Bamboo in a temperate climate: what potential for integration and application(s) in sustainable, low-carbon, and circular architecture?

A. Romboux[1], **S. Trachte**[1]

[1] Research lab ACTE, Research unit AAP – University of Liège

Corresponding: aline.romboux@uliege.be

Keywords

Bamboo, Climate change, Forest diversification, Forest resilience, Biobased materials, Sustainable construction, Circular construction, Low-tech Architecture

Abstract *(523 words)*

The building sector has a considerable impact on the environment, both through the consumption of natural resources and the emission of greenhouse gases. These impacts are primarily driven by the extensive use of concrete, cement, and steel. Therefore, this sector must embrace a sustainable and circular transition, where bio-based materials are regarded as an « eco-friendly » alternative, due to their role as carbon sinks, their locally renewable sources, and their low-energy production process.

However, the health and productivity of our European forests and territories are already affected by climate change and global economic pressure on "wood" products. These findings highlight the need to explore the integration of new plant species in our regions to enhance biodiversity and resilience, as well as well as new materials that align with a more resource-efficient approach to architecture and construction, including bamboo.

The initial findings of the master's thesis indicate that certain bamboo species, known for their resilience and ability to thrive in challenging environments, can adapt to temperate climates while producing large-diameter stems suitable for construction. In addition to their potential for mitigating climate change, these species also play a role in restoring degraded ecosystems, particularly in agricultural regions facing unique ecological challenges.

Despite its widespread use as a building material in South America, Africa, and Asia, the utilization of bamboo in Europe and other temperate climates remains largely under-researched. A critical lack of data on its mechanical and physical properties, along with a lack of expertise and know-how, as well as the absence of regulatory frameworks, are major barriers to its adoption in the European construction sector.

Within this context, this doctoral research, building on the initial findings of the master's thesis, aims to (1) demonstrate the feasibility of integrating bamboo species in the Walloon region, and by extension, in temperate climates, and (2) show that selected species offer significant potential for use in low-carbon, circular architecture and construction, particularly for structural, insulation, and finishing applications.

This work includes three aspects: (1) compiling an inventory of species adapted to the Walloon territory and climate, along with identifying areas favorable for their growth within this region; (2) analyzing the mechanical and physical properties of various parts of the plant (main stem, secondary stem, and leaf) in their raw state, minimally processed, and in combination with other materials; and (3) exploring potential applications and uses in architecture, including the identification of suitable implementations and assembly methods.

This holistic, eco-responsible approach, from territorial considerations to building materials, from the extraction or supply of raw materials to waste recovery, aims to develop context-specific building solutions while reducing environmental impact. Interdisciplinary collaboration between forest resource management, architectural design of bio-based materials, and construction material engineering is crucial for promoting the broader use of these promising future materials, which remain largely under-explored despite their numerous advantages.

This contribution will begin by briefly outlining the results of the master's thesis on the three aspects, followed by a description of the objectives and a presentation of the main steps of the methodological approach. Finally, it will discuss the preliminary results by highlighting the adapted species and the potential development areas in Wallonia.