

Mass Timber Era

Many architects and engineers believe that we are now in “the beginning of the timber age” where “plyscrapers” will soon be dotting city skylines all over the world.

These tall wood buildings are made possible through the use of mass timber: a category of construction consisting of large wood-based panels for wall, floor, and roof construction.

Products in the mass timber family include:

- Cross-Laminated Timber (CLT)
- Nail-Laminated Timber (NLT)
- Glued-Laminated Timber (Glulam)
- Dowel-Laminated Timber (DLT)
- Structural Composite Lumber (SCL) including Laminated Veneer Lumber (LVL), Laminated Strand Lumber (LSL), and Parallel Strand Lumber (PSL)
- Hybrid products manufactured with a combination of materials.

CLT Testing at UMaine

Recent work at UMaine has demonstrated Maine-grown timber to be an excellent feedstock for CLT production.

QUALIFICATION OF TWO GRADES OF CLT USING MAINE LUMBER

Researchers at UMaine recently qualified two new grades of CLT using machine stress rated (MSR) grades of SPF-S lumber. The two grades being evaluated were “E21” utilizing 1650f-1.5E SPF-S MSR lumber in the longitudinal layers and “E21M1” utilizing 2100f-1.8E SPF-S MSR lumber in the longitudinal layers. Both of these grades utilize No. 3 SPF-S lumber in the transverse layers.

Four units of 2100f-1.8E SPF-S MSR 2x6 lumber from Maibec Lumber Co. (Masardis, Maine), and 7 units of PMO SPF-S 2x6 lumber from Pleasant River Lumber Co. (Moose River, Maine), were shipped to SmartLam, LLC (Columbia Falls, Montana) for conditioning and CLT manufacturing. After CLT manufacturing and specimen preparation, materials were shipped to the University of Maine’s Advanced Structures and Composites Center (ASCC) for testing in accordance with ANSI/APA PRG 320, *Standard for Performance-Rated Cross-Laminated Timber*.

The test data justified the design values for the CLT grades, with the CLT specimens passing all testing – usually by a healthy margin. The study concluded that both of the new E21 and E21M1 grades of CLT are qualified for use.

The E21M1 grade has the highest published bending properties in the longitudinal direction of any CLT grade currently listed in PRG 320. The E21 grade is comparable to “E2” grade CLT, which is manufactured with Douglas-fir, a species known for its high stiffness and strength. Introduction of these grades to those currently available in North America will make manufacturers of CLT in Maine and New England more competitive with other regions domestically and globally.



Maine lumber at the SmartLam LLC manufacturing facility in Columbia Falls, MT



7-layer E21M1 CLT being tested at UMaine

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SPF-S SPECIES GROUPING

Red spruce (*Picea rubens*)
Black spruce (*Picea nigra*)
White spruce (*Picea glauca*)
Norway spruce (*Picea abies*)
Engelmann spruce (*Picea engelmannii*)
Sitka spruce (*Picea sitchensis*)
Balsam fir (*Abies balsamia*)
Jack pine (*Pinus banksiana*)
Red pine (*Pinus resinosa*)
Lodgepole pine (*Pinus contorta*)

FUNDING AND SUPPORT

This effort was funded by USDA Agricultural Research Service project # 0204-41510-001-68S, whose objective was to encourage CLT manufacturing in Maine.

Industry supporters included Maibec lumber of Masardis, ME, Pleasant River Lumber of Moose River, ME, and Smartlam, LLC of Columbia Falls, MT.

ABOUT THE UMAINE COMPOSITES CENTER

The UMaine Advanced Structures and Composites Center helps clients take a technology from the design state to a commercially viable product. The 100,000 ft² (8,100 m²) laboratory employs over 180 personnel with expertise in multiple disciplines including large-scale and coupon-level testing, composites manufacturing and analysis, FEA and other modeling techniques, and more. The Center may be hired to jointly develop a product, or solely as a contractor to manufacture and/or test wood composite products.

For more information, visit composite.umaine.edu

MANUFACTURING AND TESTING CAPABILITIES

As an ISO 17025 accredited testing laboratory, the UMaine Advanced Structures and Composites Center is capable of conducting most wood composites testing including the CLT qualification tests required under ANSI/APA PRG 320, *Standard for Performance-Rated Cross Laminated Timber*.

BONDING QUALITY TESTING OF SPF-S LUMBER FOR CLT

Unlike nail-laminated timber and dowel laminated timber, adhesive bonds must be used in the manufacturing of CLT and Glulam. These adhesives are responsible for transferring loads and providing durable bonds during the structure's service life. Recently researchers at UMaine evaluated the bonding performance of all the SPF-S species (listed at left), as well as two other commercially viable softwood species in the northeast: white pine and eastern hemlock, when used in CLT, to the acceptance criteria included in PRG 320.



SPF-S billets Fabricated at UMaine for Bond Durability Testing

All species in the SPF-S grouping, as well as white pine and eastern hemlock, demonstrated compliance with the face-bond acceptance criteria for North America.

The conclusion of the testing was that from a bonding perspective, all species in the SPF-S grouping are acceptable lamstock for CLT production.

Mass Timber Advantages



Environmental: As a renewable and sustainable resource, mass timber reduces the use of fossil-fuel intensive materials. With a lighter carbon footprint, roughly half the weight of mass timber is carbon removed from the atmosphere and stored in-use.

Prefabrication & Construction Efficiency: Mass timber construction is faster, leading to less construction traffic, and requires fewer workers than similarly-sized concrete construction projects.



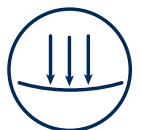
Seismic Performance: The fact that mass timber weighs less than other materials offers some structural advantages such as smaller foundations and lower forces for seismic resistance.

Fire Performance: The natural charring action of large wood members allows mass timber to maintain their structural integrity over a significant time during a fire.



Natural Insulator: Timber is a naturally insulating material that creates a barrier between hot and cold. CLT construction provides additional thermal benefits due to manufacturing processes which minimize air leakage.

Excellent Strength to Weight Ratio: Engineered timber is lighter in weight than steel or concrete, with a strength to weight ratio approximately 20% higher than steel and 4 to 5 times that of non-reinforced concrete.



Biophilia: Numerous studies have shown that being surrounded by natural materials (like mass timber) at home, work or school has positive effects on our health and well-being.

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