MASS PLY DESIGN & CONSTRUCTION GUIDE

MASS PLY
BY FRERES


Coffee
HOUSE

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WHO WE ARE

Freres Engineered Wood is an Oregon-based premier wood products manufacturing company, specializing in creating high-quality, environmentally sound, veneer-based engineered wood products to forward-thinking developers, architects and engineers who seek durable, eco-friendly building materials. Freres provides innovative, efficient, and environmentally friendly wood products to the market, while managing healthy, sustainable forests. With a reputation for integrity and a commitment to its community, the company's ability to keep an eye on the future has kept this family-owned and operated business thriving for more than 100 years.

Providing local family-wage jobs at its three operations: Freres Engineered Wood, Freres Timber and Evergreen BioPower, LCC, the company uses 100 percent of its materials in beneficial, value-added products.

Freres is a closely-held family business and its executive team has more than 100 years of combined experience in the timber and wood products industries. More than 450 employees support, and are supported by, these operations. The company's team members are what make Freres one of the premier veneer and panel manufacturers in the world.

Contributing to, and connecting with, the community is core to the company's values as is a deep respect for protecting the environment, the wood, and the fiber that comes from our forests. Freres' long history of innovation has resulted in being able to do "more with less" of one of the world's most valuable resources.

That innovative drive inspired Freres to evolve its lumber business to veneer manufacturing in 1958. It lead the company into plywood manufacturing in 1998, and it encouraged the company in 2007 to build a cogeneration facility that supplies renewable power to the utility grid. In 2017, Freres developed what could possibly be the most significant new mass timber product in the world: Mass Ply Panels.

Freres traces its roots to the hills above the Little North Fork of the N. Santiam River in 1922, nurtured by the patriarch of the Freres family, T.G. Freres. What began a century ago with one man, today employs hundreds of Oregonians and remains a strong presence in Oregon's Santiam Canyon.

FRERES

INNOVATION IS OUR TRADITION

100

> **"We look to the future and recognize that we are not just producing lumber, but the advanced, engineered wood products of the future.**
>
> – Kyle Freres, VP of Operations

OUR VISION

We strive to create the wood products of the future through continuous innovation, envisioning a time when cities and communities are built with wood from healthy, actively managed forests providing a wide array of environmental, societal and economic benefits.

FRERES OPERATES SIX PLANTS

- **P1** Small Log Veneer + Lumber Studmill
- **P2** Large Log Veneer
- **P3** Panel Mill, Plywood + Structural Composite Lumber
- **P4** Veneer Drying
- **P5** Evergreen BioPower Cogeneration
- **P6** Mass Ply Facility

MASS PLY

MASS PLY PRODUCTS

Mass Ply products are patented, veneer-based, large-format engineered wood products that can be easily substituted for Cross Laminated Timber (CLT), Dowel Laminated Timber (DLT) or Nail Laminated Timber (NLT), in any Mass Timber project. The APA - The Engineered Wood Association has performed extensive testing to certify our products under ASTM D5456 and PRG 320.

Mass Ply Lams (MPL) can also replace beams or columns for any Glu-Laminated Timber project. Freres developed Mass Ply to maximize the natural strength of wood, while adding dimensional stability. Mass Ply uses interlocking veneer layers to provide longer spans of wood that are stronger, more stable, and fire-resistant—all while producing fewer CO_2 emissions than other building materials, such as concrete or steel

The building block of each Mass Ply Panel (MPP) is Freres' Structural Composite Lumber (SCL), which consists of multiple layers of density-graded Douglas Fir veneers. These veneers are glued and pressed in a variety of combinations and orientations, and finally joined together to create 1" layers called lamellas.

Mass Ply is an environmentally efficient alternative to CLT, concrete and steel. The versatility and consistency of Freres' process provides the ability to create engineered mass timber products in an array of applications including wide-format panels, beams and columns, and just about any industrial application utilizing heavy timbers. A Computer Numeric Control (CNC) machine can then precisely cut these products to the customer's desired specifications.

Mass Ply products can be manufactured in large format sizes including:

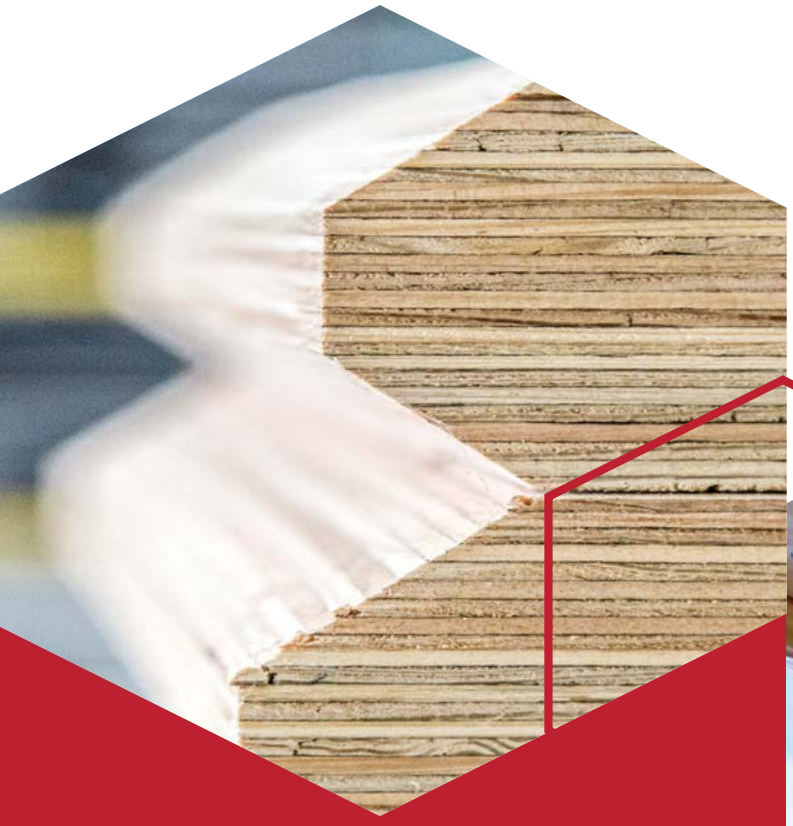
- 11'-10" wide and 48' long for floor, roof and wall panels up to 12" thick
- 3'-11 1/2" wide by 48' long for beams and columns up to 24" thick

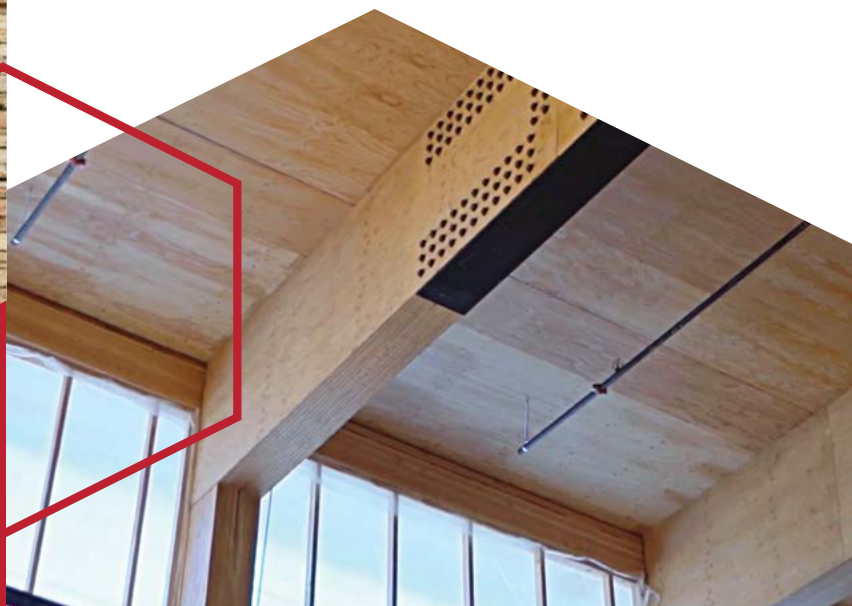
All this leads to decreased assembly times and a more economical building solution. Mass Ply is strong and fire-resistant making it an acceptable building material up to 18 stories. It is also lighter, more economical and more environmentally sustainable than concrete and steel.

WINNER

AN Best of Products

WOOD WATER RECREATION WILDLIFE CERTIFIED TREE FARM





BUILDING FOR THE FUTURE: WHY MASS TIMBER

Building with wood has significant benefits over concrete and steel. Construction of multi-story, mass timber buildings is rapidly increasing for a variety of reasons.

