor air during product usage. These adhesives are formulated to meet or exceed all global emissions standards.

TABLE 19: Adhesives for glulam and CLT mass timber products

| ADHESIVE APPLICATION | ADHESIVE BRAND | ADHESIVE TYPE | EMISSIONS CERTIFICATION | ADHESIVE PERFORMANCE TESTING | | |
|---|---|---|---|---|---|---|
| | | | | FULL SCALE FIRE TEST | HEAT DELAMINATION | MOISTURE DURABILITY |
| Finger Joints CLT/Glulam | Hexion Cascomel™ | Melamine Formaldehyde (MF) | UL GREENGUARD Gold | ✓ | ✓ | ✓ |
| Face Bond Glulam | Hexion EcoBind™ | Melamine Formaldehyde (MF) | UL GREENGUARD Gold | ✓ | ✓ | ✓ |

# 3. Mercer Glulam Product Characteristics

TABLE 20: Product characteristics

| PRODUCT CHARACTERISTICS | DOUGLAS-FIR | SOUTHERN PINE |
|---|---|---|
| WOOD SPECIES | Interior Douglas-fir (Pseudotsuga menziesii var. glauca) | Southern Yellow pine (Pinus palustris) |
| FACE BOND GLUE TYPE | Hexion EcoBind™ | Henkel Loctite HB-X PURBOND |
| FINGER JOINT GLUE TYPE | Hexion Cascomel® | Hexion Cascomel® |
| SFI/FSC CERTIFICATION | Available upon request | |
| MOISTURE CONTENT | 12% (+/-3%) at time of manufacturing | |
| SPECIFIC GRAVITY, SG | 0.50 | 0.55 |
| DENSITY | 35 lbs/ft$^3$ | 40 lbs/ft$^3$ |
| CERTIFICATIONS | ANSI A190.1, ANSI 117, CSA O122 and CSA O177 | |
| **DIMENSIONAL TOLERANCES** | | |
| WIDTH | +/- 1/16" (2 mm) | |
| DEPTH | 1/8" (3 mm) per foot (305 mm) of depth. -3/16" (5 mm) or 1/16" (2 mm) per foot of depth, whichever is larger. | |
| LENGTH | Up to 20' (6.1 m), +/- 1/16" (2 mm). Over 20' (6.1 m), +/- 1/16" (2 mm) per 20' (6.1 m) of length or fraction thereof. | |
| CAMBER OR STRAIGHTNESS | Tolerances for camber are applicable at the time of manufacture without allowance for dead load deflection. Up to 20' (6.1 m), the tolerance is +/- 1/4" (6 mm). Over 20' (6.1 m), the tolerance shall increase 1/8" (3 mm) per each additional 20' (6.1 m) or fraction thereof, but not to exceed 3/4" (19 mm).<br><br>The tolerances are intended for use with straight or slightly cambered members and are not applicable to curved members such as arches.<br>Refer to table <23> for additional information on camber availability. | |
| SQUARENESS OF CROSS SECTION | The tolerance for squareness shall be within +/- ⅛" (3 mm) per foot (305 mm) of specified depth unless a specially shaped section is specified.<br>Squareness shall be measured by placing one leg of a square across a top and/or bottom face and measuring the offset from the other leg of the square to the member at the opposite face of the beam. | |
| MACHINED SURFACES | +/- 1/8" (3 mm) with all tooling units except the chainsaw, which is +/- 1/4" (6 mm) | |
| MIN MAX WIDTH | See page 64 | |
| **AVAILABLE SIZES** | **MERCER OKANAGAN** | **MERCER CONWAY** |
| MAX LENGTH STANDARD | 60' (18.3 m) | 65' (19.8 m) |
| MAX LENGTH SPECIALTY | 110' (33.5 m) | 65' (19.8 m) |
| MAX DEPTH STANDARD | 48' (12 m) | 42.48' (10.8 m) |
| MAX DEPTH SPECIALTY | 96' (2,438 mm) | - |
| MINIMUM DEPTH | 4 1/8" (105 mm) | 4 1/8" (105 mm) |

# 4. Glulam Appearance Classifications

Listed below are the ANSI A190.1 appearance classifications that glulam products must meet. At MMT, glulam exceeds visual standards set by ANSI A190.1 (see Table 13 below). Lower-grade appearances are available by request. For more on Mercer glulam finishes, refer to page 42.

## INDUSTRIAL

- Glulam laminations may possess the natural growth characteristics of the lumber grade. No voids or low laminations are filled.
- Sides are planed true to specified dimensions.
- Occasional planing misses are permitted.
- No sanding.
- Members have a "hit and miss" (more miss) appearance.
- Wood inserts and filling are not required.
- Glue smear is allowed.

## ARCHITECTURAL

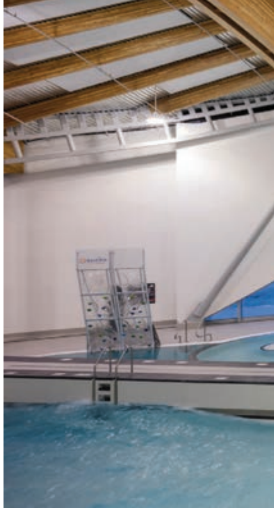
- The wide face of laminations that are exposed should be free of loose knots. Otherwise, glulam laminations may possess the natural growth characteristics of the lumber grade.
- Exposed corners should be eased.
- On exposed surfaces, voids measuring over 3/4" (19 mm) long should be filled.
- Open knot holes on the wide face that are exposed should be filled.
- All occurrences of pencil wane should be repaired with filler up to a maximum of 8" (203 mm). For pencil wane longer than 8" (203 mm), wood inserts should be used.
- Voids greater than 1/16" (2 mm) wide in edge joints on the wide exposed face should be filled with wood tone color filler.
- Exposed faces should be surfaced smooth planed.
- Misses, wane and low laminations should not be permitted. Occasional repaired pencil wane should be permitted subject to Section 11.3.2.1.
- Corners of the member exposed should be eased with a minimum radius of 1/8" (3 mm).

## PREMIUM

- Laminations should be selected to minimize loose knots, knot holes, pencil wane, bark inclusions and visible voids after final member surfacing.
- Knots should be limited to 20% of the net face of the lamination and not over two maximum sized knots should occur in a 6′ (1.83 m) length. Otherwise, laminations are permitted to possess their natural growth characteristics.
- On exposed surfaces, voids measuring over 3/4″ (19 mm) should be filled, or with clear wood inserts to match wood tone and grain color. A void not repaired is permitted to be longer than 3/4″ (19 mm) if its area does not exceed 1/2″ squared (3.23 $cm^2$).
- Repair requirements as noted above will apply when occasional voids occur due to loose knots, unsound knots or knotholes.
- All occurrences of pencil wane should be repaired with filler up to a maximum of 8″ (203 mm). For pencil wane longer than 8″ (203 mm), wood inserts should be used.
- Voids greater than 1/16″ (2 mm) wide in edge joints on the wide exposed face should be filled with wood tone color filler.
- Exposed faces should be surfaced smooth planed.
- Misses, wane and low laminations should not be permitted. Occasional repaired pencil wane should be permitted.
- Corners of the member exposed should be eased with a minimum radius of 1/8″ (3 mm).

TABLE 21: Glulam additional appearance standard features

| ADDITIONAL FEATURES FOR MERCER MASS TIMBER GLULAM BEAMS AND COLUMNS INCLUDE: |
|---|
| 1. All Architectural and Premium Mercer Mass Timber glulam beams and columns exposed faces surfaces are sanded smooth to 80 grit. |
| 2. Mercer Mass Timber uses epoxy putty for correcting larger voids to assure adhesion. |
| 3. For a staggered multi-piece lamination layup, a full length wood spline insert is applied on the visible face to cover gaps of the adjacent boards. |
| 4. Mercer Mass Timber glulam beams and columns can be coated with a factory-applied light-bodied sealer that provides some temporary protection to the finished surface during shipping and through the construction phase. |
| 5. For additional information on appearance classifications, refer to ANSI A190.1. |



