Market Discussion,
International Tropical Timber Council 2023
14th Nov. 2023

Happiness Grows from Trees
SUMITOMO FORESTRY

Mass Timber in the Building Industry

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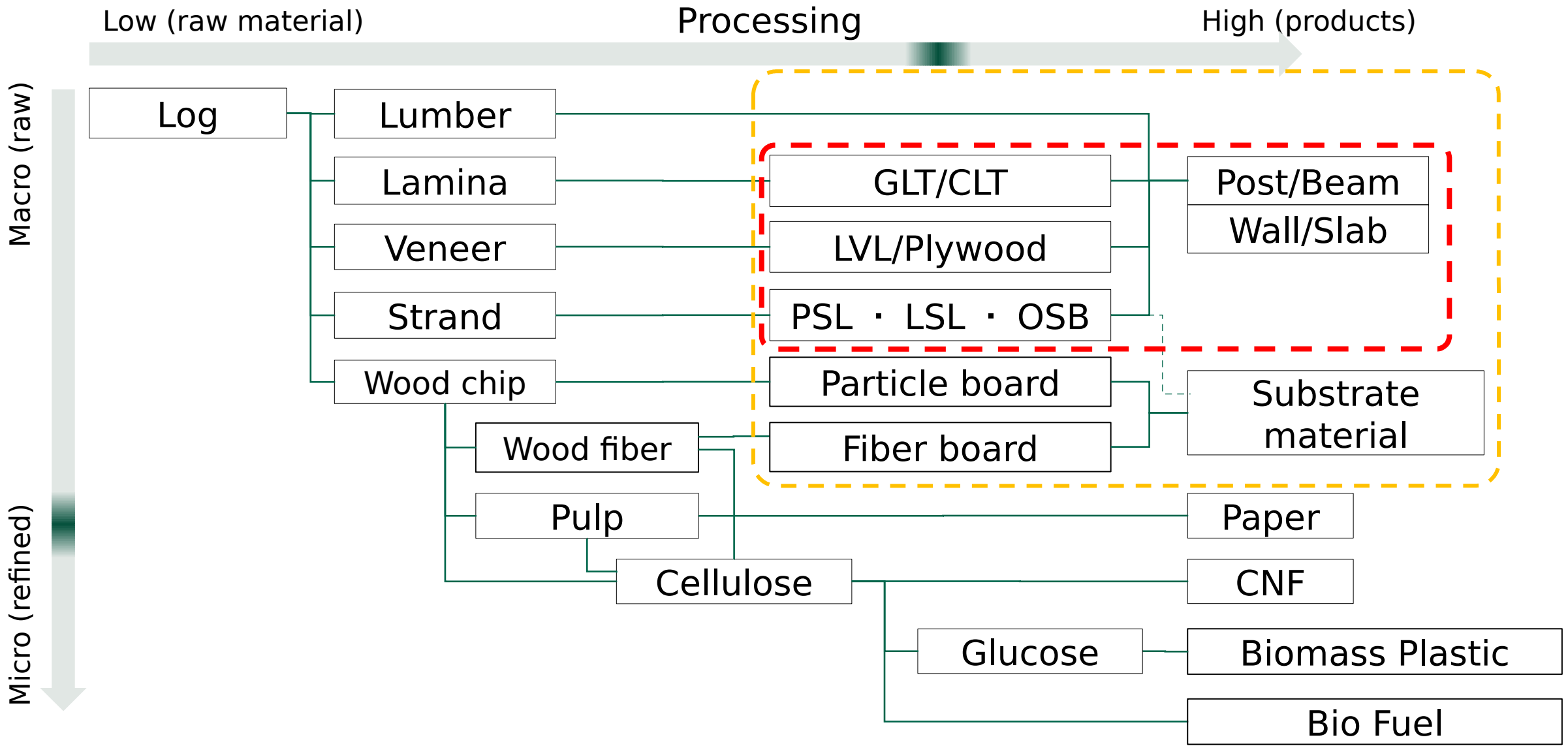
Common Wood Products



Mass Timber

A category of wood products made by fastening or bonding smaller wood components with nails, dowels or adhesives, and mainly used for structural members.

- Safe, Proven Performance
  - In the event of a fire, mass timber products char on the outside, forming a protective layer while retaining strength.
  - Mass timber buildings can achieve sufficient stiffness, strength, and ductility to resist strong winds and earthquakes.

- Lightweight Low Embodied Carbon Material
  - Mass timber products have a lighter environmental footprint than energy-intensive materials.
  - Wood products are 50% carbon by dry weight, meaning mass timber buildings can store carbon well into the future.

Lighter loads reduce transportation-related emissions, and can decrease overall foundation costs.

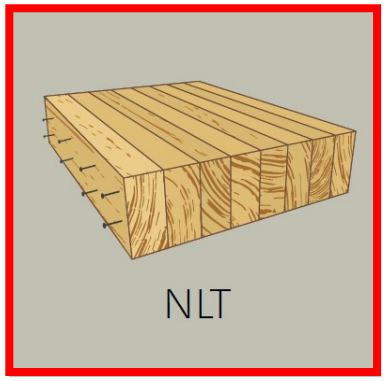
- Efficient, Cost-Saving Construction
  - Mass timber construction is faster than other structural assemblies, and speed correlates to savings and revenue.
  - Mass timber elements can be assembled by fewer workers, and lend themselves to tight, difficult to reach project sites.

- Thermal and Health Benefits
  - Mass timber products can contribute to improved occupant comfort.
  - They have lower thermal conductivity compared to concrete, steel-frame, and masonry construction.

