ABSTRACT: This article presents the history, the present and the future expectations for timber structures in Brazil. Large timber structures originated with the engineering company HAUFF, whose production of timber structures contributed in great measure to the technological advance of the industry of construction engineering with wood in Brazil. Based on graphic, photographic and descriptive documentation, this paper offers examples of roof structures and of structures for other purposes built by HAUFF, focusing on structural systems of roofs, bridges, and scaffolding that constitute most of HAUFF’s production. In its current state, an evaluation is presented of the use of wood in structural and construction systems in the country, as well as the tree species currently used for this purpose. For the future, it is predicted that timber structures will become industrialized, to judge from the international development already started by several domestic companies, who turn to research centers seeking new alternatives to substitute the existing constructive systems built by the construction carpenter, as well as knowledge, quality control and technological development of new engineered materials of wood, composites using wood fibers, and new selections of glulam structural elements using reforested wood species such as, for example, paricá, pines, lyptus, amaru and teak. To conclude, new structural and construction systems in use in Brazil for houses, frameworks, roofs and bridges are presented, since they are considered representative of the future use of timber structures in South America.

KEYWORDS: timber structures, Brazil, bridges, roofs, frameworks.

1 PAST: HISTORY OF WOOD STRUCTURE IN BRAZIL: THE COMPANY "HAUFF"

Erwin Hauff, founder of the company HAUFF, was born in Vienna, Austria and graduated in civil engineering from the Technical University of Munich in 1920. At the end of World War I, Mr. Hauff moved to Brazil, where he became fascinated in studies of Brazilian forest species upon observing the physical characteristics of their wood. He collected samples of a wide variety of species, observing their drying behavior, their defects such as cracking and warping, and their workability.

HAUFF’s success in the 1920s, 30s and 40s was due, among other things, to the greater availability of skilled labor which was abundant in those days as a result of foreign immigration, which brought to Brazil a large contingent of individuals of medium level very experienced and highly qualified in carpentry trades, as well as in other general construction tasks. A significant example of a wooden bridge built in the same period is the three-hinged arch structure constructed over the Tietê River in the city of São Paulo. This bridge had a free span of 38 meters and a total length of 48 meters. Like the Guarulhos Bridge, this one was also treated with a carbolineum-type preservation product and was supported upon a reinforced concrete foundation.

2 PRESENT: THE USE OF WOOD IN CONSTRUCTION ENGINEERING

According to ITTO, Brazil currently produces and consumes 13 million cubic meters of sawn lumber per year. How much of this wood is used in construction engineering and in what construction systems is it employed? It is estimated that the state of São Paulo uses 1,783,300 cubic meters of tropical sawn lumber per year, 50% (891,700 m³) for roofing structures, 33% (594,400 m³) for formwork and falsework for reinforced concrete, 13% (233,500 m³) for ceilings, floors, door and window frames, sashes, etc., and 4% (63,700 m³) for prefabricated houses.

Some of the uses in Brazil are wooden houses, residential roofing, formwork and falsework for concrete structures, large-span roof structures, round timber (columns, beams, poles and stakes), pedestrian and vehicle bridges, crossties and poles and cross arms.
3 FUTURE: INDUSTRIAL STRUCTURAL WOOD SYSTEMS AND NEW ENGINEERED WOOD MATERIALS

We understand that investments in the near future by companies linked to the wood sector of civil engineering will be in industrial wood structures. Wood is a material whose properties of strength and elasticity show a naturally wide variability, and to optimize this material we must classify wood into groups having the same intervals of properties. Classification methods may be visual or mechanical and their implementation is extremely important to improve the safety, quality and durability of wood. Therefore, if we use wood provided by nature, we must accept this variability and, based on it, design structures with safety coefficients that take this wide variability into consideration. On the other hand, if we apply a quality control, for example by means of classification, we can work with a smaller section and with greater safety.

The wood structures most commonly produced worldwide today are industrial trusses with tooth-plate connectors, I-joints with flanges of solid wood or LVL, web component of plywood or OSB, and Glulam beams. All these products are manufactured under quality control and transported to the work site for installation. These processes are already widely employed in Europe, the United States and Australia. The figure below depicts these products. Industrial trusses are versatile, practical, economical, built under controlled quality and redundant in their construction system, allowing for safer structures. Among the main characteristics of roof structures executed with CDE are: reduction of the structure’s weight by up to 40% over the traditional system without designs drawn up by engineering professionals. The lack of roofing manufacturers in Brazil makes the execution of these structures expensive in certain regions of the country.

I-joints are used in floors and ceilings and as load-bearing beams for concrete formwork (H20) structures. Formwork for concrete structures is the second highest consumer of timber in construction engineering, representing 50% of the cost of the structure, and structural timber elements are traditionally the most commonly used for molding structural concrete elements.

The Glulam Industry in Brazil is still under development, and is still very expensive because there are so few manufacturers in the market. However, greater competitiveness is expected in the near future, with improved quality, low cost and productivity competitive with solid timber. The new selections of wood species such as paricá, pines, lyptus, amaru and teak will be a great solution for the use of timber in civil construction.

Lastly, the new engineered wood products that are being produced in several countries, such as LVL (Laminated Veneer Lumber), SCL (Structural Composite Lumber), PSL (Parallel Strand Lumber) and LSL (Laminated Strand Lumber) with strength and elasticity properties of low variability, will undoubtedly contribute to the development of new wood construction systems, ensuring the evolution and reliability of designs and the construction of wood structures in Brazil.

4 OUR CURRENT GOAL: ENCOURAGE THE USE OF WOOD IN CIVIL ENGINEERING

Education is one of the most important factors in order to increase the correct utilization of timber in Engineering. In civil engineering courses, the time given to timber is only 10% than other structural materials as steel and concrete that means 75%. In the Laboratory of Wood and Timber Structures (LaMEM), of São Paulo University, we are developing a Timber Education Program with the aim to increase the penetration of timber structures as in Universities and Technical Courses as in timber products to the construction industry. Its activities have been developing considerably both in under-graduates as in graduate degrees. Until the moment have been concluded in LaMEM 82 works of scientific initiation, 150 Master of Science dissertations and 50 Doctoral thesis.

Amongst these stand out the proposal of several compulsory and optional disciplines for civil engineering, the presentation and learning of the new Brazilian Code "Design of Timber Structures", and supply educational resources in the form of courses notes, soft wares for design of elements and timber structures, packages multimedia and information through the internet home page.

This program also has the intention of promoting technical courses, under-graduate, specialisation and post-graduate, with the support and resources of wood industries and research fomentation institutions.

Main restrictive factors for the wider use of wood in civil engineering in Brazil:
- Joint university and company efforts to expand the use of the product;
- Necessary pressure on private and government bodies to reduce the aversion to the use of this material;
- Higher education and techniques in the area of wood design and construction;
- Database of structural strength and elasticity properties of Brazilian timber species;
- Standardization of wood and timber structures;
- Technical bulletins and manuals for wood design and construction.

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