# Mercer Glulam Standard Width Sectional Diagram

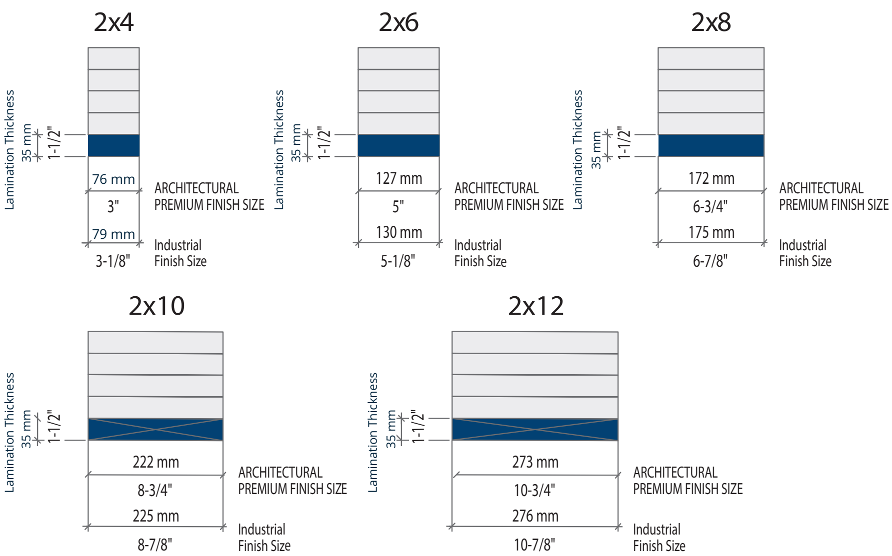



FIGURE 7: Single lamination beams

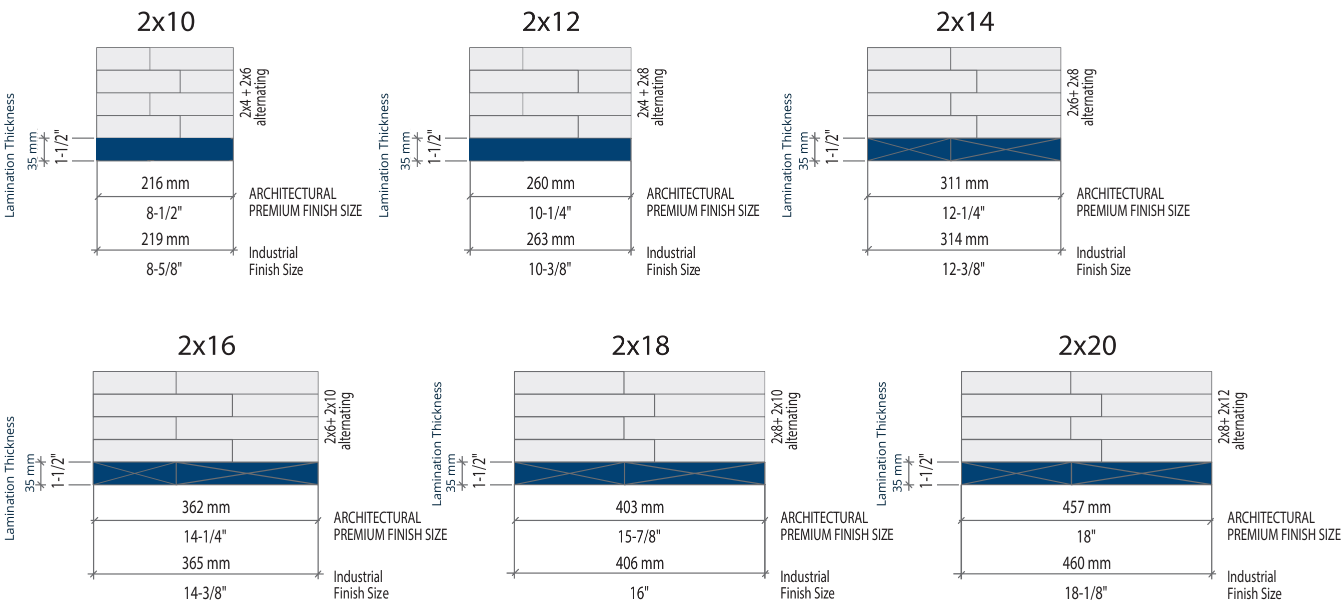
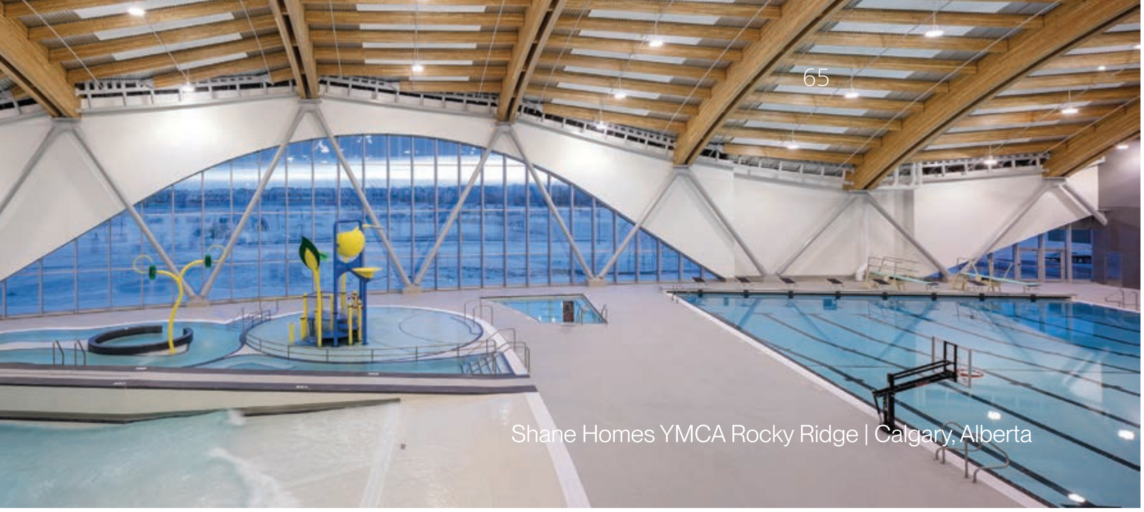



FIGURE 8: Staggered multi-piece lamination

NOTE: All premium finished beams used for either appearance grade or with tight tolerance connections are additional undersized by 6mm in depth from full lamination roundings:
35mm × # OF LAMS - 6mm.



Shane Homes YMCA Rocky Ridge | Calgary, Alberta

TABLE 22: Finished widths of glulam beams

| NOMINAL SIZE | FINISHED WIDTHS* | | | | | |
|---|---|---|---|---|---|---|
| | INDUSTRIAL | | ARCHITECTURAL | | PREMIUM | |
| | (in) | (mm) | (in) | (mm) | (in) | (mm) |
| 2x4 | 3-1/8 | 79 | 3 | 76 | 3 | 76 |
| 2x6 | 5-1/8 | 130 | 5 | 127 | 5 | 127 |
| 2x8 | 6-7/8 | 175 | 6-3/4 | 172 | 6-3/4 | 172 |
| 2x10 | 8-5/8 | 219 | 8-1/2 | 216 | 8-1/2 | 216 |
| 2x12 | 10-3/8 | 263 | 10-1/4 | 260 | 10-1/4 | 260 |
| 2x14 | 12-3/8 | 314 | 12-1/4 | 311 | 12-1/4 | 311 |
| 2x16 | 14-3/8 | 365 | 14-1/4 | 362 | 14-1/4 | 362 |
| 2x18 | 16 | 406 | 15-7/8 | 403 | 15-7/8 | 403 |
| 2x20 | 18-1/8 | 460 | 18 | 457 | 18 | 457 |

NOTE: Widths noted above apply to all manufactured species.

*Other widths available from Mercer Mass Timber

**STAGGERED MULTIPLE PIECE LAMINATION:** MMT utilizes a staggered multiple piece lamination layup technique as described in ANSI A190.1, section 9.3, in the manufacture of wide-section members for glulam beams and columns. Mercer analysis concludes staggered multiple piece lamination layup as a preferred methodology as follows:

**INCREASED HOMOGENIZATION:**
Glulam beams and columns constructed through the staggered multiple piece lamination technique are composed of more individual elements than through a single lamination layup practice. This increased number of elements acts to further diffuse the impact of any one element on the resulting component and creates a more homogeneous construction.

**DIMENSIONAL STABILITY:**
Based upon the same principle of an increased number of elements within the component, a staggered multiple piece lamination layup reduces the dimensional tendencies of any one element and can potentially increase the overall stability of the component. This can be most prominently realized in wider, deeper sections.

# 5. Camber

Four standard levels of camber are available. Camber falling outside these standards is custom processed and will carry additional fabrication costs, such as arches. Standard camber carry no additional costs. Camber cannot be used with complex multi-point connections or pre-engineered tight tolerance connections. Camber should only be used when simple bucket or knife plate connections are used on each end of the beam.

TABLE 23: Camber standards

| CAMBER | BEAM SPAN (FT) | | | | | | RADIUS (FT) |
|---|---|---|---|---|---|---|---|
| | 20' | 30' | 40' | 50' | 60' | 70' | |
| 1 | 0.46" | 1.03" | 1.83" | 2.86" | 4.12" | 5.61" | 1,310' |
| 2 | 0.33" | 0.74" | 1.31" | 2.05" | 2.95" | 4.01" | 1,833' |
| 3 | 0.23" | 0.52" | 0.92" | 1.43" | 2.06" | 2.81" | 2,620' |
| 4 | 0.18" | 0.41" | 0.73" | 1.15" | 1.65" | 2.25" | 3,274' |

1. Camber shown in inches. Camber is only available at the Mercer Okanagan factory. It is not possible to camber members produced in the Mercer Conway factory.
2. Recommended Camber = 1.5 x dead load deflection for roof applications
   1 x dead load deflection for floor applications
3. Camber is NOT recommended when using tight-tolerance pre-engineered connections.
4. Camber is NOT recommended when using beam systems with multiple interconnections as installation becomes difficult and deflection loads can cause dynamic stresses on connections.
5. Multiple span beam applications cannot have camber applied.

# 6. Glulam Stress Grades

Mercer glulam structural members are classified as either primarily axially loaded members or primarily bending members per the National Design Specification (NDS). The significance of the member being an axial or bending member influences the type of boards used for the laminations and also the location of where the specific board types exist. For axial members, the entire makeup of laminations is the same and each individual board has the same strength properties. For bending members, the highest quality boards are located on the outer laminations where the tension and compression stresses are the highest.

More information on our Mercer glulam stress grades is provided below:

TABLE 24: Glulam column allowable design properties

| COLUMN ALLOWABLE DESIGN STRESS PROPERTIES (psi) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COMBINATION | $E_{MEAN}$ | $E_{MIN}$ | $F_C$ | $F_T$ | $F_{BX}$ | $F_{BY}$ | $F_{CPX}$ | $F_{CPY}$ | $F_{VX}$ | $F_{VY}$ | SG |
| 2 DF, L2 | 1,700,000 | 850,000 | 1,950 | 1,550 | 2,100 | 2,300 | 740 | 740 | 300 | 260 | 0.50 |
| 50 SP, N1D14 | 1,900,000 | 1,000,000 | 2,300 | 1,550 | 2,100 | 2,300 | 740 | 740 | 300 | 260 | 0.55 |

NOTES:
1. Allowable design strengths are shown for prismatic beams with loads applied primarily in axial compression.
2. Properties shown are for allowable strength design (ASD).
3. Design strengths assumes 4 or more laminations.