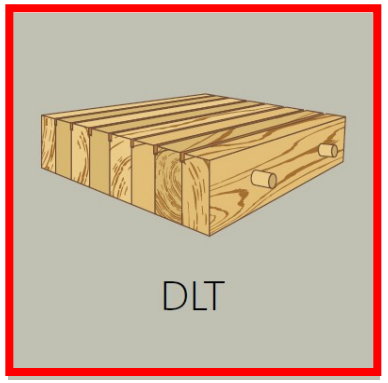
Extract of Mass Timber Design Manual vol. 2 published by WoodWorks and Think Wood

Variety of Mass Timber

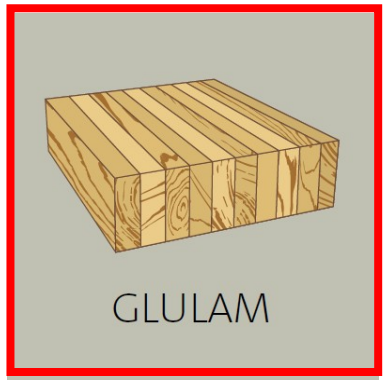
Nail-Laminated Timber (NLT)



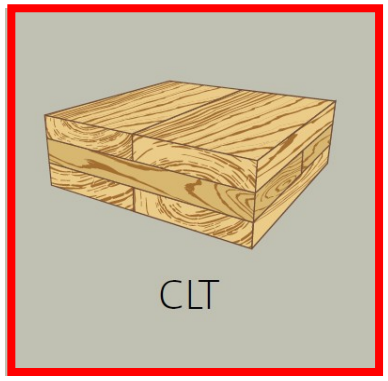
Dowel-Laminated Timber (DLT)



Glue-Laminated Timber (GLT)



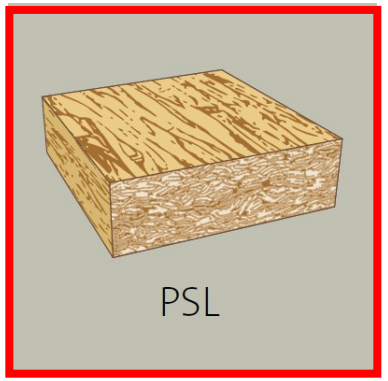
Cross-Laminated Timber (CLT)



Structural Composite Lumber (SCL)

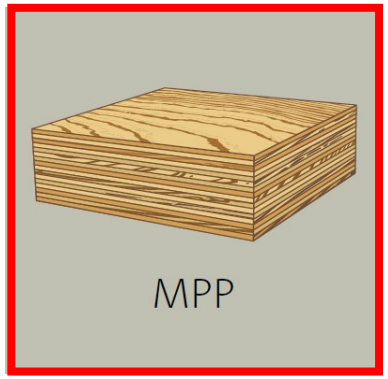
Laminated Veneer Lumber (LVL)

Parallel Strand Lumber (PSL)



Laminated Strand Lumber (LSL),
Oriented Strand Lumber (OSL)

Mass Plywood Panel (MPP)



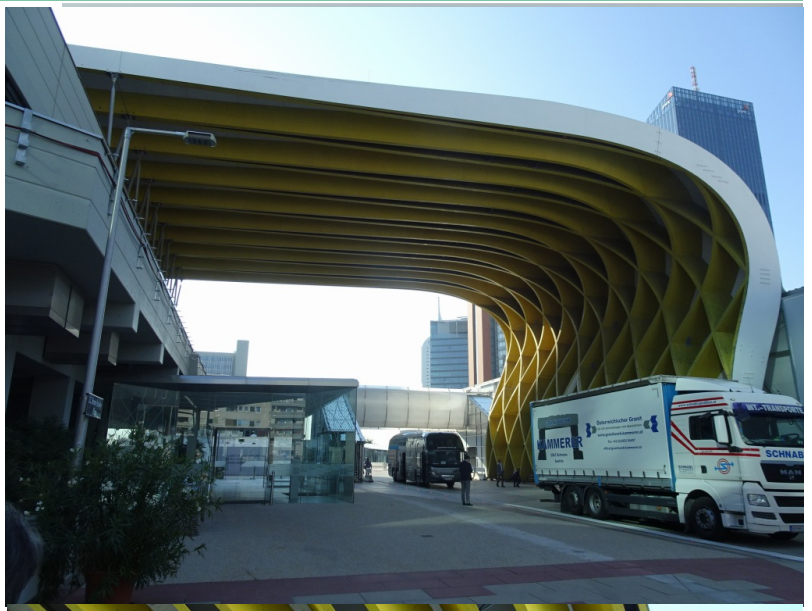
Images: WHAT IS MASS TIMBER? naturally ： wood by Forestry Innovation Investment

Variety of Mass Timber

		components	binder	grain/fiber direction	applications				
					post	beam	wall	slab	feature
NLT		Lamina (Dimension lumber)	Nail or Screw	parallel	△	△	◎	◎	Can be combined on site
DLT		Lamina (Dimension lumber)	Dowel	parallel	△	△	◎	◎	Only wood
GLT		Lamina (Dimension lumber)	Glue	parallel	◎	◎	△	△	Most widely used
CLT		Lamina (Dimension lumber)	Glue	cross	×	△	◎	◎	Widely used
	LVL	Veneer	Glue	parallel	◎	◎	○	○	Widely used
SCL	PSL	Strand (around 2.5m-long)	Glue	parallel	◎	◎	×	×	Parallam only
	LSL	Strand (300-400mm-long)	Glue	parallel	○	○	×	×	Use for stud
	OSL	Strand (200mm-long or less)	Glue	oriented	△	△	×	×	Use for stud
MPP		Veneer (Plywood)	Glue	cross	△	×	◎	◎	

