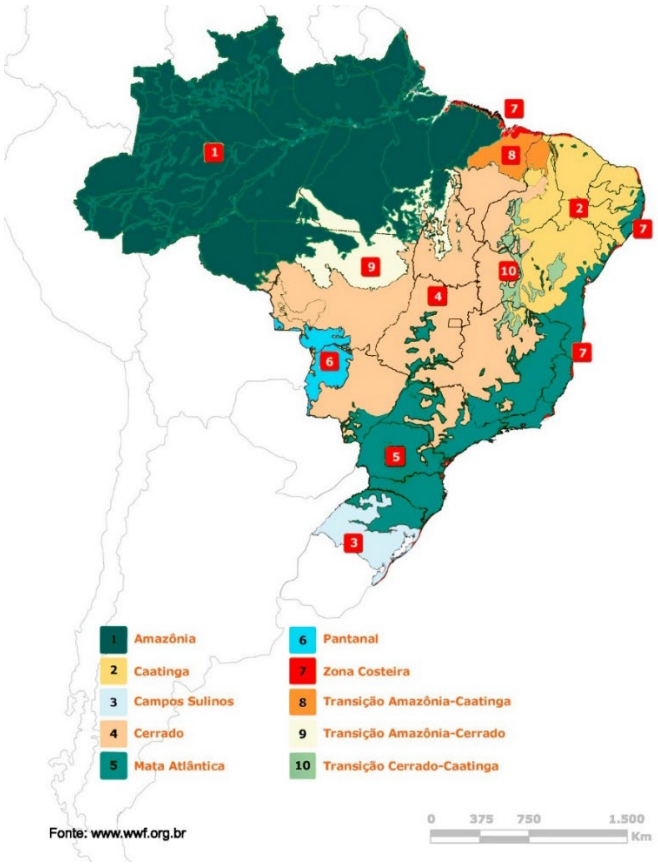
The Brazilian Forests and The Mass Timber Market

Brazilian Biomes

Brazil has eight types of biomes in its territory, namely the Amazon, Caatinga, Campos do Sul (or Pampas), Cerrado, Atlantic Forest, Pantanal, Coastal Zones and Transition Zones.

The biome located in the northern region of the country, known as the Amazon, has one of the most important and recognized forest areas in the world. The Amazon Forest extends beyond the Brazilian territory, passing through Peru, Bolivia, Ecuador, Colombia, and Venezuela.

The more than 500,000,000 hectares of forest area in the Amazon cover 30% of the species of fauna and flora in the world, in addition to being responsible for 30% of the trees and 20% of the freshwater existing on the planet.



BRAZILIAN BIOMES

Additionally, the Amazon region is the main source of wood from native forests in the country, especially in the states of Pará, Mato Grosso and Rondônia.

Despite having a vast biological richness, the Amazon is an extremely fragile ecosystem. The forest lives on its organic material in a humid environment with abundant rainfall. Therefore,

small changes in the forest can damage the entire biome, affecting not only countries that have areas of tropical forest, but also the global ecosystem.

Logging in the Amazon between August 2019 and July 2020 was three times larger than the area of the city with the highest GDP in Brazil, São Paulo – 464 thousand hectares. In this data, there is legal logging, with authorization for forest management, and a lot of mixed illegality.

The consolidated value of the area deforested by clear cut between the period of August 1, 2019 and July 31, 2020 was 10,851 km². This value represented an increase of 7.13% compared to the deforestation rate calculated by PRODES in 2019, which was 10,129 km2.

In addition, nearly 190,000 km² of the forest were consumed by fires between 2011 and 2019. Man-made fires may have affected 95.6% of known species of plants and vertebrate animals in the Amazon. Fires affected the habitat of 85% of endangered plant and animal species in the region and the non-threatened had 64% of their habitat impacted by the fire.

The importance of forestry for the protection of Brazilian biomes, for the restoration of degraded lands and for making the civil construction market more sustainable

The potential of Brazilian lands that can be used for planting forests includes not only specific plantation areas but also degraded territories that can be restored through techniques linked to forestry.

Forestry is the science that seeks, through techniques for preservation, maintenance, and rational production of forests, to meet market demands for forest products and, at the same time, preserve the environment.