The values listed for Mercer glulam beams and columns are baseline properties that require modification depending on the size of the member, the type of loads applied and the environmental conditions, as per the National Design Specification for Wood Construction (NDS). Adjustment factors to be considered include:

| | |
|---|---|
| $C_D$ | Duration of load<br>0.90 dead loads<br>1.00 normal loads<br>1.15 snow loads<br>1.25 construction loads<br>1.60 wind and earthquake loads |
| $C_M$ | Moisture (wet service) |
| $C_T$ | Temperature |
| $C_L$ | Beam stability |
| $C_V$ | Volume effect |
| $C_{FU}$ | Flat use factor |
| $C_C$ | Curvature factor |
| $C_F$ | Form factor |
| $C_P$ | Column stability factor |
| $C_B$ | Bearing factor |

Not all factors need be applied in all applications or for all design values. Refer to the National Design Specification for Wood Construction (NDS) for a listing of which adjustment factors are required for specific situations.

High Line Timber Bridge | New York, New York

**DF NAME CONVENTION**

**24F-V4 DF**

↑ ↑ ↑

Species designation from ANSI 117

Unbalanced (V4) vs. Unbalanced (V8) layup (see page 69)

Rated Bending Stress in psi x 100

**SP NAME CONVENTION**

**24F-V3 SP**

↑ ↑ ↑

Species designation from ANSI 117

Unbalanced (V3) vs. Unbalanced (V8) layup (see page 69)

Rated Bending Stress in psi x 100

TABLE 25: Glulam beam allowable design stress properties

| MERCER MASS TIMBER GLULAM BEAM LAYUP DESIGNATIONS AND DESIGN STRESS PROPERTIES (psi) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COMBINATION | BENDING ABOUT X-X | | | | | | BENDING ABOUT Y-Y | | | | | AXIAL LOADING | | SG |
| | $F_{BX+}$ | $F_{BX-}$ | $F_{CPX}$ | $F_{VX}$ | $E_X$ | $E_{X\ MIN}$ | $F_{BY}$ | $F_{CPY}$ | $F_{VY}$ | $E_Y$ | $E_{Y\ MIN}$ | $F_T$ | $F_C$ | |
| 24F-V8 DF | 2,400 | 2,400 | 650 | 265 | 1,800,000 | 950,000 | 1,550 | 560 | 230 | 1,600,000 | 850,000 | 1,650 | 1,100 | 0.50 |
| 24F-V4 DF | 2,400 | 1,850 | 650 | 265 | 1,800,000 | 950,000 | 1,450 | 560 | 230 | 1,600,000 | 850,000 | 1,650 | 1,100 | 0.50 |
| 24F-V8 SP | 2,400 | 2,400 | 740 | 300 | 1,800,000 | 950,000 | 1,700 | 650 | 260 | 1,600,000 | 850,000 | 1,150 | 1,650 | 0.55 |
| 24F-V3 SP | 2,400 | 2,000 | 740 | 300 | 1,800,000 | 950,000 | 1,700 | 650 | 260 | 1,600,000 | 850,000 | 1,150 | 1,650 | 0.55 |

NOTES:
1. Allowable design strengths are shown for prismatic beams with loads applied primarily in bending.
2. Properties shown are for allowable strength design (ASD).
3. The reference allowable shear design value, Fvy, shall be multiplied by 0.4 for members 5,7,9 laminations and 0.5 for all other layups of DF species split-lam layups. Refer to the relevant APA Product report for full details.
4. Design strengths assumes 4 or more laminations.

Carbon 12 | Portland, Oregon

## GLULAM BEAM LAYUP PATTERNS ANSI/APA 117 STANDARD

### V4/V3 – UNBALANCED BEAM LAYUP

Use a V4 layup for short cantilever or most economical solution for simple span application.

### V8 – BALANCED BEAM LAYUP

When dealing with a beam that is supported by multiple bearings or a beam that is cantilevered over a support, then a V8 balanced layup is typically required.

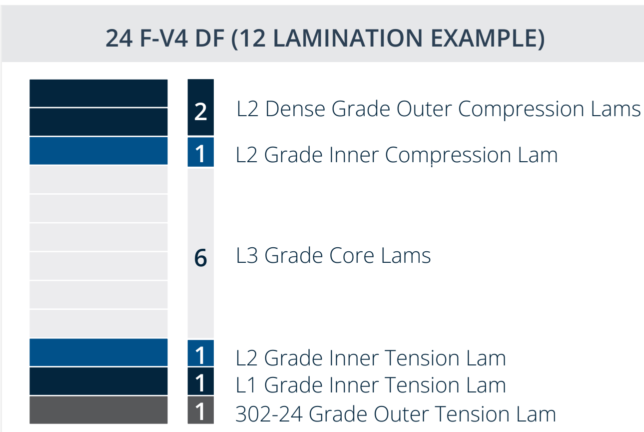



FIGURE 9: Unbalanced layup - D.Fir

**EXAMPLE FOR 12 LAMINATIONS**

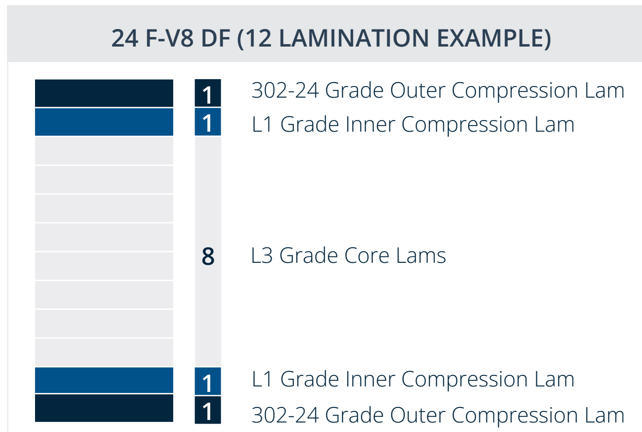



FIGURE 10: Balanced layup - D.Fir

**EXAMPLE FOR 12 LAMINATIONS**

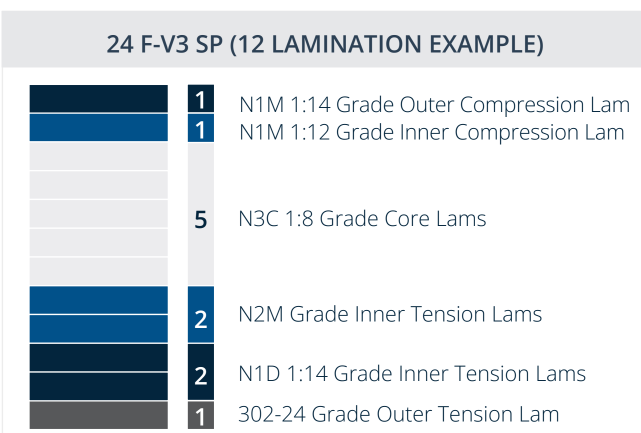



FIGURE 11: Unbalanced layup - SP

**EXAMPLE FOR 12 LAMINATIONS**

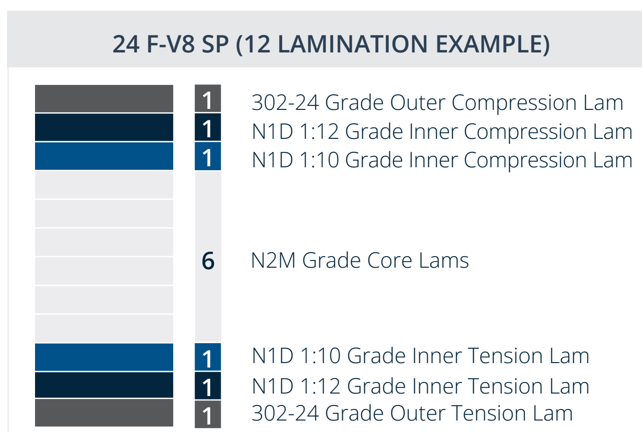



FIGURE 12: Balanced layup - SP

**EXAMPLE FOR 12 LAMINATIONS**

NOTE: See ANSI 117 for layup requirements of alternative beam depths. Example provided is for 12 laminations.

TABLE 26: Glulam column capacities: 1/6 axial load eccentricity

# ALLOWABLE AXIAL CAPACITIES, ECCENTRICITY = 1/6 (B OR D)

| | COLUMN SIZE B (IN) X D (IN) | AXIAL CAPACITY (LBS) COLUMN LENGTH L (FT) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 10 | 12 | 14 | 16 | 18 | 20 |
| COMB. 2 DF | 8.5 × 9.41 | 71,357 | 64,088 | 56,515 | 49,323 | 42,817 | 37,317 |
| | 10.25 × 10.79 | 106,388 | 98,771 | 89,882 | 80,853 | 72,152 | 64,206 |
| | 12.25 × 13.54 | 165,480 | 155,923 | 145,744 | 135,107 | 124,236 | 113,464 |
| | 14.25 × 14.92 | 215,707 | 205,966 | 195,596 | 184,684 | 173,355 | 161,765 |
| | 15.875 × 16.3 | 264,079 | 253,966 | 243,253 | 231,979 | 220,225 | 208,100 |
| | 18 × 19.06 | 350,069 | 338,849 | 327,084 | 314,754 | 301,896 | 288,582 |
| COMB. 50 SP | | | | | | | |
| | 8.5 × 9.41 | 82,277 | 74,684 | 66,494 | 58,387 | 50,919 | 44,483 |
| | 10.25 × 10.79 | 121,622 | 113,939 | 104,997 | 95,515 | 85,958 | 76,881 |
| | 12.25 × 13.54 | 189,336 | 180,432 | 170,478 | 159,639 | 148,147 | 136,334 |
| | 14.25 × 14.92 | 246,223 | 238,035 | 228,861 | 218,185 | 206,539 | 194,229 |
| | 15.875 × 16.3 | 300,307 | 291,815 | 282,353 | 271,947 | 260,666 | 248,604 |
| | 18 × 19.06 | 398,036 | 389,286 | 379,630 | 369,047 | 357,555 | 345,197 |

NOTES:

1. These tables are for preliminary design only and final design should be validated by a professional engineer and include detailed analysis of loads, eccentricities and connections.
2. Loads shown are allowable (ASD) axial loads, in pounds (lbf).
3. An axial load eccentricity of 16.6% was assumed on the worst scenario, either along depth or width of the member.
4. All calculations as per NDS 2024
5. Design capacities presented do not account for fire rating.
6. Normal load duration was assumed (CD=1.0). Provided values must be adjusted by CD for other cases.