Glue-Laminated Timber (GLT, Glulam)

- One of the oldest and widely used mass timber products.
- Composed of individual wood laminations (dimension lumber), selected and positioned based on their performance characteristics, and then bonded on together with durable, moisture-resistant adhesives.
- The grain of all laminae runs parallel with the length of the members.
- Able to arrange elements that are straight, curved, arched, and tapered.
- For single family houses, Max length is 6m, max width is around 350mm. But for multi-stories or large scale constructions, it can be much larger scale in both length and width.
- Using for quite broad applications including columns and beams.
- Beyond buildings, able to serve as the primary material for major load-bearing structures such as bridges, canopies, and pavilions. (Straight or curved) Particularly well suited to long-spanning structures and custom curvilinear shapes.
- Mostly made of softwood, but sometimes made of hardwood or combination of softwood and hardwood.



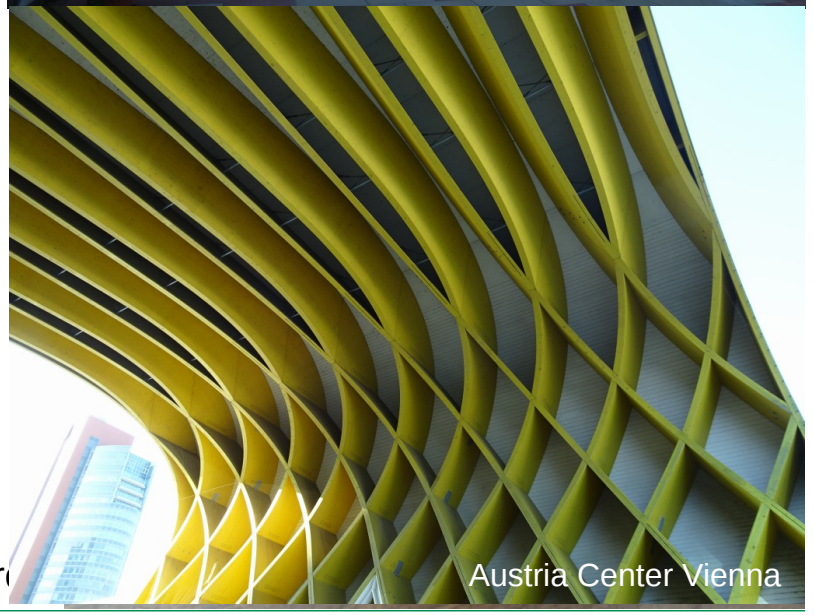


photo: GLT made of Japanese lar

Austria Center Vienna

Cross-Laminated Timber (CLT)

- Production started in Austria back in 1990s and widely spread in Europe in 2010s.
- Several (usually 3, 5 or 7) layered lumber boards (lamina) stacked and glued crosswise at 90-degree angles.
- Lamina thickness varies between 15-50mm, so CLT thickness varies between 45-300mm.
- Max length is 12-15m, max width is around 3m which depends on transportation restrictions.
- Common applications include floors, walls and roofs.
- Excellent structural rigidity in both directions and dimensionally stable because of alternating grains.
- Able to resist high racking and compressive forces even using low density wood such as spruce or Japanese cedar, therefore especially cost-effective for multistory and long-span diaphragm applications.
- Japanese government strongly promote to use CLT made of Japanese cedar, because Japan has a big stock of Japanese cedar and they need to regenerate and more a lot of people suffer from hay fever of cedar pollen.