Data from the Brazilian Agricultural Research Agency (EMBRAPA) indicate that there are around 130 million hectares of degraded land in the country that require intensive care to return to production.

Amata produces sustainable pine forests in areas in Paraná located in degraded regions of the Atlantic Forest, the most devastated biome in the country. It is estimated that only 12% of the original vegetation has been retained.

For each hectare planted, one native hectare is conserved. This combination makes it possible to improve the balance of local biodiversity, contributing to the formation of ecological corridors, increasing soil conservation, improving the nutrient cycle, in addition to being fundamental in the formation and increase of carbon stocks.

In this way, planted forests not only prevent the deforestation of native forests but also help to protect them.

Amata's area of 26 thousand hectares of forests has varied biodiversity, with 50% of the area destined for Legal Reserves and Permanent Preservation and 50% of the area dedicated to the production of pine forests.

The cultivation and use of wood from planted forests reduce local pressure for the extraction and use of native trees, indirectly contributing to the preservation of other Brazilian biomes, such as the Amazon.

The harvest of planted pine trees takes place in a sixteen-year cycle, which represents one of the highest forest productivities in the world. The feasibility of short cycles is directly linked to the Brazilian tropical climate.

The socio-environmental studies carried out by Amata over the past few years have allowed the development of activities to improve forest management, ensuring practices for the conservation of soil, fauna, and flora.

Respecting the forest means using natural resources consciously, seeking ways to ensure that the vegetation maintains its capacity to renew itself. These practices seek to restore the balance between human beings and nature, consolidating new markets capable of taking advantage of and valuing sustainable raw materials in harmony with the environment.

Mass Timber used in civil construction

The process of cutting and sawing the trees produces pieces of sawn wood with limited dimensions depending on the diameter and length of the logs from which they were extracted. However, structural engineering projects demand dimensions greater than those provided by the lumber market.

Due to this need, the smaller pieces of wood undergo an industrialization process, transforming them into mass timber products.

Mass timber products are manufactured from the union of wood lamellas using pressure bonding or wooden connectors, resulting in large structural elements. This allows the use of wooden structures in more complex constructions, with structural elements capable of overcoming large spans and loads.

The vast majority of mass timber products have been used in civil construction for over a century.

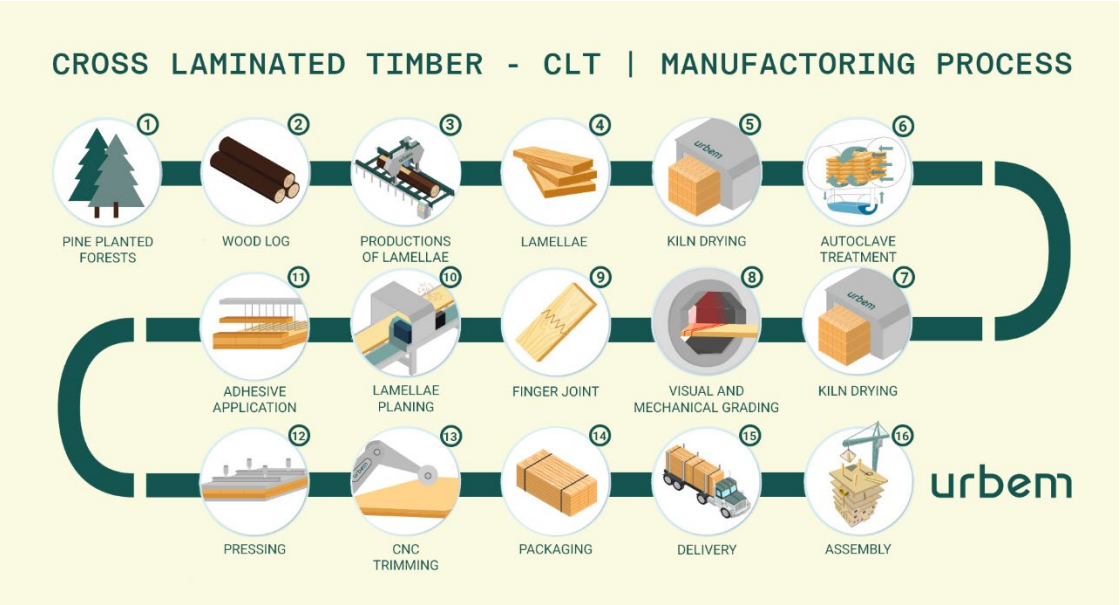
The process of manufacturing mass timber products from lamellae starts with the sawing of pine logs from reforested areas into boards with thicknesses ranging from 10 to 50 mm.

