Chapter

Introductory Chapter: Timber and Sustainability in Construction

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1. Introduction

The buildings built in the second half of the last century and in the first decade of this century are characterized by the enormous consumption of energy and natural resources, so that the consumption of natural resources, the production of a considerable amount of waste, and the pollution of air and water are the largest undesirable effects related to the construction industry. Currently, the construction industry consumes annually an average of 40% of resources such as raw materials, water, and energy and produces about 40% of solid waste and pollution. In this context it becomes imperative for the building sector to move towards a sustainable dimension. This is the reason why in recent years a cultural model based on environmental sustainability has developed, involving all sectors of human activity and evidently the construction sector. Building activity is increasingly geared towards respecting, safeguarding, and enhancing the environment, through the design and use of materials and production and management processes based on biocompatibility, energy saving, and the green economy.

The concept of sustainable development was made explicit, for the first time, in a document presented by G.H. Brundtland in a meeting of the World Commission on Environment and Development [1]. The document, better known as the Brundtland Report, Our Common Future, found that the critical points and global problems of the environment are essentially due to the great poverty of the south of the world and to the unsustainable production and consumption patterns of the north of the world. The report therefore highlighted the need to implement a strategy capable of integrating the needs of development and the environment. This strategy was defined with the term *sustainable development*, whose precise definition was as follows: *development is sustainable if it meets the needs of the present without compromising the ability of future generations to meet their own needs*. This definition contained a new concept relating to sustainable development, able to reconcile aspects such as expectations of social well-being, economic growth, maintenance of natural resources, and respect for the environment. To guarantee all this, it is necessary to fulfill ethical principles and moral responsibility, touching on fundamental elements for eco-sustainability such as maintaining existing resources and the planet's environmental balance. Nowadays there are environmental problems deriving from the poor way in which entrepreneurial, social, economic, and political systems have been designed, for which a notable change in the design concept is fundamental, in such a way as to allow a better coexistence with the ecological and social systems on which we depend. In the construction industry, the current challenge is to address these issues using environmentally friendly materials and construction processes, fulfilling the social and economic functions of the building in full respect of the environment.

2. Wood in construction

Wood is one of the oldest building materials. In the past the great availability of material, the ease of processing and handling, and renewability, combined with specific qualities, have made wood the building material par excellence, for furniture, structural use, provisional, etc. Over time, wood technology and engineering have undergone an extraordinary evolution, but this domination has come to a halt since the nineteenth century, especially in countries where reinforced concrete and steel have monopolized the market. The reasons for this downgrading of wood are due to various cultural, economic, and environmental factors. These include natural degradability, combustibility, shape and size restrictions, and general distrust of a natural material that has inherent defects that affect its mechanical performance. Wood compared to other construction materials is characterized by the fact that the environmental conditions of installation can favor degradative or destructive alterations of biological origin to which the other materials are not prone, since they can instead be deteriorated by strong changes in temperature or by the action of gases and different chemical products that, on the contrary, leave the wood almost unaltered. The environmental hygrometric conditions do not have a significant influence on metallic and stone materials, while for wood they interfere with the values of mechanical strength. Furthermore, wood is characterized by a high susceptibility to fungus and insect attacks. Added to this is its combustibility. All these features have led to a negative view of wood as a natural construction material resulting in a setback in its use and its downgrading.

In recent decades, fortunately, there has been an extraordinary turnaround of this material in structural use even in countries where its use had been downgraded or abandoned. A great stimulus is derived from the production of laminated timber, an industrial product that incorporates the greatest advantages of wood as a natural material with the reliability, constancy of production, and high performance of an industrially produced material, and therefore subjected to quality and process control and standardization.

The advantages of wood in construction are various [2, 3].

Wood is a material characterized by good mechanical strength both in tension and in compression, so it can be used for the manufacturing of elements prone to bending such as beams, compressed like the pillars, stretched like tie rods, without the need to combine it with other materials, unlike for example concrete and masonry.