- **Wood is renewable, sustainable and aesthetically appealing.**
- **Mass timber products perform predictably in fires and under seismic conditions.**
- **The manufacturing of wood products requires much less energy and generates fewer greenhouse gas emissions than concrete and steel.**
- **Building with wood sequesters carbon for the life of the product, and new trees are planted to continue the carbon-sequestration process.**
- **Pre-fabrication allows for rapid construction times with a smaller workforce than multi-story concrete structures.**

WHY MASS PLY

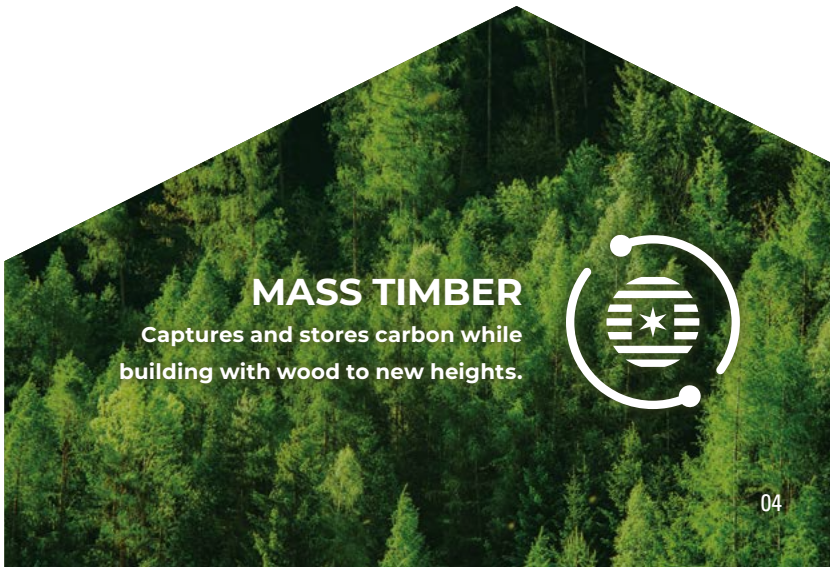
Mass Ply products can out-perform lumber-based mass timber construction in many ways.

- **Better dimensional stability with lower moisture content.**
- **Panels, columns, and beams can be sourced easily from one company.**
- **Can design in smaller increments of thickness leading to a more refined design.**
- **Uses smaller diameter trees to attain the same structural use as other wood products from larger diameter trees.**
- **Less waste from harvest to construction.**
- **Long spans with less wood than standard CLT.**
- **Greater flexibility with design.**

MASS PLY APPLICATIONS

- **Floors**
- **Roofs**
- **Beams & columns**
- **Walls & shear walls**
- **Shafts: stairs & elevator**

CLT VS. MASS PLY



MASS TIMBER

SUSTAINABILITY

SUSTAINABILITY IN PRACTICE

SUSTAINING TIMBERLAND

Freres' commitment to sustainability starts in the forest. All of our wood comes from a 150-mile radius from the mill and is harvested from sustainably managed forests as a renewable resource. Freres Timber's 17,000 acres of timberland are harvested on a sustained yield basis. This allows Freres Timber to provide high-quality timber today, while managing a healthy forest and providing timber production for future generations.

On Labor Day 2020, the Beachie Creek Fire burned through the Santiam Canyon devastating Detroit, Gates, Mill City, and 192,000 acres of the North Santiam Forest. Freres Timber lost 5,800 acres of mixed-age stands in the Santiam Canyon. Through expedient and efficient salvage operations over the next year, Freres was able to recover 98% of the burnt timber into usable forest products while also replanting the burnt lands with over 2 million seedlings. We intend to keep our forests as forests forever.

As a veneer-based product, Mass Ply allows the use of small diameter trees. The preferred tree type can be found in forests that have a suppressed understory; these trees grow slower, are smaller in diameter and are not the best candidate for dimensional lumber, whereas the veneer process can recover this fiber effectively and efficiently. These trees also produce wood that is denser due to the slower growth and therefore yield higher strength and stiffness values.

Thinning operations are a perfect means of harvest for small diameter trees resulting in a low impact method of harvest to promote a healthy forest. Such harvests are helpful given the excessive wildland fires that are a serious threat to the health and safety of our communities and forest habitat. Thinning reduces the fuel load and thus reduces the intensity and the spread of wildland fires.

WASTE NOTHING

Freres uses 100 percent of the fiber delivered to its plants from timber harvesting. We abhor waste and are always looking for ways to improve efficiency. Freres' veneer products are made with a lathe that peels thin layers from logs as small as 6 inches in diameter.

This process reduces waste since more of the wood goes into the final product than cutting square lumber from round trees. Freres produces and sells residuals such as bark dust, chips, sawdust, and bio-char which are used in a variety of industries such as farms and nurseries.

RENEWABLE ENERGY COGENERATION PLANT

Recycled urban wood and residuals from manufacturing operations provides renewable biomass energy to Freres' Evergreen BioPower cogeneration plant. Biomass energy, a renewable energy, is obtained from combusting wood debris to generate steam, which is then either utilized as heat in manufacturing processes or used to generate electricity. Steam-generated electricity from Freres' cogeneration plant supplies the local utility with enough energy to power more than 5,000 households, while also delivering heat for plant production processes.

MASS PLY: BUILDING THE FUTURE WITH WOOD

Multi-story, mass timber buildings are rapidly increasing in popularity for a number of reasons. From an environmental standpoint, wood is a natural and renewable resource. New engineered SCL products use less wood, are strong and lightweight, and achieve excellent performance in seismic integrity and fire resistance.

Freres' cogeneration plant can supply renewable energy for its production plus

5,000 HOMES

We are stewards of the land, using, protecting and nurturing our forests in the most sustainable way possible.

Freres has received Chain of Custody Certification under ASTM D7612 for its products. This certification demonstrates that we source our timber responsibly, meeting or exceeding the requirements of the Oregon Forest Practices Act.

WOOD VS. CONCRETE & STEEL

ENERGY

Wood uses far less energy during primary manufacturing than concrete and steel. During its service life, engineered wood has insulative value, thermal mass, and a tighter building envelope. At the end of its life-cycle, wood is recyclable, reusable, and reclaimable.

CARBON

Since it takes less energy to produce wood products compared to concrete and steel, the manufacturing process also generates less carbon. Additionally, trees are one of the most advanced carbon sequestering vehicles on earth! Trees sequester carbon in their cells as they grow, which is retained after harvest and through the life of the wood product.

According to the EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2013), carbon dioxide (CO_2) emitted from iron, steel, and cement production are the first and second largest sources of industrial CO_2 emissions in the U.S. Forests absorb CO_2 and store carbon. Carbon is stored in the harvested timber for the lifetime of the structure. Meanwhile, more trees are replanted that pull more CO_2 out of the atmosphere. This is why mass timber is said to be carbon negative.

MASS PLY VS. LUMBER-BASED MASS TIMBER PRODUCTS

Lumber-based mass timber products use a large volume of 2×6 and 2×8 products. Large dimensional lumber requires a larger diameter log than comparable veneer-based products. In veneer manufacturing, veneer is peeled from a log on a lathe which matches the physical properties of the tree. Lumber attempts to cut a rectangular board from a round tree, which creates additional waste.

Defects can significantly affect the performance of lumber-based mass timber products. Defects are therefore often cut from the board and boards are finger-jointed back together, generating another point of waste. In veneer-based products, the defects are distributed throughout the product, and this distribution allows the natural defect to be retained without affecting performance.

Since our Mass Ply products typically perform better by volume than other mass timber products, less fiber is used in the design and construction of Mass Ply buildings.

RESINS

All resins in the Mass Ply contain formaldehyde. Formaldehyde is a Volatile Organic Compound (VOC) that occurs in nature, the manufacturing process and in the products themselves. There is evidence that formaldehyde from engineered wood products such as plywood and LVL, is not a concern.

FORMALDEHYDE TABLE

SOURCE	EXPECTED EXPOSURE (PPB)
Human Breath	~2
Typical Indoor Air	10-30
Urban Air	5-100
Rural Air	.8-5
Raw Wood	20
Structural Plywood	10-40

The California Air Resource Board (CARB) exempts plywood and LVL as low-risk if manufactured compliant with the PS-1 Voluntary Product Standard or ASTM D5456. CARB is a highly regarded regulatory standard commonly adopted by the many green rating programs such as LEED and National Green Building Council.

The engineered wood manufacturing process lowers VOC's. Veneer processing is an even lower emitter than lumber. The veneer for Mass Ply is dried to a lower moisture content than lumber for comparable mass timber products. The lower moisture content of Mass Ply veneer leads to lower service emissions of formaldehyde than that of lumber. This difference is especially pronounced since the hot pressing of veneer further reduces in-service emissions of VOCs.

Formaldehyde breaks down easily. When emitted in the air it can take less than a few hours to break down.

LEED POINTS

Mass Ply has the potential to maximize the points for your next LEED certified building. Mass Ply inherently aligns with the U.S Green Building Council's (USBG) principles with its reduced energy capabilities and its environmental benefits. Our Life Cycle Analysis (LCA) and Environmental Product Declaration (EPD) are both available on our website.

STORAGE & HANDLING

STORAGE

- **Store panels on a level surface with space to allow for air movement around the panels.**
- **Protect Mass Ply from rain, snow, sun and mechanical damage.**
- **Keep Mass Ply 6-12 inches off the ground.**
- **Cover panels at all times with good-quality tarps to protect them from precipitation and ultraviolet (UV) damage.**
- **Timber wrap is available upon request.**

HANDLING

- **Use wide fabric, corner/edge protectors or slings that will not mar the wood. If chains or cables are used, provide blocking or padding to protect panels from damage.**
- **Walking on unprotected Mass Ply panels or handling the material with soiled hands or equipment will mar or discolor the panels.**
- **Unload trucks and move panels with lifting equipment. Do not drag, dump or drop panels. Off-loading equipment should be specified to the maximum panel weight of the project.**
- **Handling 2" and 3" panels may require special rigging or support as they should not be slung.**
- **Rigging is NOT supplied by the manufacturer.**

WHEN APPLYING HEAT TO BUILDINGS

- **Providing adequate time for the wood moisture content to equalize with environmental moisture content is desirable.**
- **Do not directly heat the Mass Ply with a forced air system.**
- **Maintain normal relative humidity in the building and monitor if necessary.**

FINAL FINISH

- **Freres does NOT provide in-house staining or finishing services. Panels are sanded as part of the manufacturing process.**

WEATHER CONDITIONS

Mass Ply panels are susceptible to adverse weather conditions and precautions must be taken to protect them.