TABLE 27: Glulam column capacities: 1/2 axial load eccentricity

## ALLOWABLE AXIAL CAPACITIES, ECCENTRICITY = 1/2 (B OR D)

| | COLUMN SIZE B (IN) X D (IN) | AXIAL CAPACITY (LBS) COLUMN LENGTH L (FT) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 10 | 12 | 14 | 16 | 18 | 20 |
| COMB. 2 DF | 8.5 × 9.41 | 35,903 | 33,627 | 31,170 | 28,656 | 26,055 | 23,667 |
| | 10.25 × 10.79 | 52,059 | 49,613 | 46,514 | 43,406 | 40,332 | 37,369 |
| | 12.25 × 13.54 | 78,990 | 75,365 | 71,757 | 68,144 | 64,518 | 60,896 |
| | 14.25 × 14.92 | 101,137 | 97,274 | 93,470 | 89,685 | 85,901 | 82,107 |
| | 15.875 × 16.30 | 122,367 | 118,219 | 114,175 | 110,179 | 106,200 | 102,223 |
| | 18 × 19.06 | 159,927 | 155,148 | 150,555 | 146,060 | 141,617 | 137,196 |
| COMB. 50 SP | | | | | | | |
| | 8.5 × 9.41 | 43,189 | 40,490 | 37,570 | 34,549 | 31,396 | 28,487 |
| | 10.25 × 10.79 | 62,582 | 59,686 | 56,022 | 52,337 | 48,664 | 45,087 |
| | 12.25 × 13.54 | 94,998 | 90,730 | 86,459 | 82,169 | 77,857 | 73,534 |
| | 14.25 × 14.92 | 119,895 | 115,648 | 111,456 | 107,270 | 103,067 | 98,831 |
| | 15.875 × 16.30 | 143,611 | 139,010 | 134,517 | 130,066 | 125,624 | 121,172 |
| | 18 × 19.06 | 185,318 | 180,209 | 175,316 | 170,535 | 165,807 | 161,097 |

NOTES:
1. Column tables are for preliminary design only and final design should include detailed analysis of loads, eccentricities and connections.
2. Loads shown are allowable (ASD) axial loads, in pounds (lbf).
3. An axial load eccentricity of 50% was assumed on the worst scenario, either along depth or width of the member.
4. All calculations as per NDS 2024
5. Design capacities presented do not account for fire rating.
6. Normal load duration was assumed (CD=1.0). Provided values must be adjusted by CD for other cases.

TABLE 28: Engineering properties of glulam beams: Douglas-Fir (D.FIR)

| **3.00" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 8.03 | 9.41 | 10.79 | 12.17 | 13.54 | 14.92 | 16.30 | 17.68 | 19.06 | 20.43 | 21.81 | 23.19 | 24.57 |
| Weight per ft length (lb/ft) | 5.9 | 6.9 | 7.9 | 8.9 | 9.9 | 10.9 | 11.9 | 12.9 | 13.9 | 14.9 | 15.9 | 16.9 | 17.9 |
| A (in$^2$) | 24 | 28 | 32 | 37 | 41 | 45 | 49 | 53 | 57 | 61 | 65 | 70 | 74 |
| Sx (in$^3$) | 32 | 44 | 58 | 74 | 92 | 111 | 133 | 156 | 182 | 209 | 238 | 269 | 302 |
| Ix (in$^4$) | 129 | 208 | 314 | 451 | 621 | 830 | 1,083 | 1,382 | 1,731 | 2,132 | 2,594 | 3,118 | 3,708 |
| EI (×$10^6$ lbf-in2) | 233 | 375 | 565 | 811 | 1,117 | 1,495 | 1,949 | 2,487 | 3,116 | 3,837 | 4,669 | 5,612 | 6,675 |
| Mr (lbf-ft) | 6,448 | 8,855 | 11,642 | 14,811 | 18,333 | 22,261 | 26,569 | 30,992 | 35,482 | 40,204 | 45,224 | 50,504 | 56,042 |
| Vr (lbf) | 4,256 | 4,987 | 5,719 | 6,450 | 7,176 | 7,908 | 8,639 | 9,370 | 10,102 | 10,828 | 11,559 | 12,291 | 13,022 |

| **5.00" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 10.79 | 12.17 | 13.54 | 14.92 | 16.30 | 17.68 | 19.06 | 20.43 | 21.81 | 23.19 | 24.57 | 25.94 | 27.32 |
| Weight per ft length (lb/ft) | 13.1 | 14.8 | 16.5 | 18.1 | 19.8 | 21.5 | 23.2 | 24.8 | 26.5 | 28.2 | 29.9 | 31.5 | 33.2 |
| A (in$^2$) | 54 | 61 | 68 | 75 | 82 | 88 | 95 | 102 | 109 | 116 | 123 | 130 | 137 |
| Sx (in$^3$) | 97 | 123 | 153 | 186 | 221 | 260 | 303 | 348 | 396 | 448 | 503 | 561 | 622 |
| Ix (in$^4$) | 523 | 751 | 1,034 | 1,384 | 1,804 | 2,303 | 2,885 | 3,553 | 4,323 | 5,196 | 6,180 | 7,273 | 8,496 |
| EI (×$10^6$ lbf-in2) | 942 | 1,352 | 1,862 | 2,491 | 3,248 | 4,145 | 5,193 | 6,395 | 7,781 | 9,353 | 11,124 | 13,091 | 15,293 |
| Mr (lbf-ft) | 19,404 | 24,685 | 30,364 | 36,161 | 42,402 | 49,082 | 56,192 | 63,670 | 71,620 | 79,982 | 88,753 | 97,858 | 107,428 |
| Vr (lbf) | 9,531 | 10,750 | 11,960 | 13,179 | 14,398 | 15,617 | 16,836 | 18,047 | 19,266 | 20,485 | 21,704 | 22,914 | 24,133 |

| **6.75" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 14.92 | 16.30 | 17.68 | 19.06 | 20.43 | 21.81 | 23.19 | 24.57 | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 |
| Weight per ft length (lb/ft) | 24.5 | 26.7 | 29.0 | 31.3 | 33.5 | 35.8 | 38.0 | 40.3 | 42.6 | 44.8 | 47.1 | 49.4 | 51.6 |
| A (in$^2$) | 101 | 110 | 119 | 129 | 138 | 147 | 157 | 166 | 175 | 184 | 194 | 203 | 212 |
| Sx (in$^3$) | 250 | 299 | 352 | 409 | 470 | 535 | 605 | 679 | 757 | 840 | 927 | 1,018 | 1,113 |
| Ix (in$^4$) | 1,868 | 2,436 | 3,109 | 3,895 | 4,797 | 5,836 | 7,015 | 8,343 | 9,818 | 11,470 | 13,297 | 15,309 | 17,515 |
| EI (×$10^6$ lbf-in2) | 3,363 | 4,385 | 5,596 | 7,011 | 8,634 | 10,504 | 12,627 | 15,018 | 17,673 | 20,646 | 23,935 | 27,557 | 31,526 |
| Mr (lbf-ft) | 47,374 | 55,551 | 64,301 | 73,616 | 83,413 | 93,828 | 104,784 | 116,274 | 128,203 | 140,740 | 153,794 | 167,360 | 181,434 |
| Vr (lbf) | 17,792 | 19,438 | 21,083 | 22,729 | 24,363 | 26,008 | 27,654 | 29,300 | 30,933 | 32,579 | 34,225 | 35,870 | 37,516 |

| **8.50" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 21.81 | 23.19 | 24.57 | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 |
| Weight per ft length (lb/ft) | 45.1 | 47.9 | 50.8 | 53.6 | 56.4 | 59.3 | 62.1 | 65.0 | 67.8 | 70.7 | 73.5 | 76.4 | 79.2 |
| A (in$^2$) | 185 | 197 | 209 | 220 | 232 | 244 | 256 | 267 | 279 | 291 | 303 | 314 | 326 |
| Sx (in$^3$) | 674 | 762 | 855 | 953 | 1,057 | 1,167 | 1,282 | 1,402 | 1,527 | 1,658 | 1,794 | 1,936 | 2,084 |
| Ix (in$^4$) | 7,349 | 8,834 | 10,506 | 12,364 | 14,444 | 16,745 | 19,278 | 22,055 | 25,064 | 28,359 | 31,932 | 35,792 | 39,952 |
| EI (×$10^6$ lbf-in2) | 13,227 | 15,901 | 18,911 | 22,255 | 25,999 | 30,141 | 34,701 | 39,700 | 45,115 | 51,047 | 57,477 | 64,426 | 71,913 |
| Mr (lbf-ft) | 115,461 | 128,943 | 143,082 | 157,762 | 173,189 | 189,253 | 205,947 | 223,266 | 241,070 | 259,616 | 278,770 | 298,528 | 318,885 |
| Vr (lbf) | 32,751 | 34,824 | 36,896 | 38,953 | 41,026 | 43,098 | 45,170 | 47,242 | 49,300 | 51,372 | 53,444 | 55,517 | 57,589 |

| **10.25" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 | 39.72 | 41.10 | 42.48 |
| Weight per ft length (lb/ft) | 64.6 | 68.1 | 71.5 | 74.9 | 78.4 | 81.8 | 85.2 | 88.7 | 92.1 | 95.5 | 99.0 | 102.4 | 105.8 |
| A (in$^2$) | 266 | 280 | 294 | 308 | 322 | 337 | 351 | 365 | 379 | 393 | 407 | 421 | 435 |
| Sx (in$^3$) | 1,150 | 1,275 | 1,407 | 1,546 | 1,691 | 1,841 | 1,999 | 2,164 | 2,335 | 2,512 | 2,695 | 2,886 | 3,083 |
| Ix (in$^4$) | 14,909 | 17,417 | 20,192 | 23,247 | 26,596 | 30,224 | 34,198 | 38,506 | 43,161 | 48,177 | 53,527 | 59,302 | 65,478 |
| EI (×$10^6$ lbf-in2) | 26,836 | 31,351 | 36,346 | 41,845 | 47,873 | 54,404 | 61,557 | 69,311 | 77,690 | 86,718 | 96,348 | 106,743 | 117,861 |
| Mr (lbf-ft) | 186,714 | 204,973 | 223,984 | 243,742 | 264,239 | 285,311 | 307,260 | 329,929 | 353,313 | 377,405 | 402,020 | 427,510 | 453,694 |
| Vr (lbf) | 46,973 | 49,472 | 51,971 | 54,470 | 56,969 | 59,450 | 61,949 | 64,448 | 66,947 | 69,445 | 71,926 | 74,425 | 76,924 |