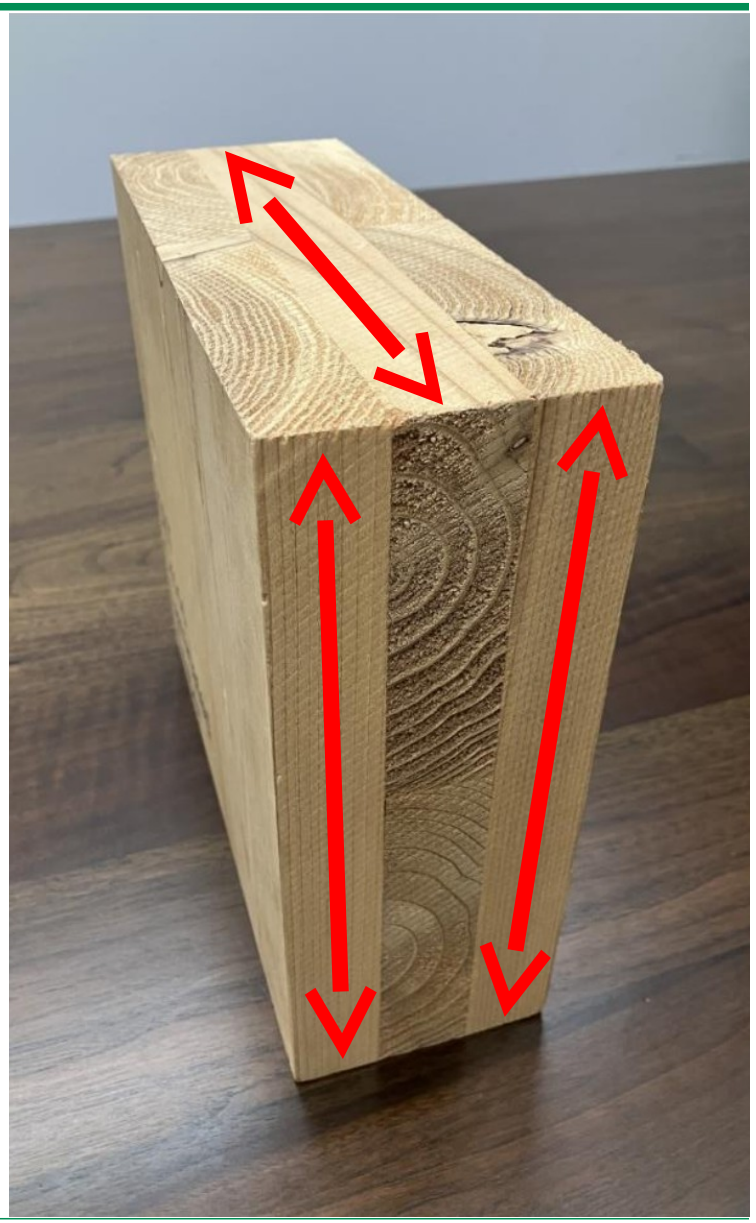


photo: CLT made of Japanese cedar

Laminated Veneer Lumber (LVL)

- Relatively recent innovated products. Lumber in American English is same term as timber, so it's commonly used in North America. Plywood is very similar production but LVL was used about 10 years later than plywood.
- Multiple layers of thin wood (veneer) assembled with adhesives. Grain directions of veneer are all parallel.
- Using rotary cutting thin veneer, you can use small diameter logs into very large panels such as 12m-long and 3m wide which depends on transportation restrictions. Max thickness is around 30 -90mm in a line manufacturing, so it has to bond side by side secondarily if you need thicker ones.
- Use as beams, trusses, planks and rafters.
- Relatively high density and stiff members and also dimensionally stable, even if using for thin rafters or studs.
- Very strong to the compressive forces in grain direction, so good for combination with post-tensioning method.

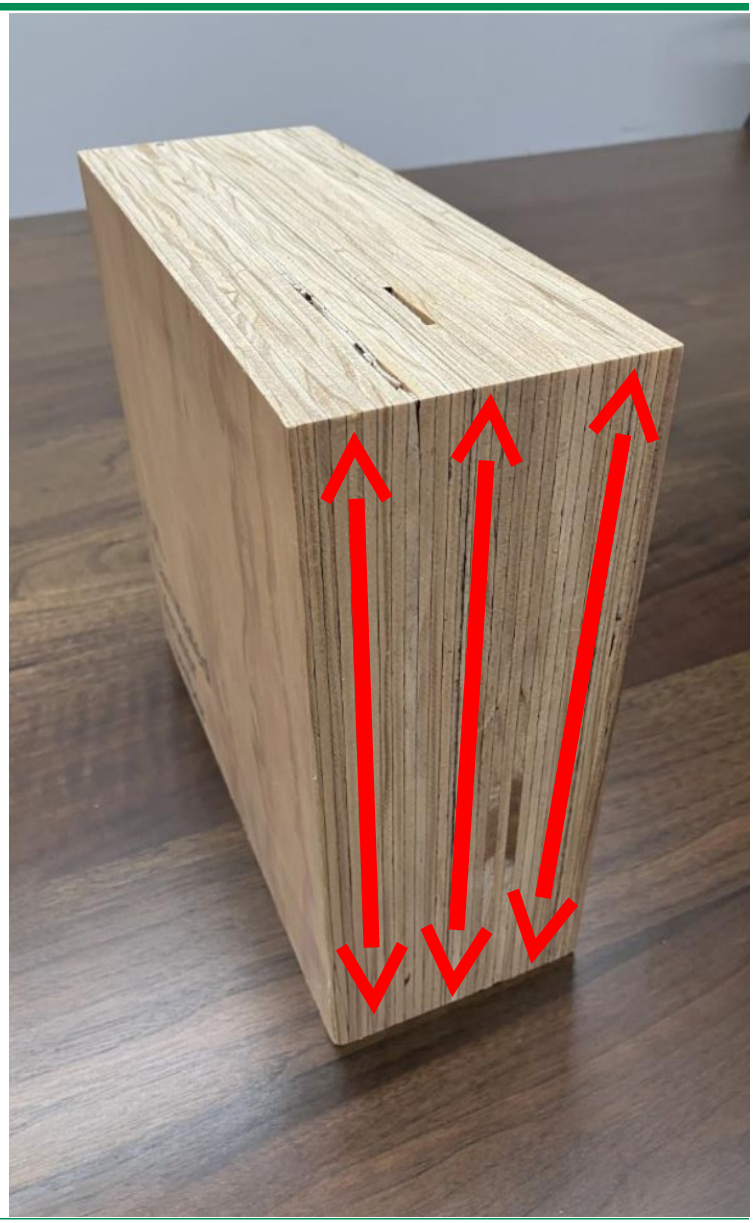
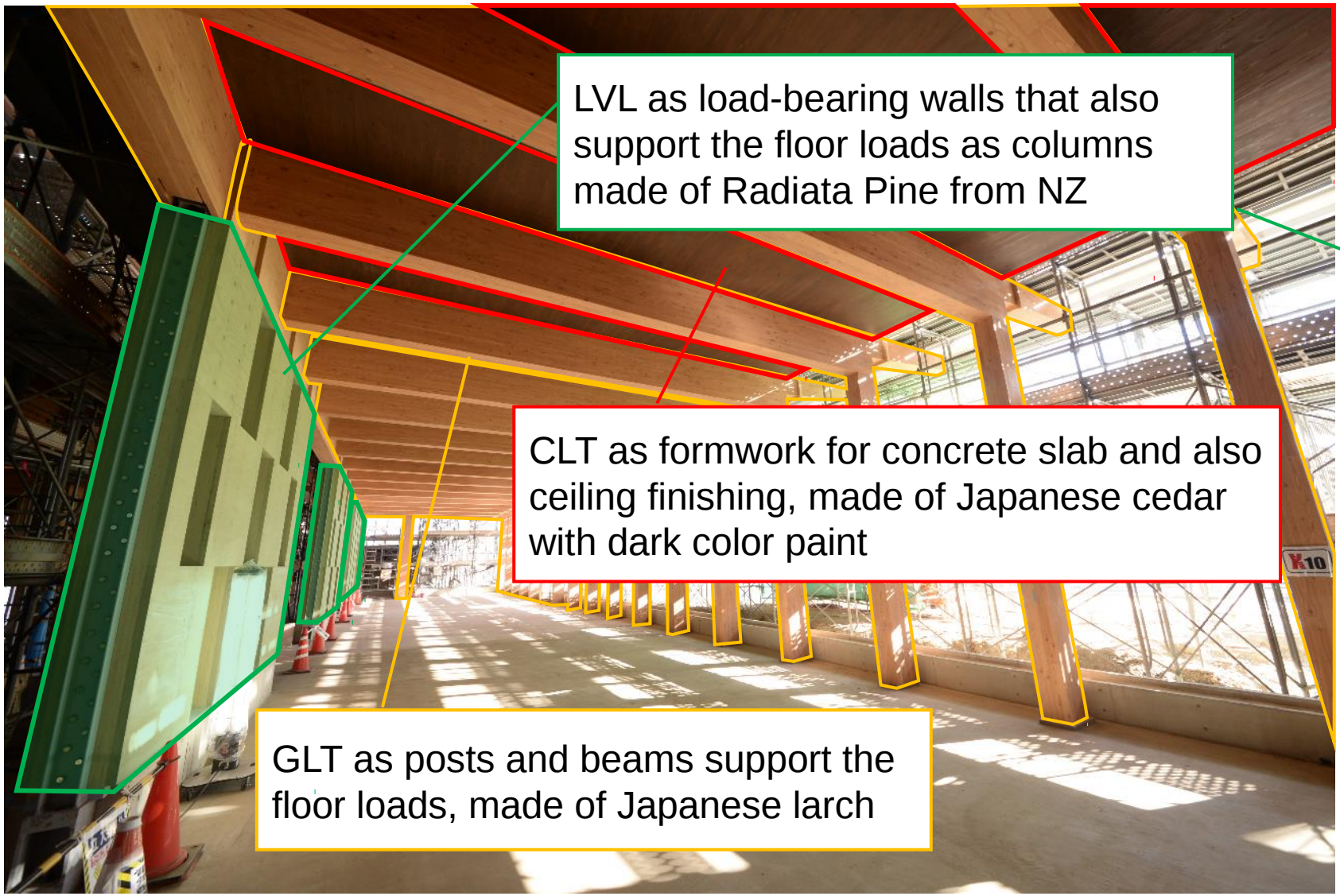