- **If unprotected, rain and moisture will cause staining of Mass Ply, like traditional plywood.**
- **If bolts are used with steel connections, ensure they are free of oil to avoid staining.**
- **Galvanized bolts and connectors will minimize staining.**

UV DAMAGE

UV damage is the result of exposing wood fiber to sunlight. Wood fibers permanently darken when exposed to direct or indirect sunlight.

- **If a portion of the panel has been left uncovered in the sun, UV damage will occur.**
- **All wood species change color over time as a result of exposure to natural light and oxidation of the wood fibers.**
- **Over the long term, the color differences will even out and in most instances will disappear.**

STRUCTURAL GRADE APPEARANCE

Mass Ply structural grade appearance will conform to density-grade requirements for PRL -324. Visual grade will be to standard C grade appearance. Knots can be any count over a 32' panel area. Splits will be limited to ½" width over 24" length.

ARCHITECTURAL APPEARANCE

STANDARD ARCHITECTURAL

Mass Ply standard architectural meets all the structural requirements of Mass Ply structural grade while putting forward a higher visual grade appearance. This visual grade requires a closed knot and reduces the knot size. Quantity of knots are not limited. Splits will be limited to ½" width over 24" length.

UPGRADED ARCHITECTURAL

For additional cost, a semi-clear-of-knot face grade can be added to one or both faces of a Mass Ply billet. Knots and defects will be limited to eight defects per 32 square foot panel area. We cannot complete panel repairs, such as boat patches or poly, so the intent is to limit defect quantity for a cleaner appearance. These veneers are typically added to the bottom of the panel, so are subject to potential handling damage. We cannot view or repair these panels prior to shipment, so they will be on a field repair basis only.

WASTE LESS IN YOUR MASS PLY DESIGN

Maximize wood use:

- **Effective billet widths are 11'-10", 9'-10", 7'-10", and 3'-10"**
- **Currently lengths are optimized between 32' and 48'. Reference "Mass Ply Design Tips" for more saving techniques.**
- **Curved panels, reentrant corners, half lap joints, plunge cuts for MEP typically require more time intensive router work.**

FIRE DESIGN

Mass Ply has proven fire performance:

- **Mass Ply has a 2-hour floor rating and a 1.5-hour wall rating with 6-inch panels.**
- **ASTM E-119 and E84 fire tests are available upon request.**
- **Thicker effective cross section after char depth.**

SPECIFICATIONS

SPECIFICATION GUIDE

Mass Ply Panels are ANSI/APA PRG 320 certified as a Cross Laminated Timber (CLT) panel. Each 1" lamella used to construct our panels is constructed of nine layers of 1/8" veneer. These thin layers are engineered and oriented to enhance the natural strength and dimensional stability of the wood.

Use of CNC technology meets the tolerances required by PRG320. Floor, roof and wall panels can be manufactured as large as 11'-10" wide and 48' long. Panel thicknesses are available in 1-inch increments from 2" to 12". Actual thickness per lamella is 1.02".

GRADES

Mass Ply Panels are currently certified in two different grades designated as F16 and F10. The grades differ primarily in their performance in major and minor force directions, which should be considered carefully in design. All grades utilize density-graded veneers in proprietary combinations and orientations in lamella construction.

Plies, when referring to lamellas, denote individual sheets of veneer. When the term ply is used to describe Mass Ply, the ply then refers to the lamella as a whole.

F16 GRADE

The lamellas of this Mass Ply grade contain nine plies out of which seven are oriented longitudinally to the lamella and two plies which are orthogonal. F16 grades should be utilized where major-force direction spans are of primary consideration.

F10 GRADE

The construction of this grade is similar to a traditional plywood layup in that each alternating veneer ply is orthogonal to the adjacent layer. Though some span is lost in the major-force direction of the panel, F10 grades will perform better in the minor-force direction. F10 grades should be utilized where bi-directional spans are preferred.

QUALITY ASSURANCE

The processes at the Mass Ply plant undergo APA site inspection. We have a verified and audited Quality Management System (QMS) program by the APA. The QMS includes ongoing material testing and traceability per the APA product report.

DESIGN

Mass Ply panels are treated like CLT panels for design. Reference the CLT Handbook and the NDS for more details. All design shall be provided by a licensed professional.

CERTIFICATIONS + APPROVALS

Mass Ply is certified by the APA - The Engineered Wood Association under ANSI/APA PRG-320 and ASTM D5456 for its lamellas. APA product reports PR-L324 and PR-L325 govern the design values and scope of use for lamellas and Mass Ply respectively.

Mass Ply is also certified by the ICC Evaluation Services. The ICC publishes product reports under the ICC-ESR 4759 and ICC-ESR 4760 for lamellas and Mass Ply respectively.

ICC also certifies that Mass Ply and its lamellas comply under the Los Angles Building and Residential Codes (LABC and LARC) as well as the California Building and Residential Codes (CBC and CRC).

MATERIALS

LVL: DOUGLAS FIR, LARCH
CERTIFIED UNDER ASTM D5456

- **APA: PR L-324**
- **ICC-ESR 4759**

MPP/MPL: DOUGLAS FIR, LARCH
CERTIFIED UNDER PRG 320

- **APA: PR L-325**
- **ICC-ESR 4760**

PANEL PROPERTIES

MAXIMUM TRIMMED PANEL LENGTH
Panel lengths up to 48'

TRIMMED PANEL WIDTHS
11'-10", 9'-10", 7'-10", and a 3'-10"

THICKNESS
2.04", 3.06", 4.08", 5.10", 6.12", 7.14", 8.16", 9.18", 10.20", 11.22", & 12.24"

MOISTURE CONTENT
8% ± 3%

GLUE SPECS
Meets adhesive requirements under PRG-320. Mass Ply are CARB exempt.

WOOD SPECIES
Douglas Fir/Larch

SQUARENESS
Unless specified otherwise the length of the two panel length corners shall not vary by more than 1/8"

STRAIGHTNESS
+ 1/16" deviation of straight edge

DIMENSIONAL TOLERANCES
Thickness + or - 1/16" or 2% of panel thickness, whichever is greater.