NOTES:

1. 24F-V8 DF glulam.
2. Uniformly distributed loading.
3. Depths are based on 35 mm 6 mm lamination thickness minus 6mm planing depth.
4. Beam properties calculated based on architectural depths and architectural beam widths.
5. Beam weight is based on density of 35lbf/ft$^3$
6. Beam span for Cv calculations (NDS 5.3.6) assumed to be 18x actual depth and x=10
7. Beam engineering properties are calculated in accordance with NDS.
8. The tabulated shear capacity Vr shall be reduced by Cvr=0.72 for repetitive/

TABLE 28 con't: Engineering properties of glulam beams: Douglas-Fir (D.FIR)

| 12.25" BEAM WIDTH, B (IN) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 27.32 | 28.70 | 30.08 | 31.46 | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 | 39.72 | 41.10 | 42.48 | 43.86 |
| Weight per ft length (lb/ft) | 81.3 | 85.5 | 89.6 | 93.7 | 97.7 | 101.9 | 106.0 | 110.1 | 114.2 | 118.3 | 122.4 | 126.5 | 130.6 |
| A (in²) | 335 | 352 | 369 | 385 | 402 | 419 | 436 | 453 | 470 | 487 | 504 | 520 | 537 |
| Sx (in³) | 1,524 | 1,682 | 1,847 | 2,021 | 2,201 | 2,389 | 2,586 | 2,791 | 3,003 | 3,221 | 3,449 | 3,684 | 3,928 |
| Ix (in⁴) | 20,816 | 24,132 | 27,784 | 31,786 | 36,122 | 40,871 | 46,019 | 51,583 | 57,577 | 63,971 | 70,873 | 78,254 | 86,131 |
| EI (×10⁶ lbf-in2) | 37,469 | 43,438 | 50,011 | 57,215 | 65,020 | 73,568 | 82,834 | 92,849 | 103,639 | 115,148 | 127,571 | 140,857 | 155,036 |
| Mr (lbf-ft) | 240,645 | 262,959 | 286,153 | 310,218 | 334,953 | 360,724 | 387,344 | 414,791 | 443,073 | 471,975 | 501,899 | 532,641 | 564,196 |
| Vr (lbf) | 59,130 | 62,116 | 65,102 | 68,087 | 71,055 | 74,041 | 77,027 | 80,012 | 82,998 | 85,966 | 88,952 | 91,937 | 94,923 |

| 14.25" BEAM WIDTH, B (IN) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 | 39.72 | 41.10 | 42.48 | 43.86 | 45.24 | 46.61 | 47.99 | 49.37 |
| Weight per ft length (lb/ft) | 113.7 | 118.5 | 123.3 | 128.0 | 132.8 | 137.6 | 142.4 | 147.1 | 151.9 | 156.7 | 161.4 | 166.2 | 171.0 |
| A (in²) | 468 | 488 | 507 | 527 | 547 | 566 | 586 | 605 | 625 | 645 | 664 | 684 | 704 |
| Sx (in³) | 2,560 | 2,780 | 3,008 | 3,246 | 3,493 | 3,747 | 4,012 | 4,286 | 4,569 | 4,861 | 5,160 | 5,470 | 5,789 |
| Ix (in⁴) | 42,019 | 47,544 | 53,533 | 60,004 | 66,978 | 74,415 | 82,444 | 91,031 | 100,193 | 109,952 | 120,246 | 131,246 | 142,897 |
| EI (×10⁶ lbf-in2) | 75,634 | 85,579 | 96,359 | 108,007 | 120,560 | 133,947 | 148,399 | 163,856 | 180,347 | 197,914 | 216,443 | 236,243 | 257,215 |
| Mr (lbf-ft) | 383,796 | 413,319 | 443,817 | 475,270 | 507,685 | 540,793 | 575,083 | 610,301 | 646,453 | 683,521 | 721,236 | 760,120 | 799,917 |
| Vr (lbf) | 82,645 | 86,125 | 89,605 | 93,068 | 96,548 | 99,993 | 103,474 | 106,936 | 110,417 | 113,897 | 117,342 | 120,822 | 124,285 |

| 15.875" BEAM WIDTH | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 38.35 | 39.72 | 41.10 | 42.48 | 43.86 | 45.24 | 46.61 | 47.99 | 49.37 | 50.75 | 52.13 | 53.50 | 54.88 |
| Weight per ft length (lb/ft) | 148.0 | 153.3 | 158.6 | 163.9 | 169.2 | 174.6 | 179.8 | 185.2 | 190.5 | 195.8 | 201.1 | 206.4 | 211.8 |
| A (in²) | 609 | 631 | 653 | 674 | 696 | 718 | 740 | 762 | 784 | 806 | 828 | 849 | 871 |
| Sx (in³) | 3,891 | 4,174 | 4,469 | 4,775 | 5,090 | 5,415 | 5,748 | 6,094 | 6,449 | 6,815 | 7,190 | 7,573 | 7,969 |
| Ix (in⁴) | 74,615 | 82,901 | 91,846 | 101,411 | 111,619 | 122,490 | 133,958 | 146,213 | 159,192 | 172,918 | 187,411 | 202,579 | 218,663 |
| EI (×10⁶ lbf-in2) | 134,307 | 149,222 | 165,323 | 182,540 | 200,914 | 220,482 | 241,124 | 263,183 | 286,546 | 311,252 | 337,340 | 364,642 | 393,593 |
| Mr (lbf-ft) | 559,501 | 595,992 | 633,782 | 672,589 | 712,436 | 753,288 | 794,854 | 837,714 | 881,560 | 926,415 | 972,246 | 1,018,723 | 1,066,520 |
| Vr (lbf) | 107,555 | 111,406 | 115,275 | 119,144 | 123,013 | 126,882 | 130,716 | 134,585 | 138,454 | 142,340 | 146,209 | 150,043 | 153,912 |

| 18" BEAM WIDTH | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 38.35 | 39.72 | 41.10 | 42.48 | 43.86 | 45.24 | 46.61 | 47.99 | 49.37 | 50.75 | 52.13 | 53.50 | 54.88 |
| Weight per ft length (lb/ft) | 167.8 | 173.8 | 179.8 | 185.9 | 191.9 | 197.9 | 203.9 | 210.0 | 216.0 | 222.0 | 228.1 | 234.1 | 240.1 |
| A (in²) | 690 | 715 | 740 | 765 | 790 | 814 | 839 | 864 | 889 | 914 | 938 | 963 | 988 |
| Sx (in³) | 4,412 | 4,733 | 5,068 | 5,414 | 5,771 | 6,140 | 6,518 | 6,909 | 7,312 | 7,727 | 8,153 | 8,587 | 9,035 |
| Ix (in⁴) | 84,603 | 93,998 | 104,140 | 114,986 | 126,560 | 138,886 | 151,890 | 165,784 | 180,501 | 196,065 | 212,498 | 229,696 | 247,933 |
| EI (×10⁶ lbf-in2) | 152,285 | 169,196 | 187,452 | 206,975 | 227,808 | 249,995 | 273,402 | 298,411 | 324,902 | 352,917 | 382,496 | 413,453 | 446,279 |
| Mr (lbf-ft) | 626,477 | 667,325 | 709,638 | 753,113 | 797,715 | 843,465 | 889,996 | 937,982 | 987,094 | 1,037,313 | 1,088,633 | 1,140,680 | 1,194,174 |
| Vr (lbf) | 121,953 | 126,317 | 130,698 | 135,079 | 139,478 | 143,860 | 148,223 | 152,605 | 157,004 | 161,385 | 165,766 | 170,130 | 174,511 |

| 10.25" BEAM WIDTH, B (IN) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 | 39.72 | 41.10 | 42.48 |
| Weight per ft length (lb/ft) | 64.6 | 68.1 | 71.5 | 74.9 | 78.4 | 81.8 | 85.2 | 88.7 | 92.1 | 95.5 | 99.0 | 102.4 | 105.8 |
| A (in²) | 266 | 280 | 294 | 308 | 322 | 337 | 351 | 365 | 379 | 393 | 407 | 421 | 435 |
| Sx (in³) | 1,150 | 1,275 | 1,407 | 1,546 | 1,691 | 1,841 | 1,999 | 2,164 | 2,335 | 2,512 | 2,695 | 2,886 | 3,083 |
| Ix (in⁴) | 14,909 | 17,417 | 20,192 | 23,247 | 26,596 | 30,224 | 34,198 | 38,506 | 43,161 | 48,177 | 53,527 | 59,302 | 65,478 |
| EI (×10⁶ lbf-in2) | 26,836 | 31,351 | 36,346 | 41,845 | 47,873 | 54,404 | 61,557 | 69,311 | 77,690 | 86,718 | 96,348 | 106,743 | 117,861 |
| Mr (lbf-ft) | 186,714 | 204,973 | 223,984 | 243,742 | 264,239 | 285,311 | 307,260 | 329,929 | 353,313 | 377,405 | 402,020 | 427,510 | 453,694 |
| Vr (lbf) | 46,973 | 49,472 | 51,971 | 54,470 | 56,969 | 59,450 | 61,949 | 64,448 | 66,947 | 69,445 | 71,926 | 74,425 | 76,924 |

impact loads, design of members at notches and design of members at connections, as per NDS 5.3.10

9. These tables do not account for charring fire protection. Fire protection should be provided by encapsulation with a fire rating material as required by the applicable Building Code. Alternatively, NDS Annex B can be used to calculate effective charring to provide fire protection.

