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Contribution to numerical study of combined heat and moisture transfers in porous building multilayer walls made of local material in dry tropical climate

Building materials, being porous media, are subject to heat and moisture transfer, when they are submitted to variables external temperature and relative humidity conditions. The moisture flow can degrade the materials thermal performances and then increase the need of energy to maintain the building interne comfort. In order to make a judicious choice of adapted materials to dry tropical environment, it's necessary to analyze and predict the hygrothermal behavior of available materials in presence of these flows. A mathematic model describing the combined heat and moisture transfer was implemented in COMSOL5.3a software to simulate the hygrothermal behavior of three type of local materials-based walls, such us cement blocks, cut lateritic block, and compressed earth block, all coated with cement mortar. To do this, these various walls were successively exposed to external static and cyclical temperature and relative humidity corresponding to general conditions of local climate. From this simulation, it appears that the compressed earth block-based wall gives the best hygrothermal comfort. In fact, under cyclical sollicitation, its thermal inertia enables it to reduce the variation of internal temperature by 68% and 66% respectively in wet and dry period, and its hygric inertia reduce the variation of relative humidity by 70% and 68% respectively at wet and dry period. In addition, for the compressed earth blocks based walls, under static sollicitation, the variation of internal temperature in 4,74°C in wet period and 2.89°C in dry period, i.e. -20.06% and -29.93% on average compared respectively to cement block and cut lateritic blocks based walls, and the relative humidity is 12.86% in dry periods and 7.93% in wet periods, i.e. -17.72% and -25.86% respectively compared to cement blocks and cut lateritic blocks based walls.

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