Subsequently, the lamellas go through the drying process, which guarantees a wood moisture content between 6% and 15%. After the drying step, the boards are visually and mechanically classified according to the strength class tables presented in international standards.

Later, the edges of the lamellae are joined together in the direction of the longitudinal in a process known as finger-joint union. Finally, the boards with elongated lengths are planed, correcting any imperfections between dimensions of the adjacent lamellae.

After the process described above, the lamellae are joined using structural adhesives, resulting in the following mass timber products:

- Glued Laminated Timber (GLT), produced by gluing under pressure wooden lamellae oriented in the same direction, originating linear structural elements used as beams and columns.
- Cross Laminated Timber (CLT), manufactured by gluing under pressure lamellae in layers orthogonal to each other, originating panels used as slabs or walls.



CLT MANUFACTORING PROCESS

The Urbem plant, which is scheduled to start operating in the second half of 2022, will have a production capacity of 50,000 m³ of CLT and 50,000 m³ of GLT. From these volumes, it will be possible to build more than 500,000 m² of sustainable buildings in Brazil and around the world.

Mass timber constructions around the world

Wooden buildings have been widely used by mankind since prehistoric times. European countries such as Austria, Germany and Norway maintained the tradition in this type of construction, even after the emergence of other structural materials, such as steel and reinforced concrete. In North America, Canada and the United States build the majority of single-family homes using wooden structures.

In the early 1990s, European timber companies and universities in Austria and Germany developed together the mass timber product known as Cross Laminated Timber (CLT).

The panels have at least three adjacent layers and are usually produced with a maximum width of 2.9 m by 16.0 m in length, with a total thickness ranging between 5.7 and 35.0 cm

CLT has characteristics that differentiate it from other prefabricated panels for structural use. Among them, the high relation between resistant capacity and self-weight, the high thermal

and acoustic performance, the low self-weight, in addition to being a product manufactured from renewable raw material.

Such characteristics made it possible, from the beginning of the 2000s, the construction of tall buildings using CLT structures. One of the first constructions is the Murray Grove nine-story tower, completed in 2008, in London. In 2012, the ten-story building known as Forté, erected in the city of Melbourne, Australia, was built.

FORTE, MELBOURNE, AUSTRALIA

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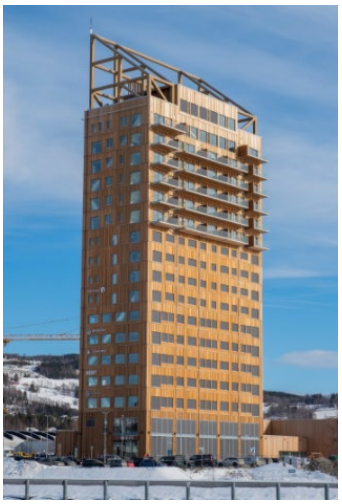
In 2017, the construction of the first building with more than 60 m in height was completed. The eighteen-story tower, known as Brock Commons, was erected in the city of Vancouver, Canada. For two years, it was the tallest mass timber building in the world, being surpassed in 2019 by the Norwegian Mjøstårnet tower, with an approximate height of 85 m.

BROCK COMMONS, VANCOURVER, CANADA



Mjøstårnet TOWER, NORWAY

Led by large constructions, there has been an exponential growth in the use of CLT in recent decades. It is estimated that in 2018, European companies have produced a volume of between 600,000 and 1 million cubic meters of panels.

Among the advantages of using mass timber products in civil construction, the following stand out:

1. Reduction of greenhouse gas emissions and carbon capture, thus combating global warming.

2. Reduction of work delivery times, since the assembly of wooden structures is faster than the assembly of other construction systems.

3. Reduction of assembly costs due to the smaller number of assemblers.

4. Reduction of waste (about 30% of the material that reaches the construction site is wasted in conventional construction methods).

