

SUCCESS STORY

WOOD-CLAY STRUCTURES: FIRE RESISTANCE, HYGROTHERMAL MODELLING, AND LIFE CYCLE ANALYSIS

Traditional wood-clay construction is attracting growing international interest, driven by the global consensus to reduce CO₂ emissions. Wood-clay construction reinforced with vegetable fibre is commonly known as the cob technique. The method is well-suited to warm climates like those found in Africa, where housing needs are in high demand. There remains pressing a need for alternatives to cement, whose production accounts for 5-8% of global CO₂ emissions. This project, led by Professor Ouellet-Plamondon of the École de technologie supérieure (ÉTS), in collaboration with Serex and York University, along with AmeriCan Structures, Technologies Boralife, Energie2025, and the Bureau de promotion des produits du bois du Québec (QWEB), sought to research the performance of wood-clay-fibre materials for Africa's construction needs—specifically those in Djibouti and Johannesburg—while expanding the market for both Quebec and Canadian wood abroad.

The cob materials studied were formulated with a 25% water-to-clay ratio and moistened wheat fibres. The approach sought to optimize consistency and workability while ensuring a low shrinkage ratio. According to the characterization tests, the addition of fibres significantly improved thermal insulation, moisture regulation capacity and porosity, making these cob mixtures particularly suitable for the construction of breathable walls. Improvements were also noted in mechanical performance. Digital simulations were also used to assess the cob mixtures' hygrothermal behaviour in different climates, confirming their thermal stability and their ability to contribute to sustainable construction, particularly in arid and sunny regions. Fire resistance tests demonstrated a solid performance. Overall, the research revealed that cob mixtures, when produced using traditional methods and adapted to contemporary requirements, provide high-performance,

« This collaborative project was led by Professor Ouellet-Plamondon and helped demonstrate that **our materials can be used in conjunction with clay-based wall solutions without compromising their protective properties**. Using the research results, we can now begin marketing our wood throughout Africa. PRIMA Québec provided financial support for the project and helped us find partners. »

- **Hugo Domaine**,
Eng.,
Vice-Président
Technologies Boralife Inc.

« We wanted to develop a new market in Africa by building houses made of wood and clay. But we needed technical data to sell the concept effectively, along with reliable technical information before presenting the project. **With financial assistance from PRIMA Québec and the NSERC, we were able to obtain this information and develop this new market.** »

- **Charles-William Houle**,
CEO,
AmeriCan Structures

SUCCESS STORY (CONTINUATION)

environmentally sound solutions for sustainable construction, thus reducing the need for air conditioning while promoting the use of both clay and wood in building envelopes.

In addition to protecting wood against termites through disodium octaborate tetrahydrate (DOT) treatments, the method also protects the cob when used as an infill material in wood building structures. It therefore plays a dual protection role for the entire structure, safeguarding both the wood and the fibres used in the cob mixture. The project led to the construction of wood-frame buildings using wood exported from Canada, with clay-based materials mixed with vegetable fibres (cob) serving as infill materials. This phase required the assistance of AmeriCan Structures for construction, QWEB for wood exports, and Boralife for wood treatment, along with Energie2025, which demonstrated the approach in Africa. The project began during the pandemic and, consequently, no demonstrations took place on the African continent. Among other things, the project sought to diversify the wood market toward Africa. AmeriCan Structures successfully expanded its operations within this market. Finally, the project provided training for three students in Quebec: one master's student, one doctoral student, and one postdoctoral trainee.

« With support from PRIMA Québec, this collaborative project **helped two of my industrial partners, AmeriCan Structures and Boralife, develop a new market in Africa** for wood exports. »

- **Sylvain Labbé**,
Chairperson and CEO,
Bureau de promotion des produits du
bois du Québec (QWEB)



SECTORS

Construction,
Environment



APPLICATIONS

Buildings



TRL

Start 2, end 4



DURATION

48 months
(2021-2025)