photo: LVL made of Radiata Pine from NZ

An example of Mass timber in a building: New Research Building, Japan

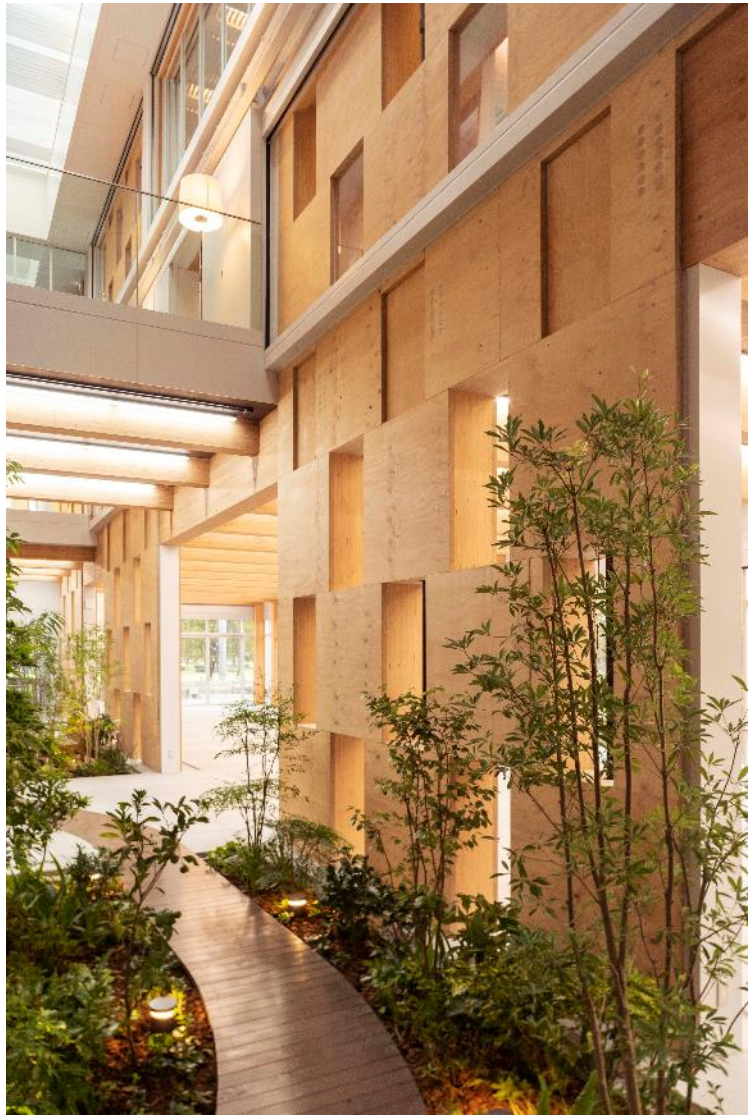
Name	New Research Building, Sumitomo Forestry Tsukuba Research Institute
Location	Tsukuba Ibaraki, Japan
Overview	3 stories above ground
Structure	Mass Timber with post-tension seismic technology
Floor area	2,532.67 ㎡
Completion	Sep. 2019