10. Assumed modification factors:

- standard term load duration (CD = 1.0)
- dry service condition (CM = 1.0)
- no preservative treatment (CT = 1.0)
- continuous lateral support along compression edge (CL = 1.0)

TABLE 29: Engineering properties of glulam beams: Southern Yellow Pine (SYP)

| **3.00" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 8.03 | 9.41 | 10.79 | 12.17 | 13.54 | 14.92 | 16.30 | 17.68 | 19.06 | 20.43 | 21.81 | 23.19 | 24.57 |
| Weight per ft length (lb/ft) | 6.7 | 7.8 | 9.0 | 10.1 | 11.3 | 12.4 | 13.6 | 14.7 | 15.9 | 17.0 | 18.2 | 19.3 | 20.5 |
| A (in$^2$) | 24 | 28 | 32 | 37 | 41 | 45 | 49 | 53 | 57 | 61 | 65 | 70 | 74 |
| Sx (in$^3$) | 32 | 44 | 58 | 74 | 92 | 111 | 133 | 156 | 182 | 209 | 238 | 269 | 302 |
| Ix (in$^4$) | 129 | 208 | 314 | 451 | 621 | 830 | 1,083 | 1,382 | 1,731 | 2,132 | 2,594 | 3,118 | 3,708 |
| EI (×10$^6$ lbf-in2) | 233 | 375 | 565 | 811 | 1,117 | 1,495 | 1,949 | 2,487 | 3,116 | 3,837 | 4,669 | 5,612 | 6,675 |
| Mr (lbf-ft) | 6,448 | 8,855 | 11,642 | 14,811 | 18,333 | 22,261 | 26,569 | 31,125 | 35,903 | 40,964 | 46,381 | 52,115 | 58,165 |
| Vr (lbf) | 4,818 | 5,646 | 6,474 | 7,302 | 8,124 | 8,952 | 9,780 | 10,608 | 11,436 | 12,258 | 13,086 | 13,914 | 14,742 |
| **5.00" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
| Beam Depth, d (in) | 10.79 | 12.17 | 13.54 | 14.92 | 16.30 | 17.68 | 19.06 | 20.43 | 21.81 | 23.19 | 24.57 | 25.94 | 27.32 |
| Weight per ft length (lb/ft) | 15.0 | 16.9 | 18.8 | 20.7 | 22.6 | 24.6 | 26.5 | 28.4 | 30.3 | 32.2 | 34.1 | 36.0 | 37.9 |
| A (in$^2$) | 54 | 61 | 68 | 75 | 82 | 88 | 95 | 102 | 109 | 116 | 123 | 130 | 137 |
| Sx (in$^3$) | 97 | 123 | 153 | 186 | 221 | 260 | 303 | 348 | 396 | 448 | 503 | 561 | 622 |
| Ix (in$^4$) | 523 | 751 | 1,034 | 1,384 | 1,804 | 2,303 | 2,885 | 3,553 | 4,323 | 5,196 | 6,180 | 7,273 | 8,496 |
| EI (×10$^6$ lbf-in2) | 942 | 1,352 | 1,862 | 2,491 | 3,248 | 4,145 | 5,193 | 6,395 | 7,781 | 9,353 | 11,124 | 13,091 | 15,293 |
| Mr (lbf-ft) | 19,404 | 24,685 | 30,460 | 36,628 | 43,332 | 50,567 | 58,329 | 66,552 | 75,352 | 84,668 | 94,497 | 104,759 | 115,602 |
| Vr (lbf) | 10,790 | 12,170 | 13,540 | 14,920 | 16,300 | 17,680 | 19,060 | 20,430 | 21,810 | 23,190 | 24,570 | 25,940 | 27,320 |
| **6.75" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
| Beam Depth, d (in) | 14.92 | 16.30 | 17.68 | 19.06 | 20.43 | 21.81 | 23.19 | 24.57 | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 |
| Weight per ft length (lb/ft) | 28.0 | 30.6 | 33.2 | 35.7 | 38.3 | 40.9 | 43.5 | 46.1 | 48.6 | 51.2 | 53.8 | 56.4 | 59.0 |
| A (in$^2$) | 101 | 110 | 119 | 129 | 138 | 147 | 157 | 166 | 175 | 184 | 194 | 203 | 212 |
| Sx (in$^3$) | 250 | 299 | 352 | 409 | 470 | 535 | 605 | 679 | 757 | 840 | 927 | 1,018 | 1,113 |
| Ix (in$^4$) | 1,868 | 2,436 | 3,109 | 3,895 | 4,797 | 5,836 | 7,015 | 8,343 | 9,818 | 11,470 | 13,297 | 15,309 | 17,515 |
| EI (×10$^6$ lbf-in2) | 3,363 | 4,385 | 5,596 | 7,011 | 8,634 | 10,504 | 12,627 | 15,018 | 17,673 | 20,646 | 23,935 | 27,557 | 31,526 |
| Mr (lbf-ft) | 48,711 | 57,627 | 67,249 | 77,571 | 88,507 | 100,211 | 112,600 | 125,672 | 139,319 | 153,738 | 168,827 | 184,585 | 201,006 |
| Vr (lbf) | 20,142 | 22,005 | 23,868 | 25,731 | 27,581 | 29,444 | 31,307 | 33,170 | 35,019 | 36,882 | 38,745 | 40,608 | 42,471 |
| **8.50" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
| Beam Depth, d (in) | 21.81 | 23.19 | 24.57 | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 |
| Weight per ft length (lb/ft) | 51.5 | 54.8 | 58.0 | 61.2 | 64.5 | 67.8 | 71.0 | 74.3 | 77.5 | 80.8 | 84.0 | 87.3 | 90.5 |
| A (in$^2$) | 185 | 197 | 209 | 220 | 232 | 244 | 256 | 267 | 279 | 291 | 303 | 314 | 326 |
| Sx (in$^3$) | 674 | 762 | 855 | 953 | 1,057 | 1,167 | 1,282 | 1,402 | 1,527 | 1,658 | 1,794 | 1,936 | 2,084 |
| Ix (in$^4$) | 7,349 | 8,834 | 10,506 | 12,364 | 14,444 | 16,745 | 19,278 | 22,055 | 25,064 | 28,359 | 31,932 | 35,792 | 39,952 |
| EI (×10$^6$ lbf-in2) | 13,227 | 15,901 | 18,911 | 22,255 | 25,999 | 30,141 | 34,701 | 39,700 | 45,115 | 51,047 | 57,477 | 64,426 | 71,913 |
| Mr (lbf-ft) | 124,745 | 140,168 | 156,440 | 173,428 | 191,377 | 210,161 | 229,776 | 250,218 | 271,326 | 293,405 | 316,301 | 340,009 | 364,528 |
| Vr (lbf) | 37,077 | 39,423 | 41,769 | 44,098 | 46,444 | 48,790 | 51,136 | 53,482 | 55,811 | 58,157 | 60,503 | 62,849 | 65,195 |
| **10.25" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
| Beam Depth, d (in) | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 | 39.72 | 41.10 | 42.48 |
| Weight per ft length (lb/ft) | 73.9 | 77.8 | 81.7 | 85.6 | 89.6 | 93.5 | 97.4 | 101.3 | 105.3 | 109.2 | 113.1 | 117.0 | 121.0 |
| A (in$^2$) | 266 | 280 | 294 | 308 | 322 | 337 | 351 | 365 | 379 | 393 | 407 | 421 | 435 |
| Sx (in$^3$) | 1,150 | 1,275 | 1,407 | 1,546 | 1,691 | 1,841 | 1,999 | 2,164 | 2,335 | 2,512 | 2,695 | 2,886 | 3,083 |
| Ix (in$^4$) | 14,909 | 17,417 | 20,192 | 23,247 | 26,596 | 30,224 | 34,198 | 38,506 | 43,161 | 48,177 | 53,527 | 59,302 | 65,478 |
| EI (×10$^6$ lbf-in2) | 26,836 | 31,351 | 36,346 | 41,845 | 47,873 | 54,404 | 61,557 | 69,311 | 77,690 | 86,718 | 96,348 | 106,743 | 117,861 |
| Mr (lbf-ft) | 207,186 | 228,628 | 251,068 | 274,501 | 298,922 | 324,139 | 350,516 | 377,868 | 406,191 | 435,483 | 465,515 | 496,725 | 528,892 |
| Vr (lbf) | 53,177 | 56,006 | 58,835 | 61,664 | 64,493 | 67,302 | 70,131 | 72,960 | 75,789 | 78,618 | 81,426 | 84,255 | 87,084 |

TABLE 29 con't: Engineering properties of glulam beams: Southern Yellow Pine (SYP)