WIDTH
± 1/8" of panel width

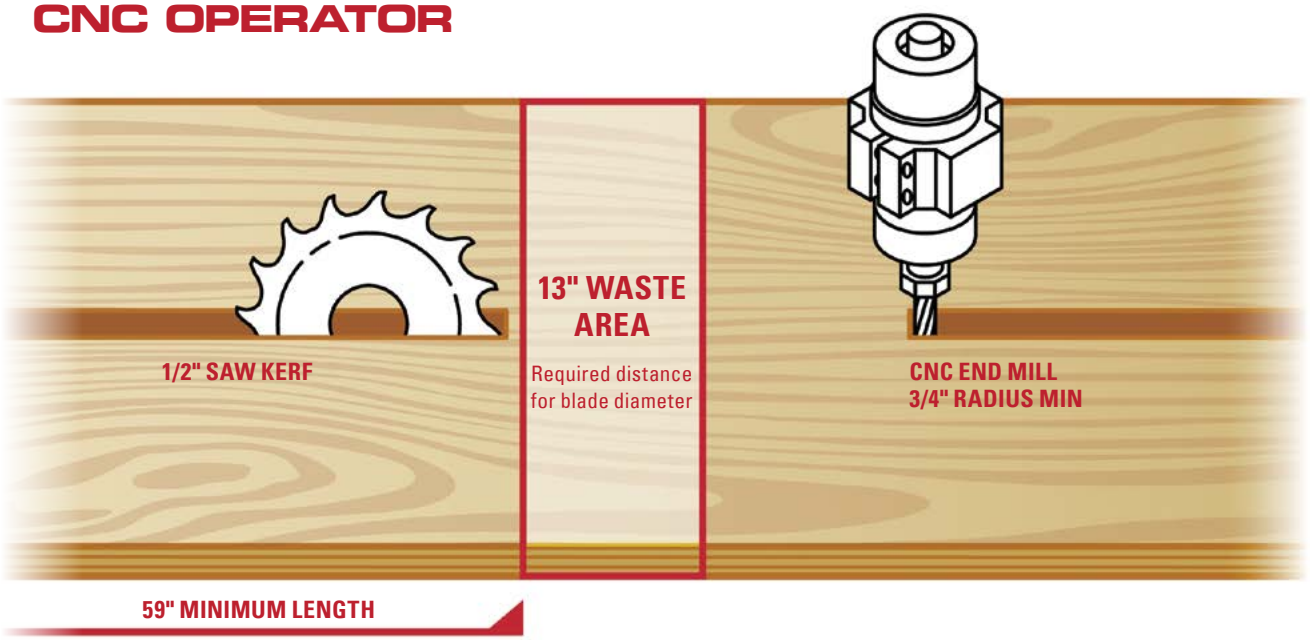
LENGTH
± 1/4" of panel length

LINEAR EXPANSION
0.16% along 0.27% across

R-VALUE
1.25 per inch

K-VALUE
(thermal conductivity): 0.798

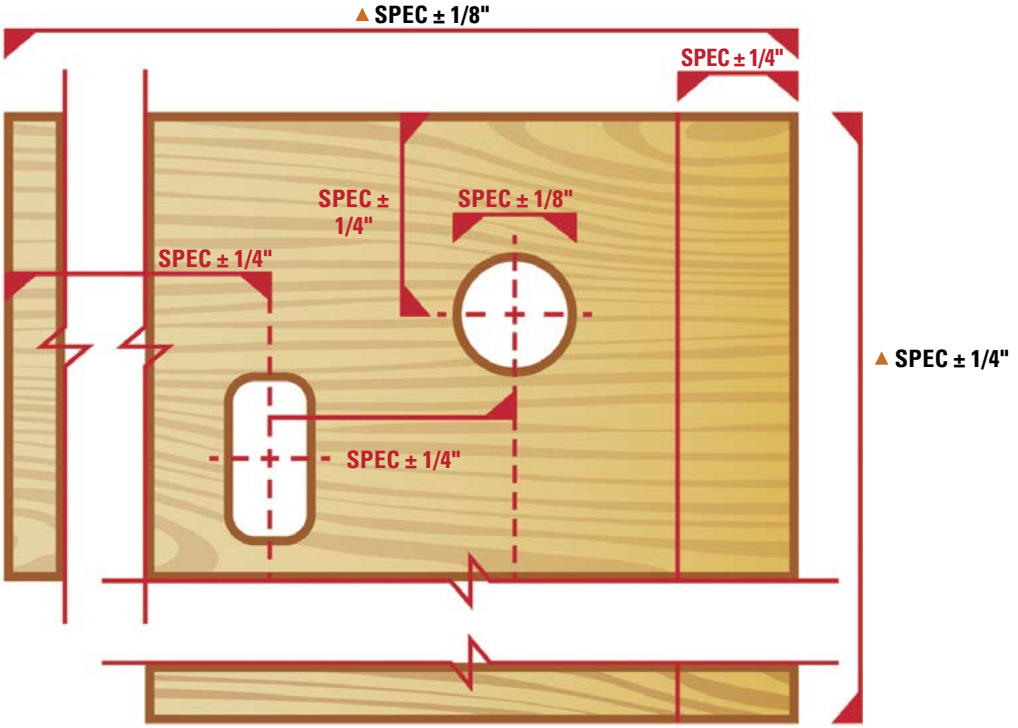
CNC OPERATOR



TOLERANCES ON CUTS

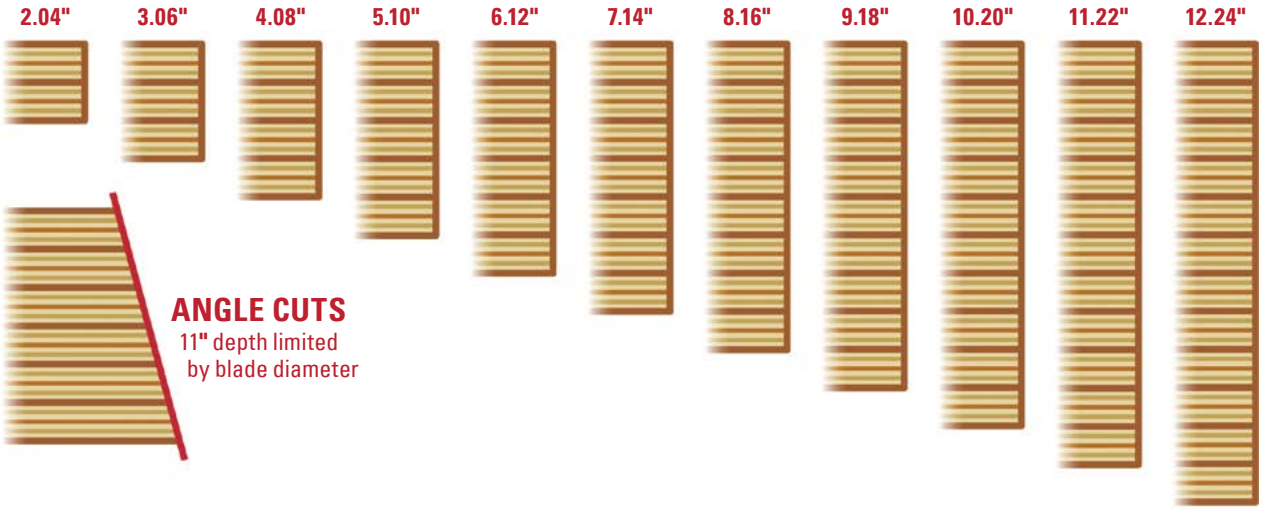
END VIEW

TOP VIEW



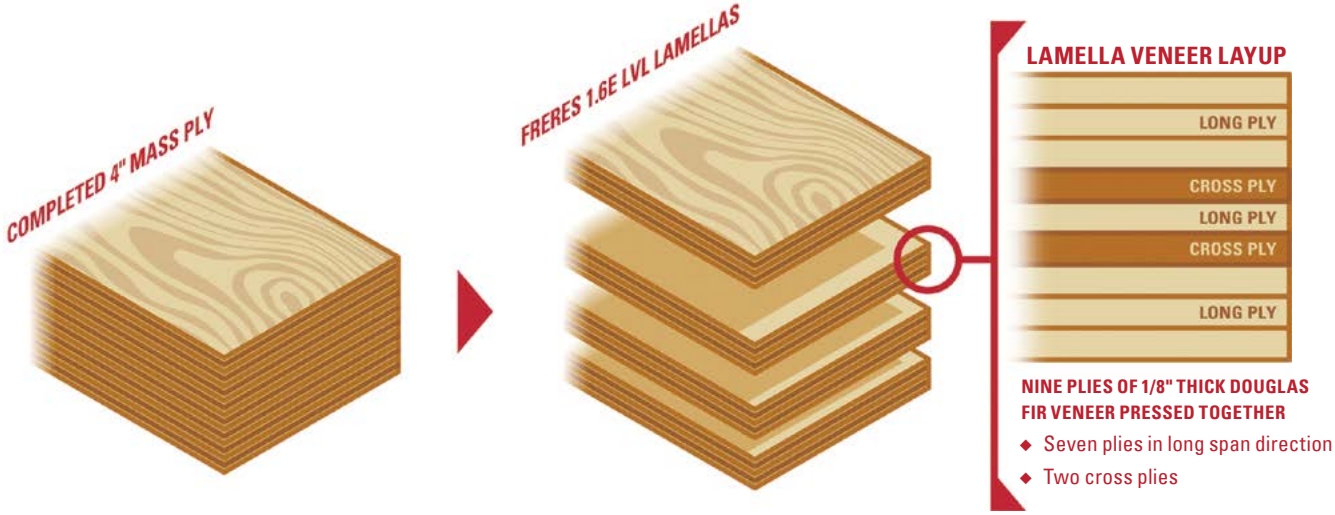
▲ PRG-320 MANDATED TOLERANCE

UTILIZE MINIMUM THICKNESS



PANEL WIDTH

F16 MASS PLY LAYUP

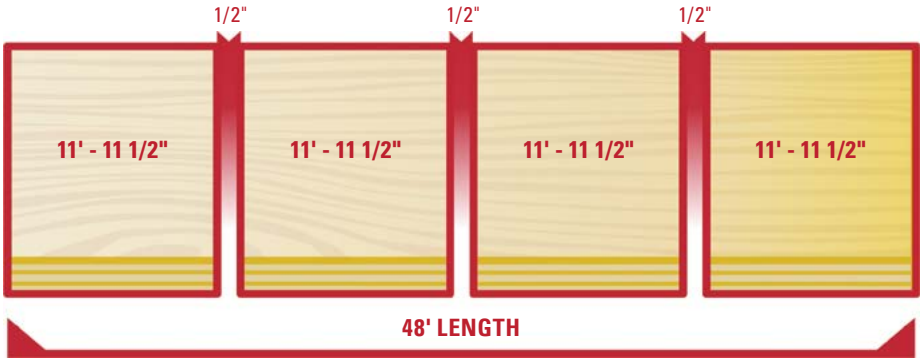


NINE PLIES OF 1/8" THICK DOUGLAS FIR VENEER PRESSED TOGETHER

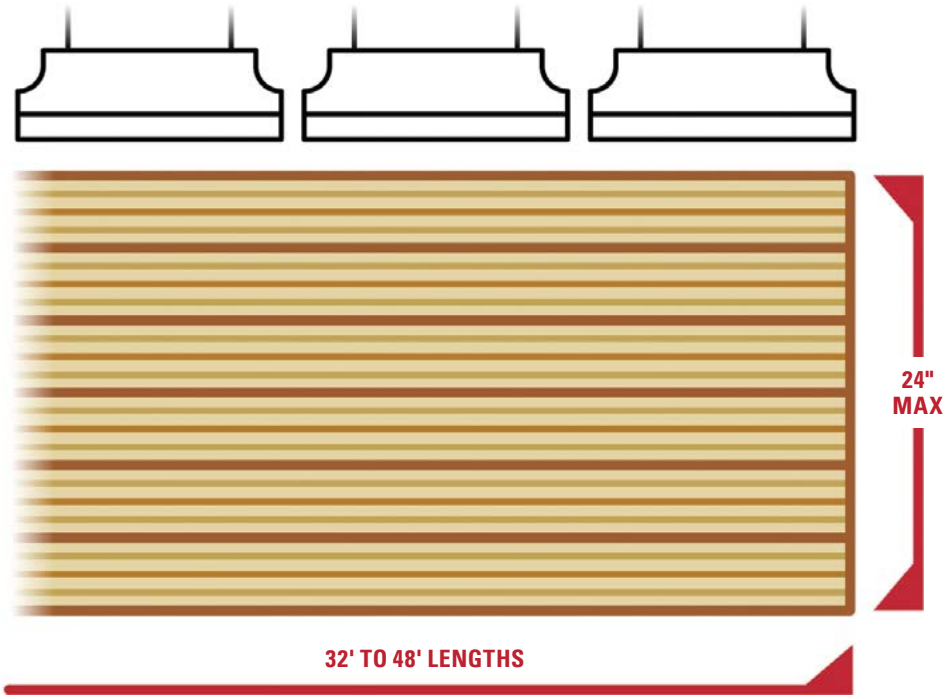
- Seven plies in long span direction
- Two cross plies