An example of Mass timber in a building: Tsukuba Research Institute New Research Building



An example of Mass timber in a building: Tsukuba Research Institute New Research Building

An example of Mass timber in a building: Tsukuba Research Institute New Research Building



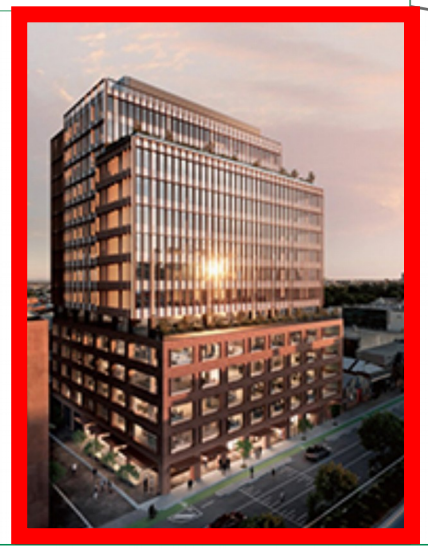
Current Mass timber projects of Sumitomo Forestry

UK Mass-timber Office
Paradise Project (7,445m²)

US Wooden Town house Apartment
398 houses / 4 projects in 2021

US Mass-timber Office
Garren Project
(14,556m2)

AU Mass-timber Office
36 Wellington Project (28,865m²)



US Mass-timber Office
Southstone Yards Project
(22,548m2)

US Light frame Apartment
4,379 houses / 13 projects in 2021

Toward the Creation of a Decarbonized Society Through Net Zero Carbon Buildings

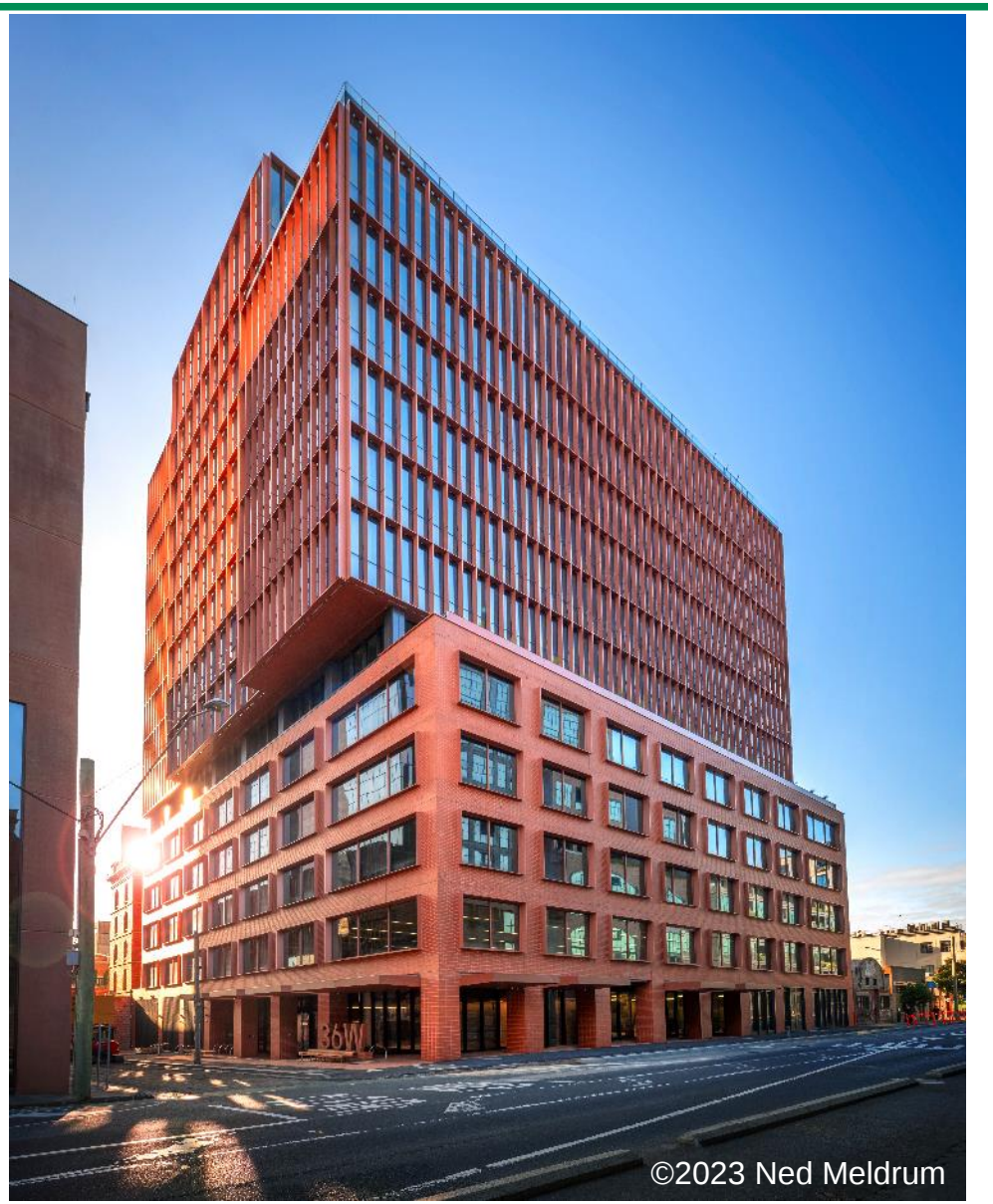
A 15-story wooden office building developed in Melbourne, Australia

About 4,000m3 of wood used for the structure frame,
fixing carbon in place about 3,000t-CO2

⇒Equal to a reduction of approximately 40% of CO2 emissions (embodied carbon) during construction processes compared to entire RC structure, if including the above biogenic carbon storage.

