CFD-HAM

Melo L. A., Advanced modeling of heat, air and moisture (HAM) transfer through porous building elements. PhD Thesis, PUCPR, Brazil, 2017.

3D HAM-CFD

Governing equations imputed in ANSYS-Fluent by means of User Defined Functions (UDF)

$$\mu\frac{\partial I(\tau,\mu)}{\partial\tau}+I(\tau,\mu)=(1-\omega)I_b(T)+\frac{\omega}{2}\left[\int_0^1 I(\tau,\mu')\mathrm{p}(\mu',\mu)\mathrm{d}\mu'+\int_0^1 I(\tau,-\mu')\mathrm{p}(\mu',-\mu)\mathrm{d}\mu'\right]$$

$$\frac{\partial w}{\partial t}=-\nabla\bullet g \quad\Rightarrow\quad g=(-v_p\cdot\nabla P_v+r_v\cdot\rho_v)+(-\lambda_{liq}\cdot\nabla Psuc)$$

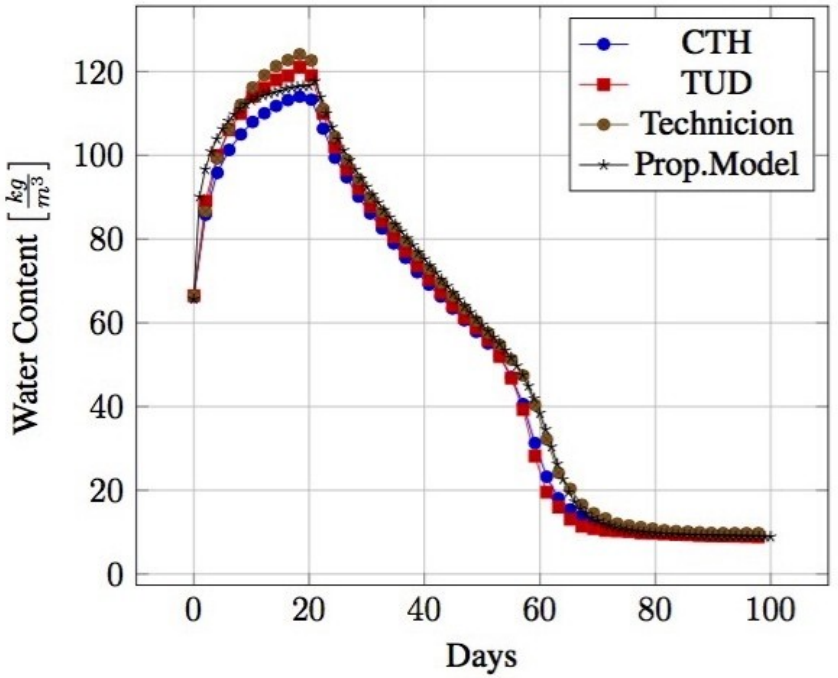
Vapor Flux — Liquid Flux

$$c\cdot\rho_{dry}\cdot\frac{\partial T}{\partial t}=-\nabla\bullet(q_t) \quad\Rightarrow\quad qt=\left[\frac{\partial w}{\partial t}\right]\cdot L_{lv}+r\cdot\rho\cdot c_p\cdot T-k\Delta T+qrad$$

Phase Change and Liquid Flow — Radiation — Convection — Conduction

3D HAM-CFD

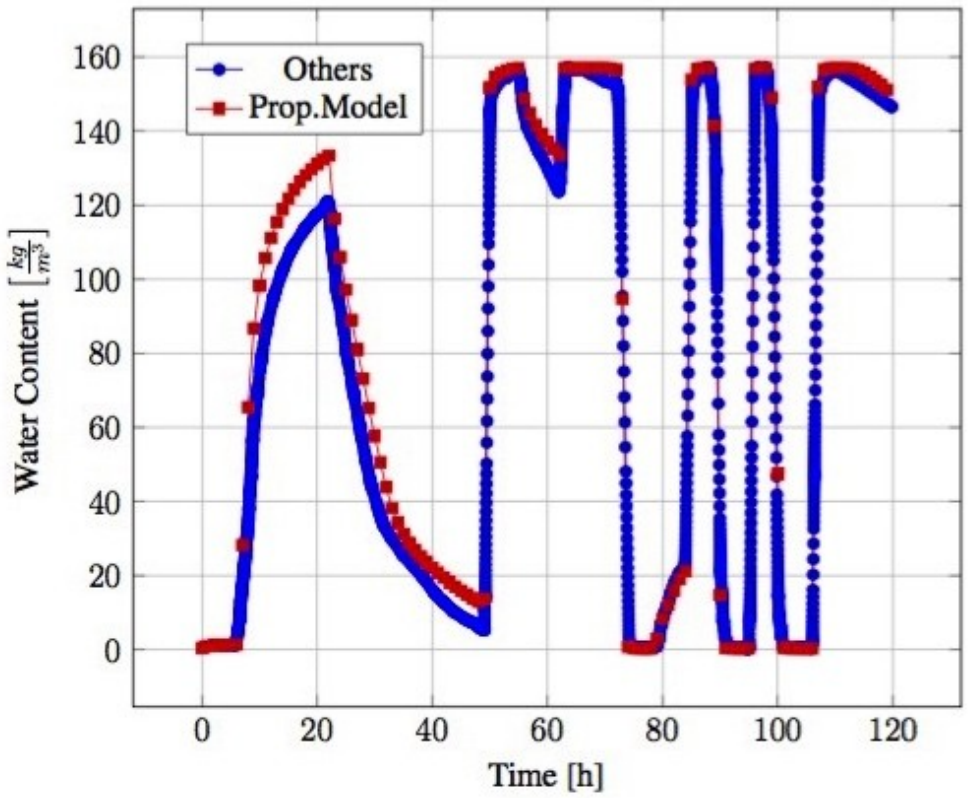
The modeling vapor migration by convection is showed in Benchmark 3 (Hamstad) and assessed by current model with good agreement.