| 12.25" BEAM WIDTH, B (IN) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beam Depth, d (in) | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 | 39.72 | 41.10 | 42.48 |
| Weight per ft length (lb/ft) | 88.3 | 93.0 | 97.7 | 102.4 | 107.1 | 111.7 | 116.4 | 121.1 | 125.8 | 130.5 | 135.2 | 139.9 | 144.6 |
| A ($in^2$) | 318 | 335 | 352 | 368 | 385 | 402 | 419 | 436 | 453 | 470 | 487 | 503 | 520 |
| Sx ($in^3$) | 1,374 | 1,524 | 1,682 | 1,847 | 2,021 | 2,201 | 2,389 | 2,586 | 2,791 | 3,003 | 3,221 | 3,449 | 3,684 |
| Ix ($in^4$) | 17,818 | 20,816 | 24,132 | 27,784 | 31,786 | 36,122 | 40,871 | 46,019 | 51,583 | 57,577 | 63,971 | 70,873 | 78,254 |
| EI ($\times 10^6$ lbf-in2) | 32,073 | 37,469 | 43,438 | 50,010 | 57,214 | 65,019 | 73,568 | 82,835 | 92,849 | 103,639 | 115,148 | 127,571 | 140,858 |
| Mr (lbf-ft) | 245,415 | 270,814 | 297,395 | 325,152 | 354,079 | 383,948 | 415,192 | 447,591 | 481,141 | 515,837 | 551,411 | 588,380 | 626,482 |
| Vr (lbf) | 63,553 | 66,934 | 70,315 | 73,696 | 77,077 | 80,434 | 83,815 | 87,196 | 90,577 | 93,958 | 97,314 | 100,695 | 104,076 |
| **14.25" BEAM WIDTH, B (IN)** | | | | | | | | | | | | | |
| Beam Depth, d (in) | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 | 39.72 | 41.10 | 42.48 |
| Weight per ft length (lb/ft) | 102.7 | 108.1 | 113.6 | 119.1 | 124.5 | 130.0 | 135.4 | 140.9 | 146.3 | 151.8 | 157.2 | 162.7 | 168.2 |
| A ($in^2$) | 370 | 389 | 409 | 429 | 448 | 468 | 487 | 507 | 527 | 546 | 566 | 586 | 605 |
| Sx ($in^3$) | 1,598 | 1,773 | 1,956 | 2,149 | 2,351 | 2,560 | 2,780 | 3,008 | 3,246 | 3,493 | 3,747 | 4,012 | 4,286 |
| Ix ($in^4$) | 20,727 | 24,215 | 28,072 | 32,320 | 36,975 | 42,019 | 47,544 | 53,533 | 60,004 | 66,978 | 74,415 | 82,444 | 91,031 |
| EI ($\times 10^6$ lbf-in2) | 37,309 | 43,586 | 50,530 | 58,175 | 66,555 | 75,634 | 85,579 | 96,359 | 108,008 | 120,560 | 133,947 | 148,399 | 163,855 |
| Mr (lbf-ft) | 283,332 | 312,656 | 343,343 | 375,388 | 408,785 | 443,269 | 479,340 | 516,745 | 555,478 | 595,535 | 636,606 | 679,286 | 723,275 |
| Vr (lbf) | 73,929 | 77,862 | 81,795 | 85,728 | 89,661 | 93,566 | 97,499 | 101,432 | 105,365 | 109,298 | 113,202 | 117,135 | 121,068 |
| **15.875" BEAM WIDTH** | | | | | | | | | | | | | |
| Beam Depth, d (in) | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 | 39.72 | 41.10 | 42.48 |
| Weight per ft length (lb/ft) | 114.4 | 120.5 | 126.6 | 132.6 | 138.7 | 144.8 | 150.9 | 156.9 | 163.0 | 169.1 | 175.2 | 181.2 | 187.3 |
| A ($in^2$) | 412 | 434 | 456 | 478 | 499 | 521 | 543 | 565 | 587 | 609 | 631 | 652 | 674 |
| Sx ($in^3$) | 1,780 | 1,975 | 2,179 | 2,394 | 2,619 | 2,852 | 3,096 | 3,351 | 3,616 | 3,891 | 4,174 | 4,469 | 4,775 |
| Ix ($in^4$) | 23,091 | 26,976 | 31,274 | 36,005 | 41,192 | 46,811 | 52,965 | 59,637 | 66,847 | 74,615 | 82,901 | 91,846 | 101,411 |
| EI ($\times 10^6$ lbf-in2) | 41,564 | 48,556 | 56,293 | 64,809 | 74,145 | 84,259 | 95,338 | 107,347 | 120,324 | 134,308 | 149,222 | 165,322 | 182,540 |
| Mr (lbf-ft) | 313,942 | 346,434 | 380,437 | 415,944 | 452,948 | 491,158 | 531,126 | 572,572 | 615,490 | 659,874 | 705,382 | 752,673 | 801,415 |
| Vr (lbf) | 82,360 | 86,741 | 91,123 | 95,504 | 99,886 | 104,235 | 108,617 | 112,998 | 117,380 | 121,761 | 126,111 | 130,493 | 134,874 |
| **18" BEAM WIDTH** | | | | | | | | | | | | | |
| Beam Depth, d (in) | 25.94 | 27.32 | 28.70 | 30.08 | 31.46 | 32.83 | 34.21 | 35.59 | 36.97 | 38.35 | 39.72 | 41.10 | 42.48 |
| Weight per ft length (lb/ft) | 129.7 | 136.6 | 143.5 | 150.4 | 157.3 | 164.2 | 171.1 | 178.0 | 184.9 | 191.8 | 198.6 | 205.5 | 212.4 |
| A ($in^2$) | 467 | 492 | 517 | 541 | 566 | 591 | 616 | 641 | 665 | 690 | 715 | 740 | 765 |
| Sx ($in^3$) | 2,019 | 2,239 | 2,471 | 2,714 | 2,969 | 3,233 | 3,511 | 3,800 | 4,100 | 4,412 | 4,733 | 5,068 | 5,414 |
| Ix ($in^4$) | 26,182 | 30,587 | 35,460 | 40,825 | 46,705 | 53,077 | 60,055 | 67,620 | 75,795 | 84,603 | 93,998 | 104,140 | 114,986 |
| EI ($\times 10^6$ lbf-in2) | 47,127 | 55,056 | 63,828 | 73,485 | 84,070 | 95,538 | 108,099 | 121,716 | 136,431 | 152,286 | 169,197 | 187,452 | 206,975 |
| Mr (lbf-ft) | 353,737 | 390,347 | 428,660 | 468,668 | 510,363 | 553,417 | 598,451 | 645,150 | 693,508 | 743,519 | 794,795 | 848,081 | 903,001 |
| Vr (lbf) | 93,384 | 98,352 | 103,320 | 108,288 | 113,256 | 118,188 | 123,156 | 128,124 | 133,092 | 138,060 | 142,992 | 147,960 | 152,928 |

NOTES:
1. 24F-V8 SP glulam.
2. Uniformly distributed loading.
3. Depths are based on 35 mm 6 mm lamination thickness minus 6mm planing depth.
4. Beam properties calculated based on architectural depths and architectural beam widths.
5. Beam weight is based on density of 40lbf/$ft^3$
6. Beam span for Cv calculations (NDS 5.3.6) assumed to be 18x actual depth and x=20
7. Beam engineering properties are calculated in accordance with NDS.
8. The tabulated shear capacity Vr shall be reduced by Cvr=0.72 for repetitive/impact loads, design of members at notches and design of members at connections, as per NDS 5.3.10
9. These tables do not account for charring fire protection. Fire protection should be provided by encapsulation with a fire rating material as required by the applicable Building Code. Alternatively, NDS Annex B can be used to calculate effective charring to provide fire protection.
10. Assumed modification factors:
    - standard term load duration (CD = 1)
    - dry service condition (CM = 1)
    - no preservative treatment (CT = 1)
    - continuous lateral support along compression edge (CL = 1)

06

# MERCER MASS TIMBER CARE, RIGGING AND INSTALLATION

# Mercer CLT and Glulam: Care, Rigging and Installation

## PACKAGING

All Mercer CLT panels and glulam beams and columns are wrapped (individual, bundle, tarp) and protected at the factory to ensure arrival on-site in the best possible condition.

## DAILY SEQUENCING

As part of our services, our project management and in-house installation teams will collaborate with the project's construction team to coordinate delivery and construction schedules. In the event temporary site storage is required, please see "Storage" for recommendations.

## RIGGING & SHORING

Before installation, Mercer CLT panels and glulam beams can be prepared for safe lifting and hoisting. All lifting equipment, rigging, and hoisting devices must be designed by the installer's erection engineer. Our in-house engineers and fabrication specialists are equipped to inform and guide the project team towards a competent solution and/or provide professional engineering advice.

## STORAGE

Store Mercer CLT and glulam elements on a flat surface, raised off ground contact by 6" to 12" using clean, wooden blocking spaced to ensure no product deflection. Separate courses with additional blocking, ensuring blocking is vertically aligned/stacked.

Cover product with good-quality, clean tarpaulin to protect from adverse weather conditions and UV exposure. Water will stain the product. Prolonged exposure to sunlight will cause "tanning" and will discolor the product. UV-resistant temporary sealants can be applied in the factory to minimize the impact of moisture and UV, but this does not eliminate the need for adequate storage on site.

For long-term storage, cut slits in the bottom of the wrapping to allow ventilation and drainage of any entrapped moisture. MMT recommends retaining factory-applied wrapping on product until fully installed and building is enclosed to best protect finished surfaces.

## FINISHING

Wood finishes are a necessary component of preserving your products. Bare wood products highlight the natural beauty of


wood but may check, swell and change color over time.

Final finish coating of visually exposed Mercer CLT and glulam members is recommended and should be applied after the building is enclosed but prior to introducing heat in the building. Finish sanding with 80 grit sandpaper in the direction of the wood grain is recommended prior to application of finishing product to exposed surfaces. Ensure that finishes are compatible with factory applied temporary coating systems.

Follow all application directions of finishing product. Finishing a small, concealed test area to ensure satisfactory end-results is always recommended.

## CONDITIONING

In order to minimize adverse checking and/or dimensional movement in Mercer CLT and glulam members, it is critical that the product is allowed to gradually adjust to final ambient moisture and temperature conditions over a period of several weeks.

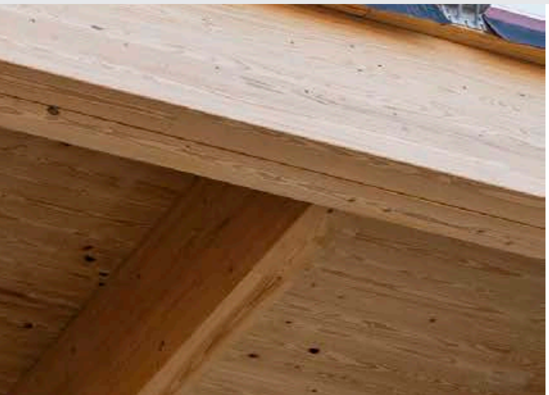
Upon building closure, adjust building temperature and relative humidity slowly, over a series of weeks, allowing mass timber components equilibrium to adjust more naturally. Remember, room temperatures near ceilings can be several degrees warmer than at floor level.

Do not expose Mercer CLT and glulam beams and columns directly to forced air during this period to avoid abrupt checking.