Wood is a material with a high strength to weight ratio, of the same order as steel, and it offers a compressive strength of the same order as reinforced concrete. Lightness is an important feature from the point of view of both strength and cost-effectiveness. In terms of strength, the reduced mass put into play by timber structures, for example, with respect to masonry, makes them less affected by seismic actions. In terms of cost-effectiveness, the use of a light material guarantees ease of manufacturing and handling and transport and minimization of the cost of supporting or foundation structures. Furthermore, the possibility of dry construction process allows rapid execution, modularity, and high degree of prefabrication.

Wood contributes to environmental comfort due to its low conductivity, high thermal inertia, and natural hygroscopicity. Natural materials such as wood or cork are already comfortable at room temperature, while those like stone or cement are perceived as comfortable only at higher surface temperatures.

Last but not least, the use of wood matches well the current trends of eco-compatible and sustainable construction as it minimizes the environmental impact at all levels as it is recyclable, renewable, biodegradable, and free of toxic contents.

3. Timber buildings and sustainability

The climate changes observed in recent decades, the global warming, and the increasingly frequent natural catastrophes are under everyone's eyes. In this context, the concept of climate protection summarizes all the possibilities that allow combating global warming as well as all measures to mitigate its effects.

The carbon cycle is the biogeochemical cycle through which carbon is exchanged between the geosphere, the hydrosphere, the biosphere, and the Earth's atmosphere. The current balance of the carbon cycle shows that CO_2 that enters the atmosphere is higher than the one that comes out. Much of the emissions due to human activities cannot be balanced by the natural absorption of the oceans and terrestrial ecosystems such as forests and soils, and the increase in CO_2 and other greenhouse gases leads to consequences such as the increase in global average temperature. In this contest, regarding climate protection there are basically two possible approaches: the reduction of climate-changing emissions (CO_2 and other greenhouse gases) and the expansion of carbon reservoirs, the term carbon reservoir meaning any stored form of CO_2. Wood allows both roads to be traveled [4, 5]. Thanks to photosynthesis, a tree can store large quantities of CO_2 in the wood. It is estimated that 1 m^3 of wood stores approximately 1 ton of CO_2, which remains stored in the material throughout its life, even when the wood undergoes the transformations that make it a semi-finished product or a finished product, for example, for the building industry, starting from the raw material. Therefore, the use of wood in construction involves two fundamental advantages: on the one hand, the gradual replacement of the most energy-intensive and polluting building materials with timber reduces the climate-changing emissions associated with the production and management of these materials; on the other hand, the management of forests aimed at the use of wood in industrial sectors such as buildings involves the continuous renewal of the forest itself with an increase in the capacity to extract CO_2 from the environment.

In addition to the strictly environmental sustainability aspects, the impulse to use wood in construction involves aspects of economic and social sustainability. The possibility of implementing short supply chains based on the use of local wood, for example, makes it possible to reduce the energy consumption linked to transport from distant areas of growth and at the same time allows to create employment in areas far from urban centers and therefore often economically depressed. The wood market is constantly expanding given the considerable possibilities of use, the high performance, and the technological progress of this material. The impulse to use timber in construction, especially if connected to short-term production chains, can allow:

a. The reduction of the costs of timber structures, thanks to the possibility of producing them on site instead of importing them from afar, thus promoting the sustainable building sector with great environmental advantages.

b. An increase in the demand for structural timber, with a consequent increase in forest surfaces for environmental, tourist, and hydro-geological protection advantages.

c. The creation of new jobs in the structural timber supply chain—activities related to forest care; new plants for the production of sawn wood (sawmills) and preparation of structural components (prefabrication workshops); new specialized assembly companies, with important repercussions in terms of employment; and a significant social function of reducing unemployment and abandoning depressed areas.

4. Conclusions

Wood is a natural building material that, when used in construction elements, can simultaneously fulfill the structural and esthetic function. Its use in the building sector allows it to simultaneously satisfy the aspects of environmental, economic, and social sustainability, especially when it is accompanied by implementation of short supply chain processes that allow the use of local wood and processes for controlling the sustainable management of forests that avoid deforestation and the impoverishment of the territories.

In the current context of implementing strategies to combat climate change and in general to protect the environment, the characteristics of this material and its qualities suggest giving impetus to its use in highly polluting sectors such as construction.

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