With a clear case study design and selected performance criteria, an informed choice can be made for the HAM-simulation software. The <strong>**European standard EN 15026**, **American ASTM E3054</strong>** or <strong> **WTA-6-2-01 </strong>**, comprise guidelines and restrictions for HAM models. These form the basis for conducting numerical procedures to determine the hygrothermal response of building assemblies and constituent materials. The hygrothermal simulations are described as a non-steady transfer of heat, air and moisture through materials, and defined by equations which quantify.

Heat storage in dry building materials and absorbed water

Heat transport by moisture-dependent thermal conduction

Heat transport by convection (air leakage) and radiation (cavities)

Latent heat transfer by vapor diffusion

Moisture storage and release by vapor sorption, desorption, and capillary forces

Moisture transport by vapor diffusion

Moisture transport by liquid transport (surface diffusion and capillary flow)

Moisture transport by convection (air leakage)

The hygrothermal equations described in **EN 15026** shall not be applied in projects where:

* Convection takes place through holes and cracks
* Specific two-dimensional effects play an important part (e.g., anisotropic material properties, effect of gravitational forces)
* Hydraulic, osmotic, electrophoretic forces are present
* Daily mean temperatures in the component exceed 50 °C.

**1D versus 2D versus 3D**

The first published version of EN15026 from 2007 was updated in 2023, and was in 2007 limited to a 2-dimensional approach. Today several commercial software packages allow to model 3D configurations. When 3D effects play a role, 3D modeling should be considered. It is important to note that with each increase in dimensionality, the computational time and infrastructure requirements will increase exponentially. Therefore, it is essential to carefully evaluate the necessity for higher dimensional modeling to strike a balance between accuracy and computational efficiency. The 2-dimensional and even the 3-dimensional geometries of the building components can be simplified in the simulation model, either by using 2D shapes like triangles, quadrilaterals or 3D shapes such as tetrahedron or hexahedron. For instance, very small details, ornaments or circular corners may be represented by polygons. In doing so, the simulation aims to maintain the thermal and moisture storage characteristics but reduce the computational time and complexity.

**Model parameters**

Despite using the same input data, different numerical software models may produce diverging results. The origin of these discrepancies can be found in a different physical model formulas or due to different implementations of model parameters. There could be a difference in time integration methods and time step sizes, inclusive of diverse algorithms for time step adjustment. Both time discretization and spatial discretization techniques, like the Finite Volume Method or Finite Element Method, will influence simulation results, along with spatial grid intricacies such as grid cell size and other properties. The significance of the latter is particularly evident in unstructured grids within two-dimensional simulations. In practice, sensitivity studies should be used to assess differences in simulation outcomes due to grid choices and time integration methods. In grid sensitivity analyses, simulations are repeated while decreasing grid size (especially near boundaries and by using gradients). An acceptable refinement is found when the discrepancies between a certain grid and its more refined grid, obtained by using half the dimensions in all directions, meet acceptable tolerances, e.g. a 1 K temperature difference or lower than 5% relative humidity. If both these tolerances are not achieved, further grid refinement should be done. The same approach applies to time step dependency, for which reducing the time step up to half should not affect the results to ensure time-step independency. (EN15026-2023)