Hygrothermal performance of building components and building elements - Assessment of moisture transfer by numerical simulation

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Hygrothermal performance of building components and building elements - Assessment of moisture transfer by numerical simulation

Performance hygrothermique des composants et parois de bâtiments - Évaluation du transfert d'humidité par simulation numérique

Wärme- und feuchtetechnisches Verhalten von Bauteilen und Bauelementen - Bewertung der Feuchteübertragung durch numerische Simulation

This European Standard was approved by CEN on 26 June 2023.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 15026:2023) has been prepared by Technical Committee CEN/TC 89 "Thermal performance of buildings and building components", the secretariat of which is held by SIS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2024, and conflicting national standards shall be withdrawn at the latest by January 2024.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15026:2007.

The significant technical changes compared to the previous edition EN 15026:2007 of the standard are:

— the scope has been shortened;

— all the transport formulae are given for two-dimensional calculations and source terms for auxiliary models accounting for special effects have been added;

— approaches to calculate the sources and sinks in the transport formulae to account for these special effects, i.e. component ventilation, rainwater penetration and air infiltration, are documented in Annex E;

— ice formation and freezing enthalpy have been added to the heat transport formula;

— the section on material properties has been expanded with more detailed information given in Annex A;

— the sections on internal and external boundary conditions and the corresponding annexes have been modified to account for new research results.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

This document defines the practical application of hygrothermal simulation software used to predict transient heat and moisture transfer in multi-layer building envelope components subjected to dynamic climate conditions on either side.

In contrast to the steady-state assessment of interstitial condensation by the Glaser method (as described in EN ISO 13788), transient hygrothermal simulation provides more detailed and accurate information on the risk of moisture problems within building components and on the design of remedial treatment. While the Glaser method considers only steady-state conduction of heat and vapour diffusion, the transient hygrothermal simulation models which are composed of the formulae defined in this document also take account of heat and moisture storage, latent heat effects and liquid and convective transport under realistic boundary and initial conditions. The application of such models has become widely used in building practice in recent years, resulting in a significant improvement in the accuracy and reproducibility of hygrothermal simulation.

The following examples of transient heat and moisture phenomena in building components can be simulated by the models covered in this document:

— drying of initial construction moisture;

— moisture accumulation by interstitial condensation due to diffusion in winter;

— moisture penetration due to driving rain exposure;

— summer condensation due to migration of moisture from outside to inside;

— outside surface condensation due to cooling by long-wave radiation exchange;

— moisture-related heat losses by transmission and moisture evaporation.

The factors relevant to hygrothermal simulation of building components are summarized below. The document starts with the description of the physical model on which hygrothermal simulation tools are based. Then the necessary input parameters and their procurement are dealt with. The evaluation, interpretation and documentation of the output form the last part. Benchmark cases for the assessment of numerical simulation tools are discussed in Annex B.

Input parameters include:

— assembly, orientation and inclination of building components;

— hygrothermal material parameters and functions;

— boundary conditions, surface transfer for inside and outside climate;

— initial condition, calculation period, numerical control parameters.

Output parameters include:

— temperature and heat flux distributions and temporal variations;

— water content, relative humidity and moisture flux distributions and temporal variations.

Based on the output parameters, experimentally validated post-processing tools can help to evaluate:

- Moisture dependent thermal performance;
- biological growth, rot and corrosion;
- moisture-related damage and degradation.

Outputs from the calculations are useful for various purposes, but applications are not covered by the standard and are made at the user's own risk.

1 Scope

This document specifies the model components to be used in a numerical hygrothermal simulation model for calculating the transient transfer of heat and moisture through building structures.

This document specifies a method to be used for validating a numeric hygrothermal simulation model claiming conformity with this document.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 7345, *Thermal performance of buildings and building components — Physical quantities and definitions (ISO 7345:2018)*

EN ISO 9346, *Hygrothermal performance of buildings and building materials — Physical quantities for mass transfer — Vocabulary (ISO 9346:2007)*

3 Terms, definitions, symbols and units

For the purposes of this document, the terms and definitions given in EN ISO 9346 and EN ISO 7345 apply. The following symbols and units apply.

Symbol	Quantity	Unit
a_r	rain water retention factor of a surface	– (0 ... 1)
c_1	specific heat capacity of liquid water	J/(kg·K)
c_v	specific heat capacity of water vapour	J/(kg·K)
c_{ice}	specific heat capacity of ice	J/(kg·K)
c_a	specific heat capacity of air	J/(kg·K)
c_s	specific heat capacity of dry material (solid)	J/(kg·K)
D_1	liquid conductivity	m^2/s
E_{sol}	total flux density of incident solar radiation	W/m^2
g, g_w	density of moisture flow rate	$kg/(m^2 \cdot s)$
g_l	density of liquid water flow rate	$kg/(m^2 \cdot s)$
$g_{l,max}$	density of water flow rate which can be absorbed at the surface of a material	$kg/(m^2 \cdot s)$
g_p	density of moisture flow rate of available water from precipitation	$kg/(m^2 \cdot s)$
g_v	density of water vapour flow rate	$kg/(m^2 \cdot s)$
h	surface heat transfer coefficient	$W/(m^2 \cdot K)$