The trend towards the use of mass timber structures observed in Europe and North America can also be noticed in South America. In Brazil, one of the first high-rise buildings using CLT panels and GLT columns and beams was completed in 2020.

The building is located on Avenida Faria Lima, a region known for being one of the main financial and business centers in the city of São Paulo. The property will be used as a factory for the production of chocolates and a showroom for the brand's products.

FAÇADE OF FIRST MASS TIMBER BUILDING IN BRAZIL

The architecture conceived the building from the overlapping of cube-shaped volumes, removing some of these elements as the building gains height. This makes the manufacturing area have a triple ceiling height, creating a differentiated view for the store's customers.

Located on a land of 800 m², the building has a total area of approximately 2200 m², distributed over 5 floors, including a basement and a tower 10 meters high above the ground floor, divided into 3 floors.

The basement will be used as parking for vehicles, changing rooms and water reservoirs. On the ground floor is the machinery for the production of chocolates, the stocks of raw materials and a store for the sale and display of the products. The structure of these two floors was designed in reinforced concrete.

The 3 floors above ground level are composed of 1000m² of CLT slabs supported by GLT columns and beams, which transfer the vertical loads to the reinforced concrete columns on the ground floor. The typical span of the structure is approximately 5.5 m, except for two composed beams that exceed a span of 11 m in length.

The first floor has manufacturing areas, an area for packaging, as well as a factory exhibition hall. On the second floor are the offices, meeting rooms and stocks for storage of already packaged products. The third floor will be used as a technical area, with air conditioning equipment covered by wooden pergolas.

The stability of the tower is guaranteed by the adoption of two reinforced concrete cores, where the stairs and elevators are located.

INTERIOR OF THE FIRST MASS TIMBER BUILDING IN BRAZIL

The CLT supplier for this project was the Austrian company KLH, which uses wood from *Picea abies* (Spruce) in almost all of its production, in addition to the species, *Pseudotsuga menziesii* (Douglas fir) and *Pinus sylvestris* (Pinus).

The panels of this project were manufactured in industrial visible quality (IVQ), with 5 layers thick, 4 layers of Pinus sp. treated and 1 outer layer of untreated Spruce, both species planted in Austria.

The wood of Pinus sp. was treated in an autoclave in Europe with the water-soluble product based on copper hydroxide and polymeric betaine (DPAB), classified in use class 4 (according to EN335-1), with retention of 5kg/m³ of the active ingredient, that allows the condition of outdoor use of the building in contact with the soil or freshwater. This treatment protects the wood against rotting fungi (white, brown, and soft rot), wood borers and termites.

For bonding the panels, a formaldehyde-free polyurethane (PUR) structural adhesive was used, approved by the European standard CEN - EN15425:2017 Adhesives - One component polyurethane (PUR) for load-bearing timber structures - Classification and performance requirements.

The GLT beams and columns were produced by a Brazilian company, using Pinus sp. treated with CCA. The formaldehyde-free polyurethane (PUR) structural adhesive

approved by the European standard CEN - EN15425:2017 was used for gluing the lamellae.

The floors throughout the building are made of CLT covered with an elastoplastomeric bituminous membrane. Above the membrane, the internal floor received a raised floor and a ceramic coating.

The external floor received a high-performance waterproofing system for large commercial and industrial roofs, produced from flexible thermoplastic polyolefin. The system reflects sunlight, contributes to energy savings, and reduces the internal temperature. In addition, the product ensures maximum resistance against ultraviolet rays.

The experience in designing in CLT and adopting solutions for this type of construction was very important for everyone involved: designers, architectures, and construction companies.

CLT is sold in the European market without treatment, but due to the Brazilian tropical climate, favorable to the attack of xylophagous insects, the decision was made to use CLT panels with pine lamellae treated by impregnation.

The strategy of using an untreated Spruce layer arose from the premise of the project's architecture to mitigate the effect of the greenish coloration that the adopted autoclave treatment imposes. However, to ensure durability and efficiency against the attack of xylophagous microorganisms, a surface layer of a fungicide and insecticide product was applied.

Brazil, being a country of continental dimensions and with a favorable climate for the cultivation of pine, has great potential to supply engineered industrialized products of GLT and CLT for the whole world.

In this context, Urbem's mass timber factory will play an important role in the development of increasingly sustainable buildings in South America and worldwide.

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