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Numerical modeling of coupled heat and mass transfer in building physics

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This work reports on a transient heat, air and moisture transfer (HAM) model. The governing partial-differential equations are simultaneously solved for temperature and capillary pressure through multi-layered porous media, including the non-linear transfer and storage properties of materials. Using partial differential equation (PDEs) functions, certain measurable properties of porous media are converted into coefficients depending on temperature and capillary pressure. Major features of the model are multi-dimensional and transient coupling of heat, air and moisture transport. The coupled PDEs are solved using the COMSOL Multiphysics time-dependent solver. This solver enables HAM (heat, air, moisture) modeling in porous media. Besides, the good agreements obtained with the respective HAMSTAD benchmarks (2D) suggest that the model can be used to assess the hygrothermal performance of building envelope components. Being able to evaluate the hygrothermal behaviour, the proposed model may turn out to be a valuable tool for other building problems.

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