A two-phase moisture transport model accounting for sorption hysteresis in layered porous building constructions

Building constructions most commonly consists of layered porous materials such as masonry on bricks. The moisture distribution and its variations due to change in surrounding environment is of special interest in such layered construction since materials adsorb different amounts of water and exhibits different transport properties. A successful model of such a case may shed light on the performance of different constructions with regards to, for example, mould growth and freeze thaw damages. For this purpose a model has been developed which is based on a two phase flow, vapor and liquid water, with account also to sorption hysteresis. The different materials in the considered layered construction are assigned different properties, i.e. vapor and liquid water diffusivities and boundary (wetting and drying) sorption curves. Further, the scanning behavior between wetting and drying boundary curves are model by introducing appropriate material constants. Special properties have to be given for the interface between different materials in the layered construction in the model to be presented. In this case it is assumed that vapor penetrates through such interfaces easily but not the liquid water phase. The model is developed by carefully examining the mass balance postulates for the two considered constituents together with appropriate and suitable constitutive assumptions. A test example is solved by using an implemented implicit finite element code which uses a modified Newton-Raphson scheme to tackle the strong non-linearities in the present problem. The numerical method is described to make it possible for the interested reader to judge the significance of the proposed technique to solve the coupled set of non-linear equations and also in order to make implementations of the proposed model easy.

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