3D HAM-CFD

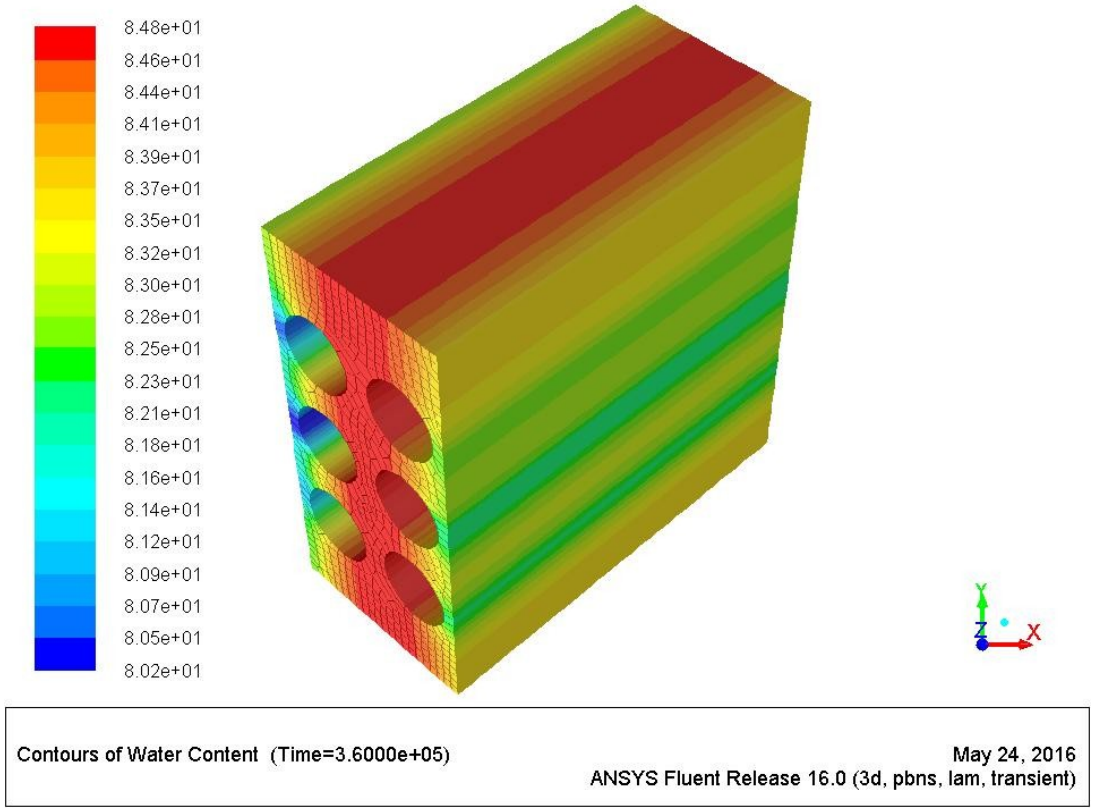
Current model solves problems with several hard boundary conditions su as high humidity, driven rain and sudden changes in pressure.

Ps: Benchmark 4 (Hamstad)