+ creating / saving energy
+ using renewable energy ⇒ achieving the 2030 target by WGBC 7 years ahead!!

Name	36 Wellington Project
Location	Melbourne Victoria, Australia
Overview	2 stories below ground and 15 stories above ground
Structure	1-5th floors: RC frame, 6-15th floors: Wooden frame with RC core
Development floor area	28,865 ㎡
Start	Dec. 2021
Completion	Oct. 2023



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Mass timber project: 36 Wellington Project

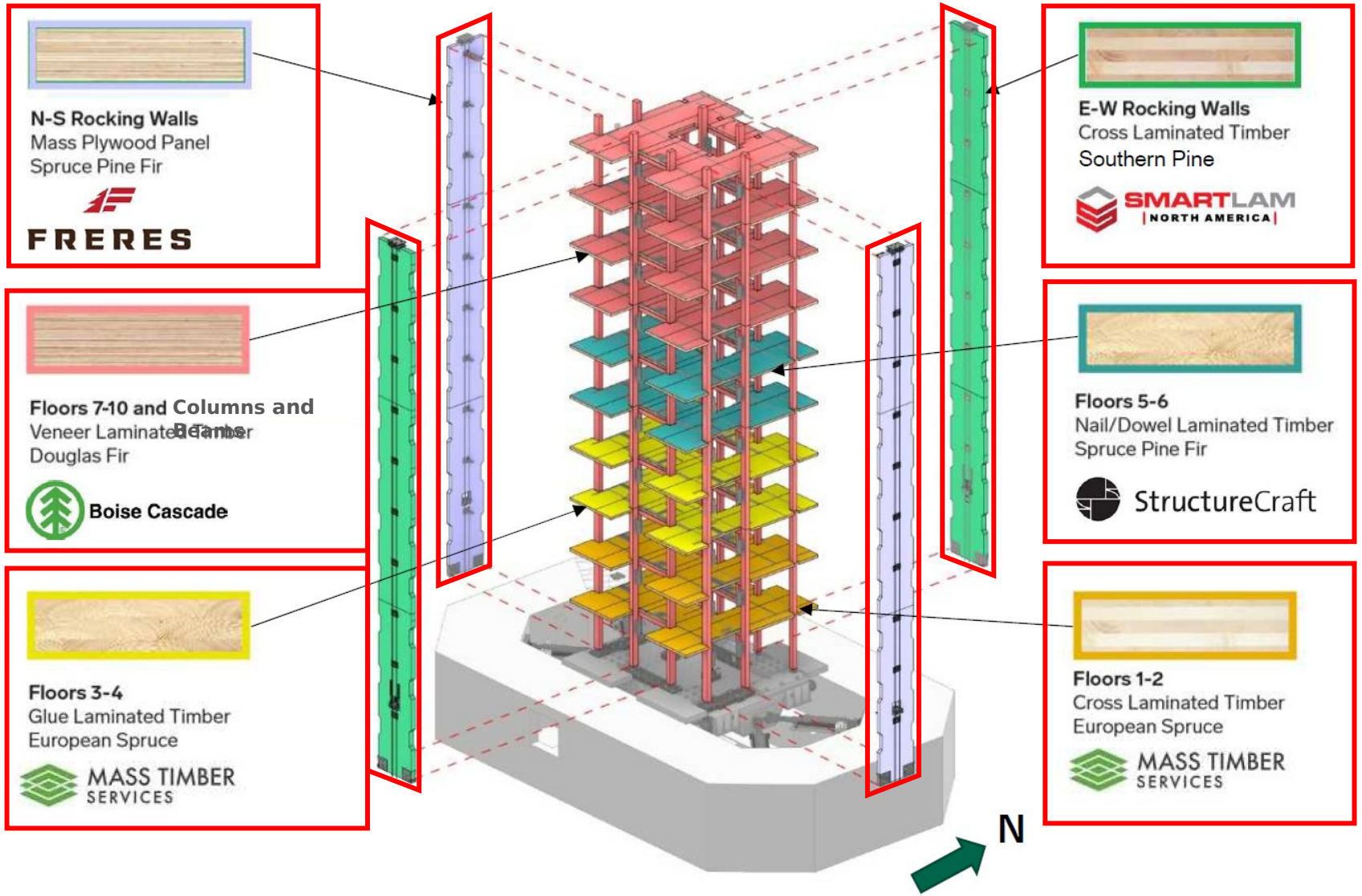
Mass timber project: 36 Wellington Project

NHERI TallWood Project: Shake Table Testing of a Full-scale 10-story Mass-Timber Building in US

- Colorado School of Mines led the planning for the NHERI TallWood Project with granted by National Science Foundation.
- This project is aimed to validate the resilient performance of mass timber structure with post-tensioned seismic technology.
- Full-scale 10 stories mass timber building had built as a test building on a large outside shake table facility managed by Natural Hazard Engineering Research Infrastructure (NHERI) at University of California San Diego (UCSD).
- Phase 1: conducted by US team from Apr. to May, 2023
- Phase 2: conducted by Sumitomo Forestry from Jul. to Aug., 2023 with cooperation of US team and Kyoto Univ. The test building was renovated to reinforce to meet Japanese standards.