REQUIRE SPECIAL PERMITS FOR TRUCKING

CUTTING MULTIPLES OUT OF PANEL

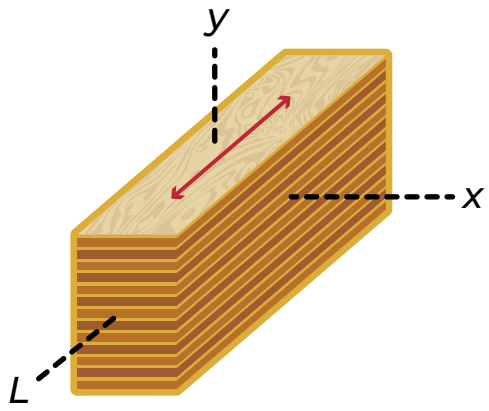


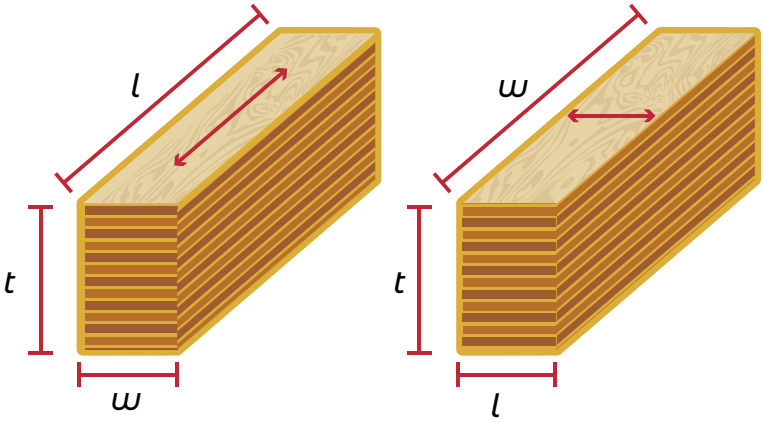
PRESS LOAD PARAMETERS



The example above shows six 4" panels being pressed simultaneously.

MASS PLY NOMENCLATURE





LEGEND

MAJOR STRENGTH DIRECTION
Grain orientation of outer veneer

MAJOR AXIS ORIENTATION

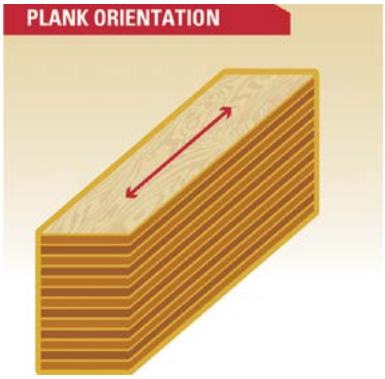
DIMENSION SYMBOL

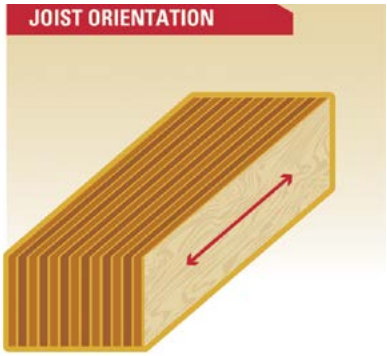
THICKNESS
t — Distance perpendicular to face of veneer

WIDTH
w — Distance parallel to face of veneer & perpendicular to major strength direction

LENGTH
l — Distance parallel to face veneer & parallel to major strength direction

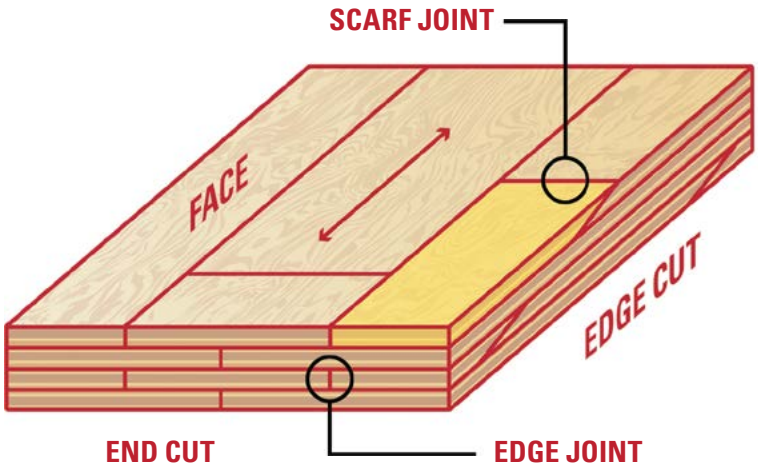
NOTE: *Nomenclature and axes referenced from ASTM D5456 Figures 1 and A4.1. These orientations may be considered on a lamella or a Mass Ply level. While lamella may lack some of the joints, the orientation of the faces or planes will always be consistent.*





PLANK ORIENTATION
Also known as flat bending

JOIST ORIENTATION
Also known as edge bending



END CUT
A cut face of the Mass Ply with EDGE joints present. This face will always be on the X-Y plane or the t-w plane of the panel according to the nomenclature above.

EDGE JOINT
A joint visible on end cut face of a panel.

EDGE CUT
A cut face of the Mass Ply showing no edge joints. This cut face will always be on the L-Y or the t-L plane according to the above nomenclature.

SCARF JOINT
A joint visible from the face & the edge cuts. This joint comes from the lamella assembly process & is randomly distributed throughout the panel.

PANEL PERFORMANCE

FLOORS

Mass Ply panels are particularly suited for floor applications. By utilizing the inherent strength of the panel, joists and other structural supports can be vastly simplified. An enormous amount of surface area can be installed quickly and easily, and connections, penetrations, and other features can be pre-manufactured into the panel prior to delivery at the job site. Refer to the Floor Span tables below for your particular design application.

FLOOR SPAN TABLES

- **F16 Mass Ply Maximum Span Floor Table - Major Strength Axis**
  frereswood.com/tables/floor/F16-major
- **F16 Mass Ply Maximum Span Floor Table - Major Strength Axis with 2" Concrete**
  frereswood.com/tables/floor/F16-major-concrete
- **F10 Mass Ply Maximum Span Floor Table - Major Strength Axis**
  frereswood.com/tables/floor/F10-major
- **F10 Mass Ply Maximum Span Floor Table - Major Strength Axis with 2" Concrete**
  frereswood.com/tables/floor/F10-major-concrete
- **F10 Mass Ply Maximum Span Floor Table - Minor Strength Axis**
  frereswood.com/tables/floor/F10-minor
- **F10 Mass Ply Maximum Span Floor Table - Minor Strength Axis with 2" Concrete**
  frereswood.com/tables/floor/F10-minor-concrete

ROOFS

Roof applications utilizing Mass Ply are very similar to those in floor applications; however, there are differences in span values in roof applications. Refer to the Roof Span tables below for your particular design application.

ROOF SPAN TABLES

- **F16 Mass Ply Maximum Span Roof Table - Major Force Direction**
  frereswood.com/tables/roof/F16-major
- **F10 Mass Ply Maximum Span Roof Table - Major Force Direction**
  frereswood.com/tables/roof/F10-major
- **F10 Mass Ply Maximum Span Roof Table - Minor Force Direction**
  frereswood.com/tables/roof/F10-minor

WALLS

Wall applications are significantly more complicated than other uses of our product due to shear and major/minor force design concerns. Refer to the Wall Loading tables below for a simplified column design example.

WALL LOADING TABLES

- **F16 Mass Ply Wall Loading Table (Axial Loads Only) in Kips**
  frereswood.com/tables/wall/F16-loading
- **F10 Mass Ply Wall Loading Table (Axial Loads Only) in Kips**
  frereswood.com/tables/wall/F10-loading

MASS PLY LAM

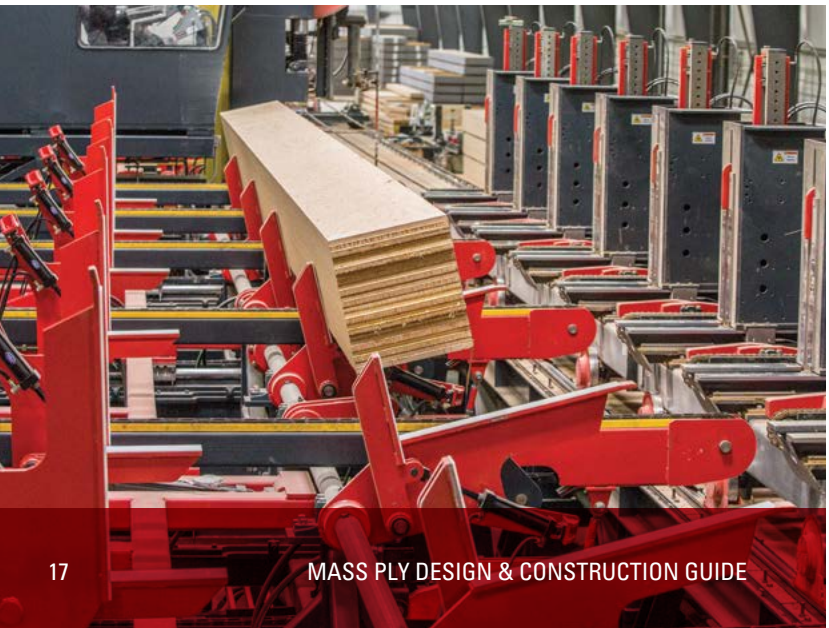
MASS PLY LAM

Mass Ply Lams (MPL) are ASTM D5456 certified products for use as beams and columns, replacing lumber-based glulam products or heavy timbers traditionally used in these applications. With this new product line supplementing our panel products, Freres is now able to provide every structural element to a mass timber project.