Walmart Home Campus | Bentonville, Arkansas

# 07

# MERCER MASS TIMBER CONSTRUCTION SERVICES



# Mercer Mass Timber Construction Services

**Mercer can offer in-house construction services to ensure that the installation of our mass timber products is easy, safe and efficient. We have a team of experienced mass timber erectors with over a decade of experience in the installation of timber buildings in North America.**

## UNPARALLELED ADVANTAGES OF MERCER MASS TIMBER INSTALLATION SERVICES

### LOGISTICS COORDINATION FOR MASS TIMBER DELIVERIES

Leveraging our vertical integration, we streamline logistics coordination for mass timber deliveries. This approach ensures efficient and timely delivery, minimizing delays and optimizing project timelines.

### REDUCTION IN SCOPE GAP FOR GENERAL CONTRACTORS/OWNERS

By having control over the entire process from engineering to manufacturing and installation, we significantly reduce scope gaps, fostering a smoother project execution and minimizing discrepancies.

### OFF-SITE ASSEMBLY ASSISTANCE

Our ability to perform off-site assembly, including the installation of necessary hardware at our factories, reduces on-site installation complexities. This approach ensures precision and quality while enhancing project efficiency.

### INSTALLATION SEQUENCE/TRUCKING SEQUENCE TRANSPARENCY

We maintain transparent and clear installation sequences and trucking sequences, providing comprehensive visibility to stakeholders. This transparency minimizes uncertainties and enhances project planning.

### VALUE ENGINEERING PROPOSITIONS

Our comprehensive understanding and collaboration among our engineering, manufacturing, and construction teams under one roof enable us to offer value engineering propositions. This results in optimized solutions that balance functionality, aesthetics, and cost-effectiveness.

### TIMBER EXPERTISE

Our construction team boasts an exceptional level of expertise in mass timber construction, having overseen the successful installation of numerous mass timber structures across a diverse array of project types and geographic locations. With a track record encompassing multi-family residences, commercial establishments, residential buildings, and warehouse-industrial structures, our team has demonstrated proficiency and versatility in handling various project complexities.

# We can Partner with Your Installer of Choice

**We can also work closely with one of the numerous mass timber installers in the market. We will nurture a collaborative environment and seek installation sequence and detailing feedback from your installer, as well as agreeing on the delivery sequence.**

**SEQUENCING**

Truckload sequencing is a standard feature of MMT's mass timber packages, with the exact sequence established during the shop drawing process. Wherever possible, Mercer CLT panels are arranged to be erected directly from the delivery truck to their installation point. However, to ensure safe shipment, some panels or members may be delivered out of sequence to facilitate the safe transportation of the load to the site.

Please contact MMT to learn more about truckload sequencing.

**SITE ASSEMBLY DRAWINGS**

Design for Manufacture and Assembly (DfMA) is at the core of what we do. Our team ensures that every component of your project can be produced, delivered, and installed with maximum efficiency. We can generate site assembly drawings from the approved 3D model to provide clear and precise instructions for the installation team, facilitating an efficient site installation.

For more information about our site assembly drawings services, please contact Mercer Mass Timber.

oN5 | Vancouver, British Columbia

COMING SOON

# Additional Features and Canadian Design Values

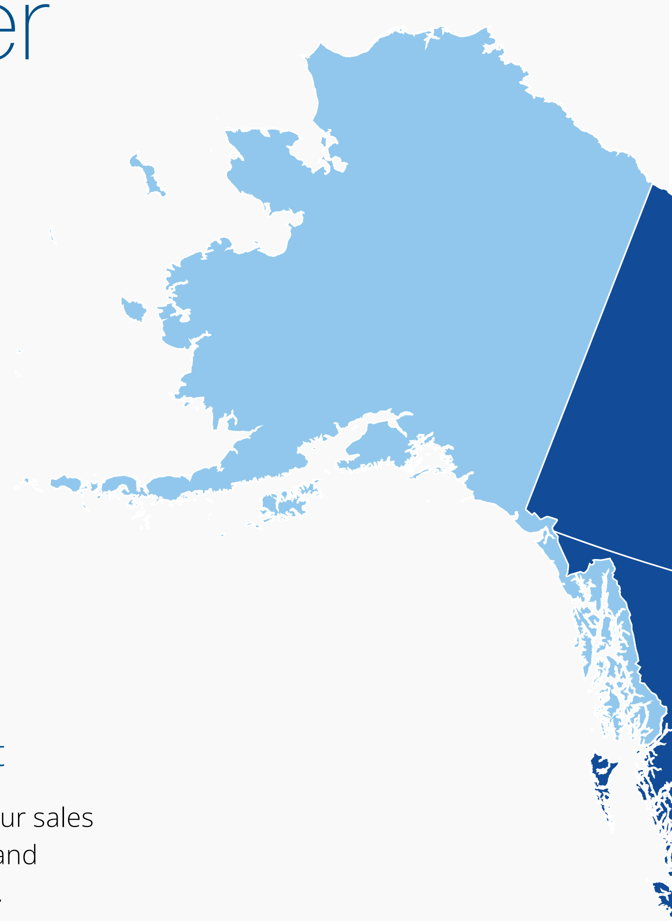
As a successor to the technical guide published by Structurlam, the Mercer Mass Timber Technical Guide will be expanded to encompass the latest product and service offerings.

At MMT, our goal is to develop the most advanced mass timber building systems in the world, making them more widely available, more efficiently produced, and of higher quality than ever before. Leveraging our comprehensive expertise in mass timber and our unprecedented investments in R&D, testing, manufacturing, design, engineering, and construction, we provide our partners with the most cutting-edge building systems available.

JOIN US IN ADVANCING MASS TIMBER, TOGETHER.

High Line Timber Bridge | New York, New York

# Let's Work Together



Designed to reduce carbon emissions while offering unparalleled strength and versatility, our products stand at the intersection of innovation and sustainability.

Discover how your projects can benefit from our cutting-edge technology and quality mass timber products.

Reach out to our sales team and start building a greener tomorrow.

## MMT Sales and Business Development

With our extensive coverage across North America, our sales team is ready to support you in creating sustainable and innovative structures with our mass timber solutions.

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Director of Sales

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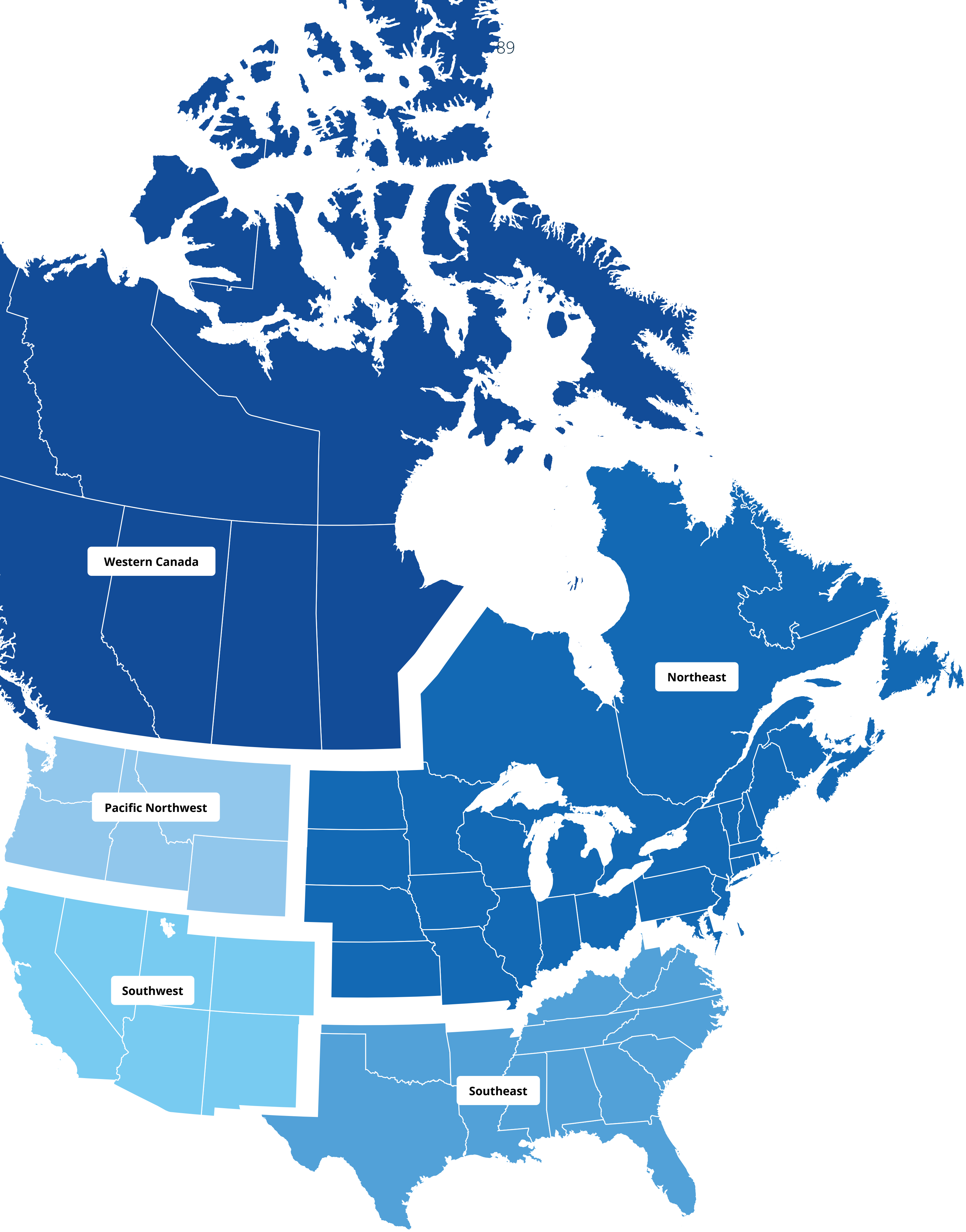
Western Canada
Northeast
Pacific Northwest
Southwest
Southeast

# Mercer Mass Timber

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Mercer Mass Timber (MMT) is
a wholly-owned subsidiary of Mercer
International, a global provider of
renewable materials and energy.

MERCER
mass timber