NHERI TallWood Project: Shake Table Testing of a Full-scale 10-story Mass-Timber Building in US

- Various Mass timber members applied to the test building.
- CLT and MPP: post-tensioned load bearing walls .
- LVL: columns and beams and also floors.
- GLT, CLT, NLT and DLT: floors.



Credit: Lever architecture & Dr. Shiling Pei

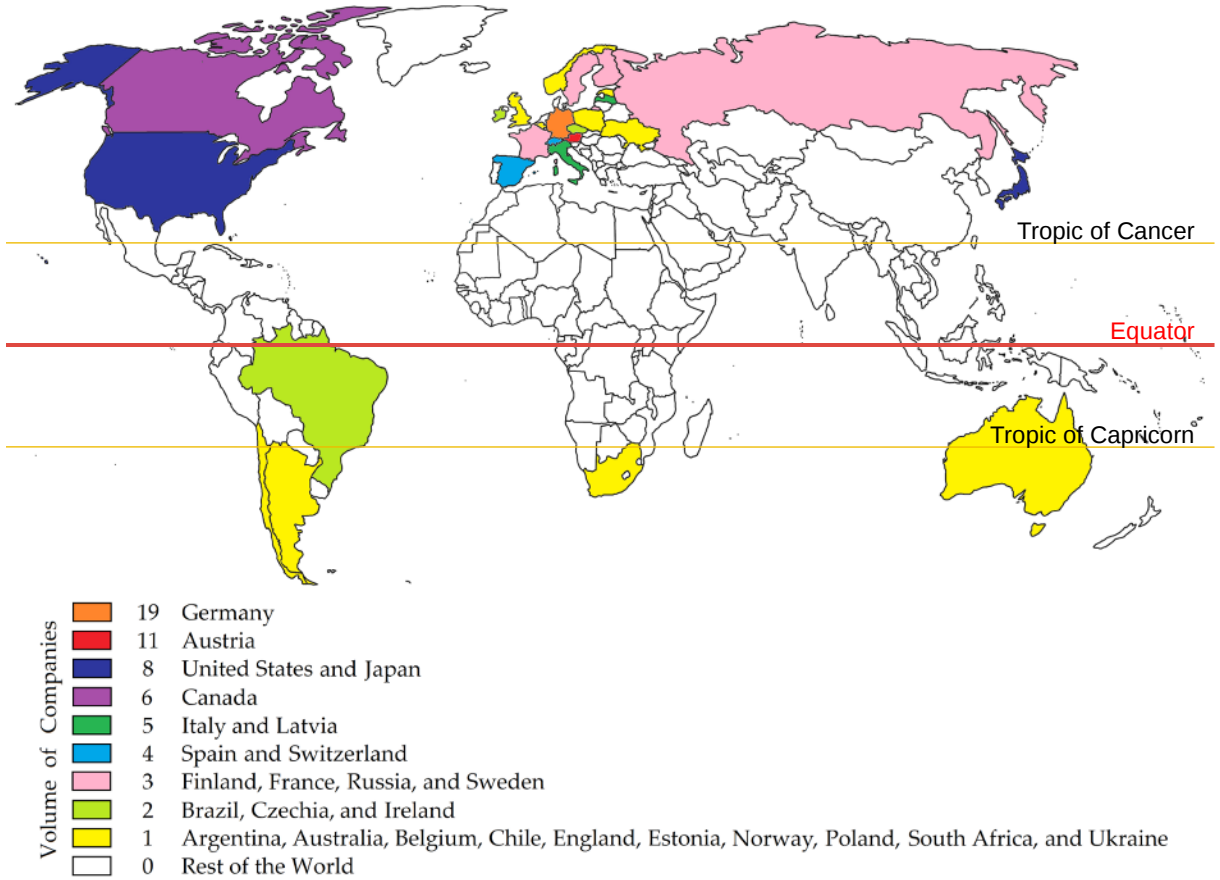
Global CLT Market

- The global market for CLT estimated at US$ 1.2 Billion in the year 2022, while GLT estimated at US$ 7.6 Billion.
- The US Market for CLT is estimated at US$ 0.21 Billion.

(Cross Laminated Timber (CLT) published by Global Industry Analysts, Inc., Aug. 2021)
(Glue Laminated Timber (GLT) published by Global Industry Analysts, Inc., Mar. 2023)

- The global production of mass timber panels (primarily CLT) in 2019 was estimated at 1.44 million m3 (valued at US$773 million).
- Global CLT production capacity was estimated at 2.8 million m3 in 2020, expanding rapidly and projected to reach 4 million m3 by 2025.

(Forest Products Annual Market Review 2019-2020, published by UNECE and FAO, Nov. 2020)



Images: Sustainability **2023**, 15, 7827. https://doi.org/10.3390/su15107827, MDPI
No manufacturers in China in this figure, but there are several manufacturers at least.

figure: Number of active CLT manufacturers around the world in 2023

Challenges

- Reliable and sustainable supply
- Certain supply of specific strength grade
- Processing logs into lamina or strand
- Drying methods of lamina or strand
- Combination with adhesive / binder

Example of countermeasure

- Plantation of specific species to use for mass timber
- Grading technology corresponding to mixed multi species
- Efficient processing and drying methods
- Reasonable binding and pressing methods

It’s a time for many discussions and trials!

Mass timber construction is a ‘big wave’ to change cities into forests.

By increasing mass timber buildings in cities,

they become carbon stores just like forests.

Mass timber in the building industry has very important role

towards the realization of a decarbonized society.

End