CONSTRUCTION

Construction of MPL is designed with beam and column applications in mind and differs from our Mass Ply Panel construction.
For all lam products of less than 47.5" in depth, lamellas are arranged in a monolithic arrangement which do not contain edge joints that are present in our panel products.
For those who need a deeper beam, our lam product may be produced in depths up to 72" with the inclusion of edge joints in the cross section of the beam. This should be carefully considered in projects and our Sales and Engineering team should be contacted for recommendations.

Utilizing the largest carriage in existence to process our product, Freres MPL is available in dimensions up to 24" x 47.5" in lengths up to 48'.



LAM PROPERTIES

MAXIMUM TRIMMED PANEL LENGTH
Raw panel lengths between 32' and 48'

TRIMMED PANEL WIDTHS
47.5" max

THICKNESS
2.04" to 24.48"

MOISTURE CONTENT
8% ± 3%

GLUE SPECS
Meets adhesive requirements under ASTM D5456 & PRG-320. Mass Ply Lams are CARB exempt.

WOOD SPECIES
Douglas Fir/Larch

SQUARENESS
Unless specified otherwise the length of the two panel length corners shall not vary by more than 1/8"

STRAIGHTNESS
+ 1/16" deviation of straight edge

DIMENSIONAL TOLERANCES
Thickness ± 1/16" or 2% of panel thickness, whichever is greater.

WIDTH
± 1/8" of panel width

LENGTH
± 1/4" of panel length

LINEAR EXPANSION
0.16% along 0.27% across

R-VALUE
1.25 per inch

K-VALUE
(thermal conductivity): 0.798

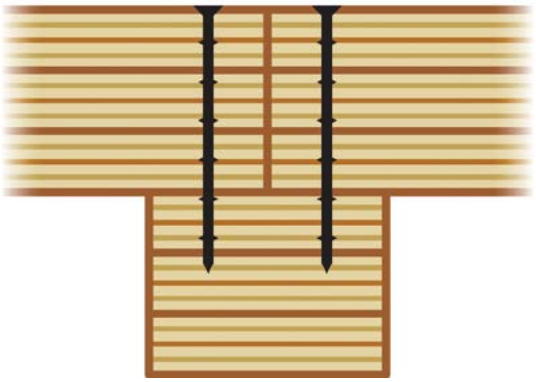
CONNECTIONS

CONNECTION REFERENCE

CLASS 1

Requires only mass timber elements and fasteners.

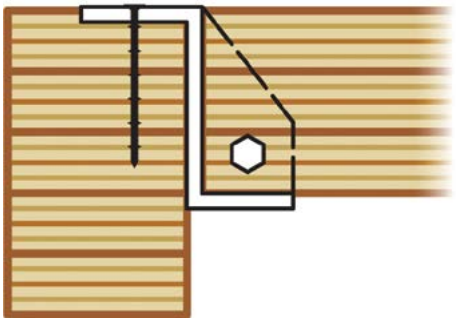
BEAM BEARS ON GIRDER



CLASS 2

Utilizes steel fabricated elements, with components such as angles and plates, and includes fasteners.

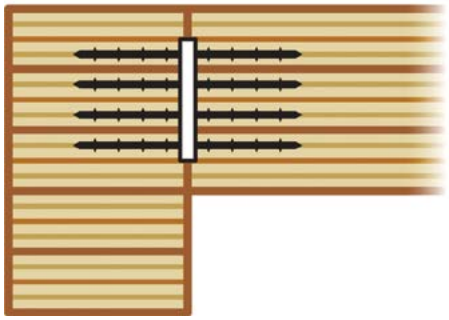
BEAM BEARS ON STEEL BEARING SEAT WITH KNIFE PLATE



CLASS 3

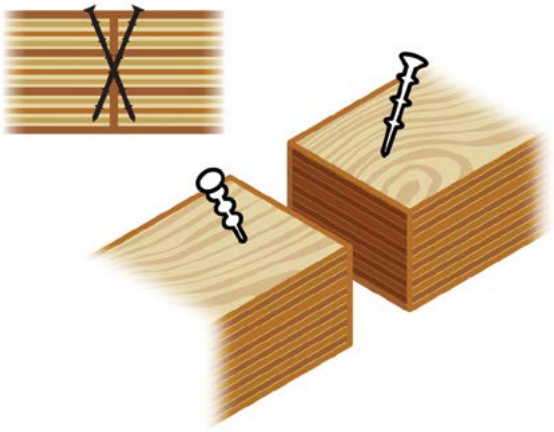
Prefabricated proprietary connectors.

BEAM CONNECTED TO GIRDER WITH PROPRIETARY CONCEALED CONNECTOR

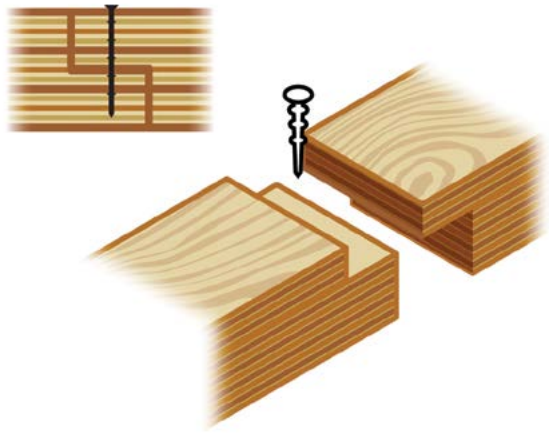


COMMON JOINTS

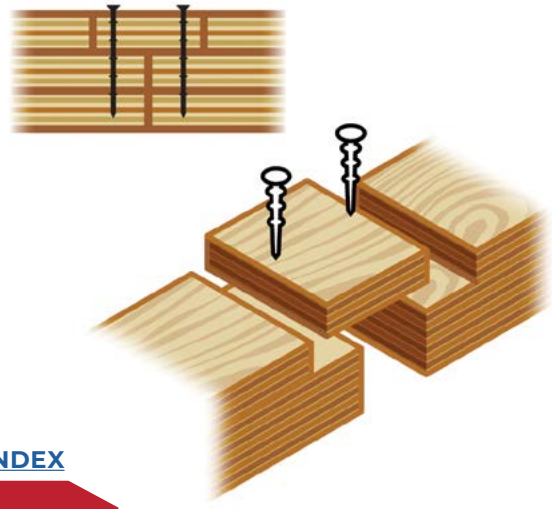
TOE-NAILED SCREWS WITH BUTT-JOINT



HALF LAP



SINGLE SURFACE SPLINE



FOR ADDITIONAL JOINT REFERENCE, SEE FRERESWOOD.COM/MTMINDEX

WOODWORKS INDEX OF MASS TIMBER CONNECTIONS

GRADES

Beam and column applications are manufactured in a narrower format than panel applications, so minor-force issues are typically not a consideration. Like our other products, density-graded veneers are utilized in proprietary combinations in lamella construction.

F16 GRADE

The lamellas of this MPL grade contain nine plies of which seven are oriented longitudinally to the lamella. This grade is ideally suited for beam and column applications. The two plies of cross-banding per lamella contribute to the overall dimensional stability of the beam and reinforce connections into the MPL.

BEAMS

Mass Ply Lams are available in traditional glulam widths in our 3, 5, 7 and 12-ply construction for on-edge orientation for beams. MPL may also be utilized in plank orientation, allowing for a wide variety of widths with depths up to 24.48 inches. Please contact our sales specialists for more specific information.