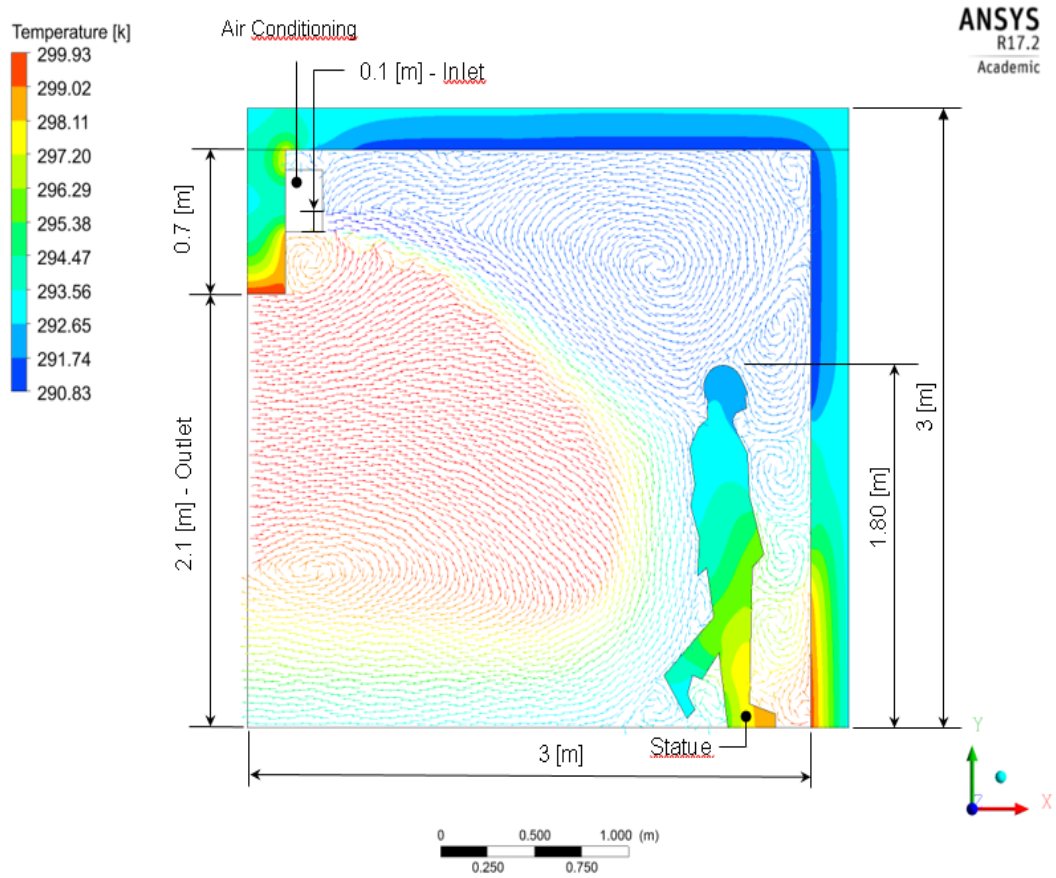
3D HAM-CFD

The current model solves the three-dimensional cases.



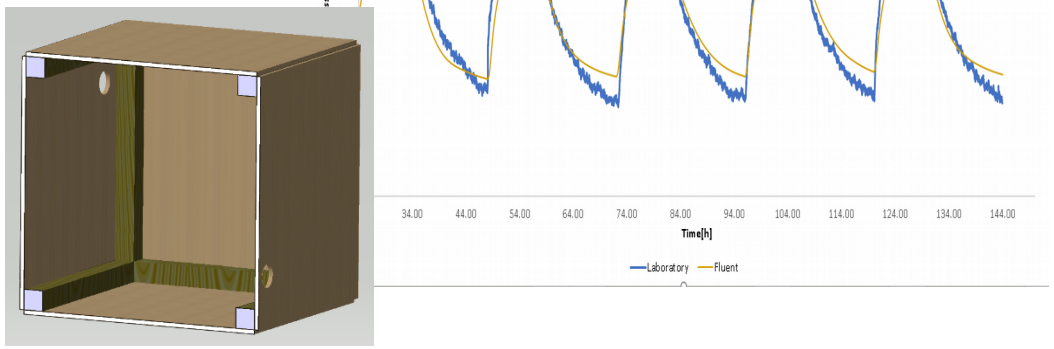
3D HAM-CFD

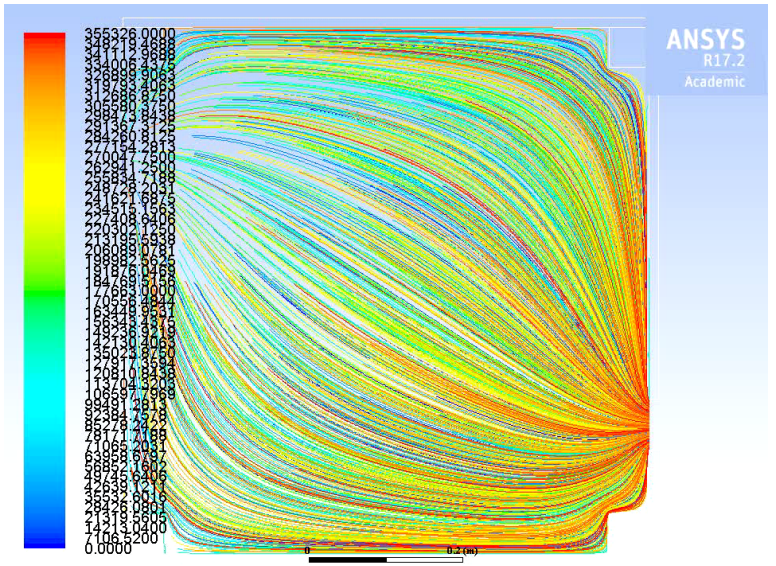
3D HAM-CFD enables to predict temperature and moisture in complex environment, considering HVAC system supply air flow and complex inside structures.



3D HAM-CFD

Comparison with laboratory tests under NORDTEST conditions to find the MBV index in a plywood box.





3D HAM-CFD

Challenges and perspectives

- *Boundary conditions*
- *Computer run time*
- *Turbulence…*