Development of a numerical model of heat and mass transfer in biosourced materials

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Bio-sourced materials are derived from biomass and can be used as thermal insulation throughout the building envelope. Several published works speak to the heat and mass transfer that occurs through bio-sourced materials and this has been addressed using numerical theoretical models.

Buildings in Haiti are built without solar protection. Haiti records a high average rate of sunshine of 6 kW/m2/day, a high average temperature of 26^{0}C and a high average relative humidity of 76% throughout the year. High use of air conditioning and mechanical ventilation in some buildings is used daily to combat the heat. There is a need to protect and improve the thermal performance of the building envelope in a tropical climate by using bio-sourced materials.

This research aimed to develop a numerical model to study heat and mass transfer in bio-sourced materials produced in a humid tropical climate. These materials can be used as thermal insulation in buildings in this climate. The numerical model developed in this paper is applied to bio-sourced materials of plant origin. This model is limited to bio-sourced materials whose hygrothermal properties are considered constant.

The model proved to be stable and convergent. These results are valid for the humid tropical climate characterised by a high rate of sunshine, a high temperature throughout the year, and relative humidity of up to 100%. Sunshine can increase the outside temperature of the building envelope by up to 60^{0}C. According to the results of numerical

simulations, these materials can slow down heat transmission but can also increase their internal humidity level. It is likely that this will cause the generation of mould inside the building.

There may be a need to treat these materials with other moisture-protection materials that are carefully selected to ensure greater effectiveness and reduction in the rate of moisture accumulation. The aforementioned disadvantage is still not enough to neglect the importance of insulating bio-sourced materials. Currently, their overabundance in Haiti is an already precious asset in this current context of global warming and depletion of fossil fuel resources at a planetary scale.

A layer of insulation using bio-sourced materials (banana and coconut fibres) deposited on the building envelop would allow to limit the thermal contribution towards the interior building in tropical climate.

What's Next

- Continued research into the hygrothermal properties of bio-sourced materials
- Application and use of these bio-sourced materials in other Caribbean islands
- Development of means to combat mold generation in buildings that use bio-sourced materials