BEAM SPAN TABLES

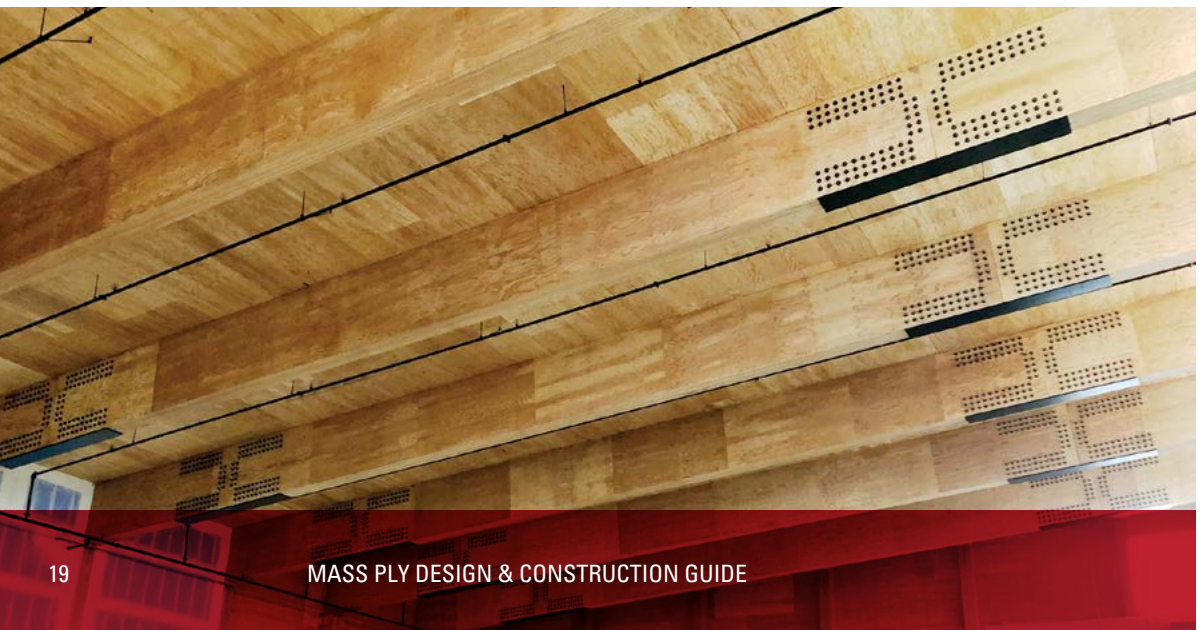
- **3 Ply N Depth**
  frereswood.com/tables/beam/3ply-N
- **5 Ply N Depth**
  frereswood.com/tables/beam/5ply-N
- **7 Ply N Depth**
  frereswood.com/tables/beam/7ply-N
- **12 Ply N Depth**
  frereswood.com/tables/beam/12ply-N

COLUMNS

Columns are available in grades and dimensions described previously.

COLUMN LOADING TABLE

- **F16 Mass Ply Column Loading Table (Axial Loads Only) in Kips**
  frereswood.com/tables/column/F16-loading



MASS PLY FAST FACTS

LESS WASTE

veneer uses more of the log by peeling on a lathe

LOW MOISTURE

veneer is dried to a 4-6% moisture content in as little as six minutes

LESS ENERGY

veneer requires less energy to produce than other building materials

LOW IMPACT

veneer uses smaller trees from thinning operations: a low-impact means of harvest

FAQS

WHAT IS MASS PLY?

Mass Ply is a patented, veneer-based engineered wood product developed by Freres. Mass Ply is a mass timber panel assembled by combining thin layers of stress-rated Douglas Fir veneer, in the long and cross direction, creating a large-format wood platform that is then prefabricated to exact dimension with a CNC machine. Mass Ply is strong, fire-resistant, and lighter per volume than traditional building materials such as concrete or steel.

WHY MASS PLY?

Mass Ply is a sustainable building product that gives superior strength and stiffness relative to other products on the market. Mass Ply allows for small increments of thickness thus saving overall cost of material while maintaining competitive price per volume. The panel is prefabricated in the factory for fast installation on the jobsite. It can also be left exposed with biophilic benefits. Also, because it is a veneer-based product, it utilizes the raw material more efficiently and lends itself to harvesting practices that are considered to be more environmentally friendly.

ARE 4' X 8' SHEETS OF PLYWOOD USED TO MAKE MASS PLY? IN WHAT THICKNESS?

The Mass Ply Panel is composed of 1" x 4' x 8' layers of Laminated Veneer Lumber (LVL), a veneer-based engineered wood product certified under ASTM D5456. The LVL layups have cross plies, which allow the mass timber panel to have strength and stability across both axes of the panel. Our higher performance layups have more long plies than cross plies to achieve greater spans. The 4' x 8' sheets are scarf-jointed together to achieve a length up to 48 ft. A width up to 11'10" is achieved by using 4' and 2' wide panels and staggering the joints as each course gets laid up to the desired thickness.

IN WHAT DIMENSIONS IS MASS PLY AVAILABLE?

Mass Ply is extremely versatile. Mass Ply is used for roof, floors, walls, beams, and columns. While it can be cut to almost any shape and size, the panel size after trim is limited to 11'10" wide by 48' long, up to 24.48" (24-ply) thick or as little as 2.04" (2-ply). Mass Ply products can be used for almost any structural wood element in a mass timber building. The CNC machine, which is typically utilized for floor and roof panels, is limited to a 12.24" panel thickness. Anything above 12.24" goes to the beam and column line where it is cut to length and width.

IN A 12" THICK MASS PLY, HOW MANY LAYERS OF VENEER ARE USED AND WHAT ARE THE THICKNESSES?

There are 108 veneer layers within a 12" deep Mass Ply. Each layer of veneer starts out at .125". There is some compression from the layup process of the 4' x 8' LVL sheets. In addition, some of the outer veneers are sanded down to ensure a good bond during the Mass Ply layup. Each one of these veneers are stress rated and can be orientated in the long and cross direction. We are continually expanding our product with different grades to optimize the panel for the application at hand.

HOW WILL MASS PLY BE USED IN CONSTRUCTION?

Freres Mass Ply can be used as a pre-fabricated mass timber floor, roof and wall panels, as well as for beams and columns to allow rapid construction on multi-story structures. Mass Ply has been used in single-family homes, industrial buildings and bridges. Mass Ply is available in thicknesses ranging from 2.04" to 12.24" in 1.02" increments. Mass Ply Lam products are available in thicknesses up to 24 inches.

HOW DO YOU STRUCTURALLY DESIGN WITH THE PANEL?

The APA Product Report, a PR-L325, has our structural values for our panels, beams and columns. Visit apawood.org to view the product report and design values. Table 1 is used for panel design, Table 2 is used for beam and columns design, where Table 3 is used for fastener design for panels, beams and columns. The design of Mass Ply Panels uses the same methods employed in the design of CLT per the NDS and PRG-320 references. Please note that we are continually adding new products, so always check for updated reports.

WHAT TESTS HAS FRERES DONE ON THE INTEGRITY OF MASS PLY?

Freres has conducted extensive product testing on Mass Ply for structural, fire, acoustics and moisture stability. The APA has performed extensive testing to certify our products under ASTM D5456 and PRG 320. This combination of certifications is unique to Mass Ply compared to CLT as we have to comply with the rigorous testing of both the CLT and LVL standard. We are also working to establish design values outside those required by those standards with partners at Oregon State University, The Tallwood Design Institute and other labs across the country. These tests include seismic loading, fastener performance, impact loading, blast resistance, ballistics, acoustics and additional fire testing.

WHAT IS CROSS LAMINATED TIMBER (CLT)?

CLT is a type of mass timber panel constructed of either machine-graded or visually graded dimensional lumber, typically consisting of odd layers of dimension lumber oriented perpendicular to one another and then glued to form structural panels.

HOW IS MASS PLY DIFFERENT FROM CLT PRODUCTS?

Mass Ply uses veneer as the primary raw material to create an LVL panel, which is then used to create a mass timber panel; whereas CLT uses dimensional lumber as the primary raw material.

Mass Ply tends to be stronger and stiffer than most grades of equivalent thickness CLT. Each veneer is electronically graded. Numerous layers of veneer effectively distribute and reduce the effect of defects such as knots. Greater flexibility in lay ups means that applications can be optimized both structurally and economically. As a result, the panels have a more predictable performance than lumber-based products.

HOW STRONG IS MASS PLY COMPARED TO CLT?

The minimum design values for Mass Ply exceeds the minimum design values of E2 CLT defined by PRG-320 in each comparable thickness in major force direction. E2 CLT is the most comparable grade of CLT in terms of engineering and species that we have to compare to Mass Ply. 5.10" F-16 Mass Ply can achieve the same spans as 6.875" 5-ply E-2 CLT.

WHY IS THIS PRODUCT NECESSARY? WHAT HOLE IN THE MARKET ARE YOU FILLING?

Mass timber panels, like CLT, are an extraordinary development that will allow the manufacture of pre-fabricated structural wood panels to construct multi-story structures rapidly. With years of experience in the veneer business, we realized we could produce a better product in this category that would open doors from a building and construction standpoint, would be better for the environment and be more cost effective than current market offerings. Mass Ply moisture content is predictably 8% +/-3%, leading to predictability, water resistance, and very little post-construction issues such as checking.

HOW ARE THE LAYERS OF PLYWOOD ADHERED TOGETHER?

The primary bond for each LVL lamella created uses phenol-formaldehyde resin in a hot press. The secondary bond for MPP/MPL is created using a melamine formaldehyde cold-press resin.

WHAT IS THE ENVIRONMENTAL IMPACT OF THE RESIN?

All resins used within Mass Ply are CARB-compliant. There is no additional formaldehyde off-gassing beyond what is normally observed in wood. For more information, please visit apawood.org, APA Technical Note: Formaldehyde and Engineered Wood Products.

CAN ARCHITECTURAL APPEARANCE GRADE VENEER BE PUT ON THE FACE OF THE PANEL? IN OTHER WORDS, WHAT ARE OPTIONS FOR FINISHING PANELS ON THE INTERIOR OF A BUILDING?

Our standard grade is visually appealing since we visually grade the veneer. It has a sanded finish and has closed knots less than 1" in diameter.

Our upgraded appearance is our HD Face, which limits the knot counts to eight or fewer per 4' x 8' sheet and the size of the knots to ½" in diameter. Freres has designed the Mass Ply production process to allow “skinning” the Mass Ply panel with any finished architectural panel for appearance characteristics. There are limitations with this option. For more information, reach out to the sales team.

HOW DOES WEATHER AFFECT THE PRODUCT?

Mass Ply is made to handle exterior exposure criteria much like plywood and other engineered wood products. It can be exposed during construction periods, but precautions must be taken to minimize exposure, and Mass Ply must be dried out before putting protective covering over it. Expansion and contraction from moisture need to be considered as well. Mass Ply is not meant to be permanently exposed to the elements. Appropriate siding products should be used in conjunction with the structural panels.

CAN THE PANELS BE PRESSED IN A WAY TO MAKE THEM CURVED?

The standard Mass Ply format is flat. We can route out a curve on the face of the panel; however, router depth limits panel thickness to 7". We do not have direct test data for this type of application.

HOW DOES MASS PLY COMPARE TO CONCRETE AND STEEL CONSTRUCTION?

Increasingly, mass timber is being used as an alternative to concrete and steel construction for mid-rise building construction. Mass timber products have a number of advantages over steel and concrete. Mass Plys are renewable, have a significantly smaller carbon footprint, have more aesthetic value and are often cost-effective because they are much faster to install.

HOW DO THE PIECES OF MASS PLY CONNECT TO ONE ANOTHER?

Many of the traditional timber joints may be used when constructing with Mass Ply. Spline joints, ship lap (half-lap) joints, and the like are very common when connecting one Mass Ply panel to another. The particular joint used will depend on the specific application.

HOW WILL YOU TRANSPORT THE FINISHED PRODUCT?

Mass Ply is transported by either rail or by truck. Rail loading facilities have been constructed at our manufacturing facility so that we may load a variety of rail cars for shipping long distances. Due to limitations with rail transportation, please contact our sales team.

DOES THE LOCAL CLIMATE WHERE MASS PLY PRODUCTS ARE USED AFFECT ITS INTEGRITY?

For example, how does Mass Ply hold up in extremely hot, humid climates versus extremely wet or very cold climates?

Mass Ply, as well as other mass timber products, are not designed to be used as exterior construction elements. Weatherproof materials should be used to protect structural products from the weather.

HOW LONG HAVE YOU BEEN WORKING ON THE DEVELOPMENT OF MASS PLY?

The idea for Mass Ply began in the summer or 2015. By 2017, the first Mass Ply facility was online.

WHAT DID YOU PATENT? WHERE DO YOU HAVE THE PATENT?

Freres patented our Mass Ply Panel engineered process. Freres' Mass Ply has earned patents in the United States, Canada, Australia and New Zealand.

ARE THERE ANY OTHER MASS PLY PRODUCTS ON THE MARKET?

No. This is a new product designed from the ground up by the Freres family. We have a variety of engineered wood products including the Mass Ply Panel, Mass Ply Lam (beams and columns) and Mass Ply Industrial (mats).

WHAT HAS BEEN YOUR BIGGEST OBSTACLE IN DEVELOPING THIS PRODUCT?

The biggest obstacle we have faced is that Freres is blazing a new trail with Mass Ply. We owe thanks to the many partners that have helped make Mass Ply a reality and success.

GLOSSARY

MASS PLY PANEL (MASS PLY)

A mass timber panel similar in application to Cross Laminated Timber that was developed, produced and patented by Freres Engineered Wood Products. Layers of Structural Composite Lumber are assembled and glued to produce a panel up to 12' wide and 48' long meeting the requirements of ANSI/APA PRG 320, and designed to be used in the construction of mid-rise to high-rise structures.

CROSS LAMINATED TIMBER (CLT)

A wood panel product made from gluing layers of solid sawn lumber together. Each board layer is oriented perpendicular to adjacent layers and glued on the wide faces of each board, usually in a symmetric way so that the outer layers have the same orientation. An odd number of layers is most common but there are configurations with even numbers, as well. Regular timber is an anisotropic material, meaning that the physical properties change depending on the direction at which the force is applied. By gluing layers of wood at perpendicular angles, the panel is able to achieve better structural rigidity in both directions.

STRUCTURAL COMPOSITE LUMBER (SCL)

An engineered wood product designed for structural use, SCL is manufactured from wood strands or veneers bonded with adhesives and created using a layering technique where the outcome is a block known as a billet. Similar to conventional sawn lumber and timber, SCL products are used for common structural applications and include laminated veneer lumber (LVL), parallel strand lumber (PSL), laminated strand lumber (LSL) and oriented strand lumber (OSL).

LAMINATED VENEER LUMBER (LVL)

A high-strength engineered wood product made from veneers bonded together under heat and pressure. It is used for permanent structural applications including beams and rafters.

COMPUTER NUMERIC CODE (CNC)

Machines are electro mechanical devices that manipulate machine shop tools using computer programming inputs. Machining is a general way to transform a piece of material like plywood and arrive at a finished product, like a wall with cutout doors and windows. CNC relies on digital instructions from a Computer Aided Manufacturing (CAM) or Computer Aided Design (CAD) file. The CNC machine interprets the design instructions into cutting instructions.

PRG 320

The ANSI/APA PRG 320 standard covers the manufacturing, qualification and quality assurance requirements for CLT.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services.

E2 CLT

This is a particular CLT layup as specified in the ANSI/APA PRG 320 standard utilizing Machine Stress Rated (MSR) Douglas Fir and Larch lumber in order to improve the performance of the panel. Mass Ply is often compared to the performance of the E2 CLT since both utilize machine graded numbers for input selection.

INTERNATIONAL BUILDING CODE (IBC)

A model building code developed by the International Code Council (ICC). It has been adopted for use as a base code standard by most jurisdictions in the United States.

PLYWOOD

A manufactured wood product; a structural material consisting of two or more layers of veneer glued and pressed together with the direction of grain altering, usually sold in sheets of four by eight feet.

APA - THE ENGINEERED WOOD ASSOCIATION

A trade organization representing manufacturers of plywood, OSB, glued laminated timber, I-Joists, Rim Board® and structural composite lumber (SCL). The Association has three main functions: 1) research to improve wood structural panel (plywood and OSB) and other engineered wood products and systems, 2) quality inspection and testing to assure the manufacture of high-quality wood structural panel and engineered wood products, and 3) promotion of engineered wood products and building systems. Commonly referred to as “APA,” and previously known as the American Plywood Association.

ENGINEERED WOOD PRODUCTS

Structural wood products manufactured by bonding together wood strands, veneers, lumber or other forms of wood fiber to produce a larger and integral composite unit with superior performance characteristics. These high-performance building components achieve predictable and reliable performance characteristics with the efficient use of natural resources.

MASS TIMBER

A product category and framing style characterized by the use of large, solid wood panels for wall, floor and roof construction.

PARALLEL STRAND LUMBER (PSL)

A composite of wood strand elements with wood fibers primarily oriented along the length of the member, where the least dimension of the wood strand elements is 0.25 inches (6.4 mm) or less and their average lengths are a minimum of 300 times the least dimension of the wood strand elements. PSL is one of several structural composite lumber (SCL) types.

LAMINATED STRAND LUMBER (LSL)

A type of engineered wood with strips of wood that once would have been considered too weak, small or misshapen to use—pressed together to transform the scrap wood into solid joists and studs. LSL lumber is most commonly shaped into framing boards; it is used for other applications.

ORIENTED STRAND LUMBER (OSL)

A composite of wood strand elements with wood fibers primarily oriented along the length of the member, where the least dimension of the wood strand elements is 0.10 inch (2.54 mm) or less and their average lengths are a minimum of 75 times and less than 150 times the least dimension of the wood strand elements. OSL is one of several structural composite lumber (SCL) types.

ORIENTED STRAND BOARD (OSB)

Also known as flakeboard, is a type of engineered wood similar to particle board, formed by adding adhesives and then compressing layers of wood strands (flakes) in specific orientations.

INTERNATIONAL CODE COUNCIL (ICC)

Evaluation service is one of a number of organizations that studies applications for new proprietary products that fall outside the scope of the model code. Evaluation reports are then issued that indicate product equivalency to specific sections of the code.

SCARF JOINT

An angled or beveled joint in panel products like plywood that splices pieces together. The length of the scarf is five to twelve times the thickness.

TONGUE AND GROOVE JOINT

A system of jointing in which the rib or tongue of one member fits exactly into the groove of another. A specially designed APA tongue-and-groove panel edge joint is particularly efficient in transferring the load across the joint. Some APA-rated STURD-I-FLOOR T&G panels measure 47-1/2 inches across the face.

VENEER

A thin sheet of wood laminated with others under heat and pressure to form plywood, or used for faces of composite panels. Also called “ply.”

VENEER GRADE

The standard grade designations of softwood veneer used in panel manufacture. Veneer grade designations for plywood are outlined is product standard PS1-09. Veneer grades for engineered wood products are based on visual characteristics and density properties.

CALIFORNIA AIR RESOURCES BOARD (CARB)

The “clean air agency” in the government of California. Established in 1967 when then-governor Ronald Reagan signed the Mulford Carrell Act, combining the Bureau of Air Sanitation and the Motor Vehicle Pollution Control Board, CARB is a department within the cabinet-level California Environmental Protection Agency.

CONTACT

OUR SALES AND ENGINEERING TEAM IS AVAILABLE TO ASSIST WITH YOUR PROJECT.

CONTACT US EARLY IN THE DESIGN PHASE, AS OUR CAPABILITIES ARE ALWAYS EVOLVING.

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